NATIONAL
ENRICHMENT
FACILITY

Designated Original

10 CFR 2.390
10 CFR 30.6
10 CFR 40.5
10 CFR 70.5

July 15, 2005

NEF#05-021A

ATTN: Document Control Desk
Director
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Louisiana Energy Services, L. P.
National Enrichment Facility
NRC Docket No. 70-3103

Subject: Revision to Applications for a Material License Under 10 CFR 70, "Domestic licensing of special nuclear material," 10 CFR 40, "Domestic licensing of source material," and 10 CFR 30, "Rules of general applicability to domestic licensing of byproduct material" – Revision A

References:

1. Letter NEF#03-003 dated December 12, 2003, from E. J. Ferland (Louisiana Energy Services, L. P.) to Directors, Office of Nuclear Material Safety and Safeguards and the Division of Facilities and Security (NRC) regarding "Applications for a Material License Under 10 CFR 70, Domestic licensing of special nuclear material, 10 CFR 40, Domestic licensing of source material, and 10 CFR 30, Rules of general applicability to domestic licensing of byproduct material, and for a Facility Clearance Under 10 CFR 95, Facility security clearance and safeguarding of national security information and restricted data"

2. Letter NEF#04-002 dated February 27, 2004, from R. M. Krich (Louisiana Energy Services, L. P.) to Director, Office of Nuclear Material Safety and Safeguards (NRC) regarding "Revision 1 to Applications for a Material License Under 10 CFR 70, "Domestic licensing of special nuclear material," 10 CFR 40, "Domestic licensing of source material," and 10 CFR 30, "Rules of general applicability to domestic licensing of byproduct material"

3. Letter NEF#04-029 dated July 30, 2004, from R. M. Krich (Louisiana Energy Services, L. P.) to Director, Office of Nuclear Material Safety and Safeguards (NRC) regarding "Revision to Applications for a Material License Under 10 CFR 70, "Domestic licensing of special nuclear material," 10 CFR 40, "Domestic licensing of source material," and 10 CFR 30, "Rules of general applicability to domestic licensing of byproduct material"

NMSS01

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23 Copies advanced to Linda Marshall

4. Letter NEF#04-037 dated September 30, 2004, from R. M. Krich (Louisiana Energy Services, L. P.) to Director, Office of Nuclear Material Safety and Safeguards (NRC) regarding "Revision to Applications for a Material License Under 10 CFR 70, "Domestic licensing of special nuclear material," 10 CFR 40, "Domestic licensing of source material," and 10 CFR 30, "Rules of general applicability to domestic licensing of byproduct material"

The purpose of this revision to the letter NEF#05-021, dated April 22, 2005, is to resubmit information previously redacted to allow for additional public disclosure. No other changes are made to the previously submitted letter and its enclosures.

By letter dated December 12, 2003 (Reference 1), E. J. Ferland of Louisiana Energy Services (LES), L. P., submitted to the NRC applications for the licenses necessary to authorize construction and operation of a gas centrifuge uranium enrichment facility. Revision 1 to these applications was submitted to the NRC by letter dated February 27, 2004 (Reference 2). Subsequent revisions (i.e., revision 2 and revision 3) to these applications were submitted to the NRC by letters dated July 30, 2004 (Reference 3) and September 30, 2004 (Reference 4), respectively.

Conference calls and meetings between representatives of LES and the NRC have been conducted since the submittal of the Reference 4 letter. Responses to some additional NRC requests for information have also been provided since the submittal of the Reference 4 letter. The changes resulting from these conference call clarifications, meetings, and requests for information are reflected in the enclosed Revision 4 to the Safety Analysis Report (SAR), Revision 4 to the Integrated Safety Analysis (ISA) Summary, Revision 3 of the Emergency Plan, Revision 4 of the Environmental Report, and Revision 4 to the Fundamental Nuclear Material Control (FNMC) Plan, as applicable. To facilitate the incorporation of the revision into the License Application and ISA Summary, page removal and insertion instructions are enclosed. No changes are made to the Physical Security Plan, the Safeguards Contingency Plan, the Guard Force Training and Qualification Plan, the Standard Practice Procedures Plan for the Protection of Classified Matter, or the classified portion of the FNMC Plan.

The changes included in this revision to the License Application and ISA Summary predominately result from conference call clarifications, meetings, and requests for information. Some of the changes also involve the correction of identified errata. These errata include minor editorial corrections/clarifications and typographical errors. The License Application and ISA Summary, updated through the specified revision of each of the affected License Application and ISA Summary documents, continue to meet the applicable requirements of 10 CFR 70.22, "Contents of applications," 10 CFR 40.31, "Application for specific licenses," and 10 CFR 30.32, "Application for specific licenses," as described in the Reference 1 letter.

Revision 4 of the FNMC Plan contains information that LES considers to proprietary in accordance with 10 CFR 2.390, "Public inspections, exemptions, requests for withholding," paragraph (d)(1). Accordingly, we request that Revision 4 of the FNMC Plan be withheld from public disclosure.

Enclosure 1 provides the updated License Application, except for Revision 4 of the FNMC Plan, and ISA Summary pages. Enclosure 1 does not include Revision 4 of the FNMC Plan since it contains proprietary information and is withheld from public disclosure. Enclosure 2 provides Revision 4 of the FNMC Plan. In Enclosure 2, the pages contain proprietary information and include the marking "Proprietary Information" consistent with 10 CFR 2.390 (d)(1).

If you have any questions, please contact me at 630-657-2813.

Respectfully,

Daniel G. Green for

R. M. Krich
Vice President – Licensing, Safety, and Nuclear Engineering

Enclosures:

1. Updated License Application (except Revision 4 of the FNMC Plan) and ISA Summary Pages
2. Revision 4 of the FNMC Plan (Contains Proprietary Information)

cc: T. C. Johnson, NRC Project Manager
M. C. Wong, NRC Environmental Project Manager

ENCLOSURE 1

Updated License Application (except Revision 4 of the FNMC Plan)
and
ISA Summary Pages

Safety Analysis Report

Revision 4, April 2005
Including Page Removal and Insertion Instructions

NATIONAL ENRICHMENT FACILITY
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PAGE REMOVAL AND INSERTION INSTRUCTIONS

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1.3.3.3 Severe Weather

Tornadoes

Tornadoes occur infrequently in the vicinity of the NEF. Only two tornadoes were reported in Lea County, New Mexico, (Grazulis, 1993) from 1880-1989. Across the state line, only one tornado was reported in Andrews County, Texas, (Grazulis, 1993) from 1880-1989.

Tornadoes are commonly classified by their intensities. The F-Scale classification of tornados is based on the appearance of the damage that the tornado causes. There are six classifications, F0 to F5, with an F0 tornado having winds of 61-116 km/hr (40-72 mi/hr) and an F5 tornado having winds of 420-520 km/hr (261-318 mi/hr) (AMS, 1996). The two tornadoes reported in Lea County were estimated to be F2 tornadoes (Grazulis, 1993).

The design parameters applicable to the design tornado with a period of recurrence of 100,000 years are as follows:

Design Wind Speed	302 km/hr	188 mi/hr
Radius of damaging winds	130 m	425 ft
Atmospheric pressure change (APC)	390 kg/m^2	80 lb/ft^2
Rate of APC	146 $kg/m^2/s$	30 $lb/ft^2/s$

Hurricanes

Hurricanes, or tropical cyclones, are low-pressure weather systems that develop over the tropical oceans. Hurricanes are fueled by the relatively warm tropical ocean water and lose their intensity quickly once they make landfall. Since the NEF is located about 805 km (500 mi) from the coast, it is most likely that any hurricane that tracked towards the site would have dissipated to the tropical depression stage, that is, wind speeds less than 63 km/hr (39 mi/hr), before it reached the NEF. Hurricanes are therefore not considered a threat to the NEF.

Thunderstorms and Lightning Strikes

Thunderstorms occur during every month but are most common in the spring and summer months. Thunderstorms occur an average of 36.4 days/year in Midland/Odessa (based on a 54-year period of record (NOAA, 2002a). The seasonal averages are: 11 days in spring (March through May); 17.4 days in summer (June through August); 6.7 days in fall (September through November); and 1.3 days in winter (December through February).

The current methodology for estimating lightning strike frequencies includes consideration of the attractive area of structures (Marshall, 1973). This method consists of determining the number of lightning flashes to earth per year per square kilometer and then defining an area over which the structure can be expected to attract a lightning strike.

Using this methodology, the attractive area of the facility structures has been conservatively determined to be 0.071 km^2. Using 4 flashes to earth per year per square kilometer (2.1 flashes to earth per year per square mile) (NWS, 2003b) it can be estimated that the NEF will experience approximately 1.36 flashes to earth per year.

Sandstorms

Blowing sand or dust may occur occasionally in the area due to the combination of strong winds, sparse vegetation, and the semi-arid climate. High winds associated with thunderstorms are frequently a source of localized blowing dust. Dust storms that cover an extensive region are rare, and those that reduce visibility to less than 1.61 km (1 mile) occur only with the strongest pressure gradients such as those associated with intense extratropical cyclones which occasionally form in the area during winter and early spring (DOE, 2003).

1.3.4 Hydrology

The hydrology information presented for the NEF was based on a subsurface investigation initiated at the NEF site in September 2003. Extensive subsurface investigations for a nearby facility, WCS, located to the east of the NEF site, have also provided hydrogeologic data that was used in planning the NEF surface investigation. Other literature searches were also conducted to obtain reference material.

The NEF site itself contains no surface water bodies or surface drainage features. Essentially all the precipitation that occurs at the site is subject to infiltration and/or evapotranspiration. Groundwater was encountered at depths of 65 to 68 m (214 to 222 ft). Significant quantities of groundwater are only found at depths over 340 m (1,115 ft) where cover for that aquifer is provided by 323 to 333 m (1,060 to 1,092 ft) or more of clay.

1.3.4.1 Characteristics Of Nearby Rivers, Streams, And Other Bodies Of Water

The climate in southeast New Mexico is semi-arid. Precipitation averages only 33 to 38 cm (13 to 15 in) a year. Evaporation and transpiration rates are high. This results in minimal, if any surface water occurrence or groundwater recharge.

The NEF site contains no surface drainage features, such as arroyos or buffalo wallows. The site topography is relatively flat. Some localized depressions exist, due to eolian processes, but the size of these features is too small to be of significance with respect to surface water collection.

1.3.4.2 Depth To The Groundwater Table

The site subsurface investigation performed during September 2003 had two main objectives: 1) to delineate the depth to the top of the Chinle Formation red bed clay that exists beneath the NEF site to assess the potential for saturated conditions above the red beds, and 2) to complete three monitoring wells in the siltstone layer beneath the red beds to monitor water level and water quality within this thin horizon of perched intermittent saturation. This work is in progress as discussed below.

The presence of the thick Chinle clay beneath the site essentially isolates the deep and shallow hydrologic systems. Groundwater occurring within the red bed clay occurs at three distinct and distant elevations. Approximately 65 to 68 m (214 to 222 ft) beneath the land surface, within the red bed unit, is a siltstone or silty sandstone unit with some saturation. It is a low permeability formation that does not yield groundwater very readily. This unit is under investigation as the first occurrence of groundwater beneath the NEF site.

Table 1.1-3 Estimated Annual Liquid Effluent

Effluent	Typical Annual Quantities	Typical Uranic Content
Contaminated Liquid Process Effluents:	m^3 (gal)	kg (lb)
Laboratory Effluent/Floor Washings/Miscellaneous Condensates	23.14 (6,112)	16 (35)[1]
Degreaser Water	3.71 (980)	18.5 (41)[1]
Spent Citric Acid	2.72 (719)	22 (49)[1]
Laundry Effluent	405.8 (107,213)	0.2 (0.44)[2]
Hand Wash and Showers	2,100 (554,802)	None
Total Contaminated Effluent :	2,535 (669,884)	56.7 (125)[3]
Cooling Tower Blowdown:	19,123 (5,051,845)	None
Heating Boiler Blowdown:	138 (36,500)	None
Sanitary:	7,253 (1,916,250)	None
Stormwater Discharge:		
Gross Discharge[4]	174,100 (46 E+06)	None

[1]Uranic quantities are before treatment, values for degreaser water and spent citric acid include process tank sludge.
[2] Laundry uranic content is a conservative estimate.
[3] Uranic quantity is before treatment. After treatment approximately 1% or 0.57 kg (1.26 lb) of uranic material is expected to be discharged into the Treated Effluent Evaporative Basin.
[4]Maximum gross discharge is based on total annual rainfall on the site runoff areas contributing runoff to the Site Stormwater Detention Basin and the UBC Storage Pad Retention Basin neglecting evaporation and infiltration.

Table 1.1-4 Estimated Annual Non-Radiological Wastes
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Waste	Annual Quantity
Spent Blasting Sand*	125 kg (275 lbs)
Miscellaneous Combustible Waste*	9000 kg (19,800 lbs)
Cutting Machine Oils	45 L (11.9 gal)
Spent Degreasing Water (from ME&I workshop)	1 m^3 (264 gal)
Spent Demineralizer Water (from ME&I workshop)	200 L (53 gal)
Empty Spray Paint Cans*	20 ea
Empty Cutting Oil Cans	20 ea
Empty Propane Gas Cylinders*	5 ea
Acetone*	27 L (7.1 gal)
Toluene*	2 L (0.5 gal)
Degreaser Solvent SS25*	2.4 L (0.6 gal)
Petroleum Ether*	10 L (2.6 gal)
Diatomaceous Earth*	10 kg (22 lbs)
Miscellaneous Scrap metal	2,800 kg (6.147 lbs)
Motor Oils (For internal combustion. engines)	3,400 L (895 gal)
Oil Filters	250 ea
Air Filters (vehicles)	50 ea
Air Filters (building ventilation)	160,652 kg (354,200 lb)
Hydrocarbon Sludge*	10 kg (22 lbs)
Methylene Chloride*	1850 L (487 gal)

* Hazardous waste as defined in Title 40, Code of Federal Regulations, Part 261, Identification and listing of hazardous waste, 2003. (in part or whole)

Table 1.1-5 Annual Hazardous Construction Wastes

Waste Type	Annual Quantity
Paint, Solvents, Thinners, Organics	1,134 L (3,000 gal)
Petroleum Products – Oils, Lubricants	1,134 L (3,000 gal)
Sulfuric Acid (Batteries)	380 L (100 gal)
Adhesives, Resins, Sealers, Caulking	910 kg (2,000 lbs)
Lead (Batteries)	91 kg (200 lbs)
Pesticide	380 L (100 gal)

Table 1.2-1 Type, Quantity and Form of Licensed Material

Page 1 of 1

Source and/or Special Nuclear Material	Physical and Chemical Form	Maximum Amount to be Possessed at Any One Time
Uranium (natural and depleted) and daughter products	Physical: Solid, Liquid and Gas Chemical: UF_6, UF_4, UO_2F_2, oxides and other compounds	136,120,000 kg
Uranium enriched in isotope ^{235}U up to 5% by weight and uranium daughter products	Physical: Solid, Liquid, and Gas Chemical: UF_6, UF_4, UO_2F_2, oxides and other compounds	545,000 kg
^{99}Tc, transuranic isotopes and other contamination	Any	Amount that exists as contamination as a consequence of the historical feed of recycled uranium at other facilities[(1)]

(1) To minimize potential sources of contamination of UF_6, such as ^{99}Tc, LES will require UF_6 suppliers to provide Commercial Natural UF_6 in accordance with ASTM C 787-03, "Standard Specification for Uranium Hexafluoride for Enrichment." In addition, cylinder suppliers will be required to preclude use of cylinders that, in the past, have contained reprocessed UF_6, unless they have been decontaminated. Periodic audits of suppliers will be performed to provide assurance that these requirements are satisfied.

- Operations
- Uranium Management
- Technical Services
- Human Resources
- Quality Assurance.

The responsibilities, authorities and lines of communication of key management positions within the operating organization are discussed in Section 2.2, Key Management Positions.

During the Operations Phase the QA Manager reports to the Plant Manager. However, the QA Manager has the authority and responsibility to contact directly the LES President, through the QA Director, with any Quality Assurance concerns during operation.

Position descriptions for key management personnel in the operating organization will be accessible to all affected personnel and to the NRC.

2.1.4 Transition From Design and Construction to Operations

LES is responsible for the design, quality assurance, construction, testing, initial startup, operation, and decommissioning of the facility.

Towards the end of construction, the focus of the organization will shift from design and construction to initial start-up and operation of the facility. As the facility nears completion, LES will staff the LES NEF Operating Organization to ensure smooth transition from construction activities to operation activities. During this transition, the Health, Safety, & Environment (HS&E) Manager position reports directly to the LES President (as shown in Figure 2.1-1) for HS&E matters related to design and construction and reports directly to the Plant Manager (as shown in Figure 2.1-2) for HS&E matters related to operations. This position is intentionally duplicated to provide significant continued focus on the health, safety, and environment goals during design and construction when the operating organization is not yet fully developed and implemented. Urenco, which has been operating gas centrifuge enrichment facilities in Europe for over 30 years, will have personnel integrated into the LES organization to provide technical support during startup of the facility and transition into the operations phase.

As the construction of systems is completed, the systems will undergo acceptance testing as required by procedure, followed by turnover from the construction organization to the operations organization by means of a detailed transition plan. The turnover will include the physical systems and corresponding design information and records. Following turnover, the operating organization will be responsible for system maintenance and configuration management. The design basis for the facility is maintained during the transition from construction to operations through the configuration management system described in Chapter 11, Management Measures.

Additional information regarding the transition from design and construction to operations, for the LES QA Organization, is provided in Section 1 of the LES Quality Assurance Program Description (i.e., Appendix A of the NEF Safety Analysis Report).

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R. Production Scheduling Manager

The Production Scheduling Manager shall have a minimum of three years of appropriate, responsible experience in implementing and supervising a continuous production scheduling program.

S. Cylinder Management Manager

The Cylinder Management Manager shall have a minimum of three years of appropriate, responsible experience in implementing and supervising a continuous production scheduling program.

T. Warehouse and Materials Manager

The Warehouse and Materials Manager shall have a minimum of three years of appropriate, responsible experience in implementing and supervising a purchasing and inventory program.

U. Safeguards Manager

The Safeguards Manager shall have as a minimum, a bachelor's degree in an engineering or scientific field, and five years of experience in the management of a safeguards program for Special Nuclear Material, including responsibilities for material control and accounting. No credit for academic training may be taken toward fulfilling this experience requirement.

V. Chemistry Manager

The Chemistry Manager shall have, as a minimum, a bachelor's degree (or equivalent) in either an engineering or a scientific field and three years of appropriate, responsible nuclear experience associated with implementation of a facility chemistry program.

W. Projects Manager

The Projects Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and have a minimum of five years of appropriate, responsible nuclear experience.

X. Engineering Manager

The Engineering Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and have a minimum of five years of appropriate, responsible experience in implementing and supervising a nuclear engineering program.

Y. Maintenance Manager

The Maintenance Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and four years of responsible nuclear experience.

Z. Administration Manager

The Administration Manager shall have a minimum of three years of appropriate, responsible experience in implementing and supervising administrative responsibilities at an industrial facility.

AA. Community Relations Manager

The Community Relations Manager shall have as a minimum, a bachelor's degree in Public Relations, Political Science or Business Administration and three years of appropriate, responsible experience in implementing and supervising a community relations program.

BB. Security Manager

The Security Manager shall have as a minimum, a bachelor's degree in an engineering or scientific field, and five years of experience in the responsible management of physical security at a facility requiring security capability similar to that required for the facility. No credit for academic training may be taken toward fulfilling this experience requirement.

CC. Document Control Manager

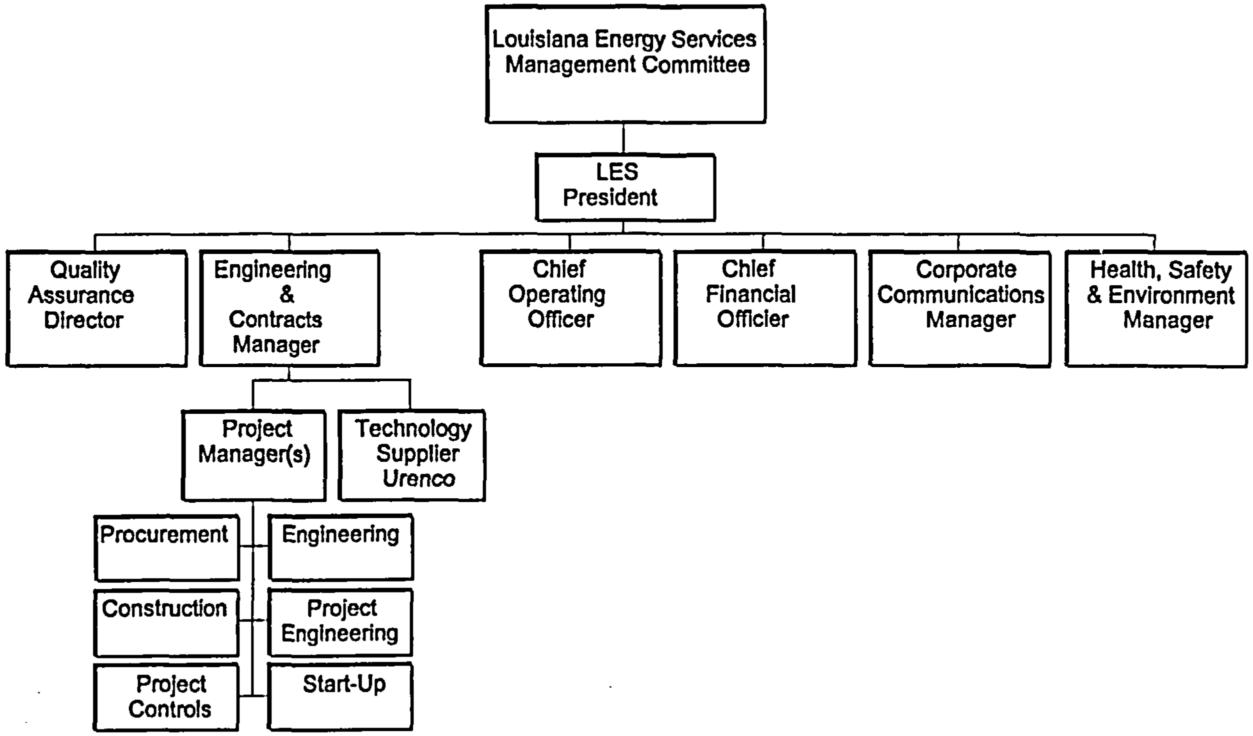
The Document Control Manager shall have a minimum of three years of appropriate, responsible experience in implementing and supervising a document control program.

DD. Training Manager

The Training Manager shall have a minimum of five years of appropriate, responsible experience in implementing and supervising a training program.

EE. Performance Manager

The Performance Manager shall have, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and four years of responsible nuclear experience.



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REFERENCE NUMBER
Figure 2.1–1.dwg

FIGURE 2.1-1
LES CORPORATE, DESIGN AND CONSTRUCTION ORGANIZATION

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3.0 SAFETY PROGRAM COMMITMENTS

This section presents the commitments pertaining to the facility's safety program including the performance of an ISA. 10 CFR Part 70 (CFR, 2003b) contains a number of specific safety program requirements related to the integrated safety analysis (ISA). These include the primary requirements that an ISA be conducted, and that it evaluate and show that the facility complies with the performance requirements of 10 CFR 70.61 (CFR, 2003c).

3.0 SAFETY PROGRAM

The three elements of the safety program defined in 10 CFR 70.62(a) (CFR, 2003d) are addressed below.

3.0.1 Process Safety Information

A. LES has compiled and maintains up-to-date documentation of process safety information. Written process-safety information is used in updating the ISA and in identifying and understanding the hazards associated with the processes. The compilation of written process-safety information includes information pertaining to:

1. The hazards of all materials used or produced in the process, which includes information on chemical and physical properties such as are included on Material Safety Data Sheets meeting the requirements of 29 CFR 1910.1200(g) (CFR, 2003e).

2. Technology of the process which includes block flow diagrams or simplified process flow diagrams, a brief outline of the process chemistry, safe upper and lower limits for controlled parameters (e.g., temperature, pressure, flow, and concentration), and evaluation of the health and safety consequences of process deviations.

3. Equipment used in the process including general information on topics such as the materials of construction, piping and instrumentation diagrams (P&IDs), ventilation, design codes and standards employed, material and energy balances, IROFS (e.g., interlocks, detection, or suppression systems), electrical classification, and relief system design and design basis.

The process-safety information described above is maintained up-to-date by the configuration management program described in Section 11.1, Configuration Management.

B. LES has developed procedures and criteria for changing the ISA. This includes implementation of a facility change mechanism that meets the requirements of 10 CFR 70.72 (CFR, 2003f).

The development and implementation of procedures is described in Section 11.4, Procedures Development and Implementation.

C. LES uses personnel with the appropriate experience and expertise in engineering and process operations to maintain the ISA. The ISA Team for the various processes consists of individuals who are knowledgeable in the ISA method(s) and the operation, hazards, and safety design criteria of the particular process. Training and qualifications of individuals responsible for maintaining the ISA are described in Section 11.3, Training and Qualifications, Section 2.2, Key Management Positions, and Section 3.2, Integrated Safety Analysis Team.

3.0.2 Integrated Safety Analysis

A. LES has conducted an ISA for each process, such that it identifies (i) radiological hazards, (ii) chemical hazards that could increase radiological risk, (iii) facility hazards that could increase radiological risk, (iv) potential accident sequences, (v) consequences and likelihood of each accident sequence and (vi) IROFS including the assumptions and conditions under which they support compliance with the performance requirements of 10 CFR 70.61 (CFR, 2003c).

A synopsis of the results of the ISA, including the information specified in 10 CFR 70.65(b) (CFR, 2003a), is provided in the National Enrichment Facility Integrated Safety Analysis Summary.

B. LES has implemented programs to maintain the ISA and supporting documentation so that it is accurate and up-to-date. Changes to the ISA Summary are submitted to the NRC, in accordance with 10 CFR 70.72(d)(1) and (3) (CFR, 2003f). The ISA update process accounts for any changes made to the facility or its processes. This update will also verify that initiating event frequencies and IROFS reliability values assumed in the ISA remain valid. Any changes required to the ISA as a result of the update process will be included in a revision to the ISA. Management policies, organizational responsibilities, revision time frame, and procedures to perform and approve revisions to the ISA are outlined in Chapter 11.0, Management Measures. Evaluation of any facility changes or changes in the process safety information that may alter the parameters of an accident sequence is by the ISA method(s) as described in the ISA Summary Document. For any revisions to the ISA, personnel having qualifications similar to those of ISA team members who conducted the original ISA are used.

C. Personnel used to update and maintain the ISA and ISA Summary are trained in the ISA method(s) and are suitably qualified. Training and Qualification of personnel used to update or maintain the ISA are described in Section 11.3, Training and Qualifications.

D. Proposed changes to the facility or its operations are evaluated using the ISA method(s). New or additional IROFS and appropriate management measures are designated as required. The adequacy of existing IROFS and associated management measures are promptly evaluated to determine if they are impacted by changes to the facility and/or its processes. If a proposed change results in a new type of accident sequence or increases the consequences or likelihood of a previously analyzed accident sequence within the context of 10 CFR 70.61 (CFR, 2003c), the adequacy of existing IROFS and associated management measures are promptly evaluated and the necessary changes are made, if required.

E. Unacceptable performance deficiencies associated with IROFS are addressed that are identified through updates to the ISA.

F. Written procedures are maintained on site. Section 11.4, Procedures Development and Implementation, discusses the procedures program.

G. All IROFS are maintained so that they are available and reliable when needed.

3.0.3 Management Measures

Management measures are functions applied to IROFS, and any items that may affect the function of IROFS. IROFS management measures ensure compliance with the performance requirements assumed in the ISA documentation. The measures are applied to particular structures, systems, equipment, components, and activities of personnel, and may be graded commensurate with the reduction of the risk attributable to that IROFS. The IROFS management measures shall ensure that these structures, systems, equipment, components, and activities of personnel within the identified IROFS boundary are designed, implemented, and maintained, as necessary, to ensure they are available and reliable to perform their function when needed, to comply with the performance requirements assumed in the ISA documentation.

The following types of management measures are required by the 10 CFR 70.4 (CFR, 2003b) definition of management measures. The description for each management measure reflects the general requirements applicable to each IROFS. Any management measure that deviates from the general requirements described in this section, which are consistent with the performance requirements assumed in the ISA documentation, are discussed in the National Enrichment Facility Integrated Safety Analysis Summary.

Configuration Management

The configuration management program is required by 10 CFR 70.72 (CFR, 2003f) and establishes a system to evaluate, implement, and track each change to the site, structures, processes, systems, equipment, components, computer programs, and activities of personnel. Configuration management of IROFS, and any items that may affect the function of IROFS, is applied to all items identified within the scope of the IROFS boundary. Any change to structures, systems, equipment, components, and activities of personnel within the identified IROFS boundary must be evaluated before the change is implemented. If the change requires an amendment to the License, Nuclear Regulatory Commission approval is required prior to implementation.

Maintenance

Maintenance of IROFS, and any items that may affect the function of IROFS, encompasses planned surveillance testing and preventative maintenance, as well as unplanned corrective maintenance. Implementation of approved configuration management changes to hardware is also generally performed as a planned maintenance function.

Planned surveillance testing (e.g., functional/performance testing, instrument calibrations) monitors the integrity and capability of IROFS, and any items that may affect the function of IROFS, to ensure they are available and reliable to perform their function when needed, to comply with the performance requirements assumed in the ISA documentation. All necessary periodic surveillance testing is generally performed on an annual frequency (any exceptions credited within the ISA are discussed in the National Enrichment Facility Integrated Safety Analysis Summary).

Planned preventative maintenance (PM) includes periodic refurbishment, partial or complete overhaul, or replacement of IROFS, as necessary, to ensure the continued availability and reliability of the safety function assumed in the ISA documentation. In determining the frequency of any PM, consideration is given to appropriately balancing the objective of preventing failures through maintenance, against the objective of minimizing unavailability of IROFS because of PM. In addition, feedback from PM and corrective maintenance and the results of incident investigations and identified root causes are used, as appropriate, to modify the frequency or scope of PM.

Planned maintenance on IROFS, or any items that may affect the function of IROFS, that do not have redundant functions available, will provide for compensatory measures to be put into place to ensure that the IROFS function is performed until it is put back into service.

Corrective maintenance involves repair or replacement of equipment that has unexpectedly degraded or failed. Corrective maintenance restores the equipment to acceptable performance through a planned, systematic, controlled, and documented approach for the repair and replacement activities.

Following any maintenance on IROFS, and before returning an IROFS to operational status, functional testing of the IROFS, as necessary, is performed to ensure the IROFS is capable of performing its intended safety function.

Training and Qualifications

IROFS, and any items that may affect the function of IROFS, require that personnel involved at each level (from design through and including any assumed process implementation steps or actions) have and maintain the appropriate training and qualifications. Employees are provided with formal training to establish the knowledge foundation and on-the-job training to develop work performance skills. For process implemented steps or actions, a needs/job analysis is performed and tasks are identified to ensure that appropriate training is provided to personnel working on tasks related to IROFS. Minimum training requirements are developed for those positions whose activities are relied on for safety. Initial identification of job-specific training requirements is based on experience. Entry-level criteria (e.g., education, technical background, and/or experience) for these positions are contained in position descriptions.

Qualification is indicated by successful completion of prescribed training, demonstration of the ability to perform assigned tasks, and where required by regulation, maintaining a current and valid license or certification.

Continuing training is provided, as required, to maintain proficiency in specific knowledge and skill related activities. For all IROFS, and any items that may affect the function of IROFS, involving process implemented steps or actions, annual refresher training or requalification is generally required (any exceptions credited within the ISA are discussed in the National Enrichment Facility Integrated Safety Analysis Summary).

Procedures

All activities involving IROFS, and any items that may affect the function of IROFS, are conducted in accordance with approved procedures. Each of the other IROFS management measures (e.g., configuration management, maintenance, training) is implemented via approved procedures. These procedures are intended to provide a pre-planned method of conducting the activity in order to eliminate errors due to on-the-spot analysis and judgments.

All procedures are sufficiently detailed that qualified individuals can perform the required functions without direct supervision. However, written procedures cannot address all contingencies and operating conditions. Therefore, they contain a degree of flexibility appropriate to the activities being performed. Procedural guidance exists to identify the manner in which procedures are to be implemented. For example, routine procedural actions may not require the procedure to be present during implementation of the actions, while complex jobs, or checking with numerous sequences may require valve alignment checks, approved operator aids, or in-hand procedures that are referenced directly when the job is conducted.

To support the requirement to minimize challenges to IROFS, and any items that may affect the function of IROFS, specific procedures for abnormal events are also provided. These procedures are based on a sequence of observations and actions to prevent or mitigate the consequences of an abnormal situation.

Audits and Assessments

Audits are focused on verifying compliance with regulatory and procedural requirements and licensing commitments. Assessments are focused on effectiveness of activities and ensuring that IROFS are reliable and are available to perform their intended safety functions as documented in the ISA. The frequency of audits and assessments is based upon the status and safety importance of the activities being performed and upon work history. However, at a minimum, all activities associated with maintaining IROFS will generally be audited or assessed on an annual basis (any exceptions credited within the ISA are discussed in the National Enrichment Facility Integrated Safety Analysis Summary).

Incident Investigations

Incident investigations are conducted within the Corrective Action Program (CAP). Incidents associated with IROFS, and any items that may affect the function of IROFS, encompass a range of items, including (a) processes that behave in unexpected ways, (b) procedural activities not performed in accordance with the approved procedure, (c) discovered deficiency, degradation, or non-conformance with an IROFS, or any items that may affect the function of IROFS. Additionally, audit and assessment results are tracked in the Corrective Action Program.

Feedback from the results of incident investigations and identified root causes are used, as appropriate, to modify management measures to provided continued assurance that the reliability and availability of IROFS remain consistent with the performance requirements assumed in the ISA documentation.

Records Management

All records associated with IROFS, and any items that may affect the function of IROFS, shall be managed in a controlled and systematic manner in order to provide identifiable and retrievable documentation. Applicable design specifications, procurement documents, or other documents specify the QA records to be generated by, supplied to, or held, in accordance with approved procedures are included.

Other Quality Assurance Elements

Other quality assurance elements associated with IROFS, or any items that may affect the function of IROFS, that are required to ensure the IROFS is available and reliable to perform the function when needed to comply with the performance requirements assumed in the ISA documentation, are discussed in the National Enrichment Facility Integrated Safety Analysis Summary.

3.1 INTEGRATED SAFETY ANALYSIS METHODS

This section outlines the approach utilized for performing the integrated safety analysis (ISA) of the process accident sequences. The approach used for performing the ISA is consistent with Example Procedure for Accident Sequence Evaluation, Appendix A to Chapter 3 of NUREG-1520 (NRC, 2002). This approach employs a semi-quantitative risk index method for categorizing accident sequences in terms of their likelihood of occurrence and their consequences of concern. The risk index method framework identifies which accident sequences have consequences that could exceed the performance requirements of 10 CFR 70.61 (CFR, 2003c) and, therefore, require designation of items relied on for safety (IROFS) and supporting management measures. Descriptions of these general types of higher consequence accident sequences are reported in the ISA Summary.

The ISA is a systematic analysis to identify plant and external hazards and the potential for initiating accident sequences, the potential accident sequences, the likelihood and consequences, and the IROFS.

The ISA uses a hazard analysis method to identify the hazards which are relevant for each system or facility. The ISA Team reviewed the hazard identified for the "credible worst-case" consequences. All credible high or intermediate severity consequence accident scenarios were assigned accident sequence identifiers, accident sequence descriptions, and a risk index determination was made.

The risk index method is regarded as a screening method, not as a definitive method of proving the adequacy or inadequacy of the IROFS for any particular accident.

The tabular accident summary resulting from the ISA identifies, for each sequence, which engineered or administrative IROFS must fail to allow the occurrence of consequences that exceed the levels identified in 10 CFR 70.61 (CFR, 2003c).

For this license application, two ISA Teams were formed. This was necessary because the sensitive nature of some of the facility design information related to the enrichment process required the use of personnel with the appropriate national security clearances. This team performed the ISA on the Cascade System, Contingency Dump System, Centrifuge Test System and the Centrifuge Post Mortem System. This ISA Team is referred to as the Classified ISA Team. The Non-Classified Team, referred to in the remainder of this text as the ISA Team, performed the ISA on the remainder of the facility systems and structures. In addition, the (non-classified) ISA Team performed the External Events and Fire Hazard Assessment for the entire facility.

In preparing for the ISA, the Accident Analysis in the Safety Analysis Report (LES, 1993) for the Claiborne Enrichment Center was reviewed. In addition, experienced personnel with familiarity with the gas centrifuge enrichment technology safety analysis where used on the ISA Team. This provides a good peer check of the final ISA results.

A procedure was developed to guide the conduct of the ISA. This procedure was used by both teams. In addition, there were common participants on both teams to further integrate the approaches employed by both teams. These steps were taken to ensure the consistency of the results of the two teams. A non-classified summary of the results of the Classified ISA has been prepared and incorporated into the ISA Summary.

3.1.1 Hazard Identification

The hazard and operability (HAZOP) analysis method was used for identifying the hazards for the Uranium Hexafluoride (UF_6) process systems and Technical Services Building systems. This method is consistent with the guidance provided in NUREG-1513 (NRC, 2001) and NUREG-1520 (NRC, 2002). The hazards identification process results in identification of physical, radiological or chemical characteristics that have the potential for causing harm to site workers, the public, or to the environment. Hazards are identified through a systematic review process that entails the use of system descriptions, piping and instrumentation diagrams, process flow diagrams, plot plans, topographic maps, utility system drawings, and specifications of major process equipment. In addition, criticality hazards identification were performed for the areas of the facility where fissile material is expected to be present. The criticality safety analyses contain information about the location and geometry of the fissile material and other materials in the process, for both normal and credible abnormal conditions. The ISA input information is included in the ISA documentation and is available to be verified as part of an on-site review.

The hazard identification process documents materials that are:

- Radioactive
- Fissile
- Flammable
- Explosive
- Toxic
- Reactive.

The hazard identification also identifies potentially hazardous process conditions. Most hazards were assessed individually for the potential impact on the discrete components of the process systems. However, for hazards from fires (external to the process system) and external events (seismic, severe weather, etc.), the hazards were assessed on a facility wide basis.

For the purpose of evaluating the impacts of fire hazards, the ISA team considered the following:

- Postulated the development of a fire occurring in in-situ combustibles from an unidentified ignition source (e.g., electrical shorting, or other source)
- Postulated the development of a fire occurring in transient combustibles from an unidentified ignition source (e.g., electrical shorting, or other source)
- Evaluated the uranic content in the space and its configuration (e.g., UF_6 solid/gas in cylinders, UF_6 gas in piping, UF_6 and/or byproducts bound on chemical traps, Uranyl Fluoride (UO_2F_2) particulate on solid waste or in solution). The appropriate configuration was considered relative to the likelihood of the target releasing its uranic content as a result of a fire in the area.

In order to assess the potential severity of a given fire and the resulting failures to critical systems, the facility Fire Hazard Analysis was consulted. However, since the design supporting the license submittal for this facility is not yet at the detailed design stage, detailed in-situ combustible loading and in-situ combustible configuration information is not yet available. Therefore, in order to place reasonable and conservative bounds on the fire scenarios analyzed, the ISA Team estimated in-situ combustible loadings based on information of the in-situ combustible loading from Urenco's Almelo SP-5 plant (on which the National Enrichment Facility (NEF) design is based). This information from SP-5 indicates that in-situ combustible loads are expected to be very low.

The Fire Safety Management Program will limit the allowable quantity of transient combustibles in critical plant areas (i.e., uranium areas). Nevertheless, the ISA Team still assumed the presence of moderate quantities of ordinary (Class A) combustibles (e.g., trash, packing materials, maintenance items or packaging, etc.) in excess of anticipated procedural limits. This was not considered a failure of the associated administrative IROFS feature for controlling/ minimizing transient combustible loading in all radiation/uranium areas. Failure of the IROFS is connoted as the presence of extreme or severe quantities of transients (e.g., large piles of combustible solids, bulk quantities of flammable/combustible liquids or gases, etc.). The Urenco ISA Team representatives all indicated that these types of transient combustible conditions do not occur in the European plants. Accordingly, and given the orientation and training that facility employees will receive indicating that these types of fire hazards are unacceptable, the administrative IROFS preventing severe accumulations has been assigned a high degree of reliability.

Fires that involve additional in-situ or transient combustibles from outside each respective fire area could result in exposure of additional uranic content being released in a fire beyond the quantities assumed above. For this reason, fire barriers are needed to ensure that fires cannot propagate from non-uranium containing areas into uranium (U) areas or from one U area to another U area (unless the uranium content in the space is insignificant, i.e., would be a low consequence event). Fire barriers shall be designed with adequate safety margin such that the total combustible loading (in-situ and transient) allowed to expose the barrier will not exceed 80% of the hourly fire resistance rating of the barrier.

For external events, the impacts were evaluated for the following hazards:

External events were considered at the site and facility level versus at individual system nodes. Specific external event HAZOP guidewords were developed for use during the external event portion of the ISA. The external event ISA considered both natural phenomena and man-made hazards. During the external event ISA team meeting, each area of the plant was discussed as to whether or not it could be adversely affected by the specific external event under consideration. If so, specific consequences were then discussed. If the consequences were known or assumed to be high, then a specific design basis with a likelihood of highly unlikely would be selected.

Given that external events were considered at the facility level, the ISA for external events was performed after the ISA team meetings for all plant systems were completed. This provided the best opportunity to perform the ISA at the site or facility level. Each external event was assessed for both the uncontrolled case and then for the controlled case. The controlled cases could be a specific design basis for that external event, IROFS or a combination of both. An Accident Sequence and Risk matrix was prepared for each external event.

External events evaluated included:

- Seismic

- Tornado, Tornado Missile and High Wind
- Snow and Ice
- Flooding
- Local Precipitation
- Other (Transportation and Nearby Facility Accidents)
- Aircraft
- Pipelines
- Highway
- Other Nearby Facilities
- Railroad
- On-site Use of Natural Gas
- Internal Flooding from On-Site Above Ground Liquid Storage Tanks.

The ISA is intended to give assurance that the potential failures, hazards, accident sequences, scenarios, and IROFS have been investigated in an integrated fashion, so as to adequately consider common mode and common cause situations. Included in this integrated review is the identification of IROFS function that may be simultaneously beneficial and harmful with respect to different hazards, and interactions that might not have been considered in the previously completed sub-analyses. This review is intended to ensure that the designation of one IROFS does not negate the preventive or mitigation function of another IROFS. An integration checklist is used by the ISA Team as a guide to facilitate the integrated review process.

Some items that warrant special consideration during the integration process are:

- Common mode failures and common cause situations.
- Support system failures such as loss of electrical power or city water. Such failures can have a simultaneous effect on multiple systems.
- Divergent impacts of IROFS. Assurance must be provided that the negative impacts of an IROFS, if any, do not outweigh the positive impacts; i.e., to ensure that the application of an IROFS for one safety function does not degrade the defense-in-depth of an unrelated safety function.
- Other safety and mitigating factors that do not achieve the status of IROFS that could impact system performance.
- Identification of scenarios, events, or event sequences with multiple impacts, i.e. impacts on chemical safety, fire safety, criticality safety, and/or radiation safety. For example, a flood might cause both a loss of containment and moderation impacts.
- Potential interactions between processes, systems, areas, and buildings; any interdependence of systems, or potential transfer of energy or materials.
- Major hazards or events, which tend to be common cause situations leading to interactions between processes, systems, buildings, etc.

3.1.2 Process Hazard Analysis Method

As noted above, the HAZOP method was used to identify the process hazards. The HAZOP process hazard analysis (PHA) method is consistent with the guidance provided in NUREG-1513 (NRC, 2001). Implementation of the HAZOP method was accomplished by either validating the Urenco HAZOPs for the NEF design or performing a new HAZOP for systems where there were no existing HAZOPs. In general, new HAZOPs were performed for the Technical Services Building (TSB) systems. In cases for which there was an existing HAZOP, the ISA Team, through the validation process, developed a new HAZOP.

For the UF_6 process systems, this portion of the ISA was a validation of the HAZOPs provided by Urenco. The validation process involved workshop meetings with the ISA Team. In the workshop meeting, the ISA Team challenged the results of the Urenco HAZOPs. As necessary the HAZOPs were revised/updated to be consistent with the requirements identified in 10 CFR 70 (CFR, 2003b) and as further described in NUREG-1513 (NRC, 2001) and NUREG-1520 (NRC, 2002).

To validate the Urenco HAZOPs, the ISA Team performed the following tasks:

- The Urenco process engineer described the salient points of the process system covered by the HAZOP being validated.
- The ISA Team divided the process "Nodes" into reasonable functional blocks.
- The process engineer described the salient points of the items covered by the "Node" being reviewed.
- The ISA Team reviewed the "Guideword" used in the Urenco HAZOP to determine if the HAZOP is likely to identify all credible hazards. A representative list of the guidewords used by the ISA Team is provided in Table 3.1-1, HAZOP Guidewords, to ensure that a complete assessment was performed.
- The ISA Team Leader introduced each Guideword being considered in the ISA HAZOP and the team reviewed and considered the potential hazards.
- For each potential hazard, the ISA Team considered the causes, including potential interactions among materials. Then, for each cause, the ISA Team considered the consequences and consequence severity category for the consequences of interest (Criticality Events, Chemical Releases, Radiation Exposure, Environment impacts). A statement of "No Safety Issue" was noted in the system HAZOP table for consequences of no interest such as maintenance problems or industrial personnel accidents.
- For each hazard, the ISA Team considered existing safeguards designed to prevent the hazard from occurring.
- For each hazard, the ISA Team also considered any existing design features that could mitigate/reduce the consequences.
- The Urenco HAZOP was modified to reflect the ISA Team's input in the areas of hazards, causes, consequences, safeguards and mitigating features.
- For each external event hazard, the ISA Team determined if the external hazard is credible (i.e., external event initiating frequency $>10^{-6}$ per year).

- When all of the Guidewords had been considered for a particular node, the ISA Team applied the same process and guidewords to the next node until the entire process system was completed.

The same process as above was followed for the TSB systems, except that instead of using the validation process, the ISA Team developed a completely new HAZOP. This HAZOP was then used as the hazard identification input into the remainder of the process.

The results of the ISA Team workshops are summarized in the ISA HAZOP Table, which forms the basis of the hazards portion of the Hazard and Risk Determination Analysis. The HAZOP tables are contained in the ISA documentation. The format for this table, which has spaces for describing the node under consideration and the date of the workshop, is provided in Table 3.1-2, ISA HAZOP Table Sample Format. This table is divided into 7 columns:

GUIDEWORD	Identifies the Guideword under consideration.
HAZARD	Identifies any issues that are raised.
CAUSES	Lists any and all causes of the hazard noted.
CONSEQUENCES	Identifies the potential and worst case consequence and consequences severity category if the hazard goes uncontrolled.
SAFEGUARDS	Identifies the engineered and/or administrative protection designed to prevent the hazard from occurring.
MITIGATION	Identifies any protection, engineered or otherwise, that can mitigate/reduce the consequences.
COMMENTS	Notes any comments and any actions requiring resolution.

This approach was used for all of the process system hazard identifications. The "Fire" and "External Events" guidewords were handled as a facility-wide assessment and were not explicitly covered in each system hazard evaluation.

The results of the HAZOP are used directly as input to the risk matrix development.

3.1.3 Risk Matrix Development

3.1.3.1 Consequence Analysis Method

10 CFR 70.61 (CFR, 2003c) specifies two categories for accident sequence consequences: "high consequences" and "intermediate consequences." Implicitly there is a third category for accidents that produce consequences less than "intermediate." These are referred to as "low consequence" accident sequences. The primary purpose of PHA is to identify all uncontrolled and unmitigated accident sequences. These accident sequences are then categorized into one of the three consequence categories (high, intermediate, low) based on their forecast radiological, chemical, and/or environmental impacts.

For evaluating the magnitude of the accident consequences, calculations were performed using the methodology described in the ISA documentation. Because the consequences of concern are the chemotoxic exposure to hydrogen fluoride (HF) and UO_2F_2, the dispersion methodology discussed in Section 6.3.2 was used. The dose consequences for all of the accident sequences were evaluated and compared to the criteria for "high" and "intermediate" consequences. The inventory of uranic material for each accident considered was dependent on the specific accident sequence. For criticality accidents, the consequences were conservatively assumed to be high for both the public and workers.

Table 3.1-3, Consequence Severity Categories Based on 10 CFR 70.61, presents the radiological and chemical consequence severity limits of 10 CFR 70.61 (CFR, 2003c) for each of the three accident consequence categories. Table 3.1-4, Chemical Dose Information, provides information on the chemical dose limits specific to the NEF.

3.1.3.2 Likelihood Evaluation Method

10 CFR 70.61 (CFR, 2003c) also specifies the permissible likelihood of occurrence of accident sequences of different consequences. "High consequence" accident sequences must be "highly unlikely" and "intermediate consequence" accident sequences must be "unlikely." Implicitly, accidents in the "low consequence" category can have a likelihood of occurrence less than "unlikely" or simply "not unlikely." Table 3.1-5, Likelihood Categories Based on 10 CFR 70.61, shows the likelihood of occurrence limits of 10 CFR 70.61 (CFR, 2003c) for each of the three likelihood categories.

The definitions of "not unlikely" and "unlikely" are taken from NUREG-1520 (NRC, 2002). The definition of "highly unlikely" is taken from NUREG-1520 (NRC, 2002). Additionally, a qualitative determination of "highly unlikely" can apply to passive design component features (e.g., tanks, piping, cylinders, etc.) of the facility that do not rely on human interface to perform the criticality safety function (i.e., termed "safe-by-design"). Safe-by-design components are those components that by their physical size or arrangement have been shown to have a $k_{eff} < 0.95$. The definition of safe-by-design components encompasses two different categories of components. The first category includes those components that are safe-by-volume, safe-by-diameter or safe-by-slab thickness. A set of generic conservative criticality calculations has determined the maximum volume, diameter, or slab thickness (i.e., safe value) that would result in a $k_{eff} < 0.95$. A component in this category has a volume, diameter or slab thickness that is less than the associated safe value resulting from the generic conservative criticality calculations and therefore the k_{eff} associated with this component is < 0.95. The components in the second category require a more detailed criticality analysis (i.e., a criticality analysis of the physical arrangement of the component's design configuration) to show that k_{eff} is < 0.95. In the second category of components, the design configuration is not bounded by the results of the generic conservative criticality calculations for maximum volume, diameter, or slab thickness that would result in a $k_{eff} < 0.95$. Examples of components in this second category are the product pumps that have volumes greater than the safe-by-volume value, but are shown by specific criticality analysis to have a $k_{eff} < 0.95$.

For failure of passive safe-by-design components to be considered "highly unlikely," these components must also meet the criterion that the only potential means to effect a change that might result in a failure to function, would be to implement a design change (i.e., geometry deformation as a result of a credible process deviation or event does not adversely impact the performance of the safety function). The evaluation of the potential to adversely impact the safety function of these passive design features includes consideration of potential mechanisms to cause bulging, corrosion, and breach of confinement/leakage and subsequent accumulation of material. The evaluation further includes consideration of adequate controls to ensure that the double contingency principle is met. For each of these passive design components, it must be concluded, that there is no credible means to effect a geometry change that might result in a failure of the safety function and that significant margin exists. For components that are safe-by-volume, safe-by-diameter, or safe-by-slab thickness (i.e., first category of safe-by-design components), significant margin is defined as a margin of at least 10%, during both normal and upset conditions, between the actual design parameter value of the component and the value of the corresponding critical design attribute. For components that require a more detailed criticality analysis (i.e., second category of safe-by-design components), significant margin is defined as $k_{eff} < 0.95$, where $k_{eff} = k_{calc} + 3\sigma_{calc}$. This margin is considered acceptable since the calculation of k_{eff} also conservatively assumes the components are full of uranic breakdown material at maximum enrichment, the worst credible moderation conditions exist, and the worst credible reflection conditions exist. In addition, the configuration management system required by 10 CFR 70.72 (implemented by the NEF Configuration Management Program) ensures the maintenance of the safety function of these features and assures compliance with the double contingency principle, as well as the defense-in-depth criterion of 10 CFR 70.64(b).

The definition of "not credible" is also taken from NUREG-1520 (NRC, 2002). If an event is not credible, IROFS are not required to prevent or mitigate the event. The fact that an event is not "credible" must not depend on any facility feature that could credibly fail to function. One cannot claim that a process does not need IROFS because it is "not credible" due to characteristics provided by IROFS. The implication of "credible" in 10 CFR 70.61 (CFR, 2003c) is that events that are not "credible" may be neglected.

Any one of the following independent acceptable sets of qualities could define an event as not credible:

a. An external event for which the frequency of occurrence can conservatively be estimated as less than once in a million years

b. A process deviation that consists of a sequence of many unlikely human actions or errors for which there is no reason or motive (In determining that there is no reason for such actions, a wide range of possible motives, short of intent to cause harm, must be considered. Necessarily, no such sequence of events can ever have actually happened in any fuel cycle facility.)

c. Process deviations for which there is a convincing argument, given physical laws that they are not possible, or are unquestionably extremely unlikely.

3.1.3.3 Risk Matrix

The three categories of consequence and likelihood can be displayed as a 3 x 3 risk index matrix. By assigning a number to each category of consequence and likelihood, a qualitative risk index can be calculated for each combination of consequence and likelihood. The risk index equals the product of the integers assigned to the respective consequence and likelihood categories. The risk index matrix, along with computed risk index values, is illustrated in Table 3.1-6, Risk Matrix with Risk Index Values. The shaded blocks identify accidents of which the consequences and likelihoods yield an unacceptable risk index and for which IROFS must be applied.

The risk indices can initially be used to examine whether the consequences of an uncontrolled and unmitigated accident sequence (i.e., without any IROFS) could exceed the performance requirements of 10 CFR 70.61 (CFR, 2003c). If the performance requirements could be exceeded, IROFS are designated to prevent the accident or to mitigate its consequences to an acceptable level. A risk index value less than or equal to four means the accident sequence is acceptably protected and/or mitigated. If the risk index of an uncontrolled and unmitigated accident sequence exceeds four, the likelihood of the accident must be reduced through designation of IROFS. In this risk index method, the likelihood index for the uncontrolled and unmitigated accident sequence is adjusted by adding a score corresponding to the type and number of IROFS that have been designated.

3.1.4 Risk Index Evaluation Summary

The results of the ISA are summarized in tabular form. This table includes the accident sequences identified for this facility. The accident sequences were not grouped as a single accident type but instead were listed individually in the table. The Table has columns for the initiating event and for IROFS. IROFS may be mitigative or preventive. Mitigative IROFS are measures that reduce the consequences of an accident. The phrase "uncontrolled and/or unmitigated consequences" describes the results when the system of existing preventive IROFS fails and existing mitigation also fails. Mitigated consequences result when the preventive IROFS fail, but mitigative measures succeed. Index numbers are assigned to initiating events, IROFS failure events, and mitigation failure events, based on the reliability characteristics of these items.

With redundant IROFS and in certain other cases, there are sequences in which an initiating event places the system in a vulnerable state. While the system is in this vulnerable state, an IROFS must fail for the accident to result. Thus, the frequency of the accident depends on the frequency of the first event, the duration of vulnerability, and the frequency of the second IROFS failure. For this reason, the duration of the vulnerable state is considered, and a duration index is assigned. The values of all index numbers for a sequence, depending on the number of events involved, are added to obtain a total likelihood index, T. Accident sequences are then assigned to one of the three likelihood categories of the risk matrix, depending on the value of this index in accordance with Table 3.1-8, Determination of Likelihood Category.

The values of index numbers in accident sequences are assigned considering the criteria in Tables 3.1-9 through 3.1-11. Each table applies to a different type of event. Table 3.1-9, Failure Frequency Index Numbers, applies to events that have *frequencies* of occurrence, such as initiating events and certain IROFS failures. Failure Probability Index Numbers are evaluated based on operating experience, (either from Urenco or the National Enrichment Facility, as appropriate) or analyses. When failure *probabilities* are required for an event, Table 3.1-10, Failure Probability Index Numbers, provides the index values. Table 3.1-11, Failure Duration Index Numbers, provides index numbers *for durations* of failure. These are used in certain accident sequences where two IROFS must simultaneously be in a failed state. In this case, one of the two controlled parameters will fail first. It is then necessary to consider the duration that the system remains vulnerable to failure of the second. This period of vulnerability can be terminated in several ways. The first failure may be "fail-safe" or be continuously monitored, thus alerting the operator when it fails so that the system may be quickly placed in a safe state. Or the IROFS may be subject to periodic surveillance tests for hidden failures. When hidden failures are possible, these surveillance intervals limit the duration that the system is in a vulnerable state. The reverse sequences, where the second IROFS fails first, should be considered as a separate accident sequence. This is necessary because the failure frequency and the duration of outage of the first and the second IROFS may differ. The values of these duration indices are not merely judgmental. They are directly related to the time intervals used for surveillance and the time needed to render the system safe.

The duration of failure is accounted for in establishing the overall likelihood that an accident sequence will continue to the defined consequence. Thus, the time to discover and repair the failure is accounted for in establishing the risk of the postulated accident.

The total likelihood index is the sum of the indices for all the events in the sequence, including those for duration. Consequences are assigned to one of the three consequence categories of the risk matrix, based on calculations or estimates of the actual consequences of the accident sequence. The consequence categories are based on the levels identified in 10 CFR 70.61 (CFR, 2003c). Multiple types of consequences can result from the same event. The consequence category is chosen for the most severe consequence.

In summarizing the ISA results, Table 3.7-1, Accident Sequence and Risk Index, provides two risk indices for each accident sequence to permit evaluation of the risk significance of the IROFS involved. To measure whether an IROFS has high risk significance, the table provides an "uncontrolled risk index," determined by modeling the sequence with all IROFS as failed (i.e., not contributing to a lower likelihood). In addition, a "controlled risk index" is also calculated, taking credit for the low likelihood and duration of IROFS failures. When an accident sequence has an uncontrolled risk index exceeding four but a controlled risk index of less than four, the IROFS involved have a high risk significance because they are relied on to achieve acceptable safety performance. Thus, use of these indices permits evaluation of the possible benefit of improving IROFS and also whether a relaxation may be acceptable.

3.2 INTEGRATED SAFETY ANALYSIS TEAM

There were two ISA Teams that were employed in the ISA. The first team worked on the non-classified portions of the facility and is referred to in the text as the ISA Team. The second team, referred to as the Classified ISA Team, performed the ISA on the classified elements of the facility. Both teams were selected with credentials consistent with the requirements in 10 CFR 70.65 (CFR, 2003a) and the guidance provided in NUREG-1520 (NRC, 2002). To facilitate consistency of results, common membership was dictated as demonstrated below (i.e., some members of the Non-Classified Team participated on the Classified Team. One of the members of the Classified Team participated in the ISA Team Leader Training, which was conducted prior to initiating the ISA. In addition, the Classified ISA Team Leader observed some of the non-classified ISA Team meetings.

The ISA was performed by a team with expertise in engineering, safety analysis and enrichment process operations. The team included personnel with experience and knowledge specific to each process or system being evaluated. The team was comprised of individuals who have experience, individually or collectively, in:

- Nuclear criticality safety
- Radiological safety
- Fire safety
- Chemical process safety
- Operations and maintenance
- ISA methods.

The ISA team leader was trained and knowledgeable in the ISA method(s) chosen for the hazard and accidents evaluations. Collectively, the team had an understanding of all process operations and hazards under evaluation.

The ISA Manager was responsible for the overall direction of the ISA. The process expertise was provided by the Urenco personnel on the team. In addition, the Team Leader has an adequate understanding of the process operations and hazards evaluated in the ISA, but is not the responsible cognizant engineer or enrichment process expert.

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3.3 COMPLIANCE ITEM COMMITMENTS

3.3.1 For accident sequences PT3-5, PB1-3, FR1-1, FR1-2, FR2-1, FR2-2, DS1-1, DS1-2, DS2-1, DS2-2, DS3-1, DS3-2, SW1-1, SW1-2, LW1-2, LW1-3, RD1-1, and EC3-1, an Initiating Event Frequency (IEF) index number of "-2" may be assigned based on evidence from the operating history of similar designed Urenco European plants. Detailed justifications for the IEF index numbers of "-2" will be developed during detailed design. If the detailed justification does not support the IEF index number of "-2," then the IEF index number assigned and the associated accident sequence(s) will be re-evaluated and revised, as necessary, consistent with overall ISA methodology.

3.3.2 For Administrative Control IROFS that involve "use of" a component or device, a Failure Probability Index Number (FPIN) of "-2" may be assigned provided the IROFS is a routine, simple, action that either: (1) involves only one or two decision points or (2) is highly detailed in the associated implementing procedure. Alternately, an FPIN of "-3" may be assigned for this type of IROFS provided the criteria specified above for an FPIN of "-2" are met and the IROFS is enhanced by requiring independent verification of the safety function. This enhancement shall meet the requirements for independent verification identified in item 3.3.5 below. If these criteria cannot be met, then the FPIN assigned to the IROFS and the associated accident sequence(s) will be re-evaluated and revised, as necessary, consistent with the overall ISA methodology.

3.3.3 For Administrative Control IROFS that involve "verification of" a state or condition, an FPIN of "-2" may be assigned provided the IROFS is a routine action performed by one person, with proceduralized, objective, acceptance criteria. Alternately, an FPIN of "-3" may be assigned for this type of IROFS provided the criteria specified above for an FPIN of "-2" are met and the IROFS is enhanced by requiring independent verification of the safety function. This enhancement shall meet the requirements for independent verification identified in item 3.3.5 below. If these criteria cannot be met, then the FPIN assigned to the IROFS and the associated accident sequence(s) will be re-evaluated and revised, as necessary, consistent with the overall ISA methodology.

3.3.4 For Administrative Control IROFS that involve " independent sampling," different samples are obtained and an FPIN of "-2" may be assigned provided at least three of the following four criteria are met.

1. Different methods/techniques are used for sample analysis.
2. Samples are obtained from different locations.
3. Samples are obtained at different times. The time period between collection of the different samples shall be sufficient to ensure results are meaningful and representative of the material sampled.
4. Samples are obtained by different personnel.

If at least three of the above criteria cannot be met, then the FPIN assigned to the IROFS and the associated accident sequence(s) will be re-evaluated and revised, as necessary, consistent with the overall ISA methodology.

3.3.5 For IROFS and IROFS with Enhanced Failure Probability Index Numbers (i.e., enhanced IROFS) that require "independent verification" of a safety function, the independent verification shall be independent with respect to personnel and personnel interface. Specifically, a second qualified individual, operating independently (e.g., not at the same time or not at the same location) of the individual assigned the responsibility to perform the required task, shall, as applicable, verify that the required task (i.e., safety function) has been performed correctly (e.g., verify a condition), or re-perform the task (i.e., safety function), and confirm acceptable results before additional action(s) can be taken which potentially negatively impact the safety function of the IROFS. The required task and independent verification shall be implemented by procedure and documented by initials or signatures of the individuals responsible for each task. In addition, the individuals performing the tasks shall be qualified to perform, for the particular system or process (as applicable) involved, the tasks required and shall possess operating knowledge of the particular system or process (as applicable) involved and its relationship to facility safety. The requirements for independent verification are consistent with the applicable guidance provided in ANSI/ANS-3.2-1994, Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants.

3.3.6 Upon completion of the design of IROFS, the IROFS boundaries will be defined. In defining the boundaries for each IROFS, Louisiana Energy Services procedure DP-ISA-1.1, "IROFS Boundary Definition," will be used. This procedure requires the identification of each support system and component necessary to ensure the IROFS is capable of performing its specified safety function.

3.3.7 The applicable guidance of the following industry standards, guidance documents and regulatory guides shall be used for the design, procurement, installation, testing, and maintenance of IROFS at the NEF.

a. Institute of Electrical and Electronics Engineers (IEEE) standard IEEE 603-1998, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations"

b. IEEE standard 384-1992, "IEEE Standard Criteria for Independence of Class IE Equipment and Circuits"

c. Branch Technical Position HICB-11, "Guidance on Application and Qualification of Isolation Devices," Revision 4, June 1977, from NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants"

d. Regulatory Guide 1.75, "Physical Independence of Electric Systems," Revision 2, September 1978

e. IEEE standard 344-1987, "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations"

f. Regulatory Guide 1.100, "Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants," Revision 2, June 1988

g. American National Standards Institute (ANSI)/Instrumentation, Systems, and Automation Society (ISA)-S67.04-1994, Part 1, "Setpoints for Nuclear Safety-Related Instrumentation"

h. Regulatory Guide 3.17, "Earthquake Instrumentation for Fuel Reprocessing Plants," February 1974 (for IROFS26 only)

i. IEEE standard 338-1987, "IEEE Standard Criteria for Periodic Surveillance Testing of Nuclear Power Generating Station Safety Systems"

j. Branch Technical Position HICB-17, "Guidance on Self-Test and Surveillance Test Provisions," Revision 4, June 1977, from NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants"

k. Regulatory Guide 1.118, "Periodic Testing of Electric Power and Protection Systems," Revision 3, April 1995

l. IEEE standard 518-1982, "IEEE Guide for Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources"

m. IEEE standard 1050-1996, "IEEE Guide for Instrumentation and Control Equipment Grounding in Generating Stations"

n. IEEE standard 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations" (for separation and isolation)

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3.4 REFERENCES

CFR, 2003a. Title 10, Code of Federal Regulations, Section 70.65, Additional content of applications, 2003.

CFR, 2003b. Title 10, Code of Federal Regulations, Part 70, Domestic Licensing of Special Nuclear Material, 2003.

CFR, 2003c. Title 10, Code of Federal Regulations, Section 70.61, Performance requirements, 2003.

CFR, 2003d. Title 10, Code of Federal Regulations, Section 70.62, Safety program and integrated safety analysis, 2003.

CFR, 2003e. Title 29, Code of Federal Regulations, Section 1910, Occupational Safety and Health Standards, 2003.

CFR, 2003f. Title 10, Code of Federal Regulations, Section 70.72, Facility changes and change process, 2003.

LES, 1993. Claiborne Enrichment Center Safety Analysis Report, Louisiana Energy Services, December 1993.

NRC, 2001. Integrated Safety Analysis Guidance Document, NUREG-1513, U.S. Nuclear Regulatory Commission, May 2001.

NRC, 2002. Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility, NUREG-1520, U.S. Nuclear Regulatory Commission, March 2002.

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TABLES

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Table 3.1-1 HAZOP Guidewords

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UF_6 PROCESS GUIDEWORDS			
Less Heat	Corrosion	Maintenance	No Flow
More Heat	Loss of Services	Criticality	Reverse Flow
Less Pressure	Toxicity	Effluents/Waste	Less Uranium
More Pressure	Contamination	Internal Missile	More Uranium
Impact/Drop	Loss of Containment	Less Flow	Light Gas
Fire (Process, internal, other)	Radiation	More Flow	External Event
NON UF_6 PROCESS GUIDEWORDS			
High Flow	Low Pressure	Impact/Drop	More Uranium
Low Flow	High Temperature	Corrosion	External Event
No Flow	Low Temperature	Loss of Services	Startup
Reverse Flow	Fire	Toxicity	Shutdown
High Level	High Contamination	Radiation	Internal Missile
Low Level	Rupture	Maintenance	
High Pressure	Loss of Containment	Criticality	
No Flow			
EXTERNAL EVENTS POTENTIAL CAUSES			
Construction on Site	Hurricane	Seismic	Transport Hazard Off-Site
Flooding	Industrial Hazard Off-site	Tornado	External Fire
Airplane	Snow/Ice	Local Intense Precipitation	

Table 3.1-2 ISA HAZOP Table Sample Format

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ISA HAZOP NODE:		DESCRIPTION:			DATE:	PAGE:
GUIDEWORD	HAZARD	CAUSE	CONSEQUENCE	SAFEGUARDS	MITIGATING FACTORS	COMMENTS

Table 3.1-3 Consequence Severity Categories Based on 10 CFR 70.61

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	Workers	Offsite Public	Environment
Category 3 High Consequence	Radiation Dose (RD) >1 Sievert (Sv) (100 rem) For the worker (elsewhere in room), except the worker (local), Chemical Dose (CD) > AEGL-3 For worker (local), CD > AEGL-3 for HF CD > * for U	RD > 0.25 Sv (25 rem) 30 mg sol U intake CD > AEGL-2	–
Category 2 Intermediate Consequence	0.25 Sv (25 rem) <RD≤ 1 Sv (100 rem) For the worker (elsewhere in room), except the worker (local), AEGL-2 < CD≤ AEGL-3 For the worker (local), AEGL-2 < CD ≤ AEGL-3 for HF ** < CD ≤ * for U	0.05 Sv (5 rem) < RD≤ 0.25 Sv (25 rem) AEGL-1 <CD≤ AEGL-2	Radioactive release > 5000 x Table 2 Appendix B of 10 CFR Part 20
Category 1 Low Consequence	Accidents of lower radiological and chemical exposures than those above in this column	Accidents of lower radiological and chemical exposures than those above in this column	Radioactive releases with lower effects than those referenced above in this column

Notes:

*NUREG-1391 threshold value for intake of soluble U resulting in permanent renal failure

**NUREG-1391 threshold value for intake of soluble U resulting in no significant acute effects to an exposed individual

Table 3.1-4 Chemical Dose Information

	High Consequence (Category 3)	**Intermediate Consequence (Category 2)**
Worker (local)	> 40 mg U intake > 139 mg HF/m^3	> 10 mg U intake > 78 mg HF/m^3
Worker (elsewhere in room)	> 146 mg U/m^3 > 139 mg HF/m^3	> 19 mg U/m^3 > 78 mg HF/m^3
Outside Controlled Area (30-min exposure)	> 13 mg U/m^3 > 28 mg HF/m^3	> 2.4 mg U/m^3 > 0.8 mg HF/m^3

Table 3.1-5 Likelihood Categories Based on 10 CFR 70.61
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	Likelihood Category	Probability of Occurrence*
Not Unlikely	3	More than 10^{-4} per-event per-year
Unlikely	2	Between 10^{-4} and 10^{-5} per-event per-year
Highly Unlikely	1	Less than 10^{-5} per-event per-year

*Based on approximate order-of-magnitude ranges

Table 3.1-6 Risk Matrix with Risk Index Values

Severity of Consequences	Likelihood of Occurrence		
	Likelihood Category 1 Highly Unlikely (1)	Likelihood Category 2 Unlikely (2)	Likelihood Category 3 Not Unlikely (3)
Consequence Category 3 High (3)	Acceptable Risk 3	Unacceptable Risk 6	Unacceptable Risk 9
Consequence Category 2 Intermediate (2)	Acceptable Risk 2	Acceptable Risk 4	Unacceptable Risk 6
Consequence Category 1 Low (1)	Acceptable Risk 1	Acceptable Risk 2	Acceptable Risk 3

Table 3.1-7 (Not Used)

Table 3.1-8 Determination of Likelihood Category

Likelihood Category	Likelihood Index T (= sum of index numbers)
1	$T \leq -5$
2	$-5 < T \leq -4$
3	$-4 < T$

Table 3.1-9 Failure Frequency Index Numbers

Frequency Index No.	Based On Evidence	Based On Type Of IROFS**	Comments
-6*	External event with freq. < 10^{-6} /yr		If initiating event, no IROFS needed.
-5*	Initiating event with freq. < 10^{-5}/yr		For passive safe-by-design components or systems, failure is considered highly unlikely when no potential failure mode (e.g., bulging, corrosion, or leakage) exists, as discussed in Section 3.1.3.2, significant margin exists*** and these components and systems have been placed under configuration management.
-4*	No failures in 30 years for hundreds of similar IROFS in industry	Exceptionally robust passive engineered IROFS (PEC), or an inherently safe process, or two independent active engineered IROFS (AECs), PECs, or enhanced admin. IROFS	Rarely can be justified by evidence. Further, most types of single IROFS have been observed to fail
-3*	No failures in 30 years for tens of similar IROFS in industry	A single IROFS with redundant parts, each a PEC or AEC	
-2*	No failure of this type in this facility in 30 years	A single PEC	
-1*	A few failures may occur during facility lifetime	A single AEC, an enhanced admin. IROFS, an admin. IROFS with large margin, or a redundant admin. IROFS	
0	Failures occur every 1 to 3 years	A single administrative IROFS	
1	Several occurrences per year	Frequent event, inadequate IROFS	Not for IROFS, just initiating events

Table 3.1-9 Failure Frequency Index Numbers

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Frequency Index No.	Based On Evidence	Based On Type Of IROFS**	Comments
2	Occurs every week or more often	Very frequent event, inadequate IROFS	Not for IROFS, just initiating events

*Indices less than (more negative than) –1 should not be assigned to IROFS unless the configuration management, auditing, and other management measures are of high quality, because, without these measures, the IROFS may be changed or not maintained.

**The index value assigned to an IROFS of a given type in column 3 may be one value higher or lower than the value given in column 1. Criteria justifying assignment of the lower (more negative) value should be given in the narrative describing ISA methods. Exceptions require individual justification.

***For components that are safe-by-volume, safe-by-diameter, or safe-by-slab thickness, significant margin is defined as a margin of at least 10%, during both normal and upset conditions, between the actual design parameter value of the component and the value of the critical design attribute. For components that require a more detailed criticality analysis, significant margin is defined as $k_{eff} < 0.95$, where $k_{eff} = k_{calc} + 3\sigma_{calc}$.

Table 3.1-10 Failure Probability Index Numbers

Probability Index No.	Probability of Failure on Demand	Based on Type of IROFS	Comments
-6*	10^{-6}		If initiating event, no IROFS needed.
-4 or -5*	10^{-4} - 10^{-5}	Exceptionally robust passive engineered IROFS (PEC), or an inherently safe process, or two redundant IROFS more robust than simple admin. IROFS (AEC, PEC, or enhanced admin.)	Can rarely be justified by evidence. Most types of single IROFS have been observed to fail
-3 or -4*	10^{-3} - 10^{-4}	A single passive engineered IROFS (PEC) or an active engineered IROFS (AEC) with high availability	
-2 or -3*	10^{-2} - 10^{-3}	A single active engineered IROFS, or an enhanced admin. IROFS, or an admin. IROFS for routine planned operations	
-1 or -2	10^{-1} - 10^{-2}	An admin. IROFS that must be performed in response to a rare unplanned demand	

*Indices less than (more negative than) –1 should not be assigned to IROFS unless the configuration management, auditing, and other management measures are of high quality, because, without these measures, the IROFS may be changed or not maintained.

Table 3.1-11 Failure Duration Index Numbers

Duration Index No.	Avg. Failure Duration	Duration in Years	Comments
1	More than 3 yrs	10	
0	1 yr	1	
-1	1 mo	0.1	Formal monitoring to justify indices less than -1
-2	A few days	0.01	
-3	8 hrs	0.001	
-4	1 hr	10^{-4}	
-5	5 min	10^{-5}	

4.1 COMMITMENT TO RADIATION PROTECTION PROGRAM IMPLEMENTATION

The radiation program meets the requirements of 10 CFR 20 (CFR, 2003b), Subpart B, Radiation Protection Programs, and is consistent with the guidance provided in Regulatory Guide 8.2, Guide for Administrative Practice in Radiation Monitoring (NRC, 1973a). The facility develops, documents and implements its Radiation Protection Program commensurate with the risks posed by a uranium enrichment operation. The facility uses, to the extent practicable, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as reasonably achievable (ALARA). The radiation program content and implementation are reviewed at least annually as required by 10 CFR 20.1101(c) (CFR, 2003d). In addition, in accordance with 10 CFR 20.1101(d) (CFR, 2003d) constraints on atmospheric releases are established for the NEF such that no member of the public would be expected to receive a total effective dose equivalent in excess of 0.1 mSv/yr (10 mrem/yr) from these releases. Additional information regarding compliance with 10 CFR 20.1101(d) is provided in Section 9.2.

The facility's philosophy for radiation protection is reflected in the establishment of a Radiation Protection Program that has the specific purpose of maintaining occupational radiation exposures ALARA. This program includes written procedures, periodic assessments of work practices and internal/external doses received, work plans and the personnel and equipment required to help implement the ALARA goal.

The facility's administrative personnel exposure limits have been set below the limits specified in 10 CFR 20 (CFR, 2003b). This provides assurance that legal radiation exposure limits are not exceeded and that the ALARA principle is emphasized. The facility administrative exposure limits are given in Table 4.1-1, Administrative Radiation Exposure Limits. Estimates of the facility area radiation dose rates and individual personnel exposures, during normal operations, are shown in Table 4.1-2, Estimated Dose Rates and Table 4.1-3, Estimated Individual Exposures. These estimates are based upon the operating experience of similar Urenco facilities in Europe.

The annual dose equivalent accrued by a typical radiation worker at a uranium enrichment plant is usually low. At the Urenco Capenhurst plant, the maximum annual worker dose equivalent was 3.1 mSv (310 mrem), 2.2 mSv (220 mrem), 2.8 mSv (280 mrem), 2.7 mSv (270 mrem) and 2.3 mSv (230 mrem) during the years 1998 through 2002, respectively. For each of these same years, the average annual worker dose equivalent was approximately 0.2 mSv (20 mrem) (Urenco, 2000; Urenco, 2001; Urenco, 2002).

Protection of plant personnel requires (a) surveillance of and control over the radiation exposure of personnel; and (b) maintaining the exposure of all personnel not only within permissible limits, but "as low as is reasonably achievable," in compliance with applicable regulations and license conditions. The objectives of Radiation Protection are to prevent acute radiation injuries (nonstochastic or deterministic effects) and to limit the potential risks of probabilistic (stochastic) effects (which may result from chronic occupational exposure) to an acceptable level.

The radiation exposure policy and control measures for personnel are set up in accordance with requirements of 10 CFR 20 (CFR, 2003b) and the guidance of applicable Regulatory Guides. Recommendations from the International Commission on Radiological Protection (ICRP) and the National Council on Radiation Protection and Measurements (NCRP) may also be used in the formulation and evolution of the facility Radiation Protection Program.

The facility corrective action process is implemented if (1) personnel dose monitoring results or personnel contamination levels exceed the administrative personnel limits; or if an incident results in airborne occupational exposures exceeding the administrative limits or (2) the dose limits in 10 CFR 20 (CFR, 2003b), Appendix B or 10 CFR 70.61 (CFR, 2003e) are exceeded.

The information developed from the corrective action process is used to improve radiation protection practices and to preclude the recurrence of similar incidents. If an incident as described in item two above occurs, the NRC is informed of the corrective action taken or planned to prevent recurrence and the schedule established by the facility to achieve full compliance. The corrective action process and incident investigation process are described in Section 11.6, Incident Investigations and Corrective Action Process.

The subject matter discussed above is identical to Claiborne Enrichment Center SAR (LES, 1993) subject matter. The NRC staff previously reviewed the Claiborne Enrichment Center SAR (LES, 1993) application relative to the general guidelines of the occupational radiation protection program and concluded that the descriptions, specifications or analyses provided an adequate basis for safety review of the facility operations and that the construction and operation of the facility would not pose an undue risk to public health and safety. The specific discussion is in NUREG-1491 (NRC, 1994), Section 8.4.

4.1.1 Responsibilities of Key Program Personnel

In this section the Radiation Protection Program's organizational structure is described. The responsibilities of key personnel are also discussed. These personnel play an important role in the protection of workers, the environment and implementation of the ALARA program. Chapter 2, Organization and Administration, discusses the facility organization and administration in further detail. Section 2.2, Key Management Positions of Chapter 2, presents a detailed discussion of the responsibilities of key management personnel.

The subject matter discussed above is identical to Claiborne Enrichment Center SAR (LES, 1993) subject matter. The NRC staff previously reviewed the Claiborne Enrichment Center SAR (LES, 1993) application relative to the responsibilities assigned to facility personnel and the extent of incorporation of the ALARA principle into the facility's radiation protection program and concluded that the descriptions, specifications or analyses provided an adequate basis for safety review of the facility operations and that the construction and operation of the facility would not pose an undue risk to public health and safety. The specific discussion is in NUREG-1491 (NRC, 1994) Section 8.3.

4.1.1.1 Plant Manager

The Plant Manager is responsible for all aspects of facility operation, including the protection of all persons against radiation exposure resulting from facility operations and materials, and for compliance with applicable NRC regulations and the facility license.

4.1.1.2 Health, Safety and Environment Manager

The Health, Safety, and Environment (HS&E) Manager reports to the Plant Manager and has the responsibility for directing the activities that ensure the facility maintains compliance with appropriate rules, regulations, and codes. This includes HS&E activities associated with nuclear safety, radiation protection, chemical safety, environmental protection, and industrial safety. The HS&E Manager works with the other facility managers to ensure consistent interpretations of HS&E requirements, performs independent reviews and supports facility and operations change control reviews.

4.1.1.3 Radiation Protection Manager

The Radiation Protection Manager reports to the HS&E Manager. The Radiation Protection Manager is responsible for implementing the Radiation Protection Program. In matters involving radiological protection, the Radiation Protection Manager has direct access to the Plant Manager. The Radiation Protection Manager and his staff are responsible for:

- Establishing the Radiation Protection Program
- Generating and maintaining procedures associated with the program
- Assuring that ALARA is practiced by all personnel
- Reviewing and auditing the efficacy of the program in complying with NRC and other governmental regulations and applicable Regulatory Guides
- Modifying the program based upon experience and facility history
- Adequately staffing the Radiation Protection group to implement the Radiation Protection Program
- Establishing and maintaining an ALARA program
- Establishing and maintaining a respirator usage program
- Monitoring worker doses, both internal and external
- Complying with the radioactive materials possession limits for the facility
- Handling of radioactive wastes when disposal is needed
- Calibration and quality assurance of all radiological instrumentation, including verification of required Lower Limits of Detection or alarm levels
- Establishing and maintaining a radiation safety training program for personnel working in Restricted Areas

- Performing audits of the Radiation Protection Program on an annual basis
- Establishing and maintaining the radiological environmental monitoring program
- Posting the Restricted Areas, and within these areas, posting: Radiation, Airborne Radioactivity, High Radiation and Contaminated Areas as appropriate; and developing occupancy guidelines for these areas as needed.

4.1.1.4 Operations Manager

The Operations Manager is responsible for operating the facility safely and in accordance with procedures so that all effluents released to the environment and all exposures to the public and facility personnel meet the limits specified in applicable regulations, procedures and guidance documents.

4.1.1.5 Facility Personnel

Facility personnel are required to work safely and to follow the rules, regulations and procedures that have been established for their protection and the protection of the public. Personnel whose duties require (1) working with radioactive material, (2) entering radiation areas, (3) controlling facility operations that could affect effluent releases, or (4) directing the activities of others, are trained such that they understand and effectively carry out their responsibilities.

4.1.2 Staffing of the Radiation Protection Program

Only suitably trained radiation protection personnel are employed at the facility. For example, the Radiation Protection Manager has, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and three years of responsible nuclear experience associated with implementation of a Radiation Protection Program. At least two years of this nuclear experience is at a facility that processes uranium, including uranium in soluble form. Other members of the Radiation Protection Program staff are trained and qualified consistent with the guidance provided in American National Standards Institute (ANSI) standard 3.1, Selection, Qualification and Training of Personnel for Nuclear Power Plants (ANSI, 1993).

Sufficient resources in terms of staffing and equipment are provided to implement an effective Radiation Protection Program.

4.1.3 Independence of the Radiation Protection Program

The Radiation Protection Program remains independent of the facility's routine operations. This independence ensures that the Radiation Protection Program maintains its objectivity and is focused only on implementing sound radiation protection principles necessary to achieve occupational doses and doses to members of the public that are ALARA. It was previously

4.3 ORGANIZATION AND PERSONNEL QUALIFICATIONS

The regulation 10 CFR 70.22 (CFR, 2003h) requires that the technical qualifications, including training and experience of facility staff be provided in the license application. This information is provided in this section.

The Radiation Protection Program staff is assigned responsibility for implementation of the Radiation Protection Program functions. Only suitably trained radiation protection personnel are employed at the facility. Staffing is consistent with the guidance provided in Regulatory Guides 8.2 (NRC, 1973a) and 8.10 (NRC, 1977).

As previously discussed, the Radiation Protection Manager has, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and three years of responsible nuclear experience associated with implementation of a Radiation Protection Program. The nuclear experience includes at least two years of experience at a facility that processes uranium, including uranium in soluble form. As stated in Section 4.1.2, Staffing of the Radiation Protection Program, other members of the Radiation Protection Program staff are trained and qualified consistent with the guidance provided in American National Standards Institute (ANSI) standard 3.1, Selection, Qualification and Training of Personnel for Nuclear Power Plants (ANSI, 1993).

The Radiation Protection Manager reports to the HS&E Manager and has the responsibility for establishing and implementing the Radiation Protection Program. These duties include the training of personnel in use of equipment, control of radiation exposure of personnel, continuous determination and evaluation of the radiological status of the facility, and conducting the radiological environmental monitoring program. The facility organization chart establishes clear organizational relationships among the radiation protection staff and the other facility line managers. The facility operating organization is described in Chapter 2, Organization and Administration.

In all matters involving radiological protection, the Radiation Protection Manager has direct access to the Plant Manager. The Radiation Protection Manager is skilled in the interpretation of radiation protection data and regulations. The Radiation Protection Manager is also familiar with the operation of the facility and radiation protection concerns relevant to the facility. The Radiation Protection Manager is a resource for radiation safety management decisions.

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4.7 RADIATION SURVEYS AND MONITORING PROGRAMS COMMITMENTS

Radiation surveys are conducted for two purposes: (1) to ascertain radiation levels, concentrations of radioactive materials, and potential radiological hazards that could be present in the facility; and (2) to detect releases of radioactive material from facility equipment and operations. Radiation surveys will focus on those areas of the facility identified in the ISA where the occupational radiation dose limits could potentially be exceeded. Measurements of airborne radioactive material and/or bioassays are used to determine that internal occupational exposures to radiation do not exceed the dose limits specified in 10 CFR 20 (CFR, 2003b), Subpart C.

To assure compliance with the requirements of 10 CFR 20 (CFR, 2003b) Subpart F, there are written procedures for the radiation survey and monitoring programs. The radiation survey and monitoring programs assure compliance with the requirements of 10 CFR 20 (CFR, 2003b) Subpart F (Surveys and Monitoring), Subpart C (Occupational Dose Limits), Subpart L (Records) and Subpart M (Reports).

The radiation survey and monitoring programs are consistent with the guidance provided in the following references:

- Regulatory Guide 8.2-Guide for Administrative Practice in Radiation Monitoring (NRC,1973a)
- Regulatory Guide 8.4-Direct-Reading and Indirect-Reading Pocket Dosimeters (NRC,1973b)
- Regulatory Guide 8.7- Instructions for Recording and Reporting Occupational Radiation Exposure Data (NRC, 1992a)
- Regulatory Guide 8.9-Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program (NRC,1993f)
- Regulatory Guide 8.24-Health Physics Surveys During Enriched Uranium-235 Processing and Fuel Fabrication (NRC,1979)
- Regulatory Guide 8.25-Air Sampling in the Workplace (NRC, 1992b)
- Regulatory Guide 8.34-Monitoring Criteria and Methods To Calculate Occupational Radiation Doses (NRC, 1992c)
- NUREG-1400-Air Sampling in the Workplace (NRC,1993a)
- ANSI/HPS N13.1-1999-Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities (ANSI, 1999)
- ANSI N323-1978-Radiation Protection Instrumentation Test and Calibration (ANSI,1978)

- ANSI N13.11-1983-Dosimetry-Personnel Dosimetry Performance-Criteria for Testing (ANSI, 1983)
- ANSI N13.15-1985-Radiation Detectors-Personnel Thermoluminescence Dosimetry Systems-Performance (ANSI,1985)
- ANSI/HPS N13.22-1995-Bioassay Program for Uranium (ANSI,1995)
- ANSI N13.27-1981-Performance Requirements for Pocket-Sized Alarm Dosimeters and Alarm Ratemeters (ANSI,1981)
- ANSI/HPS N13.30-1996-Performance Criteria for Radiobioassay (ANSI,1996)
- ANSI N13.6-1966 (R1989), Practice for Occupational Radiation Exposure Records Systems (ANSI,1989)

The procedures include an outline of the program objectives, sampling procedures and data analysis methods. Equipment selection is based on the type of radiation being monitored. Procedures are prepared for each of the instruments used and specify the frequency and method of calibration. Maintenance and calibration are in accordance with the manufacturers' recommendations. Specific types of instruments used in the facility are discussed below.

The survey program procedures also specify the frequency of measurements and record keeping and reporting requirements. As stated in Section 4.1, Commitment to Radiation Protection Program Implementation, the facility corrective action process is implemented if: 1) personnel dose monitoring results or personnel contamination levels exceed the administrative personnel limits; or if an incident results in airborne occupational exposures exceeding the administrative limits, or 2) the dose limits in 10 CFR 20, Appendix B (CFR, 2003m) or 10 CFR 70.61 (CFR, 2003e) are exceeded. In the event the occupational dose limits given in 10 CFR 20 (CFR, 2003b), Subpart C are exceeded, notification of the NRC is in accordance with the requirements of 10 CFR 20, Subpart M—Reports.

All personnel who enter Restricted Areas (as defined below) are required to wear personnel monitoring devices that are supplied by a vendor that holds dosimetry accreditation from the National Voluntary Laboratory Accreditation Program. In addition, personnel are required to monitor themselves prior to exiting Restricted Areas which may have the potential for contamination.

Continuous airborne radioactivity monitors provide indication of the airborne activity levels in the Restricted Areas of the facility. Monitoring instruments for airborne alpha emitters are provided at different locations throughout facility. These monitors are designed to detect alpha emitters in the air, which would indicate the potential for uranium contamination. When deemed necessary, portable air samplers may be used to collect a sample on filter paper for subsequent analysis in the laboratory.

Monitor data is collected for regular analysis and documentation. Monitors in locations classified as Airborne Radioactivity Areas are equipped with alarms. The alarm is activated when airborne radioactivity levels exceed predetermined limits. The limits are set with

4.12 REFERENCES

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CFR, 2003c. Title 10, Code of Federal Regulations, Part 70, Domestic Licensing of Special Nuclear Material, 2003.

CFR, 2003d. Title 10, Code of Federal Regulations, Section 20.1101, Radiation protection programs, 2003.

CFR, 2003e. Title 10, Code of Federal Regulations, Section 70.61, Performance requirements, 2003.

CFR, 2003f. Title 10, Code of Federal Regulations, Section 20.1201, Occupational dose limits for adults, 2003.

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CFR, 2003j. Title 10, Code of Federal Regulations, Section 20.2110, Form of records, 2003.

CFR, 2003k. Title 10, Code of Federal Regulations, Section 19.13, Notifications and reports to individuals, 2003.

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CFR, 2003q. Title 10, Code of Federal Regulation, Section 20.1902, Posting requirements, 2003.

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5.0 NUCLEAR CRITICALITY SAFETY

The Nuclear Criticality Safety Program for the National Enrichment Facility (NEF) is in accordance with U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 3.71, Nuclear Criticality Safety Standards for Fuels and Material Facilities (NRC, 1998). Regulatory Guide 3.71 (NRC, 1998) provides guidance on complying with the applicable portions of NRC regulations, including 10 CFR 70 (CFR, 2003a), by describing procedures for preventing nuclear criticality accidents in operations involving handling, processing, storing, and transporting special nuclear material (SNM) at fuel and material facilities. The facility is committed to following the guidelines in this regulatory guide for specific ANSI/ANS criticality safety standards with the exception of ANSI/ANS-8.9-1987, "Nuclear Criticality Safety Criteria for Steel-Pipe Intersections Containing Aqueous Solutions of Fissile Material." Piping configurations containing aqueous solutions of fissile material will be evaluated in accordance with ANSI/ANS-8.1-1998 (ANSI, 1998a), using validated methods to determine subcritical limits.

The information provided in this chapter, the corresponding regulatory requirements, and the section of NUREG-1520 (NRC, 2002), Chapter 5 in which the NRC acceptance criteria are presented is summarized below.

Information Category and Requirement	10 CFR 70 Citation	NUREG-1520 Chapter 5 Reference
Section 5.1 Nuclear Criticality Safety (NCS) Program		
Management of the NCS Program	70.61(d) 70.64(a)	5.4.3.1
Control Methods for Prevention of Criticality	70.61	5.4.3.4.2
Safe Margins Against Criticality	70.61	5.4.3.4.2
Description of Safety Criteria	70.61	5.4.3.4.2
Organization and Administration	70.61	5.4.3.2
Section 5.2 Methodologies and Technical Practices		
Methodology	70.61	5.4.3.4.1 5.4.3.4.4 5.4.3.4.6
Section 5.3 Criticality Accident Alarm System (CAAS)		
Criticality Accident Alarm System	70.24	5.4.3.4.3
Section 5.4 Reporting		
Reporting Requirements	Appendix A	5.4.3.4.7 (7)

5.1 THE NUCLEAR CRITICALITY SAFETY (NCS) PROGRAM

The facility has been designed and will be constructed and operated such that a nuclear criticality event is prevented, and to meet the regulatory requirements of 10 CFR 70 (CFR, 2003a). Nuclear criticality safety at the facility is assured by designing the facility, systems and components with safety margins such that safe conditions are maintained under normal and abnormal process conditions and any credible accident. Items Relied On For Safety (IROFS) identified to ensure subcriticality are discussed in the NEF Integrated Safety Analysis Summary.

5.1.1 Management of the Nuclear Criticality Safety (NCS) Program

The NCS criteria in Section 5.2, Methodologies and Technical Practices, are used for managing criticality safety and include adherence to the double contingency principle as stated in the ANSI/ANS-8.1-1998, Nuclear Criticality Safety In Operations with Fissionable Materials Outside Reactors (ANSI, 1998a). The adopted double contingency principle states "process design should incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible." Each process that has accident sequences that could result in an inadvertent nuclear criticality at the NEF meets the double contingency principle. The NEF meets the double contingency principle in that process design incorporates sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible.

Using these NCS criteria, including the double contingency principle, low enriched uranium enrichment facilities have never had an accidental criticality. The plant will produce no greater than 5.0 $^{w}/_{o}$ enrichment. However, as additional conservatism, the nuclear criticality safety analyses are performed assuming a ^{235}U enrichment of 6.0 $^{w}/_{o}$, except for Contingency Dump System traps which are analyzed assuming a ^{235}U enrichment of 1.5 $^{w}/_{o}$, and include appropriate margins to safety. In accordance with 10 CFR 70.61(d) (CFR, 2003b), the general criticality safety philosophy is to prevent accidental uranium enrichment excesses, provide geometrical safety when practical, provide for moderation controls within the UF_6 processes and impose strict mass limits on containers of aqueous, solvent based, or acid solutions containing uranium. Interaction controls provide for safe movement and storage of components. Plant and equipment features assure prevention of excessive enrichment. The plant is divided into six distinctly separate Assay Units (called Cascade Halls) with no common UF_6 piping. UF_6 blending is done in a physically separate portion of the plant. Process piping, individual centrifuges and chemical traps other than the contingency dump chemical traps, are safe by limits placed on their diameters. Product cylinders rely upon uranium enrichment, moderation control and mass limits to protect against the possibility of a criticality event. Each of the liquid effluent collection tanks that hold uranium in solution is mass controlled, as none are geometrically safe. As required by 10 CFR 70.64(a) (CFR, 2003c), by observing the double contingency principle throughout the plant, a criticality accident is prevented. In addition to the double contingency principle, effective management of the NCS Program includes:

- An NCS program to meet the regulatory requirements of 10 CFR 70 (CFR, 2003a) will be developed, implemented, and maintained.

- Safety parameters and procedures will be established.
- The NCS program structure, including definition of the responsibilities and authorities of key program personnel will be provided.
- The NCS methodologies and technical practices will be kept applicable to current configuration by means of the configuration management function. The NCS program will be upgraded, as necessary, to reflect changes in the ISA or NCS methodologies and to modify operating and maintenance procedures in ways that could reduce the likelihood of occurrence of an inadvertent nuclear criticality.
- The NCS program will be used to establish and maintain NCS safety limits and NCS operating limits for IROFS in nuclear processes and a commitment to maintain adequate management measures to ensure the availability and reliability of the IROFS.
- NCS postings will be provided and maintained current.
- NCS emergency procedure training will be provided.
- The NCS baseline design criteria requirements in 10 CFR 70.64(a) (CFR, 2003c) will be adhered to.
- The NCS program will be used to evaluate modifications to operations, to recommend process parameter changes necessary to maintain the safe operation of the facility, and to select appropriate IROFS and management measures.
- The NCS program will be used to promptly detect NCS deficiencies by means of operational inspections, audits, and investigations. Deficiencies will be entered into the corrective action program so as to prevent recurrence of unacceptable performance deficiencies in IROFS, NCS function or management measures.
- NCS program records will be retained as described in Section 11.7, Records Management.

Training will be provided to individuals who handle nuclear material at the facility in criticality safety. The training is based upon the training program described in ANSI/ANS-8.20-1991, Nuclear Criticality Safety Training (ANSI, 1991). The training program is developed and implemented with input from the criticality safety staff, training staff, and management. The training focuses on the following:

- Appreciation of the physics of nuclear criticality safety.
- Analysis of jobs and tasks to determine what a worker must know to perform tasks efficiently.
- Design and development of learning objectives based upon the analysis of jobs and tasks that reflect the knowledge, skills, and abilities needed by the worker.
- Implementation of revised or temporary operating procedures.

Additional discussion of management measures is provided in Chapter 11, Management Measures.

5.1.2 Control Methods for Prevention of Criticality

The major controlling parameters used in the facility are enrichment control, geometry control, moderation control, and/or limitations on the mass as a function of enrichment. In addition, reflection, interaction, and heterogeneous effects are important parameters considered and applied where appropriate in nuclear criticality safety analyses. Nuclear Criticality Safety Evaluations and Analyses are used to identify the significant parameters affected within a particular system. All assumptions relating to process, equipment, material function, and operation, including credible abnormal conditions, are justified, documented, and independently reviewed. Where possible, passive engineered controls are used to ensure NCS. The determination of the safe values of the major controlling parameters used to control criticality in the facility is described below.

Moderation control is in accordance with ANSI/ANS-8.22-1997, Nuclear Criticality Safety Based on Limiting and Controlling Moderators (ANSI, 1997). However, for the purposes of the criticality analyses, it is assumed that UF_6 comes in contact with water to produce aqueous solutions of UO_2F_2 as described in Section 5.2.1.3.3, Uranium Accumulation and Moderation Assumption. A uniform aqueous solution of UO_2F_2 and a fixed enrichment are conservatively modeled using MONK8A (SA, 2001) and the JEF2.2 library. Criticality analyses were performed to determine the maximum value of a parameter to yield $k_{eff} = 1$. The criticality analyses were then repeated to determine the maximum value of the parameter to yield a $k_{eff} = 0.95$. Table 5.1-1, Safe Values for Uniform Aqueous Solution of Enriched UO_2F_2, shows both the critical and safe limits for 5.0 $^{w}/_{o}$ and 6.0 $^{w}/_{o}$.

Table 5.1-2, Safety Criteria for Buildings/ Systems/Components, lists the safety criteria of Table 5.1-1, Safe Values for Uniform Aqueous Solutions of Enriched UO_2F_2, which are used as control parameters to prevent a nuclear criticality event. Although the NEF will be limited to 5.0 $^{w}/_{o}$ enrichment, as additional conservatism, the values in Table 5.1-2, Safety Criteria for Buildings/Systems/ Components, represent the limits based on 6.0 $^{w}/_{o}$ enrichment except for the Contingency Dump System traps which are limited to 1.5 $^{w}/_{o}$ ^{235}U.

The values on Table 5.1-1 are chosen to be critically safe when optimum light water moderation exists and reflection is considered within isolated systems. The conservative modeling techniques provide for more conservative values than provided in ANSI/ANS-8.1 (ANSI, 1998a). The product cylinders are only safe under conditions of limited moderation and enrichment. In such cases, both design and operating procedures are used to assure that these limits are not exceeded.

All Separation Plant components, which handle enriched UF_6, other than the Type 30B and 48Y cylinders and the first stage UF_6 pumps and contingency dump chemical traps, are safe by geometry. Centrifuge array criticality is precluded by a probability argument with multiple operational procedure barriers. Total moderator or H/U ratio control as appropriate precludes product cylinder criticality.

In the Technical Services Building (TSB) criticality safety for uranium loaded liquids is ensured by limiting the mass of uranium in any single tank to less than or equal to 12.2 kg U (26.9 lb U). Individual liquid storage bottles are safe by volume. Interaction in storage arrays is accounted for.

Based on the criticality analyses, the control parameters applied to NEF are as follows:

Enrichment

Enrichment is controlled to limit the percent ^{235}U within any process, vessel, or container, except the contingency dump system, to a maximum enrichment of 5 $^{w}/_{o}$. The design of the contingency dump system controls enrichment to a limit of 1.5 $^{w}/_{o}$ ^{235}U. Although NEF is limited to a maximum enrichment of 5 $^{w}/_{o}$, as added conservatism nuclear criticality safety is analyzed using an enrichment of 6 $^{w}/_{o}$ ^{235}U.

Geometry/Volume

Geometry/volume control may be used to ensure criticality safety within specific process operations or vessels, and within storage containers.

The geometry/volume limits are chosen to ensure k_{eff} ($k_{calc} + 3\ \sigma_{calc}$) ≤ 0.95.

The safe values of geometry/volume define the characteristic dimension of importance for a single unit such that nuclear criticality safety is not dependent on any other parameter assuming 6 $^{w}/_{o}$ ^{235}U for safety margin.

Moderation

Water and oil are the moderators considered in NEF. At NEF the only system where moderation is used as a control parameter is in the product cylinders. Moderation control is established consistent with the guidelines of ANSI/ANS-8.22-1997 (ANSI, 1997) and incorporates the criteria below:

- Controls are established to limit the amount of moderation entering the cylinders.
- When moderation is the only parameter used for criticality control, the following additional criteria are applied. These controls assure that at least two independent controls would have to fail before a criticality accident is possible.
  - Two independent controls are utilized to verify cylinder moderator content.
  - These controls are established to monitor and limit uncontrolled moderator prior to returning a cylinder to production thereby limiting the amount of uncontrolled moderator from entering a system to an acceptable limit.
  - The evaluation of the cylinders under moderation control includes the establishment of limits for the ratio of maximum moderator-to-fissile material for both normal operating and credible abnormal conditions. This analysis has been supported by parametric studies.
- When moderation is not considered a control parameter, either optimum moderation or worst case H/U ratio is assumed when performing criticality safety analysis.

Mass

Mass control may be utilized to limit the quantity of uranium within specific process operations, vessels, or storage containers. Mass control may be used on its own or in combination with other control methods. Analysis or sampling is employed to verify the mass of the material. Conservative administrative limits for each operation are specified in the operating procedures.

Whenever mass control is established for a container, records are maintained for mass transfers into and out of the container. Establishment of mass limits for a container involves consideration of potential moderation, reflection, geometry, spacing, and enrichment. The evaluation considers normal operations and credible abnormal conditions for determination of the operating mass limit for the container and for the definition of subsequent controls necessary to prevent reaching the safety limits. When only administrative controls are used for mass controlled systems, double batching is conservatively assumed in the analysis.

Reflection

Reflection is considered when performing Nuclear Criticality Safety Evaluations and Analyses. The possibility of full water reflection is considered but the layout of the NEF is a very open design and it is highly unlikely that those vessels and plant components requiring criticality control could become flooded from a source of water within the plant. In addition, neither automatic sprinkler nor standpipe and hose systems are provided in the TSB, Separation Buildings, Blending and Liquid Sampling, CRDB, CAB, and Centrifuge Post Mortem areas. Therefore, full water reflection of vessels has therefore been discounted. However, some select analyses have been performed using full reflection for conservatism. Partial reflection of 2.5 cm (0.984 in) of water is assumed where limited moderating materials (including humans) may be present It is recognized that concrete can be a more efficient reflector than water; therefore, it is modeled in analyses where it is present. When moderation control is identified in the ISA Summary, it is established consistent with the guidelines of ANSI/ANS-8.22-1997 (ANSI, 1997).

Interaction

Nuclear criticality safety evaluations and analyses consider the potential effects of interaction. A non-interacting unit is defined as a unit that is spaced an approved distance from other units such that the multiplication of the subject unit is not increased. Units may be considered non-interacting when they are separated by more than 60 cm (23.6 inches).

If a unit is considered interacting, nuclear criticality safety analyses are performed. Individual unit multiplication and array interaction are evaluated using the Monte Carlo computer code MONK8A to ensure k_{eff} ($k_{calc} + 3\ \sigma_{calc}$) < 0.95.

Concentration, Density and Neutron Absorbers

NEF does not use mass concentration, density, or neutron absorbers as a criticality control parameter.

5.1.3 Safe Margins Against Criticality

Process operations require establishment of criticality safety limits. The facility UF_6 systems involve mostly gaseous operations. These operations are carried out under reduced atmospheric conditions (vacuum) or at slightly elevated pressures not exceeding three atmospheres. It is highly unlikely that any size changes of process piping, cylinders, cold traps, or chemical traps under these conditions, would lead to a criticality situation because a volume or mass limit may be exceeded.

Within the Separations Building, significant accumulations of enriched UF_6 reside only in the Product Low Temperature Take-off Stations, Product Liquid Sampling Autoclaves, Product Blending System or the UF_6 cold traps. All these, except the UF_6 cold traps, contain the UF_6 in 30B and 48Y cylinders. All these significant accumulations are within enclosures protecting them from water ingress. The facility design has minimized the possibility of accidental moderation by eliminating direct water contact with these cylinders of accumulated UF_6. In addition, the facility's stringent procedural controls for enriching the UF_6 assure that it does not become unacceptably hydrogen moderated while in process. The plant's UF_6 systems operating procedures contain safeguards against loss of moderation control (ANSI, 1997). No neutron poisons are relied upon to assure criticality safety.

5.1.4 Description of Safety Criteria

Each portion of the plant, system, or component that may possibly contain enriched uranium is designed with criticality safety as an objective. Table 5.1-2, Safety Criteria for Buildings/ Systems/Components, shows how the safety criteria of Table 5.1-1, Safe Values for Uniform Aqueous Solutions of Enriched UO_2F_2, are applied to the facility to prevent a nuclear criticality event. Although the NEF will be limited to 5.0 $^w/_o$ enrichment, as additional conservatism, the values in Table 5.1-2, represent the limits based on 6.0 $^w/_o$ enrichment.

Where there are significant in-process accumulations of enriched uranium as UF_6, the plant design includes multiple features to minimize the possibilities for breakdown of the moderation control limits. These features eliminate direct ingress of water to product cylinders while in process.

5.1.5 Organization and Administration

The criticality safety organization is responsible for implementing the Nuclear Criticality Safety Program. During the design phase, the criticality safety function is performed within the design engineering organization. The criticality safety function for operations is described in the following section.

The criticality safety organization reports to the Health, Safety, and Environment (HS&E) Manager as described in Chapter 2, Organization and Administration. The HS&E Manager is accountable for overall criticality safety of the facility, is administratively independent of production responsibilities, and has the authority to shut down potentially unsafe operations.

Designated responsibilities of the criticality safety staff include the following:

- Establish the Nuclear Criticality Safety Program, including design criteria, procedures, and training
- Provide criticality safety support for integrated safety analyses and configuration control
- Assess normal and credible abnormal conditions
- Determine criticality safety limits for controlled parameters
- Develop and validate methods to support nuclear criticality safety evaluations (NCSEs) (i.e., non-calculation engineering judgments regarding whether existing criticality safety analyses bound the issue being evaluated or whether new or revised safety analyses are required)

- Perform NCS analyses (i.e., calculations), write NCS evaluations, and approve proposed changes in process conditions on equipment involving fissionable material
- Specify criticality safety control requirements and functionality
- Provide advice and counsel on criticality safety control measures, including review and approval of operating procedures
- Support emergency response planning and events
- Evaluate the effectiveness of the Nuclear Criticality Safety Program using audits and assessments
- Provide criticality safety postings that identify administrative controls for operators in applicable work areas.

The minimum qualifications for a criticality safety engineer are a Bachelor of Science (BS) or Bachelor of Arts (BA) degree in science or engineering with at least two years of nuclear industry experience in criticality safety. A criticality safety engineer must understand and have experience in the application and direction of criticality safety programs. The HS&E Manager has the authority and responsibility to assign and direct activities for the criticality safety staff. The criticality safety engineer is responsible for implementation of the NCS program. Criticality safety engineers will be provided in sufficient numbers to implement and support the operation of the NCS program.

The NEF implements the intent of the administrative practices for criticality safety, as contained in Section 4.1.1 of American National Standards Institute/American Nuclear Society (ANSI/ANS)-8.1-1998, Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors (ANSI, 1998a). A policy will be established whereby personnel shall report defective NCS conditions and perform actions only in accordance with written, approved procedures. Unless a specific procedure deals with the situation, personnel shall report defective NCS conditions and take no action until the situation has been evaluated and recovery procedures provided.

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5.2 METHODOLOGIES AND TECHNICAL PRACTICES

This section describes the methodologies and technical practices used to perform the Nuclear Criticality Safety (NCS) analyses and NCS evaluations. The determination of the NCS controlled parameters and their application and the determination of the NCS limits on IROFS are also presented.

5.2.1 Methodology

MONK8A (SA, 2001) is a powerful Monte Carlo tool for nuclear criticality safety analysis. The advanced geometry modeling capability and detailed continuous energy collision modeling treatments provide realistic 3-dimensional models for an accurate simulation of neutronic behavior to provide the best estimate neutron multiplication factor, k-effective. Complex models can be simply set up and verified. Additionally, MONK8A (SA, 2001) has demonstrable accuracy over a wide range of applications and is distributed with a validation database comprising critical experiments covering uranium, plutonium and mixed systems over a wide range of moderation and reflection. The experiments selected are regarded as being representative of systems that are widely encountered in the nuclear industry, particularly with respect to chemical plant operations, transportation and storage. The validation database is subject to on-going review and enhancement. A categorization option is available in MONK8A (SA, 2001) to assist the criticality analyst in determining the type of system being assessed and provides a quick check that a calculation is adequately covered by validation cases.

5.2.1.1 Methods Validation

The validation process establishes method bias by comparing measured results from laboratory critical experiments to method-calculated results for the same systems. The verification and validation processes are controlled and documented. The validation establishes a method bias by correlating the results of critical experiments with results calculated for the same systems by the method being validated. Critical experiments are selected to be representative of the systems to be evaluated in specific design applications. The range of experimental conditions encompassed by a selected set of benchmark experiments establishes the area of applicability over which the calculated method bias is applicable. Benchmark experiments are selected that resemble as closely as practical the systems being evaluated in the design application.

The extensive validation database contains a number of solution experiments applicable to this application involving both low and high-enriched uranium. The MONK8A (SA, 2001) code with the JEF2.2 library was validated against these experiments which are provided in the International Handbook of Evaluated Criticality Safety Benchmark Experiments (NEA, 2002) and Nuclear Science and Engineering (NSE, 1962). The experiments chosen are provided in Table 5.2-1, Uranium Solution Experiments Used for Validation, along with a brief description. The overall mean calculated value from the 80 configurations is 1.0017 ± 0.0005 (AREVA, 2004) and the results are shown in Figure 5.2-1,Validation Results for Uranium Solutions, plotted against H/U-fissile ratio. If only the 36 low-enriched solutions are considered, the mean calculated value is 1.0007 ± 0.0005.

MONK8A is distributed in ready-to-run executable form. This approach provides the user with a level of quality assurance consistent with the needs of safety analysis. The traceability from source code to executable code is maintained by the code vendor. The MONK8A software package contains a set of validation analyses which can be used to support the specific applications. Since the source code is not available to the user, the executable code is identical to that used for the validation analyses. The criticality analyses were performed with MONK8A utilizing the validation provided by the code vendor.

In accordance with the guidance in NUREG-1520 (NRC, 2002), code validation for the specific application has been performed (AREVA, 2004). Specifically, the experiments provided in Table 5.2-1, Uranium Solution Experiments Used for Validation, were calculated and documented as part of the integrated safety analysis for the National Enrichment Facility. In addition, the details of validation should state computer codes used, operations, recipes for choosing code options (where applicable), cross sections sets, and any numerical parameters necessary to describe the input. Therefore, by December 30, 2005, Louisiana Energy Services (LES) will provide NRC with a revised validation report that meets the LES commitment to ANSI/ANS-8.1-1998 (ANSI. 1998a) and includes details of validation that state computer codes used, operations, recipes for choosing code options (where applicable), cross sections sets, and any numerical parameters necessary to describe the input.

The MONK8A computer code and JEF2.2 library are within the scope of the Quality Assurance Program.

5.2.1.2 Limits on Control and Controlled Parameters

The validation process established a bias by comparing calculations to measured critical experiments. With the bias determined, an upper safety limit (USL) can be determined using the following equation from NUREG/CR-6698, Guide for Validation of Nuclear Criticality Safety Calculational Methodology (NRC, 2001):

$$USL = 1.0 + Bias - \sigma_{Bias} - \Delta_{SM} - \Delta_{AOA}$$

Where the critical experiments are assumed to have a k_{eff} of unity, and the bias was determined by comparison of calculation to experiment. From Section 5.2.1.1, Methods Validation, the bias is positive and since a positive bias may be non-conservative, the bias is set to zero. The σ_{Bias} from Section 5.2.1.1, Methods Validation is 0.0005 and a value of 0.05 is assigned to the subcritical margin, Δ_{SM}. The term Δ_{AOA} is an additional subcritical margin to account for extensions in the area of applicability. Since the experiments in the benchmark are representative of the application, the term Δ_{AOA} is set to zero. Thus, the USL becomes:

$$USL = 1 - 0.0005 - 0.05 = 0.9495$$

NUREG/CR-6698 (NRC, 2001) requires that the following condition be demonstrated for all normal and credible abnormal operating conditions:

$$k_{calc} + 2\,\sigma_{calc} < USL$$

In the NCS analysis, σ_{calc} is shown to be greater than σ_{Bias}; therefore, the NEF will be designed using the more conservative equation:

$$k_{eff} = k_{calc} + 3\,\sigma_{calc} < 0.95$$

Additionally, criticality safety in the NEF is ensured by use of geometry, volume, mass and moderation control. Table 5.1-1, Safe Values for Uniform Aqueous Solutions of Enriched UO_2F_2 provides the safe values of geometry, volume and mass at 5.0 $^{w}/_{o}$ enrichment UO_2F_2 to ensure the USL is met. Moreover, Table 5.1-2, Safety Criteria for Buildings/Systems/Components, provides the additional conservatism used in the design of the NEF. All criticality safety analyses use an enrichment of 6.0 $^{w}/_{o}$ ^{235}U, except for Contingency Dump System traps which are analyzed using an enrichment of 1.5 $^{w}/_{o}$ ^{235}U, while the facility is limited to an enrichment of 5.0 $^{w}/_{o}$ ^{235}U.

5.2.1.3 General Nuclear Criticality Safety Methodology

The NCS analyses results provide values of k-effective (k_{eff}) to conservatively meet the upper safety limit. The following sections provide a description of the major assumptions used in the NCS analyses.

5.2.1.3.1 Reflection Assumption

The layout of the NEF is a very open design and it is not considered credible that those vessels and plant components requiring criticality control could become flooded from a source of water within the plant. Full water reflection of vessels has therefore been discounted. However, where appropriate, spurious reflection due to walls, fixtures, personnel, etc. has been accounted for by assuming 2.5 cm (0.984 in) of water reflection around vessels.

5.2.1.3.2 Enrichment Assumption

The NEF will operate with a 5.0 $^{w}/_{o}$ ^{235}U enrichment limit. However, the nuclear criticality safety calculations used an enrichment of 6.0 $^{w}/_{o}$ ^{235}U. This assumption provides additional conservatism for plant design.

5.2.1.3.3 Uranium Accumulation and Moderation Assumption

Most components that form part of the centrifuge plant or are connected to it assume that any accumulation of uranium is taken to be in the form of a uranyl fluoride/water mixture at a maximum H/U atomic ratio of 7 (exceptions are discussed in the associated nuclear criticality safety analyses documentation). The ratio is based on the assumption that significant quantities of moderated uranium could only accumulate by reaction between UF_6 and moisture in air leaking into the plant. Due to the high vacuum requirements of a centrifuge plant, in-leakage is controlled at very low levels and thus the H/U ratio of 7 represents an abnormal condition. The maximum H/U ratio of 7 for the uranyl fluoride-water mixture is derived as follows:

The stoichiometric reaction between UF_6 and water vapor in the presence of excess UF_6 can be represented by the equation:

$$UF_6 + 2H_2O \rightarrow UO_2F_2 + 4HF$$

Due to its hygroscopic nature, the resulting uranyl fluoride is likely to form a hydrate compound. Experimental studies (Lychev, 1990) suggest that solid hydrates of compositions $UO_2F_2 \cdot 1.5H_2O$ and $UO_2F_2 \cdot 2H_2O$ can form in the presence of water vapor, the former composition being the stable form on exposure to atmosphere.

It is assumed that the hydrate $UO_2F_2 \cdot 1.5H_2O$ is formed and, additionally, that the hydrogen fluoride (HF) produced by the UF_6/water vapor reaction is also retained in the uranic breakdown to give an overall reaction represented by:

$$UF_6 + 3.5H_2O \rightarrow UO_2F_2 \cdot 4HF \cdot 1.5H_2O$$

For the MONK8A (SA, 2001) calculations, the composition of the breakdown product was simplified to $UO_2F_2 \cdot 3.5H_2O$ that gives the same H/U ratio of 7 as above.

In the case of oils, UF_6 pumps and vacuum pumps use a fully fluorinated perfluorinated polyether (PFPE) type lubricant, often referred to by the trade name "Fomblin." Mixtures of UF_6 and PFPE oil would be a less conservative case than a uranyl fluoride/water mixture, since the maximum HF solubility in PFPE is only about 0.1 $^w/_o$. Therefore, the uranyl fluoride/water mixture assumption provides additional conservatism in this case.

5.2.1.3.4 Vessel Movement Assumption

The interaction controls placed on movement of vessels containing enriched uranium are specified in the facility procedures. In general, any item in movement (an item being either an individual vessel or a specified batch of vessels) must be maintained at 60 cm (23.6 in) edge separation from any other enriched uranium, and that only one item of each type, e.g., one trap and one pump, may be in movement at one time. These spacing restrictions are relaxed for vessels being removed from fixed positions. In this situation, one vessel may approach an adjacent fixed plant vessel/component without spacing restrictions.

5.2.1.3.5 Pump Free Volume Assumption

There are two types of pumps used in product and dump systems of the plant:

- The vacuum pumps (product and dump) are rotary vane pumps. In the enrichment plant fixed equipment, these are assumed to have a free volume of 14 L (3.7 gal) and are modeled as a cylinder in MONK8A (SA, 2001). This adequately covers all models likely to be purchased.
- The UF_6 pumping units are a combination unit of two pumps, one 500 m^3/hr (17,656 ft^3/hr) pump with a free volume of 8.52 L (2.25 gal) modeled as a cylinder, and a larger 2000 m^3/hr (70,626 ft^3/hr) pump which is modeled explicitly according to manufacturer's drawings.

5.2.1.4 Nuclear Criticality Safety Analyses

Nuclear criticality safety is analyzed for the design features of the plant system or component and for the operating practices that relate to maintaining criticality safety. The analysis of individual systems or components and their interaction with other systems or components containing enriched uranium is performed to assure the criticality safety criteria are met. The nuclear criticality safety analyses and the safe values in Table 5.1-1, Safe Values for Uniform Aqueous Solution of Enriched UO_2F_2, provide a basis for the plant design and criticality hazards identification performed as part of the Integrated Safety Analysis.

Each portion of the plant, system, or component that may possibly contain enriched uranium is designed with criticality safety as an objective. Table 5.1-2, Safety Criteria for Buildings/ Systems/Components, shows how the safe values of Table 5.1-1, are applied to the facility design to prevent a nuclear criticality event. The NEF is designed and operated in accordance with the parameters provided in Table 5.1-2. The Integrated Safety Analysis reviewed the facility design and operation and identified Items Relied On For Safety to ensure that criticality does not pose an unacceptable risk.

Where there are significant in-process accumulations of enriched uranium as UF_6 the plant design includes multiple features to minimize the possibilities for breakdown of the moderation control limits. These features eliminate direct ingress of water to product cylinders while in process.

Each NCS analysis includes, as a minimum, the following information.

- A discussion of the scope of the analysis and a description of the system(s)/process(es) being analyzed.
- A discussion of the methodology used in the criticality calculations, which includes the validated computer codes and cross section library used and the k_{eff} limit used (0.95).
- A discussion of assumptions (e.g. reflection, enrichment, uranium accumulation, moderation, movement of vessels, component dimensions) and the details concerning the assumptions applicable to the analysis.
- A discussion on the system(s)/process(es) analyzed and the analysis performed, including a description of the accident or abnormal conditions assumed.
- A discussion of the analysis results, including identification of required limits and controls.

During the design phase of NEF, the NCS analysis is performed by a criticality safety engineer and independently reviewed by a second criticality safety engineer. During the operation of NEF, the NCS analysis is performed by criticality safety engineer, independently reviewed by a second criticality safety engineer and approved by the HS&E Manager. Only qualified criticality safety engineers can perform NCS analyses and associated independent review.

5.2.1.5 Additional Nuclear Criticality Safety Analyses Commitments

The NEF NCS analyses were performed using the above methodologies and assumptions. NCS analyses also meet the following:

- NCS analyses are performed using acceptable methodologies.
- Methods are validated and used only within demonstrated acceptable ranges.
- The analyses adhere to ANSI/ANS-8.1-1998 (ANSI, 1998a) as it relates to methodologies.
- The validation report statement in Regulatory Guide 3.71 (NRC, 1998) is as follows: LES has demonstrated (1) the adequacy of the margin of safety for subcriticality by assuring that the margin is large compared to the uncertainty in the calculated value of $k_{eff,}$ (2) that the calculation of k_{eff} is based on a set of variables whose values lie in a range for which the methodology used to determine k_{eff} has been validated, and (3) that trends in the bias support the extension of the methodology to areas outside the area or areas of applicability.

- A specific reference to (including the date and revision number) and summary description of either a manual or a documented, reviewed, and approved validation report for each methodology are included. Any change in the reference manual or validation report will be reported to the NRC by letter.
- The reference manual and documented reviewed validation report will be kept at the facility.
- The reference manual and validation report are incorporated into the configuration management program.
- The NCS analyses are performed in accordance with the methods specified and incorporated in the configuration management program.
- The NCS methodologies and technical practices in NUREG-1520 (NRC, 2002), Section 5.4.3.4, are used to analyze NCS accident sequences in operations and processes.
- The acceptance criteria in NUREG-1520 (NRC, 2002), Section 3.4, as they relate to: identification of NCS accident sequences, consequences of NCS accident sequences, likelihood of NCS accident sequences, and descriptions of IROFS for NCS accident sequences are met.
- NCS controls and controlled parameters to assure that under normal and credible abnormal conditions, all nuclear processes are subcritical, including use of an approved margin of subcriticality for safety are used.
- As stated in ANSI/ANS-8.1-1998 (ANSI, 1998a), process specifications incorporate margins to protect against uncertainties in process variables and against a limit being accidentally exceeded.
- ANSI/ANS-8.7-1998 (ANSI, 1998b), as it relates to the requirements for subcriticality of operations, the margin of subcriticality for safety, and the selection of controls required by 10 CFR 70.61(d) (CFR, 2003b), is used.
- ANSI/ANS-8.10-1983 (ANSI, 1983b), as modified by Regulatory Guide 3.71 (NRC, 1998), as it relates to the determination of consequences of NCS accident sequences, is used.
- If administrative k_{eff} margins for normal and credible abnormal conditions are used, NRC pre-approval of the administrative margins will be sought.
- Subcritical limits for k_{eff} calculations such that: k_{eff} subcritical = 1.0 - bias - margin, where the margin includes adequate allowance for uncertainty in the methodology, data, and bias to assure subcriticality are used.
- Studies to correlate the change in a value of a controlled parameter and its k_{eff} value are performed. The studies include changing the value of one controlled parameter and determining its effect on another controlled parameter and k_{eff}.
- The double contingency principle is met. The double contingency principle is used in determining NCS controls and IROFS.
- The acceptance criteria in NUREG-1520 (NRC, 2002) Section 3.4, as they relate to subcriticality of operations and margin of subcriticality for safety, are met.

5.2.1.6 Nuclear Criticality Safety Evaluations (NCSE)

For any change (i.e., new design or operation, or modification to the facility or to activities of personnel, e.g., site structures, systems, components, computer programs, processes, operating procedures, management measures), that involves or could affect uranium, a NCSE shall be prepared and approved. Prior to implementing the change, it shall be determined that the entire process will be subcritical (with approved margin for safety) under both normal and credible abnormal conditions. If this condition cannot be shown with the NCSE, either a new or revised NCS analysis will be generated that meets the criteria, or the change will not be made.

The NCSE shall determine and explicitly identify the controlled parameters and associated limits upon which NCS depends, assuring that no single inadvertent departure from a procedure could cause an inadvertent nuclear criticality and that the safety basis of the facility will be maintained during the lifetime of the facility. The evaluation ensures that all potentially affected uranic processes are evaluated to determine the effect of the change on the safety basis of the process, including the effect on bounding process assumptions, on the reliability and availability of NCS controls, and on the NCS of connected processes.

The NCSE process involves a review of the proposed change, discussions with the subject matter experts to determine the processes which need to be considered, development of the controls necessary to meet the double contingency principle, and identification of the assumptions and equipment (e.g., physical controls and/or management measures) needed to ensure criticality safety.

Engineering judgment of the criticality safety engineer is used to ascertain the criticality impact of the proposed change. The basis for this judgment is documented with sufficient detail in the NCSE to allow the independent review by a second criticality safety engineer to confirm the conclusions of the judgment of results. Each NCSE includes, as a minimum, the following information.

- A discussion of the scope of the evaluation, a description of the system(s)/process(es) being evaluated, and identification of the applicable nuclear criticality safety analysis.
- A discussion to demonstrate the applicable nuclear criticality safety analysis is bounding for the condition evaluated.
- A discussion of the impact on the facility criticality safety basis, including effect on bounding process assumptions, on reliability and availability NCS controls, and on the nuclear criticality safety of connected system(s)/process(es).
- A discussion of the evaluation results, including (1) identification of assumptions and equipment needed to ensure nuclear criticality safety is maintained and (2) identification of limits and controls necessary to ensure the double contingency principle is maintained.

The NCSE is performed and documented by a criticality safety engineer. Once the NCSE is completed and the independent review by a criticality safety engineer is performed and documented, the HS&E Manager approves the NCSE. Only criticality safety engineers who have successfully met the requirements specified in the qualification procedure can perform NCSEs and associated independent review.

The above process for NCSEs is in accordance with ANSI/ANS-8.19-1996 (ANSI, 1996).

5.2.1.7 Additional Nuclear Criticality Safety Evaluations Commitments

NCSEs also meet the following:

- The NCSEs are performed in accordance with the procedures specified and incorporated in the configuration management program.
- The NCS methodologies and technical practices in NUREG-1520 (NRC, 2002), Sections 5.4.3.4.1(10)(a), (b), (d) and (e), are used to evaluate NCS accident sequences in operations and processes.
- The acceptance criteria in NUREG-1520 (NRC, 2002), Section 3.4, as they relate to: identification of NCS accident sequences, consequences of NCS accident sequences, likelihood of NCS accident sequences, and descriptions of IROFS for NCS accident sequences are met.
- NCS controls and controlled parameters to assure that under normal and credible abnormal conditions, all nuclear processes are subcritical, including use of an approved margin of subcriticality for safety are used.
- The double contingency principle is met. The double contingency principle is used in determining NCS controls and IROFS.
- The acceptance criteria in NUREG-1520 (NRC, 2002) Section 3.4, as they relate to subcriticality of operations and margin of subcriticality for safety, are met.

5.3 CRITICALITY ACCIDENT ALARM SYSTEM (CAAS)

The facility is provided with a Criticality Accident Alarm System (CAAS) as required by 10 CFR 70.24, (CFR, 2003d). Areas where Special Nuclear Material (SNM) is handled, used, or stored in amounts at or above the 10 CFR 70.24 (CFR, 2003d) mass limits are provided with CAAS coverage. Emergency management measures are covered in the facility Emergency Plan.

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5.4 REPORTING

The following are NCS Program commitments related to event reporting:

- A program for evaluating the criticality significance of NCS events will be provided and an apparatus will be in place for making the required notification to the NRC Operations Center. Qualified individuals will make the determination of significance of NCS events. The determination of loss or degradation of IROFS or double contingency principle compliance will be made against the license and 10 CFR 70 Appendix A (CFR, 2003f).
- The reporting criteria of 10 CFR 70 Appendix A and the report content requirements of 10 CFR 70.50 (CFR, 2003g) will be incorporated into the facility emergency procedures.
- The necessary report based on whether the IROFS credited were lost, irrespective of whether the safety limits of the associated parameters were actually exceeded will be issued.
- If it cannot be ascertained within one hour of whether the criteria of 10 CFR 70 Appendix A (CFR, 2003f) Paragraph (a) or (b) apply, the event will be treated as a one-hour reportable event.

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5.5 REFERENCES

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CFR, 2003e. Title 10, Code of Federal Regulations, Section 70.72, Facility changes and change process, 2003.

CFR, 2003f. Title 10, Code of Federal Regulations, Part 70, Appendix A, Reportable Safety Events, 2003.

CFR, 2003g. Title 10, Code of Federal Regulations, Section 70.50, Reporting requirements, 2003.

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NEA, 2002. International Handbook of Evaluated Criticality Safety Benchmark Experiments, NEA/NSC/DOC(95)03, Nuclear Energy Agency, September 2002 Edition.

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NSE, 1962. The Measurement of Σta and Other Nuclear Properties of ^{233}U and ^{235}U in Critical Aqueous Solutions, R. Gwin and D. W. Magnuson, Nuclear Science and Engineering, Volume 12, 1962.

SA, 2001. Serco Assurance, ANSWERS Software Service, "Users Guide for Version 8 ANSWERS/MONK(98) 6," 1987-2001.

TABLES

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Table 5.1-1 Safe Values for Uniform Aqueous Solutions of Enriched UO_2F_2

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Parameter	Critical Value k_{eff} = 1.0	Safe Value k_{eff} = 0.95	Safety Factor
Values for 5.0 $^w/_o$ enrichment			
Volume	28.9 L (7.6 gal)	21.6 L (5.7 gal)	0.75
Cylinder Diameter	26.2 cm(10.3 in)	23.6 cm (9.3 in)	0.90
Slab Thickness	12.6 cm (5.0 in)	10.7 cm (4.2 in)	0.85
Water Mass	17.3 kg H_2O (38.1 lb H_2O)	12.7 kg H_2O (28.0 lb H_2O)	0.73
Areal Density	11.9 g/cm^2 (24.4 lb/ft^2)	9.8 g/cm^2 (20.1 lb/ft^2)	0.82
Uranium Mass	37 kg U (81.6 lb U)		
- no double batching		26.6 kg U (58.6 lb U)	0.72
- double batching		16.6 kg U (36.6 lb U)	0.45
Values for 6.0 $^w/_o$ enrichment			
Volume	24 L (6.3 gal)	18 L (4.8 gal)	0.75
Cylinder Diameter	24.4 cm (9.6 in)	21.9 cm (8.6 in)	0.90
Slab Thickness	11.5 cm (4.5 in)	9.9 cm (3.9 in)	0.86
Water Mass	15.4 kg H_2O (34.0 lb H_2O)	11.5 kg H_2O (25.4 lb H_2O)	0.75
Areal Density	9.5 g/cm^2 (19.5 lb/ft^2)	7.5 g/cm^2 (15.4 lb/ft^2)	0.79
Uranium Mass	27 kg U (59.5 lb U)		
- no double batching		19.5 kg U (43.0 lb U)	0.72
- double batching		12.2 kg U (26.9 lb U)	0.45

Table 5.1-2 Safety Criteria for Buildings/Systems/Components
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Building/System/Component	Control Mechanism	Safety Criteria
Enrichment	Enrichment	5.0 $^w/_o$ (6 $^w/_o$ ^{235}U used in NCS)
Centrifuges	Diameter	< 21.9 cm (8.6 in)
Product Cylinders (30B)	Moderation	H < 0.95 kg (2.09 lb)
Product Cylinders (48Y)	Moderation	H < 1.05 kg (2.31 lb)
UF_6 Piping	Diameter	< 21.9 cm (8.6 in)
Chemical Traps	Diameter	< 21.9 cm (8.6 in)
Product Cold Trap	Diameter	< 21.9 cm (8.6 in)
Contingency Dump System Traps	Enrichment	1.5 $^w/_o$ ^{235}U
Tanks	Mass	< 12.2 kg U (26.9 lb U)
Feed Cylinders	Enrichment	< 0.72 $^w/_o$ ^{235}U
Uranium Byproduct Cylinders	Enrichment	< 0.72 $^w/_o$ ^{235}U
UF_6 Pumps (first stage)	N/A	Safe by explicit calculation
UF_6 Pumps (second stage)	Volume	< 18.0 L (4.8 gal)
Individual Uranic Liquid Containers, e.g., Fomblin Oil Bottle, Laboratory Flask, Mop Bucket	Volume	< 18.0 L (4.8 gal)
Vacuum Cleaners Oil Containers	Volume	<18.0 L (4.8 gal)

Table 5.2-1 Uranium Solution Experiments Used for Validation

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MONK8A Case	Case Description	Number of Experiments	Handbook Reference
13	High-enriched uranyl nitrate solutions at various H:U ratios (93.17 $^{w}/_{o}$ ^{235}U)	12	HEU-SOL-THERM-002 HEU-SOL-THERM-003
23	Uranyl nitrate solution (~ 95 $^{w}/_{o}$ enriched)	5	HEU-SOL-THERM-013 NS&E
35	High-enriched uranyl nitrate solutions (U concentration from 20-700 g/L)	11	HEU-SOL-THERM-009 - HEU-SOL-THERM-012
43	Low-enriched uranyl nitrate solutions	3	LEU-SOL-THERM-002
51	Low-enriched uranium solutions (new STACY experiments)	7	LEU-SOL-THERM-004
63	Boron carbide absorber rods in uranyl nitrate (5.6 $^{w}/_{o}$ enriched)	3	LEU-SOL-THERM-005
67	Highly enriched uranyl nitrate solution with a concentration range between 59.65 and 334.66 g U/L	10	HEU-SOL-THERM-001
68	Highly enriched uranyl fluoride/heavy water solution with a concentration range between 60 and 679 g U/L and a heavy water reflector	6	HEU-SOL-THERM-004
71	STACY: 28 cm thick slabs of 10 $^{w}/_{o}$ enriched uranyl nitrate solutions, water reflected	7	LEU-SOL-THERM-016
80	STACY: Unreflected 10 $^{w}/_{o}$ enriched uranyl nitrate solution in a 60 cm diameter cylindrical tank	5	LEU-SOL-THERM-007
81	STACY: Concrete reflected 10 $^{w}/_{o}$ enriched uranyl nitrate solution reflected by concrete	4	LEU-SOL-THERM-008
84	STACY: Borated concrete reflected 10 $^{w}/_{o}$ enriched uranyl nitrate solution in a 60 cm diameter cylindrical tank	3	LEU-SOL-THERM-009
85	STACY: Polyethylene reflected 10 $^{w}/_{o}$ enriched uranyl nitrate solution in a 60 cm diameter cylindrical tank	4	LEU-SOL-THERM-010

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FIGURES

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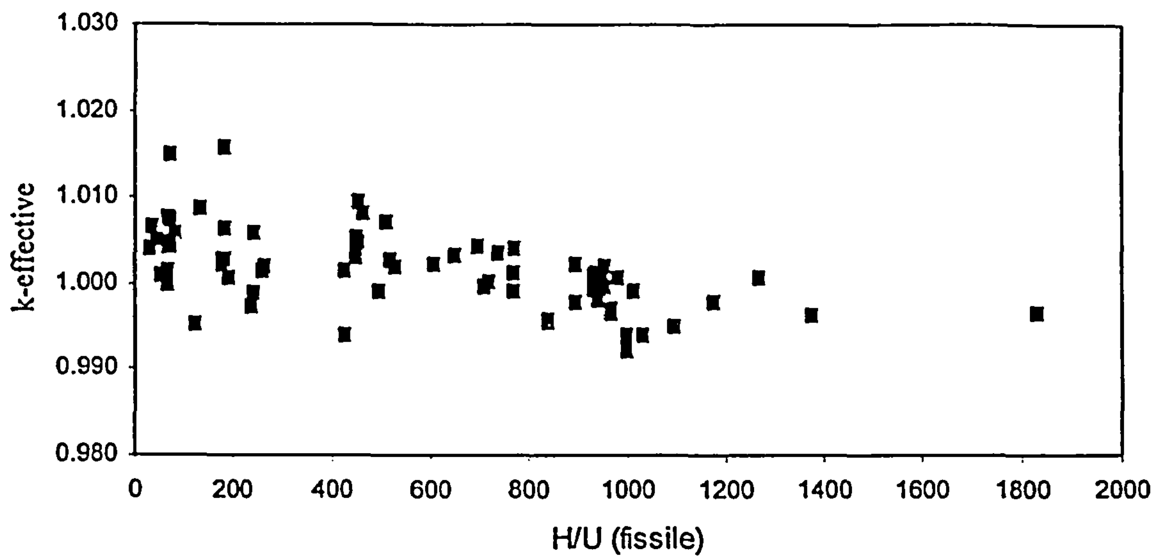

REFERENCE NUMBER
Figure 5.2–1.doc

FIGURE 5.2-1
VALIDATION RESULTS FOR URANIUM SOLUTIONS

REVISION DATE: DECEMBER 2003

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6.3 CHEMICAL HAZARDS ANALYSIS

6.3.1 Integrated Safety Analysis

LES has prepared an Integrated Safety Analysis (ISA) as required under 10 CFR 70.62 (CFR, 2003c). The ISA:

- Provides a list of the accident sequences which have the potential to result in radiological and non-radiological releases of chemicals of concern
- Provides reasonable estimates for the likelihood and consequences of each accident identified
- Applies acceptable methods to estimate potential impacts of accidental releases.

The ISA also:

- Identifies adequate engineering and/or administrative controls (IROFS) for each accident sequence of significance
- Satisfies principles of the baseline design criteria and performance requirements in 10 CFR 70.61 (CFR, 2003b) by applying defense-in-depth to high risk chemical release scenarios
- Assures adequate levels of these controls are provided so those items relied on for safety (IROFS) will satisfactorily perform their safety functions.

The ISA demonstrates that the facility and its operations have adequate engineering and/or administrative controls in place to prevent or mitigate high and intermediate consequences from the accident sequences identified and analyzed.

6.3.2 Consequence Analysis Methodology

This section describes the methodology used to determine chemical exposure/dose and radiochemical exposure/dose criteria used to evaluate potential impact to the workers and the public in the event of material release. This section limits itself to the potential effects associated with accidental release conditions. Potential impacts from chronic (e.g., long-term) discharges from the facility are detailed in the Environmental Report.

6.3.2.1 Defining Consequence Severity Categories

The accident sequences identified by the ISA need to be categorized into one of three consequence categories (high, intermediate, or low) based on their forecast radiological, chemical, and/or environmental impacts. Section 6.1.1, Chemical Screening and Classification, presented the radiological and chemical consequence severity limits defined by 10 CFR 70.61 (CFR, 2003b) for the high and intermediate consequence categories.

To quantify criteria of 10 CFR 70.61 (CFR, 2003b) for chemical exposure, standards for each applicable hazardous chemical must be applied to determine exposure that could: (a) endanger the life of a worker; (b) lead to irreversible or other serious long-lasting health effects to an individual; and (c) cause mild transient health effects to an individual. Per NUREG-1520 (NRC 2002), acceptable exposure standards include the Emergency Response Planning Guidelines (ERPG) established by the American Industrial Hygiene Association and the Acute Exposure Guideline Levels (AEGL) established by the National Advisory Committee for Acute Guideline Levels for Hazardous Substances. The definitions of various ERPG and AEGL levels are contained in Table 6.3-1, ERPG and AEGL Level Definitions.

The consequence severity limits of 10 CFR 70.61 (CFR, 2003b) have been summarized and presented in Table 6.3-2, Licensed Material Chemical Consequence Categories. The severity limits defined in this table are developed against set criteria.

The toxicity of UF_6 is due to its two hydrolysis products, HF and UO_2F_2. The toxicological effects of UF_6 as well as these byproducts were previously described in Section 6.1.2. AEGL and NUREG-1391 (NRC, 1991) values for HF and UF_6 were utilized for evaluation of chemotoxic exposure. Additionally, since the byproduct uranyl fluoride is a soluble uranium compound, the AEGL values were derived for evaluating soluble uranium (U) exposure in terms of both chemical toxicity and radiological dose. In general, the chemotoxicity of uranium inhalation/ingestions is of more significance than radiation dose resulting from internal U exposure. The ERPG and AEGL values for HF are presented in Table 6.3-3, ERPG and AEGL values for Hydrogen Fluoride. The ERPG and AEGL values for UF_6 (as soluble U) are presented in Table 6.3-4, ERPG and AEGL values for Uranium Hexafluoride (as soluble U). The values from NUREG-1391 (NRC, 1991) for soluble uranium are presented in Table 6.3-6, Health Effects from Intake of Soluble Uranium.

Table 6.3-5, Definition of Consequence Severity Categories, presents values for HF and UF_6 (as soluble U) from the AEGL and NUREG-1391 (NRC, 1991).

6.3.2.1.1 Worker Exposure Assumptions

Any release from UF_6 systems/cylinders at the facility would predominantly consist of HF with some potential entrainment of uranic particulate. An HF release would cause a visible cloud and a pungent odor. The odor threshold for HF is less than 1 ppm and the irritating effects of HF are intolerable at concentrations well below those that could cause permanent injury or which produce escape-impairing symptoms. Employees are trained in proper actions to take in response to a release and it can be confidently predicted that workers will take immediate self-protective action to escape a release area upon detecting any significant HF odor.

For the purposes of evaluating worker exposure in cases where a local worker would be expected to be in the immediate proximity of a release (e.g., connect/disconnect, maintenance, etc.), the 10-minute AEGL values have been used for HF and NUREG-1391 (NRC, 1991) values have been used for U. In these cases, it has been presumed that the operator will fail to recognize the in-rush of air into the vacuum system and will not begin to back away from the source of the leak until HF is present. Sufficient time is available for the worker to reliably detect and evacuate the area of concern.

For the purposes of evaluating worker exposures for workers who may be present elsewhere in the room of release, the values in Table 6.3-5, Definition of Consequence Severity Categories, which are the 10-minute AEGL values, have been used. Once a release is detected the worker is assumed to evacuate the area of concern. Sufficient time is available for the worker to reliably detect and evacuate the area of concern.

Another assumption made in conducting consequence severity analysis is that for releases precipitated by a fire event, only public exposure was considered in determining consequence severity; worker exposures were not considered. The worker is assumed to evacuate the area of concern once the fire is detected by the worker. Fires of sufficient magnitude to generate chemical/radiological release must either have caused failure of a mechanical system/component or involve substantive combustibles containing uranic content. In either case, the space would be untenable for unprotected workers. Sufficient time is available for the worker to reliably detect and evacuate the area of concern prior to any release. Fire brigade/fire department members responding to emergencies are required by emergency response procedure (and regulation) to have suitable respiratory and personal protective equipment.

6.3.2.1.2 Public Exposure Assumptions

Potential exposures to members of the public were also evaluated assuming conservative assumptions for both exposure concentrations and durations. Exposure was evaluated for consequence severity against chemotoxic, radiotoxic, and radiological dose.

Public exposures were estimated to last for a duration of 30 minutes. This is consistent with self-protective criteria for UF_6/HF plumes listed in NUREG-1140 (NRC, 1988).

6.3.2.2 Chemical Release Scenarios

The evaluation level chemical release scenarios based on the criteria applied in the Integrated Safety Analysis are presented in the NEF Integrated Safety Analysis Summary. Information on the criteria for the development of these scenarios is also provided in the NEF Integrated Safety Analysis Summary.

6.3.2.3 Source Term

The methodologies used to determine source term are those prescribed in NUREG/CR-6410 (NRC, 1998) and supporting documents.

6.3.2.3.1 Dispersion Methodology

In estimating the dispersion of chemical releases from the facility, conservative dispersion methodologies were utilized. Site boundary atmospheric dispersion factors were generated using a computer code based on Regulatory Guide 1.145 (NRC, 1982) methodology. The code was executed using five years (1987-1991) of meteorological data collected at Midland/Odessa, Texas, which is the closest first order National Weather Service Station to the site. This station was judged to be representative of the NEF site because the Midland Odessa National Weather Service Station site and the NEF site have similar climates and topography.

The specific modeling methods utilized follow consistent and conservative methods for source term determination, release fraction, dispersion factors, and meteorological conditions as prescribed in NRC Regulatory Guide 1.145 (NRC, 1982).

For releases inside of buildings, conservative leak path fractions were assumed as recommended by NUREG/CR-6410 (NRC, 1998) and ventilation on and off cases were evaluated for consideration of volumetric dilution and mixing efficiency prior to release to atmosphere.

6.3.2.4 Chemical Hazard Evaluation

This section is focused on presenting potential deleterious effects that might occur as a result of chemical release from the facility. As required by 10 CFR 70 (CFR, 2003a), the likelihood of these accidental releases fall into either unlikely or highly unlikely categories.

6.3.2.4.1 Potential Effects to Workers/Public

The toxicological properties of potential chemicals of concern were detailed in Section 6.2, Chemical Process Information. The evaluation level accident scenarios identified in the Integrated Safety Analysis and the associated potential consequence severities to facility workers or members of the public are presented in the NEF Integrated Safety Analysis Summary.

All postulated incidents have been determined to present low consequences to the workers/public, or where determined to have the potential for intermediate or high consequences, are protected with IROFS to values less than the likelihood thresholds required by 10 CFR 70.61 (CFR, 2003b).

6.3.2.4.2 Potential Effects to Facility

All postulated incidents have been determined to present inherently low consequences to the facility. No individual incident scenarios were identified that propagate additional consequence to the facility process systems or process equipment. The impact of external events on the facility, and their ability to impact process systems or equipment of concern is discussed in the NEF Integrated Safety Analysis Summary.

Table 6.3-2 Licensed Material Chemical Consequence Categories

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	Workers	Offsite Public	Environment
Category 3 High Consequence	Radiation Dose (RD) >1 Sievert (Sv) (100 rem) For the worker (elsewhere in room), except the worker (local), Chemical Dose (CD) > AEGL-3 For worker (local), CD > AEGL-3 for HF CD > * for U	RD > 0.25 Sv (25 rem) 30 mg sol U intake CD > AEGL-2	–
Category 2 Intermediate Consequence	0.25 Sv (25 rem) <RD≤ 1 Sv (100 rem) For the worker (elsewhere in room), except the worker (local), AEGL-2 < CD≤ AEGL-3 For the worker (local), AEGL-2 < CD ≤ AEGL-3 for HF ** < CD ≤ * for U	0.05 Sv (5 rem) < RD≤ 0.25 Sv (25 rem) AEGL-1 <CD≤ AEGL-2	Radioactive release > 5000 x Table 2 Appendix B of 10 CFR Part 20
Category 1 Low Consequence	Accidents of lower radiological and chemical exposures than those above in this column	Accidents of lower radiological and chemical exposures than those above in this column	Radioactive releases with lower effects than those referenced above in this column

Notes:

*NUREG-1391 threshold value for intake of soluble U resulting in permanent renal failure

**NUREG-1391 threshold value for intake of soluble U resulting in no significant acute effects to an exposed individual

Table 6.3-3 ERPG and AEGL values for Hydrogen Fluoride

ERPG and AEGL Values For HF (values in mg HF/m^3)

ERPG		AEGL					
	1-hr		10-min	30-min	1-hr	4-hr	8-hr
ERPG-1	1.6	AEGL-1	0.8	0.8	0.8	0.8	0.8
ERPG-2	16.4	AEGL-2	78	28	20	9.8	9.8
ERPG-3	41	AEGL-3	139	51	36	18	18

Table 6.3-4 ERPG and AEGL values for Uranium Hexafluoride (as soluble U)

ERPG and AEGL Values For UF_6 (values in mg soluble U/m^3)

ERPG		AEGL					
	1-hr		10-min	30-min	1-hr	4-hr	8-hr
ERPG-1	3.4	AEGL-1	2.4	2.4	2.4	NR	NR
ERPG-2	10	AEGL-2	19	13	6.5	1.6	0.8
ERPG-3	20	AEGL-3	146	49	24	6.1	3.1

Table 6.3-5 Definition of Consequence Severity Categories
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		High Consequence (Category 3)	Intermediate Consequence (Category 2)
Acute Radiological Doses	Worker	>100 rem TEDE	>25 rem TEDE
	Outside Controlled Area	>25 rem TEDE	>5 rem TEDE
Acute Radiological Exposure	Worker	not applicable	not applicable
	Outside Controlled Area	>30 mg U intake	>5.4 mg U/m^3 (24-hr average)
Acute Chemical Exposure	Worker (local)	>40 mg U intake; > 139 mg HF/m^3	>10 mg U intake; >78 mg HF/m^3
	Worker (elsewhere in room)	>146 mg U/m^3; > 139 mg HF/m^3	>19 mg U/m^3; >78 mg HF/m^3
	Outside Controlled Area (30-min exposure)	>13 mg U/m^3; >28 mg HF/m^3	>2.4 mg U/m^3; >0.8 mg HF/m^3

Table 6.3-6 Health Effects from Intake of Soluble Uranium

Health Effects	Uranium Intake (mg) by 70 kg Person
50% Lethality	230
Threshold for Intake Resulting in Permanent Renal Damage	40
Threshold for Intake Resulting in No Significant Acute Effects	10
No Effect	4.3

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9.2 ENVIRONMENTAL PROTECTION MEASURES

LES is committed to protecting the public, plant workers, and the environment from the harmful effects of ionizing radiation due to plant operation. Accordingly, LES is firmly committed to the "As Low As Reasonably Achievable," (ALARA) philosophy for all operations involving source, byproduct, and special nuclear material. This commitment is reflected in written procedures and instructions for operations involving potential exposures of personnel to radiation (both internal and external hazards) and the facility design. Written procedures for effluent monitoring address the need for periodic (monthly) dose assessment projections to members of the public to ensure that potential radiation exposures are kept ALARA (i.e., not in excess of 0.1 mSv/yr (10 mrem/yr)) in accordance with 10 CFR 20.1101(d).

Part of LES's environmental protective measures are described in the ER. In particular, Chapter 4 discusses the anticipated results of the radiation protection program with regard to ALARA goals and waste minimization. Chapter 6 discusses the environmental controls and monitoring program.

A detailed description of LES' radiation protection program is included separately in this License Application as Safety Analysis Report (SAR) Chapter 4. Similarly, LES's provisions for a qualified and trained staff, which also is part of the environmental protection measures required, are described separately in the SAR as part of Chapter 11.

9.2.1 Radiation Safety

The four acceptance criteria that describe the facility radiation safety program are divided between two License Application documents. SAR Chapter 4 describes:

- Radiological (ALARA) Goals for Effluent Control
- ALARA Reviews and Reports to Management.

ER Chapter 4, Environmental Impacts, addresses:

- Effluents controls to maintain public doses ALARA, and
- Waste Minimization.

In particular, ER Section 4.12 describes public and occupational health effects from both non-radiological and radiological sources. This section specifically addresses calculated total effective dose equivalent to an average member of critical groups or calculated average annual concentration of radioactive material in gaseous and liquid effluent to maintain compliance with 10 CFR 20 (CFR, 2003a).

ER Section 4.13 contains a discussion on facility waste minimization that identifies process features and systems to reduce or eliminate waste. It also describes methods to minimize the volume of waste.

9.2.2 Effluent and Environmental Controls and Monitoring

LES has designed an environmental monitoring program to provide comprehensive data to monitor the facility's impact on the environment. The preoperational program will focus on collecting data to establish baseline information useful in evaluating changes in potential environmental conditions caused by facility operation. The preoperational program will be initiated at least two years prior to facility operation.

The operational program will monitor to ensure facility emissions are maintained ALARA. Monitoring will be of appropriate pathways up to a 2-mile radius beyond the site boundary.

ER Chapter 6 describes environmental measurement and monitoring programs as they apply to preoperation (baseline), operation, and decommissioning conditions for both the proposed action and each alternative.

9.2.2.1 Effluent Monitoring

ER Section 6.1 presents information relating to the facility radiological monitoring program. This section describes the location and characteristics of radiation sources and radioactive effluent (liquid and gaseous). It also describes the various elements of the monitoring program, including:

- Number and location of sample collection points
- Measuring devices used
- Pathway sampled or measured
- Sample size, collection frequency and duration
- Method and frequency of analysis, including lower limits of detection.

Based on recorded plant effluent data, dose projections to members of the public will be performed monthly to ensure that the annual dose to members of the public does not exceed the ALARA constraint of 0.1 mSv/yr (10 mrem/yr). If the monthly dose impact assessment indicates a trend in effluent releases that, if not corrected, could cause the ALARA constraint to be exceeded, appropriate corrective action will be initiated to reduce the discharges to assure that subsequent releases will be in compliance with the annual dose constraint. In addition, an evaluation of the need for increased sampling will be performed. Corrective actions may include, for example, change out of Separation Building or Technical Services Building Gaseous Effluent Vent System filters, replacement of spent cleanup resins for liquid waste or reprocessing collected waste prior to release to the Treated Effluent Evaporative Basin.

Lastly, this section justifies the choice of sample locations, analyses, frequencies, durations, sizes, and lower limits of detection.

9.2.2.2 Environmental Monitoring

ER Section 6.1 also includes information relating to the facility environmental monitoring program. The information presented is the same as that included in the effluent monitoring program, i.e., number and location of sample collection points, etc.

9.2.3 Integrated Safety Analysis

LES has prepared an integrated safety analysis (ISA) in accordance with 10 CFR 70.60 (CFR, 2003h). The ISA

- Provides a complete list of the accident sequences that if uncontrolled could result in radiological and non-radiological releases to the environment with intermediate or high consequences
- Provides reasonable estimates for the likelihood and consequences of each accident identified
- Applies acceptable methods to estimate environmental effects that may result from accidental releases.

The ISA also

- Identifies adequate engineering and/or administrative controls for each accident sequence of environmental significance
- Assures adequate levels are afforded so those items relied on for safety (IROFS) will satisfactorily perform their safety functions.

The ISA demonstrates that the facility and its operations have adequate engineering and/or administrative controls in place to prevent or mitigate high and intermediate consequences from the accident sequences identified and analyzed.

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10.0 DECOMMISSIONING

This chapter presents the National Enrichment Facility (NEF) Decommissioning Funding Plan. The Decommissioning Funding Plan has been developed following the guidance provided in NUREG-1757 (NRC, 2003). This Decommissioning Funding Plan is similar to the decommissioning funding plan for the Claiborne Enrichment Center (CEC) approved by the NRC in NUREG-1491 (NRC, 1994).

Louisiana Energy Services (LES) commits to decontaminate and decommission the enrichment facility and the site at the end of its operation so that the facility and grounds can be released for unrestricted use. The Decommissioning Funding Plan will be reviewed and updated as necessary at least once every three years starting from the time of issuance of the license. Prior to facility decommissioning, a Decommissioning Plan will be prepared in accordance with 10 CFR 70.38 (CFR, 2003a) and submitted to the NRC for approval.

This chapter fulfills the applicable provisions of NUREG-1757 (NRC, 2003) through submittal of information in tabular form as suggested by the NUREG. Therefore a matrix showing compliance requirements and commitments is not provided herein.

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10.1 SITE-SPECIFIC COST ESTIMATE

10.1.1 Cost Estimate Structure

The decommissioning cost estimate is comprised of three basic parts that include:

- A facility description
- The estimated costs (including labor costs, non-labor costs, and a contingency factor)
- Key assumptions.

10.1.2 Facility Description

The NEF is fully described in other sections of this License Application and the NEF Integrated Safety Analysis Summary. Information relating to the following topics can be found in the referenced chapters listed below:

A general description of the facility and plant processes is presented in Chapter 1, General Information. A detailed description of the facility and plant processes is presented in the NEF Integrated Safety Analysis Summary.

A description of the specific quantities and types of licensed materials used at the facility is provided in Chapter 1, Section 1.2, Institutional Information.

A general description of how licensed materials are used at the facility is provided in Chapter 1, General Information.

10.1.3 Decommissioning Cost Estimate

10.1.3.1 Summary of Costs

The decommissioning cost estimate for the NEF is approximately $942 million (January, 2004 dollars). The decommissioning cost estimate and supporting information are presented in Tables 10.1-1A through 10.1-14, consistent with the applicable provisions of NUREG-1757, NMSS Decommissioning Standard Review Plan (NRC, 2003).

More than 97% of the decommissioning costs (except tails disposition costs) for the NEF are attributed to the dismantling, decontamination, processing, and disposal of centrifuges and other equipment in the Separations Building Modules, which are considered classified. Given the classified nature of these buildings, the data presented in the Tables at the end of this chapter has been structured to meet the applicable NUREG-1757 (NRC, 2003) recommendations, to the extent practicable. However, specific information such as numbers of components and unit rates have been intentionally excluded to protect the classified nature of the data.

The remaining 3% of the decommissioning costs are for the remaining systems and components in other buildings. Since these costs are small in relation to the overall cost estimate, the cost data for these systems has also been summarized at the same level of detail as that for the Separations Building Modules.

The decommissioning project schedule is presented in Figure 10.1-1, National Enrichment Facility – Conceptual Decommissioning Schedule. Dismantling and decontamination of the equipment in the three Separations Building Modules will be conducted sequentially (in three phases) over a nine year time frame. Separations Building Module 1 will be decommissioned during the first three-year period, followed by Separations Building Module 2, and then Separations Building Module 3. Termination of Separations Module 3 operations will mark the end of uranium enrichment operations at the NEF. Decommissioning of the remaining plant systems and buildings will begin after Separations Building Module 3 operations have been permanently terminated.

10.1.3.2 Major Assumptions

Key assumptions underlying the decommissioning cost estimate are listed below:

- Inventories of materials and wastes at the time of decommissioning will be in amounts that are consistent with routine plant operating conditions over time
- Costs are not included for the removal or disposal of non-radioactive structures and materials beyond that necessary to terminate the NRC license
- Credit is not taken for any salvage value that might be realized from the sale of potential assets (e.g., recovered materials or decontaminated equipment) during or after decommissioning
- Decommissioning activities will be performed in accordance with current day regulatory requirements
- LES will be the Decommissioning Operations Contractor (DOC) for all decommissioning operations
- Decommissioning costs are presented in January, 2002 dollars.

10.1.4 Decommissioning Strategy

The plan for decommissioning is to promptly decontaminate or remove all materials from the site which prevent release of the facility for unrestricted use. This approach, referred to in the industry as DECON (i.e., immediate dismantlement), avoids long-term storage and monitoring of wastes on site. The type and volume of wastes produced at the NEF do not warrant delays in waste removal normally associated with the SAFSTOR (i.e., deferred dismantlement) option.

At the end of useful plant life, the enrichment facility will be decommissioned such that the site and remaining facilities may be released for unrestricted use as defined in 10 CFR 20.1402 (CFR, 2003b). Enrichment equipment will be removed; only building shells and the site infrastructure will remain. All remaining facilities will be decontaminated where needed to acceptable levels for unrestricted use. Confidential and Secret Restricted Data material, components, and documents will be destroyed and disposed of in accordance with the facility Standard Practice Procedures Plan for the Protection of Classified Matter.

Depleted UF_6 (tails), if not already sold or otherwise disposed of prior to decommissioning, will be disposed of in accordance with regulatory requirements. Radioactive wastes will be disposed of in licensed low-level radioactive waste disposal sites. Hazardous wastes will be treated or disposed of in licensed hazardous waste facilities. Neither tails conversion (if done), nor disposal of radioactive or hazardous material will occur at the plant site, but at licensed facilities located elsewhere.

Following decommissioning, no part of the facilities or site will remain restricted to any specific type of use.

Activities required for decommissioning have been identified, and decommissioning costs have been estimated. Activities and costs are based on actual decommissioning experience in Europe. Urenco has a fully operational dismantling and decontamination facility at its Almelo, Netherlands plant. Data and experience from this operating facility have allowed a very realistic estimation of decommissioning requirements. Using this cost data as a basis, financial arrangements are made to cover all costs required for returning the site to unrestricted use. Updates on cost and funding will be provided periodically and will include appropriate treatment for any replacement equipment. A detailed Decommissioning Plan will be submitted at a later date in accordance with 10 CFR 70.38 (CFR, 2003a).

The remaining subsections describe decommissioning plans and funding arrangements, and provide details of the decontamination aspects of the program. This information was developed in connection with the decommissioning cost estimate. Specific elements of the planning may change with the submittal of the decommissioning plan required at the time of license termination.

10.1.5 Decommissioning Design Features

10.1.5.1 Overview

Decommissioning planning begins with ensuring design features are incorporated into the plant's initial design that will simplify eventual dismantling and decontamination. The plans are implemented through proper management and health and safety programs. Decommissioning policies address radioactive waste management, physical security, and material control and accounting.

Major features incorporated into the facility design that facilitate decontamination and decommissioning are described below.

10.1.5.2 Radioactive Contamination Control

The following features primarily serve to minimize the spread of radioactive contamination during operation, and therefore simplify eventual plant decommissioning. As a result, worker exposure to radiation and radioactive waste volumes are minimized as well.

- Certain activities during normal operation are expected to result in surface and airborne radioactive contamination. Specially designed rooms are provided for these activities to preclude contamination spread. These rooms are isolated from other areas and are provided with ventilation and filtration. The Solid Waste Collection Room, Ventilated Room and the Decontamination Workshop meet these specific design requirements.

- All areas of the plant are sectioned off into Unrestricted and Restricted Areas. Restricted Areas limit access for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. Radiation Areas and Airborne Contamination Areas have additional controls to inform workers of the potential hazard in the area and to help prevent the spread of contamination. All procedures for these areas fall under the Radiation Protection Program, and serve to minimize the spread of contamination and simplify the eventual decommissioning.

- Non-radioactive process equipment and systems are minimized in locations subject to potential contamination. This limits the size of the Restricted Areas and limits the activities occurring inside these areas.

- Local air filtration is provided for areas with potential airborne contamination to preclude its spread. Fume hoods filter contaminated air in these areas.

- Curbing, pits, or other barriers are provided around tanks and components that contain liquid radioactive wastes. These serve to control the spread of contamination in case of a spill.

10.1.5.3 Worker Exposure and Waste Volume Control

The following features primarily serve to minimize worker exposure to radiation and minimize radioactive waste volumes during decontamination activities. As a result, the spread of contamination is minimized as well.

- During construction, a washable epoxy coating is applied to floors and walls that might be radioactively contaminated during operation. The coating will serve to lower waste volumes during decontamination and simplify the decontamination process. The coating is applied to floors and walls that might be radioactively contaminated during operation that are located in the Restricted Areas.

- Sealed, nonporous pipe insulation is used in areas likely to be contaminated. This will reduce waste volume during decommissioning.

- Ample access is provided for efficient equipment dismantling and removal of equipment that may be contaminated. This minimizes the time of worker exposure.

- Tanks are provided with accesses for entry and decontamination. Design provisions are also made to allow complete draining of the wastes contained in the tanks.

- Connections in the process systems provided for required operation and maintenance allow for thorough purging at plant shutdown. This will remove a significant portion of radioactive contamination prior to disassembly.

- Design drawings, produced for all areas of the plant, will simplify the planning and implementing of decontamination procedures. This in turn will shorten the durations that workers are exposed to radiation.

- Worker access to contaminated areas is controlled to assure that workers wear proper protective equipment and limit their time in the areas.

10.1.5.4 Management Organization

An appropriate organizational strategy will be developed to support the phased decommissioning schedule discussed in Section 10.1.3.1, Summary of Costs. The organizational strategy will ensure that adequate numbers of experienced and knowledgeable personnel are available to perform the technical and administrative tasks required to decommission the facility.

LES intends to be the prime Decommissioning Operations Contractor (DOC) responsible for decommissioning the NEF. In this capacity, LES will have direct control and oversight over all decommissioning activities. The role will be similar to that taken by Urenco at its facilities in Europe. In that role, Urenco has provided operational, technical, licensing, and project management support of identical facilities during both operational and decommissioning campaigns. LES also plans to secure contract services to supplement its capabilities as necessary.

Management of the decommissioning program will assure that proper training and procedures are implemented to assure worker health and safety. Programs and procedures, based on already existing operational procedures, will focus heavily on minimizing waste volumes and worker exposure to hazardous and radioactive materials. Qualified contractors assisting with decommissioning will likewise be subject to facility training requirements and procedural controls.

10.1.5.5 Health and Safety

As with normal operation, the policy during decommissioning shall be to keep individual and collective occupational radiation exposure as low as reasonably achievable (ALARA). A health physics program will identify and control sources of radiation, establish worker protection requirements, and direct the use of survey and monitoring instruments.

10.1.5.6 Waste Management

Radioactive and hazardous wastes produced during decommissioning will be collected, handled, and disposed of in accordance with all regulations applicable to the facility at the time of decommissioning. Generally, procedures will be similar to those described for wastes produced during normal operation. These wastes will ultimately be disposed of in licensed radioactive or hazardous waste disposal facilities located elsewhere. Non-hazardous and non-radioactive wastes will be disposed of consistent with good industrial practice, and in accordance with applicable regulations.

10.1.5.7 Security/Material Control

Requirements for physical security and for material control and accounting will be maintained as required during decommissioning in a manner similar to the programs in force during operation. The LES plan for completion of decommissioning, submitted near the end of plant life, will provide a description of any necessary revisions to these programs.

10.1.5.8 Record Keeping

Records important for safe and effective decommissioning of the facility will be stored in the LES Records Management System until the site is released for unrestricted use. Information maintained in these records includes:

1. Records of spills or other unusual occurrences involving the spread of contamination in and around the facility, equipment, or site. These records may be limited to instances when contamination remains after any cleanup procedures or when there is reasonable likelihood that contaminants may have spread to inaccessible areas as in the case of possible seepage into porous materials such as concrete. These records will include any known information on identification of involved nuclides, quantities, forms, and concentrations.

2. As-built drawings and modifications of structures and equipment in restricted areas where radioactive materials are used and/or stored and of locations of possible inaccessible contamination such as buried pipes which may be subject to contamination. Required drawings will be referenced as necessary, although each relevant document will not be indexed individually. If drawings are not available, appropriate records of available information concerning these areas and locations will be substituted.

3. Except for areas containing only sealed sources, a list contained in a single document and updated every two years, of the following:
   - (i) All areas designed and formerly designated as Restricted Areas as defined under 10 CFR 20.1003; (CFR, 2003c)
   - (ii) All areas outside of Restricted Areas that require documentation specified in item 1 above;

(iii) All areas outside of Restricted Areas where current and previous wastes have been buried as documented under 10 CFR 20.2108 (CFR, 2003d); and

(iv) All areas outside of Restricted Areas that contain material such that, if the license expired, the licensee would be required to either decontaminate the area to meet the criteria for decommissioning in 10 CFR 20, subpart E, (CFR, 2003e) or apply for approval for disposal under 10 CFR 20.2002 (CFR, 2003f).

4. Records of the cost estimate performed for the decommissioning funding plan or of the amount certified for decommissioning, and records of the funding method used for assuring funds if either a funding plan or certification is used.

10.1.6 Decommissioning Process

10.1.6.1 Overview

Implementation of the DECON alternative for decommissioning may begin immediately following Separations Building Module equipment shutdown, since only low radiation levels exist at this facility. In the phased approach presented herein, dismantling and decontamination of the equipment in the three Separations Building Modules will be conducted sequentially (in three phases) over a nine year time frame. Separations Building Module 1 will be decommissioned during the first three year period, followed by Separations Building Module 2 in the next three years, and then Separations Building Module 3 in the final three years. Termination of Separations Building Module 3 operations will mark the end of uranium enrichment operations at the facility. Decommissioning of the remaining plant systems and buildings will begin after Separations Building Module 3 operations have been permanently terminated. A schematic of the NEF decommissioning schedule is presented in Figure 10.1-1, NEF – Conceptual Decommissioning Schedule.

Prior to beginning decommissioning operations, an extensive radiological survey of the facility will be performed in conjunction with a historical site assessment. The findings of the radiological survey and historical site assessment will be presented in a Decommissioning Plan to be submitted to the NRC. The Decommissioning Plan will be prepared in accordance with 10 CFR 70.38 (CFR, 2003a) and the applicable guidance provided in NUREG-1757 (NRC, 2003).

Decommissioning activities will generally include (1) installation of decontamination facilities, (2) purging of process systems, (3) dismantling and removal of equipment, (4) decontamination and destruction of Confidential and Secret Restricted Data material, (5) sales of salvaged materials, (6) disposal of wastes, and (7) completion of a final radiation survey. Credit is not taken for any salvage value that might be realized from the sale of potential assets (e.g., recovered materials or decontaminated equipment) during or after decommissioning.

Decommissioning, using the DECON approach, requires residual radioactivity to be reduced below specified levels so the facilities may be released for unrestricted use. Current Nuclear Material Safety and Safeguards guidelines for release serve as the basis for decontamination costs estimated herein. Portions of the facility that do not exceed contamination limits may remain as is without further decontamination measures applied. The intent of decommissioning the facility is to remove all enrichment-related equipment from the buildings such that only the building shells and site infrastructure remain. The removed equipment includes all piping and components from systems providing UF_6 containment, systems in direct support of enrichment (such as refrigerant and chilled water), radioactive and hazardous waste handling systems, contaminated HVAC filtration systems, etc. The remaining site infrastructure will include services such as electrical power supply, treated water, fire protection, HVAC, cooling water and communications.

Decontamination of plant components and structures will require installation of two new facilities dedicated for that purpose. Existing plant buildings, such as the Centrifuge Assembly Building, are assumed to house the facilities. These facilities will be specially designed to accommodate repetitive cleaning of thousands of centrifuges, and to serve as a general-purpose facility used primarily for cleaning larger components. The two new facilities will be the primary location for decontamination activities during the decommissioning process. The small decontamination area in the Technical Services Building (TSB), used during normal operation, may also handle small items at decommissioning.

Decontaminated components may be reused or sold as scrap. All equipment that is to be reused or sold as scrap will be decontaminated to a level at which further use is unrestricted. Materials that cannot be decontaminated will be disposed of in a licensed radioactive waste disposal facility. As noted earlier, credit is not taken for any salvage value that might be realized from the sale of potential assets (e.g., recovered materials or decontaminated equipment) during or after decommissioning.

Any UF_6 tails remaining on site will be removed during decommissioning. Depending on technological developments occurring prior to plant shutdown, the tails may have become marketable for further enrichment or other processes. The disposition of UF_6 tails and relevant funding provisions are discussed in Section 10.3, Tails Disposition. The cost estimate takes no credit for any value that may be realized in the future due to the potential marketability of the stored tails.

Contaminated portions of the buildings will be decontaminated as required. Structural contamination should be limited to structures in the Restricted Areas. The liners and earthen covers on the facility evaporative basins are assumed to be mildly contaminated and provisions are made for appropriate disposal of these materials in the decommissioning cost estimate. Good housekeeping practices during normal operation will maintain the other areas of the site clean.

When decontamination is complete, all areas and facilities on the site will be surveyed to verify that further decontamination is not required. Decontamination activities will continue until the entire site is demonstrated to be suitable for unrestricted use.

10.1.6.2 Decontamination Facility Construction

New facilities for decontamination can be installed in existing plant buildings to avoid unnecessary expense. Estimated time for equipment installation is approximately one year. These new facilities will be completed in time to support the dismantling and decontamination of Separations Building Module 1. These facilities are described in Section 10.1.7, Decontamination Facilities.

10.1.6.3 System Cleaning

At the end of the useful life of each Separations Building Module, the enrichment process is shut down and UF_6 is removed to the fullest extent possible by normal process operation. This is followed by evacuation and purging with nitrogen. This shutdown and purging portion of the decommissioning process is estimated to take approximately three months.

10.1.6.4 Dismantling

Dismantling is simply a matter of cutting and disconnecting all components requiring removal. The operations themselves are simple but very labor intensive. They generally require the use of protective clothing. The work process will be optimized, considering the following.

- Minimizing the spread of contamination and the need for protective clothing
- Balancing the number of cutting and removal operations with the resultant decontamination and disposal requirements
- Optimizing the rate of dismantling with the rate of decontamination facility throughput
- Providing storage and laydown space required, as impacted by retrievability, criticality safety, security, etc
- Balancing the cost of decontamination and salvage with the cost of disposal.

Details of the complex optimization process will necessarily be decided near the end of plant life, taking into account specific contamination levels, market conditions, and available waste disposal sites. To avoid laydown space and contamination problems, dismantling should be allowed to proceed generally no faster than the downstream decontamination process. The time frame to accomplish both dismantling and decontamination is estimated to be approximately three years per Separations Building Module.

10.1.6.5 Decontamination

The decontamination process is addressed separately in detail in Section 10.1.7.

10.1.6.6 Salvage of Equipment and Materials

Items to be removed from the facilities can be categorized as potentially re-usable equipment, recoverable scrap, and wastes. However, based on a 30 year facility operating license, operating equipment is not assumed to have reuse value. Wastes will also have no salvage value.

With respect to scrap, a significant amount of aluminum will be recovered, along with smaller amounts of steel, copper, and other metals. For security and convenience, the uncontaminated materials will likely be smelted to standard ingots, and, if possible, sold at market price. The contaminated materials will be disposed of as low-level radioactive waste. No credit is taken for any salvage value that might be realized from the sale of potential assets during or after decommissioning.

10.1.6.7 Disposal

All wastes produced during decommissioning will be collected, handled, and disposed of in a manner similar to that described for those wastes produced during normal operation. Wastes will consist of normal industrial trash, non-hazardous chemicals and fluids, small amounts of hazardous materials, and radioactive wastes. The radioactive waste will consist primarily of crushed centrifuge rotors, trash, and citric cake. Citric cake consists of uranium and metallic compounds precipitated from citric acid decontamination solutions. It is estimated that approximately 5,000 m^3 (6,539 yd^3) of radioactive waste will be generated over the nine-year decommissioning operations period. (This waste is subject to further volume reduction processes prior to disposal).

Radioactive wastes will ultimately be disposed of in licensed low-level radioactive waste disposal facilities. Hazardous wastes will be disposed of in hazardous waste disposal facilities. Non-hazardous and non-radioactive wastes will be disposed of in a manner consistent with good industrial practice and in accordance with all applicable regulations. A complete estimate of the wastes and effluent to be produced during decommissioning will be provided in the Decommissioning Plan that will be submitted prior to initiating the decommissioning of the plant.

Confidential and Secret Restricted Data components and documents on site shall be disposed of in accordance with the requirements of 10 CFR 95 (CFR, 2003g). Such classified portions of the centrifuges will be destroyed, piping will likely be smelted, documents will be destroyed, and other items will be handled in an appropriate manner. Details will be provided in the facility Standard Practice Procedures Plan for the Protection of Classified Matter and Information, submitted separately in accordance with 10 CFR 95 (CFR, 2003g).

10.1.6.8 Final Radiation Survey

A final radiation survey must be performed to verify proper decontamination to allow the site to be released for unrestricted use. The evaluation of the final radiation survey is based in part on an initial radiation survey performed prior to initial operation. The initial survey determines the natural background radiation of the area; therefore it provides a datum for measurements which determine any increase in levels of radioactivity.

The final survey will systematically measure radioactivity over the entire site. The intensity of the survey will vary depending on the location (i.e. the buildings, the immediate area around the buildings, and the remainder of the site). The survey procedures and results will be documented in a report. The report will include, among other things, a map of the survey site, measurement results, and the site's relationship to the surrounding area. The results will be analyzed and shown to be below allowable residual radioactivity limits; otherwise, further decontamination will be performed.

10.1.7 Decontamination Facilities

10.1.7.1 Overview

The facilities, procedures, and expected results of decontamination are described in the paragraphs below. Since reprocessed uranium will not be used as feed in the NEF, no consideration of ^{232}U, transuranic alpha-emitters and fission product residues is necessary for the decontamination process. Only contamination from ^{238}U, ^{235}U, ^{234}U, and their daughter products will require handling by decontamination processes. The primary contaminant throughout the plant will be in the form of small amounts of UO_2F_2, with even smaller amounts of UF_4 and other compounds.

10.1.7.2 Facilities Description

A decontamination facility will be required to accommodate decommissioning. This specialized facility is needed for optimal handling of the thousands of centrifuges to be decontaminated, along with the UF_6 vacuum pumps and valves. Additionally, a general purpose facility is required for handling the remainder of the various plant components. These facilities are assumed to be installed in existing plant buildings (such as the Centrifuge Assembly Building).

The decontamination facility will have four functional areas that include (1) a disassembly area, (2) a buffer stock area, (3) a decontamination area, and (4) a scrap storage area for cleaned stock. The general purpose facility may share the specialized decontamination area. However, due to various sizes and shapes of other plant components needing handling, the disassembly area, buffer stock areas and scrap storage areas may not be shared. Barriers and other physical measures will be installed and administrative controls implemented, as needed, to limit the spread of contamination.

Equipment in the decontamination facility is assumed to include:

- Transport and manipulation equipment
- Dismantling tables for centrifuge externals
- Sawing machines

- Dismantling boxes and tanks, for centrifuge internals
- Degreasers
- Citric acid and demineralized water baths
- Contamination monitors
- Wet blast cabinets
- Crusher, for centrifuge rotors
- Smelting and/or shredding equipment
- Scrubbing facility.

The decontamination facilities provided in the TSB for normal operational needs would also be available for cleaning small items during decommissioning.

10.1.7.3 Procedures

Formal procedures for all major decommissioning activities will be developed and approved by plant management to minimize worker exposure and waste volumes, and to assure work is carried out in a safe manner. The experience of decommissioning European gas centrifuge enrichment facilities will be incorporated extensively into the procedures.

At the end of plant life, some of the equipment, most of the buildings, and all of the outdoor areas should already be acceptable for release for unrestricted use. If they are accidentally contaminated during normal operation, they would be cleaned up when the contamination is discovered. This limits the scope of necessary decontamination at the time of decommissioning.

Contaminated plant components will be cut up or dismantled, then processed through the decontamination facilities. Contamination of site structures will be limited to areas in the Separations Building Modules and TSB, and will be maintained at low levels throughout plant operation by regular cleaning. The Decontamination Workshop Area, Ventilated Room, Vacuum Pump Rebuild Workshop, and a portion of the Laundry Room are included as permanent Restricted Areas. Through the application of special protective coatings, to surfaces that might become radioactively contaminated during operation, and good housekeeping practices, final decontamination of these areas is assumed to require minimal removal of surface concrete or other structural material.

The centrifuges will be processed through the specialized facility. The following operations will be performed.

- Removal of external fittings
- Removal of bottom flange, motor and bearings, and collection of contaminated oil

- Removal of top flange, and withdrawal and disassembly of internals
- Degreasing of items as required
- Decontamination of all recoverable items for smelting
- Destruction of other classified portions by shredding, crushing, smelting, etc.

10.1.7.4 Results

Urenco plant experience in Europe has demonstrated that conventional decontamination techniques are effective for all plant items. Recoverable items have been decontaminated and made suitable for reuse except for a very small amount of intractably contaminated material. The majority of radioactive waste requiring disposal in the NEF will include crushed centrifuge rotors, trash, and residue from the effluent treatment systems.

European experience has demonstrated that the aluminum centrifuge casings can be successfully decontaminated and recycled. However, as a conservative measure for this decommissioning cost estimate, the aluminum centrifuge casings for the NEF are assumed to be disposed of as low-level radioactive waste.

Overall, no problems are anticipated that will prevent the site from being released for unrestricted use.

10.1.7.5 Decommissioning Impact on Integrated Safety Analysis (ISA)

As was described in Section 10.1.3.1, Summary of Costs, dismantling and decontamination of the equipment in the three Separations Building Modules will be conducted sequentially (in three phases) over a nine year time frame. Separations Building Module 1 will be decommissioned during the first three-year period, followed by Separations Building Module 2, and then Separations Building Module 3. Termination of Separations Module 3 operations will mark the end of uranium enrichment operations at the NEF. Decommissioning of the remaining plant systems and buildings will begin after Separations Building Module 3 operations have been permanently terminated.

Although decommissioning operations are planned to be underway while all the activities considered in the ISA continue to occur in the other portions of the plant, the current ISA has not considered these decommissioning risks. An updated ISA will be performed at a later date, but prior to decommissioning, to incorporate the risks from decommissioning operations on concurrent enrichment operations.

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10.2 FINANCIAL ASSURANCE MECHANISM

10.2.1 Decommissioning Funding Mechanism

LES intends to utilize a surety method to provide reasonable assurance of decommissioning funding as required by 10 CFR 40.36(e)(2) (CFR, 2003h) and 70.25(f)(2) (CFR, 2003i). Finalization of the specific financial instruments to be utilized will be completed, and signed originals of those instruments will be provided to the NRC, prior to LES receipt of licensed material. LES intends to provide continuous financial assurance from the time of receipt of licensed material to the completion of decommissioning and termination of the license. Since LES intends to sequentially install and operate the Separations Building Modules over time, financial assurance for decommissioning will be provided during the operating life of the NEF at a rate that is in proportion to the decommissioning liability for these facilities as they are phased in. Similarly, LES will provide decommissioning funding assurance for disposition of depleted tails at a rate in proportion to the amount of accumulated tails onsite up to the maximum amount of the tails as described in Section 10.3, Tails Disposition.

The surety method adopted by LES will provide an ultimate guarantee that decommissioning costs will be paid in the event LES is unable to meet its decommissioning obligations at the time of decommissioning. The surety method will also be structured and adopted consistent with applicable NRC regulatory requirements and in accordance with NRC regulatory guidance contained in NUREG-1757 (NRC, 2003). Accordingly, LES intends that its surety method will contain, but not be limited to, the following attributes:

- The surety method will be open-ended or, if written for a specified term, such as five years, will be renewed automatically unless 90 days or more prior to the renewal date, the issuer notifies the NRC, the trust to which the surety is payable, and LES of its intention not to renew. The surety method will also provide that the full face amount be paid to the beneficiary automatically prior to the expiration without proof of forfeiture if LES fails to provide a replacement acceptable to the NRC within 30 days after receipt of notification of cancellation.

- The surety method will be payable to a trust established for decommissioning costs. The trustee and trust will be ones acceptable to the NRC. For instance, the trustee may be an appropriate State or Federal government agency or an entity which has the authority to act as a trustee and whose trust operations are regulated and examined by a Federal or State agency.

- The surety method will remain in effect until the NRC has terminated the license.

- Unexecuted copies of the surety method documentation are provided in Appendices 10A through 10F. Prior to LES receipt of licensed material, the applicable unexecuted copies of the surety method documentation will be replaced with the finalized, signed, and executed surety method documentation, including a copy of the broker/agent's power of attorney authorizing the broker/agent to issue bonds.

10.2.2 Adjusting Decommissioning Costs and Funding

In accordance with 10 CFR 40.36(d) (CFR, 2003h) and 70.25(e) (CFR, 2003i), LES will update the decommissioning cost estimate for the NEF, and the associated funding levels, over the life of the facility. These updates will take into account changes resulting from inflation or site-specific factors, such as changes in facility conditions or expected decommissioning procedures. These funding level updates will also address anticipated operation of additional Separations Building Modules and accumulated tails.

As required by the applicable regulations 10 CFR 70.25(e) (CFR, 2003i), such updating will occur approximately every three years. A record of the update process and results will be retained for review as discussed in Section 10.2.3, below. The NRC will be notified of any material changes to the decommissioning cost estimate and associated funding levels (e.g., significant increases in costs beyond anticipated inflation). To the extent the underlying instruments are revised to reflect changes in funding levels, the NRC will be notified as appropriate.

10.2.3 Recordkeeping Plans Related to Decommissioning Funding

In accordance with 10 CFR 40.36(f) (CFR, 2003h) and 70.25(g) (CFR, 2003i), LES will retain records, until the termination of the license, of information that could have a material effect on the ultimate costs of decommissioning. These records will include information regarding: (1) spills or other contamination that cause contaminants to remain following cleanup efforts; (2) as-built drawings of structures and equipment, and modifications thereto, where radioactive contamination exists (e.g., from the use or storage of such materials); (3) original and modified cost estimates of decommissioning; and (4) original and modified decommissioning funding instruments and supporting documentation.

10.3 TAILS DISPOSITION

The disposition of tails from the NEF is an element of authorized operating activities. It involves neither decommissioning waste nor is it a part of decommissioning activities. The disposal of these tails is analogous to the disposal of radioactive materials generated in the course of normal operations (even including spent fuel in the case of a power reactor), which is authorized by the operating license and subject to separate disposition requirements. Such costs are not appropriately included in decommissioning costs (this principle (in the 10 CFR 50 context) is discussed in Regulatory Guide 1.159 (NRC, 1990), Section 1.4.2, page 1.159-8). Further, the "tails" products from the NEF are not mill tailings, as regulated pursuant to the Uranium Mill Tailings Radiation Control Act, as amended and 10 CFR 40, Appendix A (CFR, 2003j), and are not subject to the financial requirements applicable to mill tailings.

Nevertheless, LES intends to provide for expected tails disposition costs (even assuming ultimate disposal as waste) during the life of the facility. Funds to cover these costs are based on the amount of tails generated and the unit cost for the disposal of depleted UF_6.

It is anticipated that the NEF will generate 132,942 MT of depleted uranium over a nominal 30 year operational period. This estimate is conservative as it assumes continuous production of tails over 30 years of operation. Actual tails production will cease prior to the end of the license term as shown in Figure 10.1-1, NEF – Conceptual Decommissioning Schedule.

Waste processing and disposal costs for UF_6 tails are currently estimated to be $5.50 per kg U or $5,500 per MT U. This unit cost was obtained from four sets of cost estimates for the conversion of DUF_6 to DU_3O_8 and the disposal of DU_3O_8 product, and the transportation of DUF_6 and DU_3O_8. The cost estimates were obtained from analyses of four sources: a 1997 study by the Lawrence Livermore National Laboratory (LLNL) (Elayat, 1997), the Uranium Disposition Services (UDS) contract with the Department of Energy (DOE) of August 29, 2002 (DOE, 2002), information from Urenco, and the costs submitted to the Nuclear Regulatory Commission as part of the Claiborne Enrichment Center (CEC) license application (LES, 1993a) in the 1990s.

The four sets of cost estimates obtained are presented in Table 10.3-1, Summary Of Depleted UF_6 Disposal Costs From Four Sources, below, in 2002 dollars per kg of uranium (kg U). Note that the Claiborne Energy Center cost had a greater uncertainty associated with it. The UDS contract does not allow the component costs for conversion, disposal and transportation to be estimated. The costs in the table indicate that $5.50 per kg U ($2.50 per lb U) is a conservative and, therefore, prudent estimate of total depleted UF_6 disposition cost for the LES NEF. That is, the historical cost estimates from LLNL and CEC and the more recent actual costs from the UDS contract were used to inform the LES cost estimate. Urenco has reviewed this estimate and, based on its current cost for UBC disposal, finds this figure to be prudent.

In May 1997, the LLNL published UCRL-AR-127650, Cost Analysis Report for the Long-Term Management of Depleted Uranium Hexafluoride (Elayat, 1997). The report was prepared to provide comparative life-cycle cost data for the Department of Energy's (DOE's) Draft 1997 Programmatic Environmental Impact Statement (PEIS) (DOE, 1997) on alternative strategies for management and disposition of DUF_6. The LLNL report is the most comprehensive assessment of DUF_6 disposition costs for alternative disposition strategies available in the public domain.

The technical data on which the LLNL report is based is principally the May 1997 Engineering Analysis Report (UCRL-AR-124080, Volumes 1 and 2) (Dubrin, 1997).

When the LLNL report was prepared in 1997, more than six years ago, the cost estimates in it were based on an inventory of 560,000 MT of DUF_6, or 378,600 MTU after applying the 0.676 mass fraction multiplier. This amount corresponds to an annual throughput rate of 28,000 MT of UF6 or about 19,000 MTU of depleted uranium. The costs in the LLNL report are based on the 20 year life-cycle quantity of 378,600 MTU. The LLNL annual DUF_6 quantities are about 3.6 times the annual production rate of the proposed NEF.

The LLNL cost analyses assumed that the DUF_6 would be converted to DU_3O_8, the DOE's preferred disposal form, using one of two dry process conversion options. The first --- the anhydrous hydrogen fluoride (AHF) option ---- upgrades the hydrogen fluoride (HF) product to anhydrous HF (< 1.0% water). In the second option --- the HF neutralization option --- the hydrofluoric acid would be neutralized with lime to produce calcium fluoride (CaF_2). The LLNL cost analyses assumed that the AHF and CaF_2 conversion products are of sufficient purity that they could be sold for unrestricted use (negligible uranium contamination). LES will not use a deconversion facility that employs a process that results in the production of anhydrous HF.

The costs in Table 10.3-1, represent the LLNL-estimated life-cycle capital, operating, and regulatory costs, in 2002 dollars, for conversion of 378,600 MTU over 20 years, of DUF_6 to DU_3O_8 by anhydrous hydrogen fluoride (HF) processing, followed by DU_3O_8 long-term storage disposal in a concrete vault, or in an exhausted underground uranium mine in the western United States, at or below the same cost. An independent new underground mine production cost analysis confirmed that the LLNL concrete vault alternative costs represent an upper bound for under ground mine disposal. The discounted 1996 dollar costs in the LLNL report were undiscounted and escalated to 2002 dollars. The LLNL life-cycle costs in 1996 dollars were converted to per kgU costs and adjusted to 2002 dollars using the Gross Domestic Product (GDP) Implicit Price Deflator (IPD). The escalation adjustment resulted in the 1996 costs being escalated by 11%.

On August 29, 2002, the DOE announced the competitive selection of Uranium Disposition Services, LLC to design, construct, and operate conversion facilities near the DOE enrichment plants at Paducah, Kentucky and Portsmouth, Ohio. UDS will operate these facilities for the first five years, beginning in 2005. The UDS contract runs from August 29, 2002 to August 3, 2010. UDS will also be responsible for maintaining the depleted uranium and product inventories and transporting depleted uranium from Oak Ridge East Tennessee Technology Park (ETTP) to the Portsmouth site for conversion. The DOE-UDS contract scope includes packaging, transporting and disposing of the conversion product DU_3O_8.

UDS is a consortium formed by Framatome ANP Inc., Duratek Federal Services Inc., and Burns and Roe Enterprises Inc. The DOE-estimated value of the cost reimbursement contract is $558 million (DOE Press Release, August 29, 2002) (DOE, 2002). Design, construction and operation of the facilities will be subject to appropriations of funds from Congress. On December 19, 2002, the White House confirmed that funding for both conversion facilities will be included in President Bush's 2004 budget. However, the Office of Management and Budget has not yet indicated how much funding will be allocated. The UDS contract quantities and costs are given in Table 10.3-2, DOE-UDS August 29, 2002, Contract Quantities and Costs.

Urenco is currently contracted with a supplier for DUF_6 to DU_3O_8 conversion. The supplier has been converting DUF_6 to DU_3O_8 on an industrial scale since 1984.

The CEC costs given in Table 10.3-1, are those presented to John Hickey of the NRC in the CEC letter of June 30, 1993 (LES, 1993b) as adjusted for changes in units and escalated to 2002 ($6.74 per kgU). The conversion cost of $4.00 per kg U was provided to CEC by Cogema at that time. It should also be noted that this highest cost estimate is at least 10 years old and was based on the information available at that time. The value of $5.50 per kgU used in the decommissioning cost estimate is 22% above the average of the more recent LLNL and UDS cost estimates, which is $4.49 per kgU {(5.06+3.92)/2}. The LLNL Cost Analysis Report (page 30) states that its cost estimate already includes a 30% contingency in the capital costs of the process and manufacturing facilities, a 20% contingency in the capital costs of the balance of plant; and a minimum of a 30% contingency in the capital costs of process and manufacturing equipment.

Also, the 1997 LLNL cost information is five years older than the more recent 2002 UDS cost information. The value of $5.50 per kgU used in the decommissioning cost estimate for tails disposition is 40% greater than the 2002 UDS-based cost estimate of $3.92 per kgU, which does not include offset credits for HF sales or proceeds from the sale of recycled products.

The costs in Table 10.3-1, indicate that $5.50 is a conservative and, therefore, prudent estimate of total DU disposition cost for the NEF. Urenco has reviewed this estimate and, based on its current cost after tails disposal, finds this figure to be prudent.

In summary, there is already substantial margin between the value of $5.50 per kgU being used by LES in the decommissioning cost estimate and the most recent information (2002 UDS) from which LES derived a cost estimate of $3.92 per kgU.

Based on information from corresponding vendors, the value of $5.50 per kgU (2002 dollars), which is equal to $5.70 per kgU when escalated to 2004 dollars, was revised in December 2004 to $4.68 per kgU (2004 dollars). The value of $4.68 per kgU was derived from the estimates of costs from the three components that make up the total disposition cost of DUF_6 (i.e., deconversion, disposal, and transportation). Based on a computed tails production of 132,942 MTU during a nominal 30 years of operation and a tails processing cost of $4.68 per kgU or $4,680 per MTU, the total tails disposition funding requirement is estimated at $622,169,000. This sum will be included as part of the financial assurance for decommissioning (see Table 10.1-14, Total Decommissioning Costs). See Environmental Report Section 4.13.3.1.6, Costs Associated with UF_6 Tails Conversion and Disposal, for additional details.

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10.4 REFERENCES

CFR, 2003a. Title 10, Code of Federal Regulations, Section 70.38, Expiration and termination of licenses and decommissioning of sites and separate buildings or outdoor areas, 2003.

CFR, 2003b. Title 10, Code of Federal Regulations, Section 20.1402, Radiological criteria for unrestricted use, 2003.

CFR, 2003c. Title 10, Code of Federal Regulations, Part 20.1003, Definitions, 2003.

CFR, 2003d. Title 10, Code of Federal Regulations, Part 20.2108, Records of waste disposal, 2003.

CFR, 2003e. Title 10, Code of Federal Regulations, Part 20, Subpart E, Radiological Criteria for License Termination, 2003.

CFR, 2003f. Title 10, Code of Federal Regulations, Part 20.2002, Method for obtaining approval of proposed disposal procedures, 2003.

CFR, 2003g. Title 10, Code of Federal Regulations, Part 95, Security Facility Approval and Safeguarding of National Security Information and Restricted Data, 2003.

CFR, 2003h. Title 10, Code of Federal Regulations, Section 40.36, Financial assurance and recordkeeping for decommissioning, 2003.

CFR, 2003i. Title 10, Code of Federal Regulations, Section 70.25, Financial assurance and recordkeeping for decommissioning, 2003.

CFR, 2003j. Title 10, Code of Federal Regulations, Part 40, Appendix A, Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material From Ores Processed Primarily for Their Source Material Content, 2003.

DOE, 1997. Programmatic Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride, U.S. Department of Energy, December 1997.

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LES, 1993a. Clairborne Enrichment Center Safety Analysis Report, Section 11.8, Decommissioning, Louisiana Energy Services, 1993.

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NRC, 1990. Assuring the Availability of Funds for Decommissioning Nuclear Reactors, Regulatory Guide 1.159, U.S. Nuclear Regulatory Commission, August 1990.

NRC, 1994. Safety Evaluation Report for the Claiborne Enrichment Center, Homer, Louisiana, NUREG-1491, U.S. Nuclear Regulatory Commission, January 1994.

NRC, 2003. Consolidated NMSS Decommissioning Guidance – Financial Assurance, Recordkeeping, and Timeliness, NUREG-1757, Volume 3, U.S. Nuclear Regulatory Commission, September 2003.

TABLES

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Table 10.1-1A Number and Dimensions of Facility Components
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Separations Modules (Note 1)

Component	Number of Components	Dimensions of Components	Total Dimensions
Glove Boxes			
Fume Cupboards			
Lab Benches			
Sinks			
Drains			
Floors			
Walls			
Ceilings			
Ventilation/Ductwork			
Hot Cells			
Equipment/Materials			
Soil Plots			
Storage Tanks			
Storage Areas			
Radwaste Areas			
Scrap Recovery Areas			
Maintenance Shop			
Equipment Decontamination Areas			
Other			

Notes:

1. More than 97% of the decommissioning costs for the facility are attributed to the dismantling, decontamination, processing, and disposal of centrifuges and other equipment in the Separations Building Modules, which are considered classified. Given the classified nature of these buildings, the data presented in these Tables have been structured to meet the applicable NUREG-1757 recommendations, to the extent practicable. However, specific information regarding numbers of components, dimensions of components, and total dimensions, has been intentionally excluded to protect the classified nature of the data.

Table 10.1-1B Number and Dimensions of Facility Components

Decommission Decontamination Facility

Component	Number of Components	Dimensions of Components	Total Dimensions
Glove Boxes	None	NA	NA
Fume Cupboards	None	NA	NA
Lab Benches	10	Various sizes of lab and workshop benches ranging from 6.5 to 13 feet long by 2.5 feet wide	(Note 1)
Sinks	6	Standard laboratory sinks and hand wash basins	(Note 1)
Drains	6	Standard laboratory type drains	(Note 1)
Floors	1 Lot (Note 2)	(Note 1)	(Note 1)
Walls	1 Lot (Note 2)	(Note 1)	(Note 1)
Ceilings	1 Lot (Note 2)	(Note 1)	(Note 1)
Ventilation/Ductwork	(Note 3)	Various sizes of ductwork ranging from 3 to 18 inches plus dampers, valves and flexibles	640 feet
Hot Cells	None	NA	NA
Equipment/Materials	20	Various pieces of equipment including citric cleaning tanks, centrifuge cutting machines	(Note 1)
Soil Plots	None	NA	NA
Storage Tanks	1 Lot (Note 2)	Various storage tanks	(Note 1)
Storage Areas	1	Storage area for centrifuges and pipe work	(Note 1)
Radwaste Areas	None	NA	NA
Scrap Recovery Areas	None	NA	NA
Maintenance Shop	None	NA	NA
Equipment Decontamination Areas	None	NA	NA
Other	1 Lot (Note 2)	Hand tools and consumables that become contaminated while carrying out dismantling and decontamination work, unmeasured work and scaffolding	(Note 1)

Notes:

1. Total dimensions not used in estimating model.
2. Allocation based on Urenco decommissioning experience.
3. Total dimensions provided.

Table 10.1-1C Number and Dimensions of Facility Components

Technical Services Building

Component	Number of Components	Dimensions of Components	Total Dimensions
Glove Boxes	None	NA	NA
Fume Cupboards	18	Standard laboratory fume cupboards, approx 6.5 - 8 feet high x 5 feet wide	(Note 1)
Lab Benches	25	Various sizes of lab and workshop benches ranging from 6.5 – 13 feet long by 2.5 feet wide	(Note 1)
Sinks	12	Standard laboratory sinks and hand wash basins plus larger sinks for laundry	(Note 1)
Drains	12	Standard Laboratory type drains plus larger laundry drain	(Note 1)
Floors	(Note 3)	Floor area covers all Workshops and Labs in the Technical Services Bldg that may be exposed to contamination	26,340 ft^2
Walls	(Note 3)	Wall area covers all Workshops and Labs in the Technical Services Bldg that may be exposed to contamination	40,074 ft^2
Ceilings	(Note 3)	Ceiling area covers all Workshops and Labs in the Technical Services Bldg that may be exposed to contamination	26,340 ft^2
Ventilation/ Ductwork	(Note 3)	Various pieces of equipment including, filter banks, extractor fans, vent stack, dampers and approx 2,034 feet of large and small ductwork	2,034 feet
Hot Cells	None	NA	NA
Equipment/ Materials	57	Various pieces of equipment including, mass spectrometers, washing machines, hydraulic lift tables, cleaning cabinets	(Note 1)
Soil Plots	None	NA	NA
Storage Tanks	1	Waste oil storage tank (53 gal)	(Note 1)
Storage Areas	2	Storage area for product removal, dirty pumps	(Note 1)
Radwaste Areas	None	NA	NA
Scrap Recovery Areas	None	NA	NA
Maintenance Shop	None	NA	NA
Equipment Decontamination Areas	None	NA	NA
Other	1 Lot (Note 2)	Hand tools and consumables that become contaminated while carrying out dismantling/decontamination work, unmeasured work and scaffolding	(Note 1)

Notes:

1. Total dimensions not used in estimating model.
2. Allocation based on Urenco decommissioning experience.
3. Total dimensions provided.

Table 10.1-1D Number and Dimensions of Facility Components

Gaseous Effluent Vent (GEV) System Throughout Plant

Component	Number of Components	Dimensions of Components	Total Dimensions
Glove Boxes	None	NA	NA
Fume Cupboards	None	NA	NA
Lab Benches	None	NA	NA
Sinks	None	NA	NA
Drains	None	NA	NA
Floors	None	NA	NA
Walls	None	NA	NA
Ceilings	None	NA	NA
Ventilation/Ductwork	(Note 3)	Various sizes of ductwork ranging from 3 to 18 inches plus dampers, valves and flexibles	5,656 feet
Hot Cells	None	NA	NA
Equipment/Materials	None	NA	NA
Soil Plots	None	NA	NA
Storage Tanks	None	NA	NA
Storage Areas	None	NA	NA
RadWaste Areas	None	NA	NA
Scrap Recovery Areas	None	NA	NA
Maintenance Shop	None	NA	NA
Equipment Decontamination Areas	None	NA	NA
Other	1 Lot (Note 2)	Hand tools and consumables that become contaminated while carrying out dismantling/decontamination work, unmeasured work and scaffolding	(Note 1)

Notes:

1. Total dimensions not used in estimating model.
2. Allocation based on Urenco decommissioning experience.
3. Total dimensions provided.

Table 10.1-1E Number and Dimensions of Facility Components
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Blending and Sampling

Component	Number of Components	Dimensions of Components	Total Dimensions
Glove Boxes	None	NA	NA
Fume Cupboards	None	NA	NA
Lab Benches	None	NA	NA
Sinks	None	NA	NA
Drains	None	NA	NA
Floors	None (Note 4)	NA	NA
Walls	None (Note 4)	NA	NA
Ceilings	None (Note 4)	NA	NA
Ventilation/Ductwork	Covered in GEV System estimate	Covered in GEV System estimate	Covered in GEV System estimate
Hot Cells	None	NA	NA
Equipment/Materials	(Note 3)	Various sizes of pipe-work ranging from DN25 to DN65	2,461 feet
	38 Valves	Various types of valve ranging from 0.6 to 2.5 inches and manual to control	(Note 1)
	12	Various pieces of equipment including hot boxes and traps	(Note 1)
Soil Plots	None	NA	NA
Storage Tanks	None	NA	NA
Storage Areas	None	NA	NA
Radwaste Areas	None	NA	NA
Scrap Recovery Areas	None	NA	NA
Maintenance Shop	None	NA	NA
Equipment Decontamination Areas	None	NA	NA
Other	1 Lot (Note 2)	Hand tools and consumables that become contaminated while carrying out dismantling/decontamination work, unmeasured work and scaffolding	(Note 1)

Notes:

1. Total dimensions not used in estimating model.
2. Allocation based on Urenco decommissioning experience.
3. Total dimensions provided.
4. No floors, walls or ceilings are anticipated needing decontamination.

Table 10.1-1F Number and Dimensions of Facility Components

Centrifuge Test and Post Mortem

Component	Number of Components	Dimensions of Components	Total Dimensions
Glove Boxes	None	NA	NA
Fume Cupboards	None	NA	NA
Lab Benches	4	Various sizes of lab and workshop benches ranging from 6.5 – 13 feet long by 2.5 feet wide	(Note 1)
Sinks	2	Standard laboratory sinks and hand wash basins plus larger sinks for laundry	(Note 1)
Drains	2	Standard laboratory type drains plus larger laundry drain	(Note 1)
Floors	None (Note 4)	NA	NA
Walls	None (Note 4)	NA	NA
Ceilings	None (Note 4)	NA	NA
Ventilation/ Ductwork	None	NA	NA
Hot Cells	None	NA	NA
Equipment/ Materials	(Note 3)	Various sizes of pipe-work ranging from DN16 to DN40	164 feet
	56 Valves	Various types of valve ranging from 0.6 to 1.6 inches and manual to control	(Note 1)
	7	Various pieces of equipment including feed take off vessels and traps	(Note 1)
Soil Plots	None	NA	NA
Storage Tanks	None	NA	NA
Storage Areas	None	NA	NA
Radwaste Areas	None	NA	NA
Scrap Recovery Areas	None	NA	NA
Maintenance Shop	None	NA	NA
Equipment Decontamination Areas	None	NA	NA
Other	1 Lot (Note 2)	Hand tools and consumables that become contaminated while carrying out dismantling/decontamination work, unmeasured work and scaffolding	(Note 1)

Notes:

1. Total dimensions not used in estimating model.
2. Allocation based on Urenco decommissioning experience.
3. Total dimensions provided.
4. No floors, walls or ceilings are anticipated needing decontamination.

Table 10.1-2 Planning and Preparation

Activity	Costs ($000)	Labor Shift-worker (multi-functional) (Man-days)	Labor Project Management (Man-days)	Labor HP&S (Man-days)	Activity Duration (Months)
Project Plan & Schedule	100	0	178	0	4
Site Characterization Plan	200	0	356	0	4
Site Characterization	300	82	368	144	4
Decommissioning Plan	350	0	622	0	6
NRC Review Period	50	0	89	0	12
Site Services Specifications	100	0	178	0	2
Project Procedures	100	0	178	0	4
TOTAL	1,200	82	1,969	144	(Note 1)

Note:

1. Some activities will be conducted in parallel to achieve a 24 month time frame.

Table 10.1-3 Decontamination or Dismantling of Radioactive Components (Man-Hours)

Other Buildings (Note 1)

Component	Decon Method (Note 4)	Craftsman	Supervision (Note 2)	Project Management	HP&S/Chem (Note 3)
Glove Boxes		0	0	0	0
Fume Cupboards		312	62	53	66
Lab Benches		324	64	55	68
Sinks		101	20	17	21
Drains		102	20	17	21
Floors		647	129	111	136
Walls		422	84	72	89
Ceilings		275	55	47	58
Ventilation/Ductwork		8,468	1,693	1,447	1,780
Hot Cells		0	0	0	0
Equipment/Materials		1,533	307	262	322
Soil Plots		0	0	0	0
Storage Tanks		14	3	2	3
Storage Areas		110	22	19	23
Radwaste Areas		0	0	0	0
Scrap Recovery Areas		0	0	0	0
Maintenance Shop		0	0	0	0
Equipment Decontamination Areas		0	0	0	0
Other		1,913	382	327	402
TOTAL Hours	--	14,221	2,841	2,430	2,990

Notes:

1. Includes the Decontamination Facility, Technical Services Building, Gaseous Effluent Vent System Throughout Plant, Blending and Sampling, and Centrifuge Test and Post Mortem Facilities.
2. Supervision at 20%.
3. Supply ongoing monitoring and analysis service for dismantling teams.
4. Specific details of decontamination method not defined at this time.

Table 10.1-4 Restoration of Contaminated Areas on Facility Grounds
(Work Days)
Page 1 of 1

Activity	Labor Category	Labor Category	Labor Category	Labor Category	Labor Category	Labor Category
Backfill and Restore Site (Note 1)						
TOTAL						

Note:

1. Deviates from NUREG-1757 because cost is based on volume and unit cost associated with removal and disposal of liners and earthen covers of the facility Treated Effluent Evaporative Basin. The cost (see Table 10.1-14) assumes transport and disposal of approximately 33,000 ft^3 of contaminated soil and basin membrane. The cost of removal of the facility Treated Effluent Evaporative Basin material (33,000 ft^3) is based on a $30/$ft^3$ disposal cost and includes the cost of excavation ($5.00/$yd^3$ which includes labor and equipment costs) and cost of transportation ($4.00/mile for approximately 1,100 miles from the NEF site to the Envirocare facility in Utah). Based on Urenco experience, other areas outside of the plant buildings are not expected to be contaminated.

Table 10.1-5 Final Radiation Survey

Activity	Costs ($000)	Labor Shift-worker (multi-functional) (Man-days)	Labor Project Management (Man-days)	Labor HP&S (Man-days)	Activity Duration (Months)
Prepare Survey Plans and Grid Areas	500	439	334	360	8
Collect Survey Readings and Analyze Data	1,400 (Note 1)	1,261	343	1,013	16
Sample Analysis			568		
Final Status Survey Report and NRC Review	300	0	533	0	8
Confirmatory Survey and Report	200	0	355	0	6
Terminate Site License	100	0	178	0	2
TOTAL	2,500	1,700	2,311	1,373	(Note 2)

Notes:

1. The $1.4 million cost assigned to the conduct of the final radiation survey includes a cost of $365,000 to conduct the sampling and perform the sample analysis by a contractor. The sampling labor cost component ($45,000) was estimated assuming $60/hr (HP&S man-hour rate) for an estimated 500 samples with an average sample duration of 1.5 hours/sample. The analysis cost component ($320,000) for the 500 samples was estimated using a conservative $640/sample based on recent actual 2004 lab analysis costs. Because of the modeling for this activity, this sample analysis cost is expressed in terms of equivalent man-hours at the Project Management man-hour rate.
2. Some activities will be conducted in parallel to achieve a 36 month time frame.

Table 10.1-6 Site Stabilization and Long-Term Surveillance
(Work Days)

Activity	Labor Category	Labor Category	Labor Category	Labor Category	Labor Category	Labor Category
(Note 1)	N/A	N/A	N/A	N/A	N/A	N/A

Note:

1. Urenco experience with decommissioning gas centrifuge uranium enrichment plants has been that there is no resultant ground contamination. As a result, site stabilization and long-term surveillance will not be required and associated decommissioning provisions are not provided.

Table 10.1-7 Total Work Days by Labor Category
(Based on a 7.5 hr Working Day)
Page 1 of 1

Task	Shift- worker (multi-functional)	Craftsman	Supervision	Project Management	HP&S	Cleaner
Planning and Preparation (see Table 10.1-2)	82	0	0	1,969	144	0
Decontamination and/or Dismantling of Radioactive Facility Components (Note 2)	56,067	1,896	6,156	1,478	1,828	2,897
Restoration of Contaminated Areas on Facility Grounds (Note 1) (see Table 10.1-4)	-	-	-	-	-	-
Final Radiation Survey (see Table 10.1-5)	1,700	0	0	2,311	1,373	0
Site Stabilization and Long-Term Surveillance (see Table 10.1-6)	0	0	0	0	0	0

Notes:

1. Cost estimate is activity-based.
2. The values shown are inclusive of the Separations Module input derived using the total costs in Table 10.1-9 and dividing by the cost per day for each labor category.

Table 10.1-8 Worker Unit Cost Schedule

Labor Cost Component	Shift- worker (multi-functional)	Craftsman	Supervision	Project Management	HP&S	Cleaner
Salary & Fringe ($/year)	73,006	65,184	96,000	120,000	96,000	73,006
Overhead Rate (%)	excluded	excluded	excluded	excluded	excluded	excluded
Total Cost Per Year ($)	73,006	65,184	96,000	120,000	96,000	73,006
Total Cost Per Work Day ($/day) (Note 1)	342	306	450	563	450	342

Note:

1. Based on 213.33 work days per year at 7.5 hrs per day (1,600 hrs per year).

Table 10.1-9 Total Labor Costs by Major Decommissioning Task
($000)

Task	Shift-worker (multi-functional)	Craftsman	Supervision	Project Management	HP&S	Cleaner
Planning and Preparation (see Table 10.1-2)	28	0	0	1,109	65	0
Decontamination and/or Dismantling of Radioactive Facility Components	19,175	579	2,770	832	823	991
Restoration of Contaminated Areas on Facility Grounds (Note 1) (see Table 10.1-4)	-	-	-	-	-	-
Final Radiation Survey (see Table 10.1-5)	581	0	0	1,301	618	0
Site Stabilization and Long-Term Surveillance (see Table 10.1-6)	0	0	0	0	0	0

Note:

1. Cost estimate is activity-based.

Table 10.1-10 Packaging, Shipping and Disposal of Radioactive Wastes (Excluding Labor Costs)

(a) Waste Disposal Costs (includes packaging & shipping costs)

Waste Type	Disposal Volume (m^3 (ft^3))	Unit Cost ($/$ft^3$)	# of drums	Total Disposal Costs ($000)
Other Buildings :				
Miscellaneous low level waste	83 (2.930)	150	400	440
Separation Modules:				
Solidified Liquid Wastes	432 (15,251)	100	2,159	1,525
Centrifuge Components, Piping and Other Parts	1,036 (36,595)	100	5,180	3,659
Aluminum	3,602 (127,200)	100	NA	12,720
TOTAL	5,153 (181,976)	--	7,739	18,344

(b) Processing Costs

Materials	Disposal Weight (tons)	Unit Cost ($/lb)	Total Disposal Costs ($000)
Aluminum	10,177	0.14	2,860
Other materials	155	2.67	830
TOTAL	10,332	--	3,690

Table 10.1-11 Equipment and Supply Costs
(Excluded Containers)
Page 1 of 1

(a) Equipment

Equipment	Quantity	Unit Cost ($/unit)	Total Cost Equipment ($000)
Separation Building Modules			
Dismantling and decontamination building	45,210 ft^2	1,545	6,490
Special floor and vent system	45,210 ft^2	294	1,240
Plant equipment			
Basic decontamination equipment	lot (Note 1)	600,000	600
Decontamination line equipment	2 units	3,908,850	7,820
Evaporation installation	lot (Note 1)	390,000	390
Radiation and control equipment	lot (Note 1)	410,000	410
Electrical and Instrumentation			
Electrical system	lot (Note 1)	500,000	500
Instrumentation	lot (Note 1)	590,000	590
Design and Engineering			
Building	-	20% (Note 1)	1,550
Plant and equipment	-	15% (Note 1)	1,400
Electrical and Instrumentation	-	25% (Note 1)	270
Other Buildings:			
Dismantling/Cleaning Tools, Equipment and Consumables	lot (Note 1)	100,000	100
TOTAL	--	--	21,360

Note:
1. Allocation based on Urenco decommissioning experience.

(b) Supply

Equipment	Quantity	Unit Cost ($/$ft^3$)	Total Cost Equipment ($000)
Electricity kwh	2,910,344	0.062	180
Gas ft^3	16,900,000	0.004	75
Water ft^3	86,300	0.035	3
Materials	lot (Note 1)		653
TOTAL	--	--	910

Note:
1. Allocation based on Urenco decommissioning experience.

Table 10.1-12 Laboratory Costs
Page 1 of 1

Activity	Quantity	Unit Cost ($)	Total Costs ($000)
Analysis of batch samples (Note 1)	931	934	870
TOTAL	--	--	870

Note:

1. Sample analysis costs are for aluminum only. The unit cost for this sampling is the cost of performing the analysis using onsite laboratory equipment and assumes 8 samples for each of the estimated 931 batch melts. Costs associated with other sampling and analysis are included in Table 10.1-5, Final Radiation Survey.

Table 10.1-13 Period Dependent Costs
Page 1 of 1

Cost Item	Total Cost ($000)
License Fees	(Note 1)
Insurance	(Note 1)
Taxes	(Note 1)
Other	(Note 1)
TOTAL	10,000

Note:

1. Period Dependent Costs include management, insurance, taxes, and other costs for the period beginning with the termination of operations of Separations Building Module 3 and the remaining plant facilities. This assumes $2,000,000 per year for each of the five years at the end of the project. It has been assumed that the period dependent decommissioning costs incurred during concurrent enrichment operations will be funded from operating plant funding and not the decommissioning trust fund.

Table 10.1-14 Total Decommissioning Costs
Page 1 of 2

(Note 7)

Task/Components	Costs ($000)		Total ($000)	Percentage	Notes
	Separations Modules	Other Buildings			
Planning and Preparation (see Table 10.1-2)	1,200	0	1,200	1%	1
Decontamination and Dismantling of Radioactive Facility Components (see Table 10.1-9)	24,060	1,110	25,170	20%	8
Restoration of Contamination Areas on Facility Grounds (see Table 10.1-4)	1,357	0	1,357	1%	2
Final Radiation Survey (see Table 10.1-5)	2,500	0	2,500	2%	3
Cost of Third Party Use	39,829	1,232	41,061	32%	11
Site Stabilization and Long-term Surveillance	0	0	0	0%	4
Waste Processing Costs (see Table 10.1-10)	3,690	0	3,690	3%	5
Waste Disposal Costs (see Table 10.1-10)	17,904	440	18,344	14%	6
Equipment Costs (see Table 10.1-11)	21,260	100	21,360	17%	--
Supply Costs (see Table 10.1-11)	910	0	910	1%	--
Laboratory Costs (see Table 10.1-12)	870	0	870	1%	--
Period Dependent Costs (see Table 10.1-13)	10,000	0	10,000	8%	--
SUBTOTAL (2002)	123,580	2,882	126,462		--
SUBTOTAL (with escalation to 2004)	128,115	2,988	131,103		12
Tails Disposition (2004)	--	--	622,169		9
Contingency (25%)	--	--	188,318		--
TOTAL (2004)	--	--	941,590		10

Table 10.1-14 Total Decommissioning Costs
Page 2 of 2

Notes:

1. The $1,200 includes planning, site characterization, Decommissioning Plan preparation, and NRC review for the entire plant.
2. Cost provided is for removal and disposal of liners and earthen covers of the facility Treated Effluent Evaporative Basin. The cost assumes transport and disposal of approximately 33,000 ft^3 of contaminated soil and basin membrane at recent commercial rates. The cost of removal of the facility Treated Effluent Evaporative Basin material (33,000 ft^3) is based on a $30/ft^3 disposal cost and includes the cost of excavation ($5.00/yd^3 which includes labor and equipment costs) and cost of transportation ($4.00/mile for approximately 1,100 miles from the NEF site to the Envirocare facility in Utah). Other areas outside of the plant buildings are not expected to be contaminated.
3. The $2,500 includes the Final Radiation Survey, NRC review, confirmatory surveys and license termination for the entire plant.
4. Site stabilization and long-term surveillance will not be required.
5. Waste processing costs are based on commercial metal melting equipment and unit rates obtained from Urenco experience in Europe.
6. Includes waste packaging and shipping costs. Waste disposal costs for Other Buildings are based on a $150 per cubic foot unit rate which includes packaging, shipping and disposal at Envirocare in Utah.
7. More than 97% of the decommissioning costs for the facility are attributed to the dismantling, decontamination, processing, and disposal of centrifuges and other equipment in the Separations Building Modules, which are considered classified. Given the classified nature of these buildings, the data presented in these Tables have been structured to meet the applicable NUREG-1757 recommendations, to the extent practicable. However, specific information such as numbers of components and unit rates has been intentionally excluded to protect the classified nature of the data. The remaining 3% of the decommissioning costs are for the remaining systems and components in Other Buildings.
8. The $1,110 for Other Buildings includes the decontamination and dismantling of contaminated equipment in the TBS, Blending and Liquid Sampling Area, Centrifuge Test and Post Mortem Facilities, and Gaseous Effluent Vent System.
9. Refer to Section 10.3, for Tails Disposition discussion.
10. Combined total for both decommissioning and tails disposition.
11. An adjustment has been applied to account for use of a third party for performing decommissioning operations associated with planning and preparation, decontamination and dismantling of radioactive facility components, restoration of contaminated grounds, and the final radiation survey. The adjustment includes an overhead rate on direct staff labor of 110%, plus 15% profit on labor and its overheads.
12. The escalation cost factor applied is based on the Gross Domestic Product (GDP) implicit price deflator. The resulting escalation cost factor for January 2002 to January 2004 is a 3.67% increase. The escalation cost factor is not applied to the tails disposition costs since these costs are provided in 2004 dollars.

Table 10.3-1 Summary of Depleted UF_6 Disposal Costs from Four Sources
Page 1 of 1

Source	Costs in 2002 Dollars per kgU			
	Conversion	Disposal	Transportation	Total
LLNL (UCRL-AR-127650) (a)	2.64	2.17	0.25	5.06
UDS Contract (b)	(d)	(d)	(d)	3.92
URENCO (e)	(d)	(d)	(d)	(d)
CEC Cost Estimate (c)	4.93	1.47	0.34	6.74

Notes:

(a) 1997 Lawrence Livermore National Laboratory cost estimate study for DOE, discounted costs in 1996 dollars were undiscounted and escalated to 2002 by ERI.

(b) Uranium Disposition Services (UDS) contract with DOE for capital and operating costs for first five years of Depleted UF_6 conversion and Depleted U_3O_8 conversion product disposition.

(c) Based upon Depleted UF_6 and Depleted U_3O_8 disposition costs provided to the NRC during Claiborne Enrichment Center license application in 1993.

(d) Cost component is proprietary or not made available.

(e) The average of the three costs is $5.24/kg U. LES has selected $5.50/kg U as the disposal cost for the National Enrichment Facility. Urenco has reviewed this cost estimate, and based on its current experience with UF_6 disposal, finds this figure to be prudent.

Table 10.3-2 DOE-UDS August 29, 2002, Contract Quantities and Costs

	Target Million kgU	
UDS Conversion and Disposal Quantities:	DUF6 (a)	U (b)
FY 2005 (August-September)	1.050	0.710
FY 2006	27.825	18.800
FY 2007	31.500	21.294
FY 2008	31.500	21.294
FY 2009	31.500	21.294
FY 2010 (October-July)	26.250	17.745
Total:	149.625	101.147
Nominal Conversion Rate (c) and Target Conversion Rate (Million kgU/Yr)		21.3
UDS Contract Workscope Costs: (d)		**Million $**
Design, Permitting, Project Management, etc.		27.99
Construct Paducah Conversion Facility		93.96
Construct Portsmouth Conversion Facility		90.40
Operations for First 5 Years DUF_6 and DU_3O_8 (e)		283.23
Contract Estimated Total Cost w/o Fee		495.58
Contract Estimated Value per DOE PR, August 29, 2003		558.00
Difference Between Cost and Value is the Estimated Fee of 12.6%		62.42
Capital Cost w/o Fee		212.35
Capital Cost with Fee		239.10
First 5 Years Operating Cost with Fee		318.92
Estimated Unit Conversion and Disposal Costs:		
Unit Capital Cost (f)		$0.77/kgU
2005-2010 Unit Operating Costs in 2002 $		$3.15/kgU
Total Estimated Unit Cost		$3.92/kgU

Notes:

(a) As on page B-10 of the UDS contract.
(b) DUF_6 weight multiplied by the uranium atomic mass fraction, 0.676.
(c) Based on page H-34 of the UDS contract.
(d) Workscope costs as on UDS contract pages B-2 and B-3.
(e) Does not include any potential off-set credit for HF sales.
(f) Assumed operation over 25 years, 6% government cost of money, and no taxes.

FIGURES

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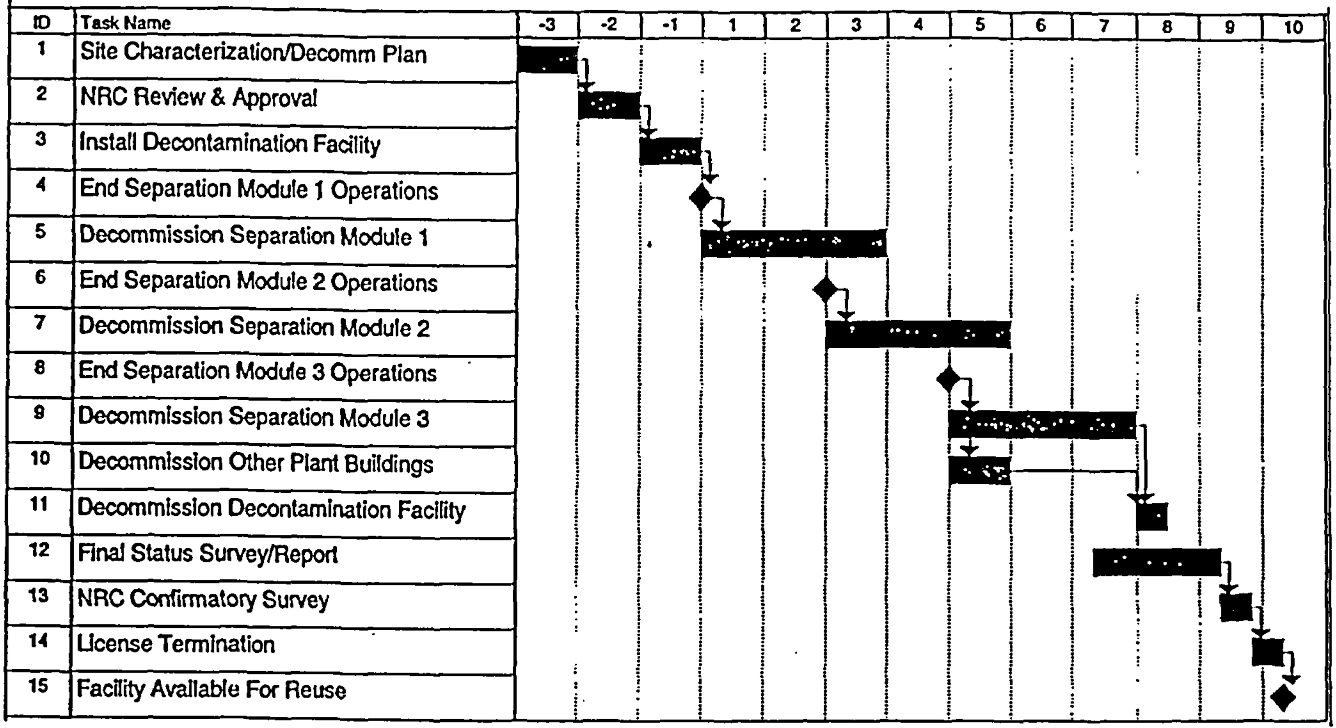
NATIONAL ENRICHMENT FACILITY - CONCEPTUAL DECOMMISSIONING SCHEDULE



REFERENCE NUMBER	FIGURE 10.1-1
Figure 10.1–1.doc	NATIONAL ENRICHMENT FACILITY – CONCEPTUAL DECOMMISSIONING SCHEDULE
	REVISION DATE: DECEMBER 2003

APPENDIX 10A

PAYMENT SURETY BOND

Date bond executed: ____________

Effective date: ____________

Principal: Louisiana Energy Services, L.P.
100 Sun Avenue NE, Suite 204
Albuquerque, NM 87109

Type of organization: Limited Partnership

State of incorporation: Delaware

NRC license number, name and address of facility, and amount for decommissioning activities guaranteed by this bond: ____________

Surety: [*Insert name and business address*]

Type of organization: [*Insert "proprietorship," "partnership," or "corporation"*]

State of incorporation: ____________ *(if applicable)*

Surety's qualification in jurisdiction where licensed facility is located.

Surety's bond number: ____________

Total penal sum of bond: $____________

Know all persons by these presents, that we, the Principal and Surety hereto, are firmly bound to the U.S. Nuclear Regulatory Commission (hereinafter called NRC) in the above penal sum for the payment of which we bind ourselves, our heirs, executors, administrators, successors, and assigns jointly and severally; provided that, where the Sureties are corporations acting as co-sureties, we, the Sureties, bind ourselves in such sum "jointly and severally" only for the purpose of allowing a joint action or actions against any or all of us, and for all other purposes each Surety binds itself, jointly and severally with the Principal, for the payment of such sum only as is set forth opposite the name of such Surety; but if no limit of liability is indicated, the limit of liability shall be the full amount of the penal sum.

WHEREAS, the NRC, an agency of the U.S. Government, pursuant to the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974, has promulgated regulations in title 10, Chapter I of the *Code of Federal Regulations*, Parts 30, 40, and 70, applicable to the Principal, which require that a license holder or an applicant for a facility license provide financial assurance that funds will be available when needed for facility decommissioning;

NOW, THEREFORE, the conditions of the obligation are such that if the Principal shall faithfully, before the beginning of decommissioning of each facility identified above, fund the standby trust fund in the amount(s) identified above for the facility;

Or, if the Principal shall fund the standby trust fund in such amount(s) after an order to begin facility decommissioning is issued by NRC or a U.S. District Court or other court of competent jurisdiction;

Or, if the Principal shall provide alternative financial assurance, and obtain NRC's written approval of such assurance, within 30 days after the date a notice of cancellation from the Surety is received by both the Principal and NRC, then this obligation shall be null and void; otherwise it is to remain in full force and effect.

The Surety shall become liable on this bond obligation only when the Principal has failed to fulfill the conditions described above. Upon notification by NRC that the Principal has failed to perform as guaranteed by this bond, the Surety shall place funds in the amount guaranteed for the facility into the standby trust fund.

The liability of the Surety shall not be discharged by any payment or succession of payments hereunder, unless and until such payment or payments shall amount in the aggregate to the penal sum of the bond, but in no event shall the obligation of the Surety hereunder exceed the amount of said penal sum.

The Surety may cancel the bond by sending notice of cancellation by certified mail to the Principal and to NRC provided, however, that cancellation shall not occur during the 90 days beginning on the date of receipt of the notice of cancellation by both the Principal and NRC, as evidenced by the return receipts.

The Principal may terminate this bond by sending written notice to NRC and to the Surety 90 days prior to the proposed date of termination, provided, however, that no such notice shall become effective until the Surety receives written authorization for termination of the bond from NRC.

The Principal and Surety hereby agree to adjust the penal sum of the bond yearly so that it guarantees a new amount, provided that the penal sum does not increase by more than 20 percent in any one year and no decrease in the penal sum takes place without the written permission of NRC.

If any part of this agreement is invalid, it shall not affect the remaining provisions that will remain valid and enforceable.

In Witness Whereof, the Principal and Surety have executed this financial guarantee bond and have affixed their seals on the date set forth above.

The persons whose signatures appear below hereby certify that they are authorized to execute this surety bond on behalf of the Principal and Surety.

Principal

[*Signatures*]
E. James Ferland
President, Louisiana Energy Services, L.P.
[*Corporate seal*]

Corporate Surety

[*Name and address*]

State of incorporation: ____________

Liability limit: $____________

[*Signatures*]
[*Names and titles*]
[*Corporate seal*]

Bond Premium: $____________

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APPENDIX 10B

STANDBY TRUST AGREEMENT

TRUST AGREEMENT, the Agreement entered into as of [*insert date*] by and between Louisiana Energy Service, L. P., a Delaware limited partnership, herein referred to as the "Grantor," and [*insert name and address of a trustee acceptable to NRC*], the "Trustee."

WHEREAS, the U.S. Nuclear Regulatory Commission (NRC), an agency of the U.S.

Government, pursuant to the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974, has promulgated regulations in title 10, Chapter I, of the *Code of Federal Regulations*, Parts 30, 40, and 70. These regulations, applicable to the Grantor, require that a holder of, or an applicant for, a materials license issued pursuant to 10 CFR Parts 30, 40, and 70 provide assurance that funds will be available when needed for required decommissioning activities.

WHEREAS, the Grantor has elected to use a surety bond to provide all of such financial assurance for the facilities identified herein; and

WHEREAS, when payment is made under a surety bond, this standby trust shall be used for the receipt of such payment; and

WHEREAS, the Grantor, acting through its duly authorized officers, has selected the Trustee to be the trustee under this Agreement, and the Trustee is willing to act as trustee;

NOW, THEREFORE, the Grantor and the Trustee agree as follows:

Section 1. Definitions. As used in this Agreement:

(a)The term "Grantor" means the NRC licensee who enters into this Agreement and any successors or assigns of the Grantor.

(b) The term "Trustee" means the trustee who enters into this Agreement and any successor trustee.

Section 2. Costs of Decommissioning. This Agreement pertains to the costs of decommissioning the materials and activities identified in License Number [*insert license number*] issued pursuant to 10 CFR Parts 30, 40, and 70, as shown in Schedule A.

Section 3. Establishment of Fund. The Grantor and the Trustee hereby establish a standby trust fund (the Fund) for the benefit of NRC. The Grantor and the Trustee intend that no third party shall have access to the Fund except as provided herein.

Section 4. Payments Constituting the Fund. Payments made to the Trustee for the Fund shall consist of cash, securities, or other liquid assets acceptable to the Trustee. The Fund is established initially as consisting of the property, which is acceptable to the Trustee , described in Schedule B attached hereto. Such property and any other property subsequently transferred to the Trustee are referred to as the "Fund," together with all earnings and profits thereon, less any payments or distributions made by the Trustee pursuant to this Agreement. The Fund shall be held by the Trustee, IN TRUST, as hereinafter provided. The Trustee shall not be responsible nor shall it undertake any responsibility for the amount of, or adequacy of the Fund, nor any duty to collect from the Grantor, any payments necessary to discharge any liabilities of the Grantor established by NRC.

<u>Section 5. Payment for Required Activities Specified in the Plan.</u> The Trustee shall make payments from the Fund to the Grantor upon presentation to the Trustee of the following:

(a) A certificate duly executed by the Secretary of the Grantor's Management Committee attesting to the occurrence of the events, and in the form set forth in the attached Certificate of Events, and

(b) A certificate attesting to the following conditions:

  (1) that decommissioning is proceeding pursuant to an NRC-approved plan;

  (2) that the funds withdrawn will be expended for activities undertaken pursuant to that plan; and

  (3) that NRC has been given 30 days prior notice of Louisiana Energy Service's intent to withdraw funds from the trust fund.

No withdrawal from the Fund for a particular license can exceed 10 percent of the remaining funds available for that license unless NRC written approval is attached.

In addition, the Trustee shall make payments from the Fund as NRC shall direct, in writing, to provide for the payment of the costs of required activities covered by this Agreement. The Trustee shall reimburse the Grantor or other persons as specified by NRC from the Fund for expenditures for required activities in such amounts as NRC shall direct in writing. In addition, the Trustee shall refund to the Grantor such amounts as NRC specifies in writing. Upon refund, such funds shall no longer constitute part of the Fund as defined herein.

<u>Section 6. Trust Management.</u> The Trustee shall invest and reinvest the principal and income of the Fund and keep the Fund invested as a single fund, without distinction between principal and income, in accordance with general investment policies and guidelines which the Grantor may communicate in writing to the Trustee from time to time, subject, however, to the provisions of this section. In investing, reinvesting, exchanging, selling, and managing the Fund, the Trustee shall discharge its duties with respect to the Fund solely in the interest of the beneficiary and with the care, skill, prudence and diligence under the circumstances then prevailing which persons of

prudence, acting in a like capacity and familiar with such matters, would use in the conduct of an enterprise of a like character and with like aims, <u>except that</u>:

(a) Securities or other obligations of the Grantor, or any other owner or operator of the facilities, or any of their affiliates as defined in the Investment Company Act of 1940, as amended (15 U.S.C. 80a-2(a)), shall not be acquired or held, unless they are securities or other obligations of the Federal or a State government;

(b) The Trustee is authorized to invest the Fund in time or demand deposits of the Trustee, to the extent insured by an agency of the Federal government, and in obligations of the Federal government such as GNMA, FNMA, and FHLM bonds and certificates or State and Municipal bonds rated BBB or higher by Standard & Poor's or Baa or higher by Moody's Investment Services; and

(c) For a reasonable time, not to exceed 60 days, the Trustee is authorized to hold uninvested cash, awaiting investment or distribution, without liability for the payment of interest thereon.

Section 7. Commingling and Investment. The Trustee is expressly authorized in its discretion:

(a) To transfer from time to time any or all of the assets of the Fund to any common, commingled, or collective trust fund created by the Trustee in which the Fund is eligible to participate, subject to all of the provisions thereof, to be commingled with the assets of other trusts participating therein; and

(b) To purchase shares in any investment company registered under the Investment Company Act of 1940 (15 U.S.C. 80a-1 et seq.), including one that may be created, managed, underwritten, or to which investment advice is rendered, or the shares of which are sold by the Trustee. The Trustee may vote such shares in its discretion.

Section 8. Express Powers of Trustee. Without in any way limiting the powers and discretion conferred upon the Trustee by the other provisions of this Agreement or by law, the Trustee is expressly authorized and empowered:

(a) To sell, exchange, convey, transfer, or otherwise dispose of any property held by it, by public or private sale, as necessary to allow duly authorized withdrawals at the joint request of the Grantor and NRC or to reinvest in securities at the direction of the Grantor;

(b) To make, execute, acknowledge, and deliver any and all documents of transfer and conveyance and any and all other instruments that may be necessary or appropriate to carry out the powers herein granted;

(c) To register any securities held in the Fund in its own name, or in the name of a nominee, and to hold any security in bearer form or in book entry, or to combine certificates representing such securities with certificates of the same issue held by the Trustee in other fiduciary capacities, to reinvest interest payments and funds from matured and redeemed instruments, to file proper forms concerning securities held in the Fund in a timely fashion with appropriate government agencies, or to deposit or arrange for the deposit of such securities in a qualified central depository even though, when so deposited, such securities may be merged and held in bulk in the name of the nominee or such depository with other securities deposited therein by another person, or to deposit or arrange for the deposit of any securities issued by the U.S. Government, or any agency or instrumentality thereof, with a Federal Reserve Bank, but the books and records of the Trustee shall at all times show that all such securities are part of the Fund;

(d) To deposit any cash in the Fund in interest-bearing accounts maintained or savings certificates issued by the Trustee, in its separate corporate capacity, or in any other banking institution affiliated with the Trustee, to the extent insured by an agency of the Federal government; and

(e) To compromise or otherwise adjust all claims in favor of or against the Fund.

Section 9. Taxes and Expenses. All taxes of any kind that may be assessed or levied against or in respect of the Fund and all brokerage commissions incurred by the Fund shall be paid from the Fund. All other expenses incurred by the Trustee in connection with the administration of this Trust, including fees for legal services rendered to the Trustee, the compensation of the Trustee to the extent not paid directly by the Grantor, and all other proper charges and disbursements of the Trustee shall be paid from the Fund.

Section 10. Annual Valuation. After payment has been made into this standby trust fund, the Trustee shall annually, at least 30 days before the anniversary date of receipt of payment into the standby trust fund, furnish to the Grantor and to NRC a statement confirming the value of the Trust. Any securities in the Fund shall be valued at market value as of no more than 60 days before the anniversary date of the establishment of the Fund. The failure of the Grantor to object in writing to the Trustee within 90 days after the statement has been furnished to the Grantor and NRC shall constitute a conclusively binding assent by the Grantor, barring the Grantor from asserting any claim or liability against the Trustee with respect to the matters disclosed in the statement.

Section 11. Advice of Counsel. The Trustee may from time to time consult with counsel with respect to any question arising as to the construction of this Agreement or any action to be taken hereunder. The Trustee shall be fully protected, to the extent permitted by law, in acting on the advice of counsel.

Section 12. Trustee Compensation. The Trustee shall be entitled to reasonable compensation for its services as agreed upon in writing with the Grantor. (See Schedule C.)

Section 13. Successor Trustee. Upon 90 days notice to NRC and the Grantor, the Trustee may resign; upon 90 days notice to NRC and the Trustee, the Grantor may replace the Trustee; but such resignation or replacement shall not be effective until the Grantor has appointed a successor Trustee, the successor accepts the appointment, the successor is ready to assume its duties as trustee, and NRC has agreed, in writing, that the successor is an appropriate Federal or State government agency or an entity that has the authority to act as a trustee and whose trust operations are regulated and examined by a Federal or State agency. The successor Trustee shall have the same powers and duties as those conferred upon the Trustee hereunder. When the resignation or replacement is effective, the Trustee shall assign, transfer, and pay over to the successor Trustee the funds and properties then constituting the Fund. If for any reason the Grantor cannot or does not act in the event of the resignation of the Trustee, the Trustee may apply to a court of competent jurisdiction for the appointment of a successor Trustee or for instructions. The successor Trustee shall specify the date on which it assumes administration of the trust, in a writing sent to the Grantor, NRC, and the present Trustee, by certified mail 10 days before such change becomes effective. Any expenses incurred by the Trustee as a result of any of the acts contemplated by this section shall be paid as provided in Section 9.

Section 14. Instructions to the Trustee. All orders, requests, and instructions by the Grantor to the Trustee shall be in writing, signed by such persons as are signatories to this Agreement or such other designees as the Grantor may designate in writing. The Trustee shall be fully protected in acting without inquiry in accordance with the Grantor's orders, requests, and instructions. If NRC issues orders, requests, or instructions to the Trustee these shall be in writing, signed by NRC or its designees, and the Trustee shall act and shall be fully protected in acting in accordance with such orders, requests, and instructions. The Trustee shall have the right to assume, in the absence of written notice to the contrary, that no event constituting a change or a termination of the authority of any person to act on behalf of the Grantor or NRC hereunder has occurred. The Trustee shall have no duty to act in the absence of such orders, requests, and instructions from the Grantor and/or NRC, except as provided for herein.

Section 15. Amendment of Agreement. This Agreement may be amended by an instrument in writing executed by the Grantor, the Trustee, and NRC, or by the Trustee and NRC if the Grantor ceases to exist. All amendments shall meet the relevant regulatory requirements of NRC.

Section 16. Irrevocability and Termination. Subject to the right of the parties to amend this Agreement as provided in Section 15, this trust shall be irrevocable and shall continue until terminated at the written agreement of the Grantor, the Trustee, and NRC, or by the Trustee and NRC if the Grantor ceases to exist. Upon termination of the trust, all remaining trust property, less final trust administration expenses, shall be delivered to the Grantor or its successor.

Section 17. Immunity and Indemnification. The Trustee shall not incur personal liability of any nature in connection with any act or omission, made in good faith, in the administration of this trust, or in carrying out any directions by the Grantor or NRC issued in accordance with this Agreement. The Trustee shall be indemnified and saved harmless by the Grantor or from the trust fund, or both, from and against any personal liability to which the Trustee may be subjected by reason of any act or conduct in its official capacity, including all expenses reasonably incurred in its defense in the event the Grantor fails to provide such defense.

Section 18. This Agreement shall be administered, construed, and enforced according to the laws of the State of [*insert name of State*].

Section 19. Interpretation and Severability. As used in this Agreement, words in the singular include the plural and words in the plural include the singular. The descriptive headings for each section of this Agreement shall not affect the interpretation or the legal efficacy of this Agreement. If any part of this Agreement is invalid, it shall not affect the remaining provisions which will remain valid and enforceable.

IN WITNESS WHEREOF the parties have caused this Agreement to be executed by the respective officers duly authorized and the incorporate seals to be hereunto affixed and attested as of the date first written above.

Louisiana Energy Services, L. P.
[*Signature of E. James Ferland*]
E. James Ferland
President, Louisiana Energy Services, L. P

ATTEST:
[*Title*]
[*Seal*]

[*Insert name and address of Trustee*]
[*Signature of representative of Trustee*]
[*Title*]

ATTEST:
[*Title*]
[*Seal*]

APPENDIX 10C

STANDBY TRUST AGREEMENT SCHEDULES

Schedule A

This Agreement demonstrates financial assurance for the following cost estimates or prescribed amounts for the following licensed activities:

U.S. NUCLEAR REGULATORY COMMISSION LICENSE NUMBER(S)	NAME AND ADDRESS OF LICENSEE	ADDRESS OF LICENSED ACTIVITY	COST ESTIMATES FOR REGULATORY ASSURANCES DEMONSTRATED BY THIS AGREEMENT
	Louisiana Energy Services, L.P. 100 Sun Avenue NE, Suite 204 Albuquerque, NM 87109		

The cost estimates listed here were last adjusted and approved by NRC on [*insert date*].

Schedule B

DOLLAR AMOUNT________________

AS EVIDENCED BY________________

Schedule C

[*Insert name, address, and phone number of Trustee.*]
Trustee's fees shall be $________________per year.

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APPENDIX D
SPECIMEN CERTIFICATE OF EVENTS

[*Insert name and address of trustee*]

Attention: Trust Division

Gentlemen:

In accordance with the terms of the Agreement with you dated ________, I, _________, Secretary of the Management Committee of Louisiana Energy Services, L. P., hereby certify that the following events have occurred:

1. Louisiana Energy Services, L. P., is required to commence the decommissioning of its facility located in Lea County, New Mexico (hereinafter called the decommissioning).

2. The plans and procedures for the commencement and conduct of the decommissioning have been approved by the United States Nuclear Regulatory Commission, or its successor, on _______________(copy of approval attached).

3. The Management Committee of Louisiana Energy Services, L. P., has adopted the attached resolution authorizing the commencement of the decommissioning.

____

Secretary of the Management Committee of
Louisiana Energy Services, L. P.

____

Date

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APPENDIX 10E

SPECIMEN CERTIFICATE OF RESOLUTION

I, _________, do hereby certify that I am Secretary of the Management Committee of Louisiana Energy Services, L. P., a Delaware Limited Partnership, and that the resolution listed below was duly adopted at a meeting of this Limited Partnership's Management Committee on __________, 20__.

IN WITNESS WHEREOF, I have hereunto signed my name and affixed the seal of this Limited Partnership this ___ day of _________, 20__.

____

Secretary of the Management Committee of
Louisiana Energy Services, L. P.

RESOLVED, that this Management Committee hereby authorizes the President, or such other employee of the Limited Partnership as he may designate, to commence decommissioning activities at the National Enrichment Facility in accordance with the terms and conditions described to this Management Committee at this meeting and with such other terms and conditions as the President shall approve with and upon the advice of Counsel.

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APPENDIX 10F
LETTER OF ACKNOWLEDGMENT

STATE OF ________________

To Wit: ________________

CITY OF ________________

On this ___ day of ___________, before me, a notary public in and for the city and State aforesaid, personally appeared ____________, and she/he did depose and say that she/he is the [*insert title*] of _________________[*if applicable, insert ", national banking association" or ", State banking association"*], Trustee, which executed the above instrument; that she/he knows the seal of said association; that the seal affixed to such instrument is such corporate seal; that it was so affixed by order of the association; and that she/he signed her/his name thereto by like order.

____
[*Signature of notary public*]

My Commission Expires: ___________
[*Date*]

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11.1 CONFIGURATION MANAGEMENT (CM)

This section describes the configuration management program for the NEF. Configuration management for the NEF is implemented through requirements of the QA Program and associated procedures.

The LES President is the executive responsible for quality assurance and is the highest level of management responsible for LES's QA policies, goals, and objectives. The President receives policy direction from the LES Management Committee. The LES organization during the design, construction and operation phases, including QA, is presented in Chapter 2, Organization and Administration.

11.1.1 Configuration Management Policy

Configuration management is provided throughout facility design, construction, testing, and operation. Configuration management provides the means to establish and maintain a technical baseline for the facility based on clearly defined requirements. During design and construction, the Engineering and Contracts Manager has responsibility for configuration management through the design control process. Selected documentation, including the integrated safety analysis (ISA), is controlled under the configuration management system in accordance with procedures associated with design control, document control, and records management. Design changes undergo formal review, including interdisciplinary reviews as appropriate, in accordance with these procedures. This interdisciplinary review includes as a minimum the review for ISA impacts.

Configuration management provides the means to establish and maintain the essential features of the design basis of IROFS, including the ISA. As the project progresses from design and construction to operation, configuration management is maintained by the Technical Services organization as the overall focus of activities changes. Procedures will define the turnover process and responsibilities since construction will continue on new work modules during operations.

During the design phase of the project, configuration management is based on the design control provisions and associated procedural controls over design documents to establish and maintain the technical baseline. Design documents, including the ISA, that provide design input, design analysis, or design results specifically for IROFS are identified with the appropriate QA level. These design documents undergo interdisciplinary review during the initial issue and during each subsequent revision. During the construction phase of the project, changes to drawings and specifications issued for construction, procurement, or fabrication are systematically reviewed and verified, evaluated for impact, including impact to the ISA, and approved prior to implementation. Proper implementation is verified and reflected in the design basis documentation.

In order to provide for the continued safe and reliable operation of the facility structures, systems and components, measures are implemented to ensure that the quality of these structures, systems and components is not compromised by planned changes (modifications). After issuance of the Operating License, the Plant Manager is responsible for the design of and modifications to facility structures, systems or components. The design and implementation of modifications are performed in a manner so as to assure quality is maintained in a manner commensurate with the remainder of the system which is being modified, or as dictated by applicable regulations.

The administrative instructions for modifications during the operations phase are contained in procedures that are approved, including revisions, by the Technical Services Manager. The modification procedure contains the following items necessary to ensure quality in the modification program:

- The technical and quality requirements which shall be met to implement a modification
- The requirements for initiating, approving, monitoring, designing, verifying, and documenting modifications. The facility modification procedure shall be written to ensure that policies are formulated and maintained to satisfy the LES QA Program, as applicable.

Each change to the facility or to activities of personnel shall have an evaluation performed in accordance with the requirements of 10 CFR 70.72 (CFR, 2003e), as applicable. Each modification shall also be evaluated for any required changes or additions to the facility's procedures, personnel training, testing program, or regulatory documents.

For any change (i.e., new design or operation, or modification to the facility or to activities of personnel, e.g., site structures, systems, components, computer programs, processes, operating procedures, management measures), that involves or could affect uranium on site, a Nuclear Criticality Safety (NCS) evaluation and, if required, an NCS analysis shall be prepared and approved. Prior to implementing the change, it shall be determined that the entire process will be subcritical (with applicable margin for safety) under both normal and credible abnormal conditions.

Each modification is also evaluated and documented for radiation exposure to minimize worker exposures in keeping with the facility as low as reasonably achievable (ALARA) program, criticality and worker safety requirements and/or restrictions. Other areas of consideration in evaluating modifications may include, but are not limited to the review of:

- Modification cost
- Lessons learned from similar completed modifications
- QA requirements
- Potential operability or maintainability concerns
- Constructability concerns
- Post-modification testing requirements
- Environmental considerations
- Human factors
- Integrated safety analysis.

After completion of a modification to a structure, system, or component, the modification Project Manager, or designee, shall ensure that all applicable testing has been completed to ensure correct operation of the system(s) affected by the modification and documentation regarding the modification is complete. In order to ensure operators are able to operate a modified system safely, when a modification is complete, all documents necessary, e.g., the revised process description, checklists for operation and flowsheets are made available to operations and maintenance departments prior to the start-up of the modified system. Appropriate training on the modification is completed before a system is placed in operation. A formal notice of a modification being completed is distributed to all appropriate managers. As-built drawings incorporating the modification are completed in accordance with the design control procedures. These records shall be identifiable and shall be retained in accordance with the records management procedures.

11.1.1.1 Scope of Structures, Systems, and Components

The scope of Structures, Systems, and Components (SSC) under configuration management includes all IROFS identified by the integrated safety analysis of the design bases and any items which may affect the function of the IROFS. Design documents subject to configuration management include calculations, safety analyses, design criteria, engineering drawings, system descriptions, technical documents, and specifications that establish design requirements for IROFS. During the design phase, these design documents are maintained under configuration management when initially approved.

The scope of documents included in the configuration management program expands throughout the design process. As drawings and specification sections related to IROFS or items affecting the functions of IROFS are prepared and issued for procurement, fabrication, or construction, these documents are included in configuration management.

During construction, initial startup, and operations, the scope of documents under configuration management similarly expands to include, as appropriate: vendor data; test data; inspection data; initial startup, test, operating and administrative procedures as applicable to IROFS and nonconformance reports. These documents include documentation related to IROFS that is generated through functional interfaces with QA, maintenance, and training and qualifications of personnel. Configuration management procedures will provide for evaluation, implementation, and tracking of changes to IROFS, and processes, equipment, computer programs, and activities of personnel that impact IROFS.

11.1.1.2 Interfaces with Other Management Measures

Configuration management is implemented through or otherwise related to other management measures. Key interfaces and relationships to other management measures are described below:

- **Quality Assurance -** The QA program establishes the framework for configuration management and other management measures for IROFS and items that affect the function of the IROFS.

- **Records Management** - Records associated with IROFS and items affecting IROFS are generated and processed in accordance with the applicable requirements of the QA Program and provide evidence of the conduct of activities associated with the configuration management of those IROFS.

- **Maintenance** – Maintenance requirements are established as part of the design basis, which is controlled under configuration management. Maintenance records for IROFS and items affecting IROFS provide evidence of compliance with preventative and corrective maintenance schedules.

- **Training and Qualifications** - Training and qualification are controlled in accordance with the applicable provisions of the QA Program. Personnel qualifications and/or training to specific processes and procedures are management measures that support the safe operation, maintenance, or testing of IROFS. Also, work activities that are themselves IROFS, (i.e., administrative controls) are proceduralized, and personnel are trained and qualified to these procedures. Training and qualification requirements and documentation of training may be considered part of the design basis controlled under configuration management. Reference Sections 11.3.2, Analysis and Identification of Functional Areas Requiring Training, and 11.3.3, Position Training Requirements, for interfaces with configuration management.

- **Incident Investigation/Audits and Assessments** - Audits, assessments, and incident investigations are described in Sections 11.5, Audits and Assessments, and 11.6, Incident Investigations and Corrective Action Process. Corrective actions identified as a result of these management measures may result in changes to design features, administrative controls, or other management measures (e.g., operating procedures). The Corrective Action Program (CAP) is described in Section 11.6, "Incident Investigations and Corrective Action Process." Changes are evaluated under the provisions of configuration management through the QA Program and procedures. Periodic assessments of the configuration management program are also conducted in accordance with the audit and assessment program described in Section 11.5.

- **Procedures** - Operating, administrative, maintenance, and emergency procedures are used to conduct various operations associated with IROFS and items affecting IROFS and will be reviewed for potential impacts to the design basis. Also, work activities that are themselves IROFS, (i.e., administrative controls) are contained in procedures.

11.1.1.3 Objectives of Configuration Management

The objectives of configuration management are to ensure design and operation within the design basis of IROFS by: identifying and controlling preparation and review of documentation associated with IROFS; controlling changes to IROFS; and maintaining the physical configuration of the facility consistent with the approved design.

The Urenco technology transfer documentation provides the enrichment plant design, and identifies those safety trips and features credited in the European safety analyses. The ISA of the design bases determines the IROFS and establishes the safety function(s) associated with each IROFS. Configuration control is accomplished during design through the use of procedures for controlling design, including preparation, review (including interdisciplinary review), design verification where appropriate, approval, and release and distribution for use. Engineering documents will be assessed for QA level classification. Changes to the approved design are subject to a review to ensure consistency with the design bases of IROFS. Configuration verification is also accomplished through design verification, which ensures that design documents are consistent and that design requirements for IROFS are met. During construction and testing, this verification also extends to verification that as-built configurations are consistent with the design, and that testing that is specified to demonstrate performance of IROFS is accomplished successfully. Periodic audits and assessments of the configuration management program and of the design confirm that the system meets its goals and that the design is consistent with the design bases. The corrective action process occurs in accordance with the LES QA Program and associated procedures in the event problems are identified. Prompt corrective actions are developed as a result of incident investigations or in response to audit or assessment results.

11.1.1.4 Description of Configuration Management Activities

Configuration management includes those activities conducted under design control provisions for ensuring that design and construction documentation is prepared, reviewed, and approved in accordance with a systematic process. This process includes interdisciplinary reviews appropriate to ensure consistency between the design and the design bases of IROFS. During construction, it also includes those activities that ensure that construction is consistent with design documents. Finally, it includes activities that provide for operation of the IROFS in accordance with the limits and constraints established in the ISA, and that provide for control of changes to the facility in accordance with 10 CFR 70.72 (CFR, 2003e).

Configuration management also includes records to demonstrate that personnel conducting activities that are relied on for safety or that are associated with IROFS are appropriately qualified and trained to conduct that work.

Implementing documents are controlled within the document control system. These documents support configuration management by ensuring that only reviewed and approved procedures, specifications and drawings are used for procurement, construction, installation, testing, operation, and maintenance of IROFS, as appropriate.

11.1.1.5 Organizational Structure and Staffing Interfaces

The configuration management program is administered by the Engineering and Contracts organization during design and construction. Engineering includes engineering disciplines with responsible lead engineers in charge of each discipline, under the direction of design managers or project managers who report to the Engineering and Contracts Manager. The lead discipline engineers have primary technical responsibility for the work performed by their disciplines, and are responsible for the conduct of interdisciplinary reviews as discussed previously in this section. Reviews are also conducted, as appropriate, by construction management, operations, QA, and procurement personnel. The design control process also interfaces with the document control and records management process via procedures.

The various LES departments and contractors of LES perform quality-related activities. The primary LES contractors are responsible for development of their respective QA Programs, which shall be consistent with the requirements of the LES QA Program for those activities determined to be within the scope of the LES QA Program. The interfaces between contractors and LES or among contractors shall be documented. LES and contracted personnel have the responsibility to identify quality problems. If a member of another area disagrees, that individual is instructed to take the matter to appropriate management. The disagreement may either be resolved at this level or at any level up to and including the LES President.

11.1.2 Design Requirements

Design requirements and associated design bases are established and maintained by the Engineering and Contracts organization during design and construction and by the Technical Services organization during operations. The configuration management controls on design requirements and the integrated safety analysis of the design bases are described previously in this section. Design requirements are documented in a design requirements document that provides for a hierarchical distribution of these requirements through basis of design documents. The design requirements document and basis of design documents are controlled under the design control provisions of the configuration management program as described above, and are subject to the same change control as analyses, specifications, and drawings. Computer codes used in the design of IROFS are also subject to these design control measures, with additional requirements as appropriate for software control, verification, and validation.

IROFS, any items that affect the function of the IROFS, and, in general, items required to satisfy regulatory requirements are designated as QA Level 1. The associated design documents are subject to interdisciplinary reviews and design verification. Analyses constituting the integrated safety analysis of the design bases are subject to the same requirements. Changes to the design are evaluated to ensure consistency with the design bases.

IROFS are listed in the design requirements document. This list will be augmented and maintained current as appropriate as IROFS are identified in more detail during detailed design.

A qualified individual who specifies and includes the appropriate codes, standards, and licensing commitments within the design documents prepares each design document, such as a calculation, specification, procedure, or drawing. This individual also notes any deviations or changes from such standards within the design documentation package. Each design document is then checked by another individual qualified in the same discipline and is reviewed for concept and conformity with the design inputs. These design inputs are in sufficient detail to permit verification of the document. The manager having overall responsibility for the design function approves the document. The Engineering Manager documents the entire review process in accordance with approved procedures. These procedures include provisions to assure that appropriate quality standards are specified in design documents, including quantitative or qualitative acceptance criteria. The QA Director conducts audits on the design control process using independent technically qualified individuals to augment the QA audit team.

During the check and review, emphasis is placed on assuring conformance with applicable codes, standards and license application design commitments. The individuals in engineering assigned to perform the check and review of a document have full and independent authority to withhold approval until questions concerning the work have been resolved. Design reviews, alternative calculations, or qualification testing accomplishes verification of design. The bases for a design, such as analytical models, theories, examples, tables, codes and computer programs must be referenced in the design document and their application verified during check and review. Model tests, when required to prove the adequacy of a concept or a design, are reviewed and approved by the responsible qualified individual. Testing used for design verification shall demonstrate adequacy of performance under conditions that simulate the most adverse design conditions. The tests used for design verification must meet all the design requirements.

Qualified individuals other than those who performed the design but may be from the same organization perform design verification. Verification may be performed by the supervisor of the individual performing the design, provided this need is documented, approved in advance by the supervisor's management, and the supervisor did not specify a singular design approach or rule out certain design considerations, and did not establish the design inputs used in the design or, provided the supervisor is the only individual in the organization competent to perform the verification. The verification by a supervisor of their own design constraints, design input, or design work would only occur in rare instances. This would occur only when the supervisor is the only individual in the organization competent to perform the verification. These instances are authorized and documented in writing on a case-by-case basis.

Independent design verification shall be accomplished before the design document (or information contained therein) is used by other organizations for design work or to support other activities such as procurement, construction, or installation. When this is not practical due to time constraints, the unverified portion of the document is identified and controlled. In all cases, the design verification shall be completed before relying on the item to perform its function or installation becomes irreversible. Any changes to the design and procurement documents, including field changes, must be reviewed, checked and approved commensurate with the original approval requirements.

After design documents have been properly prepared, checked, reviewed, and approved by the appropriate parties, the responsible engineer sends the document to document control for distribution. When required, each recipient of a design document verifies receipt of such document to the document control center.

The document control center, after verification of distribution to a recipient, maintains the required documentation in its files.

When deficiencies are identified which affect the design of IROFS, such deficiencies are documented and resolved in accordance with approved CAP procedures. In accordance with the CAP the report is forwarded for appropriate review to the responsible manager, who coordinates further review of the problem and revises all design documents affected by the deficiency as necessary. Where required, the responsible manager forwards the report to the engineers in other areas, who coordinate necessary revisions to their affected documents

Design interfaces are maintained by communication among the principals. Methods by which this is accomplished include the following:

A. Design documents are reviewed by the responsible engineer or authorized representative. As appropriate, subsequent review or waiver of review by the other area engineers is documented.

B. Project review meetings are scheduled and held to coordinate design, procurement, construction and pre-operational testing of the facility. These meetings provide a primary working interface among the principal organizations.

C. Reports of nonconformances are transmitted and controlled by procedures. As required by the nonconformance procedure, the QA Director/Manager or designee approves resolution of nonconformances.

During the operational phase, measures are provided to ensure responsible facility personnel are made aware of design changes and modifications that may affect the performance of their duties.

11.1.2.1 Configuration Management Controls on the Design Requirements

Configuration control is accomplished during design through the use of procedures for controlling design, including preparation, review (including interdisciplinary review and preparation of NCS analyses and NCS evaluations as applicable), and design verification where appropriate, approval, and release and distribution for use. Engineering documents are assessed for QA level classification. Changes to the approved design also are subject to a review to ensure consistency with the design bases of IROFS.

Configuration verification is also accomplished through design verification, which ensures that design documents are consistent and that design requirements for IROFS are met. During construction and testing, this verification also extends to verification that as-built configurations are consistent with the design, and that testing that is specified to demonstrate performance of IROFS is accomplished successfully.

The QA Program requires procedures that specify that work performed shall be accomplished in accordance with the requirements and guidelines imposed by applicable specifications, drawings, codes, standards, regulations, quality assurance criteria and site characteristics.

Acceptance criteria established by the designer are incorporated in the instructions, procedures and drawings used to perform the work. Documentation is maintained, including test results, and inspection records, demonstrating that the work has been properly performed. Procedures also provide for review, audit, approval and documentation of activities affecting the quality of items to ensure that applicable criteria have been met.

Maintenance, modification, and inspection procedures are reviewed by qualified personnel knowledgeable in the quality assurance disciplines to determine:

A. The need for inspection, identification of inspection personnel, and documentation of inspection result

B. That the necessary inspection requirements, methods, and acceptance criteria have been identified.

Facility procedures shall be reviewed by an individual knowledgeable in the area affected by the procedure on a frequency determined by the age and use of the procedure to determine if changes are necessary or desirable. Procedures are also reviewed to ensure procedures are maintained up-to-date with facility configuration. These reviews are intended to ensure that any modifications to facility systems, structures or components are reflected in current maintenance, operations and other facility procedures.

11.1.3 Document Control

Procedures are established which control the preparation and issuance of documents such as manuals, instructions, drawings, procedures, specifications, procurement documents and supplier-supplied documents, including any changes thereto. Measures are established to ensure documents, including revisions, are adequately reviewed, approved, and released for use by authorized personnel.

Document control procedures require documents to be transmitted and received in a timely manner at appropriate locations including the location where the prescribed activity is to be performed. Controlled copies of these documents and their revisions are distributed to and used by the persons performing the activity.

Superseded documents are destroyed or are retained only when they have been properly labeled. Indexes of current documents are maintained and controlled.

Document control is implemented in accordance with procedures. An electronic document management system is used both to file project records and to make available the latest revision (i.e., the controlled copy) of design documents. The system provides an "official" copy of the current document, and personnel are trained to use this system to retrieve controlled documents. The system is capable of generating indices of controlled documents, which are uniquely numbered (including revision number). Controlled documents are maintained until cancelled or superseded, and cancelled or superseded documents are maintained as a record, currently for the life of the project or termination of the license, whichever occurs later. Hard-copy distribution of controlled documents is provided when needed in accordance with applicable procedures (e.g., when the electronic document management system is not available).

A part of the configuration management program, the document control and records management procedures, as appropriate, capture the following documents:

- Design requirements, through the controlled copy of the design requirements document
- The design bases, through the controlled copy of the basis of design documents
- The integrated safety analysis of the design bases of IROFS, through the controlled copies of supporting analyses
- Nuclear Criticality Safety Analyses
- Nuclear Criticality Safety Evaluations
- As-built drawings
- Specifications
- All procedures that are IROFS
- Procedures involving training

- QA
- Maintenance
- Audit and assessment reports
- Emergency operating procedures
- Emergency response plans
- System modification documents
- Assessment reports
- Engineering documents including analyses, specifications, technical reports, and drawings.

These items are documented in approved procedures.

11.1.4 Change Control

Procedures control changes to the technical baseline. The process includes an appropriate level of technical, management, and safety review and approval prior to implementation. During the design phase of the project, the method of controlling changes is the design control process described in the QA Program. This process includes the conduct of interdisciplinary reviews that constitute a primary mechanism for ensuring consistency of the design with the design bases. During both construction and operation, appropriate reviews to ensure consistency with the design bases of IROFS and the ISA, respectively, will similarly ensure that the design is constructed and operated/modified within the limits of the design basis. Additional details are provided below.

11.1.4.1 Design Phase

Changes to the design include a systematic review of the design bases for consistency. In the event of changes to reflect design or operational changes from the established design bases, both the integrated safety analysis and other documents affected by design bases of IROFS including the design requirements document and basis of design documents, as applicable are properly modified, reviewed, and approved prior to implementation. Approved changes are made available to personnel through the document control function discussed previously in this section.

During design (i.e., prior to issuance of the NEF Materials License), the method of ensuring consistency between documents, including consistency between design changes and the safety assessment, is the interdisciplinary review process. The interdisciplinary reviews ensure design changes either (1) do not impact the ISA, (2) are accounted for in subsequent changes to the ISA, or (3) are not approved or implemented. Prior to issuance of the License, LES will notify the NRC of potential changes that reduce the level of commitments or margin of safety in the design bases of IROFS.

11.1.4.2 Construction Phase

When the project enters the construction phase, changes to documents issued for construction, fabrication, and procurement will be documented, reviewed, approved, and posted against each affected design document. Vendor drawings and data also undergo an interdisciplinary review to ensure compliance with procurement specifications and drawings, and to incorporate interface requirements into facility documents.

During construction, design changes will continue to be evaluated against the approved design bases. Changes are expected to the design as detailed design progresses and construction begins. A systematic process consistent with the process described above will be used to evaluate changes in the design against the design bases of IROFS and the ISA. Upon issuance of the NEF Materials License, the configuration change process will fully implement the provisions of 10 CFR 70.72 (CFR, 2003e), including reporting of changes made without prior NRC approval as required by 10 CFR 70.72(d)(2) and (3). Any change that requires Commission approval, will be submitted as a license amendment request as required by 10 CFR 70.72(d)(1) and the change will not be implemented without prior NRC approval.

11.1.4.3 Operations Phase

During the operations phase, changes to design will also be documented, reviewed, and approved prior to implementation. LES will implement a change process that fully implements the provisions of 10 CFR 70.72 (CFR, 2003e). Measures are provided to ensure responsible facility personnel are made aware of design changes and modifications that may affect the performance of their duties.

In order to provide for the continued safe and reliable operation of the facility structures, systems and components, measures are implemented to ensure that the quality of these structures, systems and components is not compromised by planned changes (modifications). After issuance of the Operating License, the Plant Manager is responsible for the design of and modifications to facility structures, systems or components. The design and implementation of modifications are performed in a manner so as to assure quality is maintained in the remainder of the system that is being modified, or as dictated by applicable regulations.

The administrative instructions for modifications are contained in a facility administrative procedure that is approved, including revisions, by the Technical Services Manager with concurrence of the Quality Assurance Manager. The modification procedure contains the following items necessary to ensure quality in the modification program:

- The requirements that shall be met to implement a modification
- The requirements for initiating, approving, monitoring, designing, verifying, and documenting modifications. The facility modification procedure shall be written to ensure that policies are formulated and maintained to satisfy the quality assurance requirements specified in the LES QA Program, as applicable.

Each change to the facility or to activities of personnel shall have an evaluation performed in accordance with the requirements of 10 CFR 70.72 (CFR, 2003e), as applicable. Each modification shall also be evaluated for any required changes or additions to the facility's procedures, personnel training, testing program, or regulatory documents.

For any change (i.e., new design or operation, or modification to the facility or to activities of personnel, e.g., site structures, systems, components, computer programs, processes, operating procedures, management measures) that involves or could affect uranium on site, an NCS evaluation and, if required, an NCS analysis shall be prepared and approved. Prior to implementing the change, it shall be determined that the entire process will be subcritical (with applicable margin for safety) under both normal and credible abnormal conditions.

Each modification is also evaluated and documented for radiation exposure to minimize worker exposures in keeping with the facility ALARA program, criticality and worker safety requirements and/or restrictions. Other areas of consideration in evaluating modifications may include, but are not limited to the review of:

- Modification cost
- Lessons learned from similar completed modifications
- QA aspects
- Potential operability or maintainability concerns
- Constructability concerns
- Post-modification testing requirements
- Environmental considerations
- Human factors.

After completion of a modification to a structure, system, or component, the modification Project Manager, or designee, shall ensure that all applicable testing has been completed to ensure correct operation of the system(s) affected by the modification and documentation regarding the modification is complete. In order to ensure operators are able to operate a modified system safely, when a modification is complete, all documents necessary, e.g., the revised process description, checklists for operation and flowsheets are made available to operations and maintenance departments once the modified system becomes "operational." Appropriate training on the modification is completed before a system is placed in operation. A formal notice of a modification being completed is distributed to all appropriate managers. As-built drawings incorporating the modification are completed promptly. These records shall be identifiable and shall be retained for the duration of the facility license.

11.1.5 Assessments

Periodic assessments of the configuration management program are conducted to determine the system's effectiveness and to correct deficiencies. These assessments include review of the adequacy of documentation and system walk downs of the as-built facility. Such audits and assessments are conducted and documented in accordance with procedures and scheduled as discussed in Appendix A, Section 18, "Audit Schedules."

Periodic audits and assessments of the configuration management program and of the design confirm that the system meets its goals and that the design is consistent with the design bases. Incident investigations occur in accordance with the QA Program and associated CAP procedures in the event problems are encountered. Prompt corrective actions are developed as a result of incident investigations or in response to adverse audit/assessment results, in accordance with CAP procedures.

11.2 MAINTENANCE

This section outlines the maintenance and functional testing programs to be implemented for the operations phase of the facility. Preventive maintenance activities, surveillance, and performance trending provide reasonable and continuing assurance that IROFS will be available and reliable to perform their safety functions.

The purpose of planned and scheduled maintenance for IROFS is to ensure that the equipment and controls are kept in a condition of readiness to perform the planned and designed functions when required. Appropriate plant management is responsible for ensuring the operational readiness of IROFS under this control. For this reason, the maintenance function is administratively closely coupled to operations. The Maintenance organization plans, schedules, tracks, and maintains records for maintenance activities.

In order to provide for the continued safe and reliable operation of the facility structures, systems and components, measures are implemented to ensure that the quality of these structures, systems and components is not compromised by planned changes (modifications) or maintenance activities. After issuance of the Operating License, the Plant Manager is responsible for the design of and modifications to facility structures, systems or components and all maintenance activities. The design and implementation of modifications are performed in a manner so as to assure quality is maintained in a manner commensurate with the remainder of the system which is being modified, or as dictated by applicable regulations.

The administrative instructions for modifications are contained in a facility administrative procedure that is approved, including revisions, by the Technical Services Manager with concurrence of the Quality Assurance Manager. The modification procedure contains the following items necessary to ensure quality in the modification program:

- The requirements which shall be met to implement a modification
- The requirements for initiating, approving, monitoring, designing, verifying, and documenting modifications. The facility modification procedure shall be written to ensure that policies are formulated and maintained to satisfy the quality assurance standards specified in the LES QA Program, as applicable.

Listed below are methods or practices that will be applied to the corrective, preventive, and functional-test maintenance elements. LES will prepare written procedures for performance of these methods and practices. These methods and practices include, as applicable:

Authorized work instructions with detailed steps and a reminder of the importance of the IROFS identified in the ISA Summary:

- Parts lists
- As-built or redlined drawings
- A notification step to the Operations function before conducting repairs and removing an IROFS from service

- Radiation Work Permits
- Replacement with like-kind parts and the control of new or replacement parts to ensure compliance with 10 CFR 21 (CFR, 2003a)
- Compensatory measures while performing work on IROFS
- Procedural control of removal of components from service for maintenance and for return to service
- Ensuring safe operations during the removal of IROFS from service
- Notification to Operations personnel that repairs have been completed.

Written procedures for the performance of maintenance activities include the steps listed above. The details of maintenance procedure acceptance criteria, reviews, and approval are provided in Section 11.4, Procedures Development and Implementation.

As applicable, contractors that work on or near IROFS identified in the ISA Summary will be required by LES to follow the same maintenance procedures described for the corrective, preventive, functional testing, or surveillance/monitoring activities listed above for the maintenance function.

Maintenance procedures involving IROFS commit to the topics listed below for corrective and preventive maintenance, functional testing after maintenance, and surveillance/monitoring maintenance activities:

- Pre-maintenance activities require reviews of the work to be performed, including procedure reviews for accuracy and completeness.
- New procedures or work activities that involve or could affect uranium on site require preparation and approval of an NCS evaluation and, if required, an NCS analysis.
- Steps that require notification of all affected parties (operators and appropriate managers) before performing work and on completion of maintenance work. The discussion includes potential degradation of IROFS during the planned maintenance.
- Control of work by comprehensive procedures to be followed by maintenance technicians. Maintenance procedures are reviewed by the various safety disciplines, including criticality, fire, radiation, industrial, and chemical process safety. The procedures describe, as a minimum, the following:
    - Qualifications of personnel authorized to perform the maintenance, functional testing or surveillance/monitoring
    - Controls on and specification of any replacement components or materials to be used (this will be controlled by Configuration Management, to ensure like-kind replacement and adherence to 10 CFR 21 (CFR, 2003a))
    - Post-maintenance testing to verify operability of the equipment
    - Tracking and records management of maintenance activities

The facility's maintenance department under the Maintenance Manager has responsibility for preparation and implementation of maintenance procedures. The maintenance, testing and calibration of facility IROFS is performed in accordance with approved written procedures.

Testing conducted on a periodic basis to determine various facility parameters and to verify the continuing capability of IROFS to meet performance requirements is conducted in accordance with approved, written procedures. Periodic test procedures are utilized to perform such testing and are sufficiently detailed that qualified personnel can perform the required functions without direct supervision. Testing performed on IROFS that are not redundant will provide for compensatory measures to be put into place to ensure that the IROFS performs until it is put back into service.

Periodic test procedures are performed by the facility's Technical Services, Operations and Maintenance departments. The Maintenance Manager has overall responsibility for assuring that the periodic testing is in compliance with the requirements.

Chemical and radiochemical activities associated with facility IROFS are performed in accordance with approved, written procedures. The facility's chemistry department has responsibility for preparation and implementation of chemistry procedures.

Radioactive waste management activities associated with the facility's liquid, gaseous, and solid waste systems are performed in accordance with approved written procedures. The facility's operations, chemistry and radiation protection departments have responsibility for preparation and implementation of the radioactive waste management procedures.

Likewise, other departments at the facility develop and implement activities at the facility through the use of procedures.

Procedures will include provisions for operations to stop and place the process in a safe condition if a step of a procedure cannot be performed as written.

11.4.4 Changes to Procedures

Changes to procedures shall be processed as described below.

A. The preparer documents the change as well as the reason for the change.

B. An evaluation shall be performed in accordance with 10 CFR 70.72 (CFR, 2003e) as appropriate. If the evaluation reveals that a change to the license is needed to implement the proposed changes, the change is not implemented until prior approval is received from the NRC.

C. The procedure with proposed changes shall be reviewed by a qualified reviewer.

D. The Plant Manager, a Department Manager, or a designee approved by the Plant Manager shall be responsible for approving procedure changes, and for determining whether a cross-disciplinary review is necessary, and by which department(s). The need for the following cross-disciplinary reviews shall be considered, as a minimum:

   1. For proposed changes having a potential impact on chemical or radiation safety, a review shall be performed for chemical and radiation hazards. Changes shall be approved by the HS&E Manager or designee.

2. For proposed changes having a potential impact on criticality safety, an NCS evaluation and, if required, an NCS analysis shall be performed. Any necessary controlled parameters, limits, IROFS, management measures, or NCS analyses that must be imposed or revised are adequately reflected in appropriate procedures and/or design basis documents. Changes shall be independently reviewed by a criticality safety engineer, and approved by the HS&E Manager or designee.

3. For proposed changes potentially affecting Material Control and Accounting, a material control review shall be performed. Changes shall be approved by the HS&E Manager or designee.

Records of completed cross-functional reviews shall be maintained in accordance with Section 11.7, Records Management, for all changes to procedures involving licensed materials or IROFS.

11.4.5 Distribution of Procedures

Originally issued approved procedures and approved procedure revisions are distributed in a controlled manner by document control.

Document Control shall establish and maintain an index of the distribution of copies of all facility procedures. Revisions are controlled and distributed in accordance with this index. Indexes are reviewed and updated on a periodic basis or as required.

Department Managers or their designees shall be responsible for ensuring all personnel doing work which require the use of the procedures have ready access to controlled copies of the procedures.

11.5 AUDITS AND ASSESSMENTS

LES will have a tiered approach to verifying compliance to procedures and performance to regulatory requirements. Audits are focused on verifying compliance with regulatory and procedural requirements and licensing commitments. Assessments are focused on effectiveness of activities and ensuring that IROFS, and any items that affect the function of IROFS, are reliable and are available to perform their intended safety functions. This approach includes performing Assessments and Audits on critical work activities associated with facility safety, environmental protection and other areas as identified via trends.

Assessments are divided into two categories that will be owned and managed by the line organizations as follows:

- Management Assessments conducted by the line organizations responsible for the work activity
- Independent Assessments conducted by individuals not involved in the area being assessed.

Audits of the QA Level 1 work activities associated with IROFS and any items that affect the function of the IROFS and items required to satisfy regulatory requirements for which QA Level 1 requirements are applied will be the responsibility of the QA Department.

Audits and assessments are performed to assure that facility activities are conducted in accordance with the written procedures and that the processes reviewed are effective. As a minimum, they shall assess activities related to radiation protection, criticality safety control, hazardous chemical safety, industrial safety including fire protection, and environmental protection.

Audits and assessments shall be performed routinely by qualified staff personnel that are not directly responsible for production activities. Deficiencies identified during the audit or assessment requiring corrective action shall be forwarded to the responsible manager of the applicable area or function for action in accordance with the CAP procedure. Future audits and assessments shall include a review to evaluate if corrective actions have been effective.

The Quality Assurance Department shall be responsible for audits. Audits shall be performed in accordance with a written plan that identifies and schedules audits to be performed. Audit team members shall not have direct responsibility for the function and area being audited. Team members shall have technical expertise or experience in the area being audited and shall be indoctrinated in audit techniques. Audits shall be conducted on an annual basis.

The results of the audits shall be provided in a written report in a timely manner to the Plant Manager, the Safety Review Committee (SRC), and the Managers responsible for the activities audited. Any deficiencies noted in the audits shall be responded to promptly by the responsible Managers or designees, entered into the CAP and tracked to completion and re-examined during future audits to ensure corrective action has been completed.

Records of the instructions and procedures, persons conducting the audits or assessments, and identified violations of license conditions and corrective actions taken shall be maintained.

The management measure described in this section and Chapter 2, Organization and Administration, is consistent with that previously submitted for NRC review in the Claiborne

Enrichment Center Safety Analysis Report (LES, 1993). The NRC Staff reviewed the previous submittal and found it to be acceptable. The NRC Staff's review and conclusions associated with audits and assessments are documented in Section 10.7 of NUREG-1491 (NRC, 1994).

11.5.1 Activities to be Audited or Assessed

Audits and assessments are conducted for the areas of:

- Radiation safety
- Nuclear criticality safety
- Chemical safety
- Industrial safety including fire protection
- Environmental protection
- Emergency management
- QA
- Configuration management
- Maintenance
- Training and qualification
- Procedures
- CAP/Incident investigation
- Records management.

Assessments of nuclear criticality safety, performed in accordance with ANSI/ANS-8.19-1996 (ANSI, 1996), will ensure that operations conform to criticality requirements.

11.5.2 Scheduling of Audits and Assessments

A schedule is established that identifies audits and assessments to be performed and the responsible organization assigned to conduct the activity. The frequency of audits and assessments is based upon the status and safety importance of the activities being performed and upon work history. All major activities will be audited or assessed on an annual basis. The audit and assessment schedule is reviewed periodically and revised as necessary to ensure coverage commensurate with current and planned activities.

Nuclear Criticality safety audits are conducted and documented quarterly such that all aspects of the Nuclear Criticality Safety Program will be audited at least every two years. The Operations Group is assessed periodically to ensure that nuclear critical safety procedures are being followed and the process conditions have not been altered to adversely affect nuclear criticality safety. The frequency of these assessments is based on the controls identified in the NCS analyses and NCS evaluations. Assessments are conducted at least semi-annually. In addition, weekly nuclear criticality safety walkthroughs of UF_6 process areas are conducted and documented.

11.5.3 Procedures for Audits and Assessments

Internal and external audits and assessments are conducted using approved procedures that meet the QA Program requirements. These procedures provide requirements for the following audit and assessment activities:

- Scheduling and planning of the audit and assessment
- Certification requirements of audit personnel
- Development of audit plans and audit and assessment checklists as applicable
- Performance of the audit and assessment
- Reporting and tracking of findings to closure
- Closure of the audit and assessment.

The applicable procedures emphasize reporting and correction of findings to prevent recurrence.

Audits and assessments are conducted by:

- Using the approved audit and assessment checklists as applicable
- Interviewing responsible personnel
- Performing plant area walkdowns
- Reviewing controlling plans and procedures
- Observing work in progress
- Reviewing completed QA documentation.

Audit and assessment results are tracked in the Corrective Action Program. The data is periodically analyzed for potential trends and needed program improvements to prevent recurrence and/or for continuous program improvements. The resulting trend is evaluated and reported to applicable management. This report documents the effectiveness of management measures in controlling activities, as well as deficiencies. Deficiencies identified in the trend report require corrective action in accordance with the applicable CAP procedure. The QA organization also performs follow up reviews on identified deficiencies and verifies completion of corrective actions reported as a result of the trend analysis.

The audit and /or assessment team leader is required to develop the audit and /or assessment report documenting the findings, observations, and recommendations for program improvement. These reports provide management with documented verification of performance against established performance criteria for IROFS. These reports are developed, reviewed, approved, and issued following established formats and protocols detailed in the applicable procedures. Responsible managers are required to review the reports and provide any required responses due to reported findings.

Corrective actions following issuance of the audit and/or assessment report require compliance with the CAP procedure. Audit reports are required to contain an effectiveness evaluation and statement for each of the applicable QA program elements reviewed during the audit. The audit/assessment is closed with the proper documentation as required by the applicable audit and assessment procedure. The QA organization will conduct follow-up audits or assessments to verify that corrective actions were taken in a timely manner. In addition, future assessments will include a review to evaluate if corrective actions have been effective.

11.5.4 Qualifications and Responsibilities for Audits and Assessments

The QA Director or QA Manager initiates audits. The responsible Lead Auditor and QA Director or Manager determines the scope of each audit. The QA Director or QA Manager may initiate special audits or expand the scope of audits. The Lead Auditor directs the audit team in developing checklists, instructions, or plans and performing the audit. The audit shall be conducted in accordance with the checklists, but the scope may be expanded by the audit team during the audit. The audit team consists of one or more auditors.

Auditors and lead auditors are responsible for performing audits in accordance with the applicable QA procedures. Auditors and lead auditors hold certifications as required by the QA Program. Additional details can be found in Appendix A of this chapter. Before being certified under the LES QA Program, auditors must complete training on the following topics:

- LES QA Program
- Audit fundamentals, including audit scheduling, planning, performance, reporting, and follow-up action involved in conducting audits
- Objectives and techniques of performing audits
- On-the-job training.

Certification of auditors and lead auditors is based on the QA Director's or Manager's evaluation of education, experience, professional qualifications, leadership, sound judgment, maturity, analytical ability, tenacity, and past performance and completion of QA training courses. A lead auditor must also have participated in a minimum of five QA audits or audit equivalent within a period of time not to exceed three years prior to the date of certification. Audit equivalents include assessments, pre-award evaluations or comprehensive surveillances (provided the

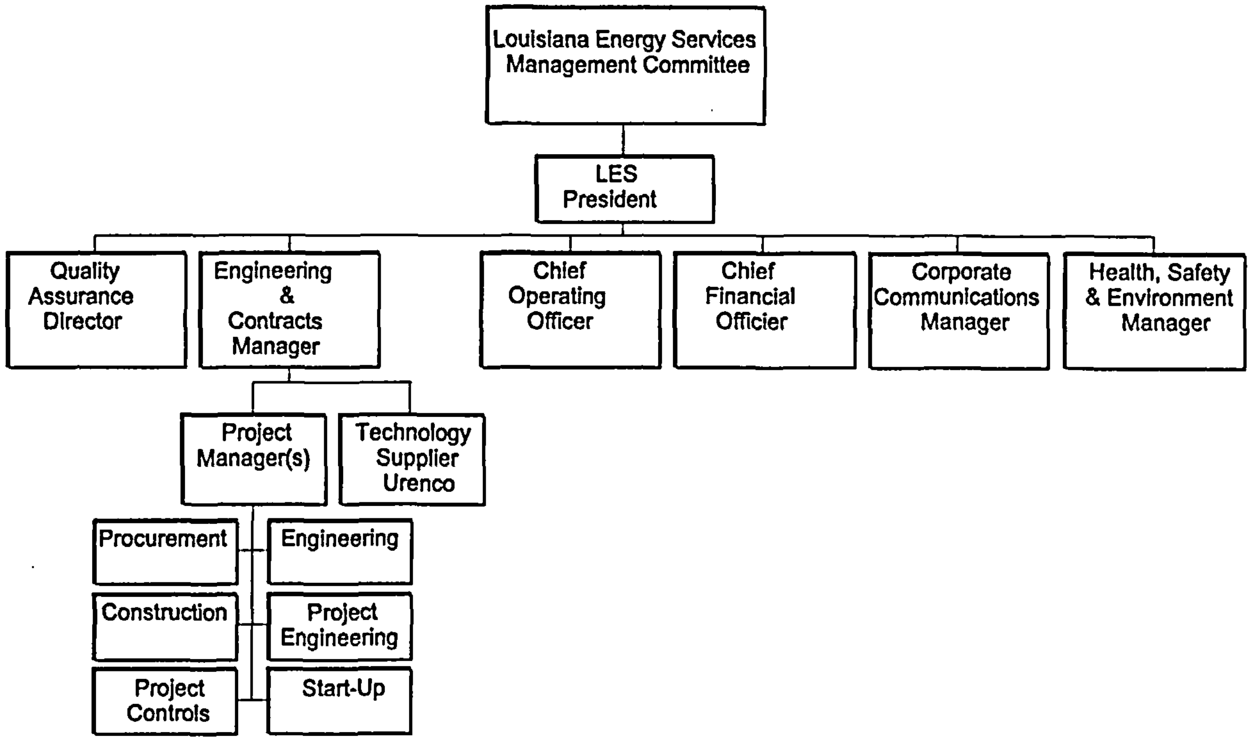

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FIGURE A1

LES CORPORATE, DESIGN AND CONSTRUCTION ORGANIZATION

REVISION 4 APRIL 2005

REFERENCE NUMBER
Figure A1.dwg

Integrated Safety Analysis Summary

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3.1 GENERAL INTEGRATED SAFETY ANALYSIS (ISA) INFORMATION

3.1.1 ISA Methods

This section outlines the approach utilized for performing the integrated safety analysis (ISA) of the process accident sequences. The approach used for performing the ISA is consistent with Example Procedure for Accident Sequence Evaluation, Appendix A to Chapter 3 of NUREG-1520 (NRC, 2002). This approach employs a semi-quantitative risk index method for categorizing accident sequences in terms of their likelihood of occurrence and their consequences of concern. The risk index method framework identifies which accident sequences have consequences that could exceed the performance requirements of 10 CFR 70.61 (CFR, 2003c) and, therefore, require designation of items relied on for safety (IROFS) and supporting management measures. Descriptions of these general types of higher consequence accident sequences are reported in the ISA Summary.

The ISA is a systematic analysis to identify plant and external hazards and the potential for initiating accident sequences, the potential accident sequences, the likelihood and consequences, and the IROFS.

The ISA uses a hazard analysis method to identify the hazards which are relevant for each system or facility. The ISA Team reviewed the hazard identified for the "credible worst-case" consequences. All credible high or intermediate severity consequence accident scenarios were assigned accident sequence identifiers, accident sequence descriptions, and a risk index determination was made.

The risk index method is regarded as a screening method, not as a definitive method of proving the adequacy or inadequacy of the IROFS for any particular accident.

The tabular accident summary resulting from the ISA identifies, for each sequence, which engineered or administrative IROFS must fail to allow the occurrence of consequences that exceed the levels identified in 10 CFR 70.61 (CFR, 2003c).

For this license application, two ISA Teams were formed. This was necessary because the sensitive nature of some of the facility design information related to the enrichment process required the use of personnel with the appropriate national security clearances. This team performed the ISA on the Cascade System, Contingency Dump System, Centrifuge Test System and the Centrifuge Post Mortem System. This ISA Team is referred to as the Classified ISA Team. The Non-Classified Team, referred to in the remainder of this text as the ISA Team, performed the ISA on the remainder of the facility systems and structures. In addition, the (non-classified) ISA Team performed the External Events and Fire Hazard Assessment for the entire facility.

In preparing for the ISA, the Accident Analysis in the Safety Analysis Report (LES, 1993) for the Claiborne Enrichment Center was reviewed. In addition, experienced personnel with familiarity with the gas centrifuge enrichment technology safety analysis where used on the ISA Team. This provides a good peer check of the final ISA results.

A procedure was developed to guide the conduct of the ISA. This procedure was used by both teams. In addition, there were common participants on both teams to further integrate the approaches employed by both teams. These steps were taken to ensure the consistency of the results of the two teams. A non-classified summary of the results of the Classified ISA has been prepared and incorporated into the ISA Summary.

3.1.1.1 Hazard Identification

The hazard and operability (HAZOP) analysis method was used for identifying the hazards for the Uranium Hexafluoride (UF_6) process systems and Technical Services Building systems. This method is consistent with the guidance provided in NUREG-1513 (NRC, 2001) and NUREG-1520 (NRC, 2002). The hazards identification process results in identification of physical, radiological or chemical characteristics that have the potential for causing harm to site workers, the public, or to the environment. Hazards are identified through a systematic review process that entails the use of system descriptions, piping and instrumentation diagrams, process flow diagrams, plot plans, topographic maps, utility system drawings, and specifications of major process equipment. In addition, criticality hazards identification were performed for the areas of the facility where fissile material is expected to be present. The criticality safety analyses contain information about the location and geometry of the fissile material and other materials in the process, for both normal and credible abnormal conditions. The ISA input information is included in the ISA documentation and is available to be verified as part of an on-site review.

The hazard identification process documents materials that are:

- Radioactive
- Fissile
- Flammable
- Explosive
- Toxic
- Reactive.

The hazard identification also identifies potentially hazardous process conditions. Most hazards were assessed individually for the potential impact on the discrete components of the process systems. However, for hazards from fires (external to the process system) and external events (seismic, severe weather, etc.), the hazards were assessed on a facility wide basis.

For the purpose of evaluating the impacts of fire hazards, the ISA team considered the following:

- Postulated the development of a fire occurring in in-situ combustibles from an unidentified ignition source (e.g., electrical shorting, or other source)
- Postulated the development of a fire occurring in transient combustibles from an unidentified ignition source (e.g., electrical shorting, or other source)
- Evaluated the uranic content in the space and its configuration (e.g., UF_6 solid/gas in cylinders, UF_6 gas in piping, UF_6 and/or byproducts bound on chemical traps, Uranyl Fluoride (UO_2F_2) particulate on solid waste or in solution). The appropriate configuration

was considered relative to the likelihood of the target releasing its uranic content as a result of a fire in the area.

In order to assess the potential severity of a given fire and the resulting failures to critical systems, the facility Fire Hazard Analysis was consulted. However, since the design supporting the license submittal for this facility is not yet at the detailed design stage, detailed in-situ combustible loading and in-situ combustible configuration information is not yet available. Therefore, in order to place reasonable and conservative bounds on the fire scenarios analyzed, the ISA Team estimated in-situ combustible loadings based on information of the in-situ combustible loading from Urenco's Almelo SP-5 plant (on which the National Enrichment Facility (NEF) design is based). This information from SP-5 indicates that in-situ combustible loads are expected to be very low.

The Fire Safety Management Program will limit the allowable quantity of transient combustibles in critical plant areas (i.e., uranium areas). Nevertheless, the ISA Team still assumed the presence of moderate quantities of ordinary (Class A) combustibles (e.g., trash, packing materials, maintenance items or packaging, etc.) in excess of anticipated procedural limits. This was not considered a failure of the associated administrative IROFS feature for controlling/ minimizing transient combustible loading in all radiation/uranium areas. Failure of the IROFS is connoted as the presence of extreme or severe quantities of transients (e.g., large piles of combustible solids, bulk quantities of flammable/combustible liquids or gases, etc.). The Urenco ISA Team representatives all indicated that these types of transient combustible conditions do not occur in the European plants. Accordingly, and given the orientation and training that facility employees will receive indicating that these types of fire hazards are unacceptable, the administrative IROFS preventing severe accumulations has been assigned a high degree of reliability. Refer to Section 3.8.3 for additional discussion.

Fires that involve additional in-situ or transient combustibles from outside each respective fire area could result in exposure of additional uranic content being released in a fire beyond the quantities assumed above. For this reason, fire barriers are needed to ensure that fires cannot propagate from non-uranium containing areas into uranium (U) areas or from one U area to another U area (unless the uranium content in the space is insignificant, i.e., would be a low consequence event). Fire barriers shall be designed with adequate safety margin such that the total combustible loading (in-situ and transient) allowed to expose the barrier will not exceed 80% of the hourly fire resistance rating of the barrier.

For external events, the impacts were evaluated for the following hazards:

External events were considered at the site and facility level versus at individual system nodes. Specific external event HAZOP guidewords were developed for use during the external event portion of the ISA. The external event ISA considered both natural phenomena and man-made hazards. During the external event ISA team meeting, each area of the plant was discussed as to whether or not it could be adversely affected by the specific external event under consideration. If so, specific consequences were then discussed. If the consequences were known or assumed to be high, then a specific design basis with a likelihood of highly unlikely would be selected.

Given that external events were considered at the facility level, the ISA for external events was performed after the ISA team meetings for all plant systems were completed. This provided the best opportunity to perform the ISA at the site or facility level. Each external event was assessed for both the uncontrolled case and then for the controlled case. The controlled cases could be a specific design basis for that external event, IROFS or a combination of both. An Accident Sequence and Risk matrix was prepared for each external event.

External events evaluated included:

- Seismic
- Tornado, Tornado Missile and High Wind
- Snow and Ice
- Flooding
- Local Precipitation
- Other (Transportation and Nearby Facility Accidents)
- Aircraft
- Pipelines
- Highway
- Other Nearby Facilities
- Railroad
- On-site Use of Natural Gas
- Internal Flooding from On-Site Above Ground Liquid Storage Tanks.

The ISA is intended to give assurance that the potential failures, hazards, accident sequences, scenarios, and IROFS have been investigated in an integrated fashion, so as to adequately consider common mode and common cause situations. Included in this integrated review is the identification of IROFS function that may be simultaneously beneficial and harmful with respect to different hazards, and interactions that might not have been considered in the previously completed sub-analyses. This review is intended to ensure that the designation of one IROFS does not negate the preventive or mitigation function of another IROFS. An integration checklist is used by the ISA Team as a guide to facilitate the integrated review process.

Some items that warrant special consideration during the integration process are:

- Common mode failures and common cause situations.
- Support system failures such as loss of electrical power or city water. Such failures can have a simultaneous effect on multiple systems.
- Divergent impacts of IROFS. Assurance must be provided that the negative impacts of an IROFS, if any, do not outweigh the positive impacts; i.e., to ensure that the application of an IROFS for one safety function does not degrade the defense-in-depth of an unrelated safety function.
- Other safety and mitigating factors that do not achieve the status of IROFS that could impact system performance.
- Identification of scenarios, events, or event sequences with multiple impacts, i.e. impacts on chemical safety, fire safety, criticality safety, and/or radiation safety. For example, a flood might cause both a loss of containment and moderation impacts.

- Potential interactions between processes, systems, areas, and buildings; any interdependence of systems, or potential transfer of energy or materials.
- Major hazards or events, which tend to be common cause situations leading to interactions between processes, systems, buildings, etc.

3.1.1.2 Process Hazard Analysis Method

As noted above, the HAZOP method was used to identify the process hazards. The HAZOP process hazard analysis (PHA) method is consistent with the guidance provided in NUREG-1513 (NRC, 2001). Implementation of the HAZOP method was accomplished by either validating the Urenco HAZOPs for the NEF design or performing a new HAZOP for systems where there were no existing HAZOPs. In general, new HAZOPs were performed for the Technical Services Building (TSB) systems. In cases for which there was an existing HAZOP, the ISA Team, through the validation process, developed a new HAZOP.

For the UF_6 process systems, this portion of the ISA was a validation of the HAZOPs provided by Urenco. The validation process involved workshop meetings with the ISA Team. In the workshop meeting, the ISA Team challenged the results of the Urenco HAZOPs. As necessary the HAZOPs were revised/updated to be consistent with the requirements identified in 10 CFR 70 (CFR, 2003b) and as further described in NUREG-1513 (NRC, 2001) and NUREG-1520 (NRC, 2002).

To validate the Urenco HAZOPs, the ISA Team performed the following tasks:

- The Urenco process engineer described the salient points of the process system covered by the HAZOP being validated.
- The ISA Team divided the process "Nodes" into reasonable functional blocks.
- The process engineer described the salient points of the items covered by the "Node" being reviewed.
- The ISA Team reviewed the "Guideword" used in the Urenco HAZOP to determine if the HAZOP is likely to identify all credible hazards. A representative list of the guidewords used by the ISA Team is provided in Table 3.1-1, HAZOP Guidewords, to ensure that a complete assessment was performed.
- The ISA Team Leader introduced each Guideword being considered in the ISA HAZOP and the team reviewed and considered the potential hazards.
- For each potential hazard, the ISA Team considered the causes, including potential interactions among materials. Then, for each cause, the ISA Team considered the consequences and consequence severity category for the consequences of interest (Criticality Events, Chemical Releases, Radiation Exposure, Environment impacts). A statement of "No Safety Issue" was noted in the system HAZOP table for consequences of no interest such as maintenance problems or industrial personnel accidents.
- For each hazard, the ISA Team considered existing safeguards designed to prevent the hazard from occurring.
- For each hazard, the ISA Team also considered any existing design features that could mitigate/reduce the consequences.

- The Urenco HAZOP was modified to reflect the ISA Team's input in the areas of hazards, causes, consequences, safeguards and mitigating features.
- For each external event hazard, the ISA Team determined if the external hazard is credible (i.e., external event initiating frequency >10^{-6} per year).
- When all of the Guidewords had been considered for a particular node, the ISA Team applied the same process and guidewords to the next node until the entire process system was completed.

The same process as above was followed for the TSB systems, except that instead of using the validation process, the ISA Team developed a completely new HAZOP. This HAZOP was then used as the hazard identification input into the remainder of the process.

The results of the ISA Team workshops are summarized in the ISA HAZOP Table, which forms the basis of the hazards portion of the Hazard and Risk Determination Analysis. The HAZOP tables are contained in the ISA documentation. The format for this table, which has spaces for describing the node under consideration and the date of the workshop, is provided in Table 3.1-2, ISA HAZOP Table Sample Format. This table is divided into 7 columns:

GUIDEWORD	Identifies the Guideword under consideration.
HAZARD	Identifies any issues that are raised.
CAUSES	Lists any and all causes of the hazard noted.
CONSEQUENCES	Identifies the potential and worst case consequence and consequences severity category if the hazard goes uncontrolled.
SAFEGUARDS	Identifies the engineered and/or administrative protection designed to prevent the hazard from occurring.
MITIGATION	Identifies any protection, engineered or otherwise, that can mitigate/reduce the consequences.
COMMENTS	Notes any comments and any actions requiring resolution.

This approach was used for all of the process system hazard identifications. The "Fire" and "External Events" guidewords were handled as a facility-wide assessment and were not explicitly covered in each system hazard evaluation.

The results of the HAZOP are used directly as input to the risk matrix development.

3.1.1.3 Risk Matrix Development

3.1.1.3.1 Consequence Analysis Method

10 CFR 70.61 (CFR, 2003c) specifies two categories for accident sequence consequences: "high consequences" and "intermediate consequences." Implicitly there is a third category for accidents that produce consequences less than "intermediate." These are referred to as "low consequence" accident sequences. The primary purpose of PHA is to identify all uncontrolled and unmitigated accident sequences. These accident sequences are then categorized into one

of the three consequence categories (high, intermediate, low) based on their forecast radiological, chemical, and/or environmental impacts.

For evaluating the magnitude of the accident consequences, calculations were performed using the methodology described in the ISA documentation. Because the consequences of concern are the chemotoxic exposure to hydrogen fluoride (HF) and UO_2F_2, the dispersion methodology discussed in Section 6.3.2 was used. The dose consequences for all of the accident sequences were evaluated and compared to the criteria for "high" and "intermediate" consequences. The inventory of uranic material for each accident considered was dependent on the specific accident sequence. For criticality accidents, the consequences were conservatively assumed to be high for both the public and workers.

Table 3.1-3, Consequence Severity Categories Based on 10 CFR 70.61, presents the radiological and chemical consequence severity limits of 10 CFR 70.61 (CFR, 2003c) for each of the three accident consequence categories. Table 3.1-4, Chemical Dose Information, provides information on the chemical dose limits specific to the NEF.

3.1.1.3.2 Likelihood Evaluation Method

10 CFR 70.61 (CFR, 2003c) also specifies the permissible likelihood of occurrence of accident sequences of different consequences. "High consequence" accident sequences must be "highly unlikely" and "intermediate consequence" accident sequences must be "unlikely." Implicitly, accidents in the "low consequence" category can have a likelihood of occurrence less than "unlikely" or simply "not unlikely." Table 3.1-5, Likelihood Categories Based on 10 CFR 70.61, shows the likelihood of occurrence limits of 10 CFR 70.61 (CFR, 2003c) for each of the three likelihood categories.

The definitions of "not unlikely" and "unlikely" are taken from NUREG-1520 (NRC, 2002). The definition of "highly unlikely" is taken from NUREG-1520 (NRC, 2002). Additionally, a qualitative determination of "highly unlikely" can apply to passive design component features (e.g., tanks, piping, cylinders, etc.) of the facility that do not rely on human interface to perform the criticality safety function (i.e., termed "safe-by-design"). Safe-by-design components are those components that by their physical size or arrangement have been shown to have a $k_{eff} < 0.95$. The definition of safe-by-design components encompasses two different categories of components. The first category includes those components that are safe-by-volume, safe-by-diameter or safe-by-slab thickness. A set of generic conservative criticality calculations has determined the maximum volume, diameter, or slab thickness (i.e., safe value) that would result in a $k_{eff} < 0.95$. A component in this category has a volume, diameter or slab thickness that is less than the associated safe value resulting from the generic conservative criticality calculations and therefore the k_{eff} associated with this component is < 0.95. The components in the second category require a more detailed criticality analysis (i.e., a criticality analysis of the physical arrangement of the component's design configuration) to show that k_{eff} is < 0.95. In the second category of components, the design configuration is not bounded by the results of the generic conservative criticality calculations for maximum volume, diameter, or slab thickness that would result in a $k_{eff} < 0.95$. Examples of components in this second category are the product pumps that have volumes greater than the safe-by-volume value, but are shown by specific criticality analysis to have a $k_{eff} < 0.95$.

For failure of passive safe-by-design components to be considered "highly unlikely," these components must also meet the criterion that the only potential means to effect a change that might result in a failure to function, would be to implement a design change (i.e., geometry deformation as a result of a credible process deviation or event does not adversely impact the performance of the safety function). The evaluation of the potential to adversely impact the safety function of these passive design features includes consideration of potential mechanisms to cause bulging, corrosion, and breach of confinement/leakage and subsequent accumulation of material. The evaluation further includes consideration of adequate controls to ensure that the double contingency principle is met. For each of these passive design components, it must be concluded, that there is no credible means to effect a geometry change that might result in a failure of the safety function and that significant margin exists. For components that are safe-by-volume, safe-by-diameter, or safe-by-slab thickness (i.e., first category of safe-by-design components), significant margin is defined as a margin of at least 10%, during both normal and upset conditions, between the actual design parameter value of the component and the value of the corresponding critical design attribute. For components that require a more detailed criticality analysis (i.e., second category of safe-by-design components), significant margin is defined as $k_{eff} < 0.95$, where $k_{eff} = k_{calc} + 3\sigma_{calc}$. This margin is considered acceptable since the calculation of k_{eff} also conservatively assumes the components are full of uranic breakdown material at maximum enrichment, the worst credible moderation conditions exist, and the worst credible reflection conditions exist.

The demonstration of significant margin to meet "highly unlikely" is provided, for each of the components listed in Tables 3.7-6 through 3.7-21, in the following classified documents.

- ETC4009554, Criticality Assessment of Passive Safe-by-Design Components, Decontamination Workshop
- ETC4009555, Criticality Assessment of Passive Safe-by-Design Components, Mass Spectrometry Laboratory
- ETC4009556, Criticality Assessment of Passive Safe-by-Design Components, Chemical Laboratory System
- ETC4009557, Criticality Assessment of Passive Safe-by-Design Components, Fomblin Oil Recovery System
- ETC4009558, Criticality Assessment of Passive Safe-by-Design Components, Solid Waste Collection System
- ETC4009559, Criticality Assessment of Passive Safe-by-Design Components, Product Blending System
- ETC4009561, Criticality Assessment of Passive Safe-by-Design Components, Cascade System
- ETC4009565, Criticality Assessment of Passive Safe-by-Design Components, Centrifuge Test System
- ETC4009566, Criticality Assessment of Passive Safe-by-Design Components, Centrifuge Post Mortem Facility
- ETC4009567, Criticality Assessment of Passive Safe-by-Design Components, Contingency Dump System
- ETC4009609, Criticality Assessment of Passive Safe-by-Design Components, Tails System

- ETC4009614, Criticality Assessment of Passive Safe-by-Design Components, Product System
- ETC4009677, Criticality Assessment of Passive Safe-by-Design Components, Liquid Effluent Collection and Treatment System
- ETC4009679, Criticality Assessment of Passive Safe-by-Design Components, Ventilated Room System
- ETC4009723, Criticality Assessment of Passive Safe-by-Design Components, Cylinder Preparation System
- ETC4009730, Criticality Assessment of Passive Safe-by-Design Components, Liquid Sampling System

These classified documents are incorporated by reference into this ISA Summary.

In addition, the configuration management system required by 10 CFR 70.72 (implemented by the NEF Configuration Management Program) ensures the maintenance of the safety function of these features and assures compliance with the double contingency principle, as well as the defense-in-depth criterion of 10 CFR 70.64(b).

The definition of "not credible" is also taken from NUREG-1520 (NRC, 2002). If an event is not credible, IROFS are not required to prevent or mitigate the event. The fact that an event is not "credible" must not depend on any facility feature that could credibly fail to function. One cannot claim that a process does not need IROFS because it is "not credible" due to characteristics provided by IROFS. The implication of "credible" in 10 CFR 70.61 (CFR, 2003c) is that events that are not "credible" may be neglected.

Any one of the following independent acceptable sets of qualities could define an event as not credible:

a. An external event for which the frequency of occurrence can conservatively be estimated as less than once in a million years

b. A process deviation that consists of a sequence of many unlikely human actions or errors for which there is no reason or motive (In determining that there is no reason for such actions, a wide range of possible motives, short of intent to cause harm, must be considered. Necessarily, no such sequence of events can ever have actually happened in any fuel cycle facility.)

c. Process deviations for which there is a convincing argument, given physical laws that they are not possible, or are unquestionably extremely unlikely.

3.1.1.3.3 Risk Matrix

The three categories of consequence and likelihood can be displayed as a 3 x 3 risk index matrix. By assigning a number to each category of consequence and likelihood, a qualitative risk index can be calculated for each combination of consequence and likelihood. The risk index equals the product of the integers assigned to the respective consequence and likelihood categories. The risk index matrix, along with computed risk index values, is illustrated in Table 3.1-6, Risk Matrix with Risk Index Values. The shaded blocks identify accidents of which the consequences and likelihoods yield an unacceptable risk index and for which IROFS must be applied.

The risk indices can initially be used to examine whether the consequences of an uncontrolled and unmitigated accident sequence (i.e., without any IROFS) could exceed the performance requirements of 10 CFR 70.61 (CFR, 2003c). If the performance requirements could be exceeded, IROFS are designated to prevent the accident or to mitigate its consequences to an acceptable level. A risk index value less than or equal to four means the accident sequence is acceptably protected and/or mitigated. If the risk index of an uncontrolled and unmitigated accident sequence exceeds four, the likelihood of the accident must be reduced through designation of IROFS. In this risk index method, the likelihood index for the uncontrolled and unmitigated accident sequence is adjusted by adding a score corresponding to the type and number of IROFS that have been designated.

3.1.1.4 Risk Index Evaluation Summary

The results of the ISA are summarized in tabular form (see Section 3.7, General Types of Accident Sequences). This table includes the accident sequences identified for this facility. The accident sequences were not grouped as a single accident type but instead were listed individually in the table. The Table has columns for the initiating event and for IROFS. IROFS may be mitigative or preventive. Mitigative IROFS are measures that reduce the consequences of an accident. The phrase "uncontrolled and/or unmitigated consequences" describes the results when the system of existing preventive IROFS fails and existing mitigation also fails. Mitigated consequences result when the preventive IROFS fail, but mitigative measures succeed. Index numbers are assigned to initiating events, IROFS failure events, and mitigation failure events, based on the reliability characteristics of these items.

With redundant IROFS and in certain other cases, there are sequences in which an initiating event places the system in a vulnerable state. While the system is in this vulnerable state, an IROFS must fail for the accident to result. Thus, the frequency of the accident depends on the frequency of the first event, the duration of vulnerability, and the frequency of the second IROFS failure. For this reason, the duration of the vulnerable state is considered, and a duration index is assigned. The values of all index numbers for a sequence, depending on the number of events involved, are added to obtain a total likelihood index, T. Accident sequences are then assigned to one of the three likelihood categories of the risk matrix, depending on the value of this index in accordance with Table 3.1-8, Determination of Likelihood Category.

The values of index numbers in accident sequences are assigned considering the criteria in Tables 3.1-9 through 3.1-11. Each table applies to a different type of event. Table 3.1-9, Failure Frequency Index Numbers, applies to events that have *frequencies* of occurrence, such as initiating events and certain IROFS failures. In addition to further support the failure frequency index numbers used in the ISA (i.e., when ISA Summary Tables 3.7-2 and 3.7-4 state "This failure frequency index was selected based on evidence from history of similarly designed Urenco European plant..."), operating data from similar systems, components, and safety functions at the Urenco Almelo SP5 facility, which is similar to the NEF design, is reviewed. This review is conducted using searches of computer-based databases at the Urenco Almelo facility. A list of ISA Summary initiating events caused by component failures or human events is developed. Using this list of initiating events, keyword searches of computer based databases for plant control systems, operational logs, and maintenance records are performed. The resulting information relevant to the Almelo SP5 facility is extracted for further review, evaluation, and comparison to the failure frequency index number(s) used in the applicable ISA Summary accident sequences. When failure *probabilities* are required for an event, Table 3.1-10, Failure Probability Index Numbers, provides the index values. Table 3.1-11, Failure Duration Index Numbers, provides index numbers *for durations* of failure. These are used in certain accident sequences where two IROFS must simultaneously be in a failed state. In this case, one of the two controlled parameters will fail first. It is then necessary to consider the duration that the system remains vulnerable to failure of the second. This period of vulnerability can be terminated in several ways. The first failure may be "fail-safe" or be continuously monitored, thus alerting the operator when it fails so that the system may be quickly placed in a safe state. Or the IROFS may be subject to periodic surveillance tests for hidden failures. When hidden failures are possible, these surveillance intervals limit the duration that the system is in a vulnerable state. The reverse sequences, where the second IROFS fails first, should be considered as a separate accident sequence. This is necessary because the failure frequency and the duration of outage of the first and the second IROFS may differ. The values of these duration indices are not merely judgmental. They are directly related to the time intervals used for surveillance and the time needed to render the system safe.

The duration of failure is accounted for in establishing the overall likelihood that an accident sequence will continue to the defined consequence. Thus, the time to discover and repair the failure is accounted for in establishing the risk of the postulated accident.

The total likelihood index is the sum of the indices for all the events in the sequence, including those for duration. Consequences are assigned to one of the three consequence categories of the risk matrix, based on calculations or estimates of the actual consequences of the accident sequence. The consequence categories are based on the levels identified in 10 CFR 70.61 (CFR, 2003c). Multiple types of consequences can result from the same event. The consequence category is chosen for the most severe consequence.

In summarizing the ISA results, Table 3.7-1, Accident Sequence and Risk Index, provides two risk indices for each accident sequence to permit evaluation of the risk significance of the IROFS involved. To measure whether an IROFS has high risk significance, the table provides an "uncontrolled risk index," determined by modeling the sequence with all IROFS as failed (i.e., not contributing to a lower likelihood). In addition, a "controlled risk index" is also calculated, taking credit for the low likelihood and duration of IROFS failures. When an accident sequence has an uncontrolled risk index exceeding four but a controlled risk index of less than four, the IROFS involved have a high risk significance because they are relied on to achieve acceptable safety performance. Thus, use of these indices permits evaluation of the possible benefit of improving IROFS and also whether a relaxation may be acceptable.

3.1.2 ISA Team

There were two ISA Teams that were employed in the ISA. The first team worked on the non-classified portions of the facility and is referred to in the text as the ISA Team. The second team, referred to as the Classified ISA Team, performed the ISA on the classified elements of the facility. Both teams were selected with credentials consistent with the requirements in 10 CFR 70.65 (CFR, 2003a) and the guidance provided in NUREG-1520 (NRC, 2002). To facilitate consistency of results, common membership was dictated as demonstrated below (i.e., some members of the Non-Classified Team participated on the Classified Team. One of the members of the Classified Team participated in the ISA Team Leader Training, which was conducted prior to initiating the ISA. In addition, the Classified ISA Team Leader observed some of the non-classified ISA Team meetings.

The ISA was performed by a team with expertise in engineering, safety analysis and enrichment process operations. The team included personnel with experience and knowledge specific to each process or system being evaluated. The team was comprised of individuals who have experience, individually or collectively, in:

- Nuclear criticality safety
- Radiological safety
- Fire safety
- Chemical process safety
- Operations and maintenance
- ISA methods.

The ISA team leader was trained and knowledgeable in the ISA method(s) chosen for the hazard and accidents evaluations. Collectively, the team had an understanding of all process operations and hazards under evaluation.

The ISA Manager was responsible for the overall direction of the ISA. The process expertise was provided by the Urenco personnel on the team. In addition, the Team Leader has an adequate understanding of the process operations and hazards evaluated in the ISA, but is not the responsible cognizant engineer or enrichment process expert.

A description of the ISA Team, their areas of expertise, qualifications and experience is provided below.

ISA Team Member	Experience and Qualifications
Michael Kennedy, ISA Manager and Team Leader	Over 29 years experience in nuclear safety analyses and risk assessment. Advanced degrees in Nuclear Engineering. Completed ISA Team Leader training course.
Richard Turcotte, Team Leader	Over 25 years experience providing engineering and risk assessment support for nuclear plants. Significant experience in probabilistic risk assessment. Degreed Mechanical Engineer. Completed ISA Team Leader training course.

ISA Team Member	Experience and Qualifications
Melvin Gmyrek, Team Leader	Over 30 years experience in nuclear facility operations. Has held a number of reactor operator licenses and held positions as Senior Reactor Operator, shift supervisor and operations manager. Completed ISA Team Leader training course.
David Pepe, Scribe	Over 26 years experience in providing engineering and risk assessment support on nuclear facilities. Significant experience in probabilistic risk assessment. Degreed Nuclear Engineer. Completed ISA Team Leader training course.
Scott Tyler, Chemical/Fire Safety	Over 17 years experience in fire and chemical safety on nuclear and non-nuclear facilities. Experienced in process hazard and consequence analysis. Degreed engineer in Fire Protection and Safety Engineering Technology and a registered Professional Fire Protection Engineer.
Richard Dible, Fire Safety	Over 19 years experience in fire protection and analysis. Degreed engineer in Fire Protection and Safety Engineering.
Douglas Setzer, Chemical/Fire Safety	Over 16 years experience in design and analysis in chemical and fire safety. Experienced in process hazard and consequence analysis. Degreed engineer in Mechanical and Chemical engineering. Registered Professional Fire Protection Engineer.
Kevin Morrissey, Criticality Safety	Over 24 years of nuclear industry experience, including particle transport methods, nuclear criticality, activation analysis and reactor physics.
Mark Strum, Radiological Safety	Over 30 years of nuclear utility experience performing radiological assessments supporting the design, licensing and operation of both PWR and BWR nuclear power plant facilities. Degreed nuclear engineer with an advanced degree in Radiological Sciences and Protection.
Chris Andrews, Process Expert	Over 30 years experience in the licensing, engineering and safety analysis of gas centrifuge enrichment technology. Senior Manager responsible for safety analysis and licensing for Urenco. Degree in Physics. Professional Engineer. Completed ISA Team Leader training course.
Allan Brown, Process Expert	Over 26 years experience in the design, operations, start-up, decommissioning of gas centrifuge enrichment facilities. Design Manager

ISA Team Member	Experience and Qualifications
	with responsibility for the NEF for Urenco. Degree in Physics.
Jan Kleissen, Operations Expert	Over 30 years experience in the operation and start-up of gas centrifuge enrichment plants. Production Manager at the Almelo SP-5 plant. The NEF is based on the SP-5 design. Degreed engineer.
Edwin Mulder, Operations Expert	Over four years experience in operations of gas centrifuge enrichment plant.
Herald Voschezang, Operations Expert	Over 19 years of experience with Urenco, predominantly in operations of gas centrifuge enrichment plants. Commissioning Manager of the Almelo SP-5 plant. The NEF is based on the SP-5 design. Degreed engineer.
Randy Campbell, Facility Engineering	Over 25 years experience in engineering, design and construction in the power (nuclear and fossil), chemicals, automotive and other various industries and 12 years nuclear experience. Degreed Mechanical Engineer.

Classified ISA Team Member	Experience and Qualifications
Andrew Pilkington, Team Leader/Risk Analysis	Over 14 years experience in nuclear and non-nuclear facility risk assessment. Significant experience in the risk assessment of gas centrifuge enrichment facilities. Knowledgeable in the HAZOP methodology. Degreed engineer.
Tony Duff, Scribe/Risk Analysis	Over 13 years experience in nuclear facility risk assessment. Most recent experience in gas centrifuge enrichment facility risk assessment. Degree in Applied Physics.
Chris Andrews, Process Safety	Over 30 years experience in the licensing, engineering and safety analysis of gas centrifuge enrichment technology. Senior Manager responsible for safety analysis and licensing for Urenco. Degree in Physics. Professional Engineer. Completed ISA Team Leader training course.
Edwin Mulder, Operations Expert	Over four years experience in operations of gas centrifuge enrichment plant.

Classified ISA Team Member	Experience and Qualifications
Philip Hale, Lead Engineer	Over 21 years experience in mechanical and process design engineering on gas centrifuge enrichment facilities. Lead design engineer for the NEF. Advanced degree in Mechanical Engineering.
Owen Parry, Criticality	Over 20 years experience in gas centrifuge technology. Most recent experience is in the criticality analysis related to gas centrifuge enrichment facilities. Degree in Chemistry and Doctoral degree in Physics.
Ian Forrest, Dump Systems	Over 27 years experience in design engineering. Presently package manager for work associated with development and qualification of Dump Systems, and providing related support for plant and projects. Degreed Mechanical Engineer.
Alan Coles, Fire Safety	Over 36 years experience in fire protection and fire safety.
Heather Tur, Test Facilities	Over 32 years experience in centrifuge research and development and centrifuge test facility operations.
Ian Crombie, Test Facilities	Over 20 years experience in design engineering related to gas centrifuge enrichment plant. Most recently involved in the NEF design.
Herald Voschezang, Operations Expert	Over 19 years of experience with Urenco, predominantly in operations of gas centrifuge enrichment plants. Commissioning Manager of the Almelo SP-5 plant. The NEF is based on the SP-5 design. Degreed engineer.
Stephen Thomas, Process Design Engineer	Over 25 years of experience. Approximately 10 years of centrifuge plant design experience. Design support for NEF design.

The management commitments related to the conduct and maintenance of the ISA are described in Section 3.1.8.2, Integrated Safety Analysis.

3.1.3 Selection of Quantitative Standards

Uranium hexafluoride (UF_6) is the only chemical of concern that will be used at the facility. For licensed material or hazardous chemicals produced from licensed materials, chemicals of concern are those that, in the event of release have the potential to exceed concentrations defined in 10 CFR Part 70 (CFR, 2003b). UF_6 represents a health hazard to facility workers and the public if released to atmosphere due to the radiological and toxicological properties of two byproducts – hydrogen fluoride (HF) and uranyl fluoride (UO_2F_2) – which are generated when UF_6 is released and reacts with water vapor in the air.

Criteria for evaluating potential releases and characterizing their consequences as either "high" or "intermediate" for members of the public and facility workers are presented in Table 3.1-3, Consequence Severity Categories Based on 10 CFR 70.61 and Table 3.1-4, Chemical Dose Information.

3.1.4 Hazards Analyzed

The hazards of concern for this facility are all related to either a loss of confinement (of UF_6) or criticality. All of the consequences of concern are the result of initiating events due to hazards that would result in accidents of these types. The initiating events considered for this facility are the result of failures in process components, human error or misoperation including maintenance activities, fires (external to the process), and external events (e.g., severe weather, seismic, transportation and industrial hazards). These initiating events or potential causes could result in a loss of enrichment system containment or criticality. In general, the loss of confinement would initially result in an in-leakage of air because the systems are at sub-atmospheric pressure. Moisture in the air would react with the UF_6 forming UO_2F_2 and HF as by-products. The HF, which would be in a gaseous form, could be transported through the facility and ultimately beyond the site boundary. HF is a toxic chemical with the potential to cause harm to the plant workers or the public.

A criticality event, if one should occur, is a potential source of damaging energy and would result in the release of prompt gamma rays and airborne fission products. The gamma rays and airborne fission products result in direct radiation and chemical/radiological inhalation dose exposure to plant workers and the public. Each portion of the plant, system, or component that may possibly contain enriched uranium is designed with criticality safety as an objective. Where there is a potential for significant in-process accumulations of enriched uranium, the plant design includes multiple features to minimize the possibilities for breakdown of criticality control features.

Nuclear criticality safety is evaluated for the design features of the plant system or component and for the operating practices that relate to maintaining criticality safety. The evaluation of individual systems or components and their interaction with other systems or components containing enriched uranium is performed to assure the criticality safety criteria are met. The nuclear criticality safety analyses provide a basis for the plant design and criticality hazards identifications performed as part of the ISA.

3.1.5 Criticality Monitoring and Alarms

The facility is provided with a Criticality Accident Alarm System (CAAS) as required by 10 CFR 70.24, Criticality accident requirements (CFR, 2003d). Areas where Special Nuclear Material (SNM) is handled, used, or stored in amounts at or above the 10 CFR 70.24 (CFR, 2003d) mass limits are provided with CAAS coverage.

The CAAS is designed, installed, and maintained in accordance with ANSI/ANS-8.3-1997 Criticality Accident Alarm System (ANSI, 1997) as modified by Regulatory Guide 3.71, Nuclear Criticality Safety Standards Fuels and Material Facilities (NRC, 1998).

CAAS coverage consists of an overlapping detection layout, where all required covered areas are monitored by a minimum of a pair (2) of gamma detectors. Detectors trip based on both steady radiation rate and time integrated total radiation dose levels. The detectors have a stated trigger response of 1mGy/hr (0.1 rad/hr) as a gamma radiation rate meter detector. Based on this design and the guidance provided in Appendix B of ANSI/ANS-8.3 (ANSI, 1997), the radius of detection must be less than 106 m (348 ft). Because of building steel spacing and equipment arrangement as well as a desire to maintain a factor of two safety margin, a radius of detection of 40 m (131 ft) is used in the design. This ensures that the CAAS is capable of detecting a criticality that produces an absorbed dose in soft tissue of 0.2 Gy (20 rads) of combined neutron and gamma radiation at an unshielded distance of 2 m (6.6 ft) from the reacting material within one minute. The CAAS will be uniform throughout the facility for the type of radiation detected, the mode of detection, the alarm signal, and the system dependability. The CAAS, if tripped, will automatically initiate a clearly audible signal in areas that must be evacuated.

The CAAS is provided with emergency power and is designed to remain operational during credible events or conditions, including fire, explosion, corrosive atmosphere, or seismic shock (equivalent to the site-specific design-basis earthquake or the equivalent value specified by the uniform building code).

Whenever the CAAS is not functional, compensatory measures, such as limiting access and restricting SNM movement, will be implemented. Should the CAAS coverage be lost and not restored within a specified number of hours, the operations will be rendered safe (by shutdown and quarantine) if necessary. Onsite guidance is provided and is based on process-specific considerations that consider applicable risk trade-off of the duration of reliance on compensatory measures versus the risk associated with process upset in shutdown.

3.1.6 Fire Hazards Analysis

Fire Hazards Analyses (FHAs) are conducted for the processing buildings located within the site boundary. The FHA evaluates the facility design with respect to fire safety codes, and ensures that the facility is designed and operated such that there is acceptable risk for postulated fire accident scenarios.

The results of the FHA have been used to identify potential fire initiators and accident sequences leading to radiological consequences or toxic chemical consequences. The FHA is a fundamental input for evaluating fire hazards in the ISA.

3.1.7 Baseline Design Criteria

10 CFR 70.64 (CFR, 2003e) specifies baseline design criteria (BDC) that must be used for new facilities. The ISA accident sequences for the credible high and intermediate consequence events for the NEF have defined the design basis events. The IROFS for these events and safety parameter limits ensure that the associated BDC are satisfied. IROFS safety parameter limits are available in the ISA documentation. These BDC have been used as bases for the design of the NEF.

A. Quality Standards and Records.

Structures, systems, and components (SSCs) that are determined to have safety significance are designed, fabricated, erected, and tested in accordance with the quality assurance criteria set forth in Appendix B to 10 CFR Part 50 (CFR, 2003f). Appropriate records of the design, fabrication, erection, procurement and testing of SSCs which are determined to have safety significance are maintained throughout the life of the facility. A safety function is a function performed by a SSC that prevents a release of UF_6 to the environment that could result in a dose to a member of the public of at least the limits provided in Section 3.1.3, Selection of Quantitative Standards. An SSC that performs a safety function is designated as an "item relied on for safety" (IROFS). Management Measures applicable to IROFS are discussed in Section 3.1.8.3, Management Measures.

B. Natural Phenomena Hazards.

Structures, systems, and components that are determined to have safety significance (IROFS) are designed to withstand the effects of, and be compatible with, the environmental conditions associated with operation, maintenance, shutdown, testing, and accidents for which the IROFS are required to function.

Natural phenomena hazards are identified in Section 3.2, Site Description.

C. Fire Protection.

Structures, systems, and components that are determined to have safety significance (IROFS) are designed and located so that they can continue to perform their safety functions effectively under credible fire and explosion exposure conditions. Non-combustible and heat resistant materials are used wherever practical throughout the facility, particularly in locations vital to the control of hazardous materials and to the maintenance of safety control functions. IEEE-383 (ANSI/IEEE, 1974) fire resistant cabling shall be used for all uranic material system power, instrumentation and control circuits. Fire detection, alarm, and suppression systems are designed and provided with sufficient capacity and capability to minimize the adverse effects of fires and explosion on IROFS. The design includes provisions to protect against adverse effects that might result from either the operation or the failure of the fire suppression system.

D. Environmental and Dynamic Effects.

Structures, systems, and components that are determined to have safety significance (IROFS) are protected against dynamic effects, including effects of missiles and discharging fluids, that may result from natural phenomena, accidents at nearby industrial, military, or transportation facilities, equipment failure, and other similar events and conditions both inside and outside the facility.

E. Chemical Protection.

The design provides adequate protection against chemical risks produced from licensed material, facility conditions which affect the safety of licensed material, and hazardous chemicals produced from licensed material.

F. Emergency Capability.

Structures, systems, and components that are required to support the Emergency Plan are designed for emergencies. The design provides accessibility to the equipment of onsite and available offsite emergency facilities and services such as hospitals, fire and police departments, ambulance service, and other emergency agencies.

G. Utility Services.

Onsite utility service systems required to support IROFS shall be provided. Each utility service system required to support IROFS shall provide for the meeting of safety demands under normal and abnormal conditions.

Utility systems are described in Section 3.5, Utility and Support Systems.

H. Inspection, Testing, and Maintenance.

Structures, systems and components that are determined to have safety significance (IROFS) are designed to permit inspection, maintenance, and testing.

I. Criticality Control.

Safety Margins

The design of process and storage systems shall include demonstrable margins of safety for the nuclear criticality parameters that are commensurate with the uncertainties in the process and storage conditions, in the data and methods used in calculations, and in the nature of the immediate environment under accident conditions. All process and storage systems should be designed and maintained with sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible.

Methods of Control

The major controlling parameters used in the facility are enrichment control, geometry control, moderation control and/or limitations on the mass as a function of enrichment.

Neutron Absorbers

Neutron absorbers are not needed and are not used at the NEF.

J. Instrumentation and Controls.

Instrumentation and control systems shall be provided to monitor variables and operating systems that are significant to safety over anticipated ranges for normal operation, for abnormal operation, for accident conditions, and for safe shutdown. These systems shall ensure adequate safety of process and utility service operations in connection with their safety function. The variables and systems that require constant surveillance and control include process systems having safety significance, the overall confinement system, confinement barriers and their associated systems, and other systems that affect the overall safety of the plant. Controls shall be provided to maintain these variables and systems within the prescribed operating ranges under all normal conditions. Instrumentation and control systems shall be designed to fail into a safe state or to assume a state demonstrated to be acceptable on some other basis if conditions such as disconnection, loss of energy or motive power, or adverse environments are experienced.

For hardware IROFS involving instrumentation that provides automatic prevention or mitigation of events, status and operation will be monitored by the plant control system (PCS) by means of an alarm. This alarm will be provided by an isolated, hardwired digital signal from the associated IROFS to the PCS programmable logic controller (PLC). This signal will only be directed from the associated IROFS to the PCS PLC. The required isolation is provided at the IROFS hardware interface in the process equipment for the connections to the PCS PLC. Consistent with IEEE-279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations" (IEEE, 1971), the isolation devices will be classified as part of the IROFS boundary and will be designed such that no credible failure at the output of the isolation device shall prevent the associated IROFS from meeting its specified safety function.

K. Defense-in-Depth Practices.

The facility and system designs are based on defense-in-depth practices. The design incorporates a preference for engineered controls over administrative controls to increase overall system reliability. For criticality safety, the engineered controls preference is for use of passive engineered controls over active engineered controls. The design also incorporates features that enhance safety by reducing challenges to items relied on for safety. Facility and system IROFS are identified in Section 3.8, IROFS. The process systems are described in Section 3.4, Enrichment and Other Process Systems. The utility and support systems are described in Section 3.5, Utility and Support Systems. In addition to identifying the IROFS associated with each system, the system descriptions also identify the additional design and safety features (considerations) that provide defense-in-depth.

3.1.8 Safety Program Commitments

This section presents the commitments pertaining to the facility's safety program including the performance of an ISA. 10 CFR Part 70 (CFR, 2003b) contains a number of specific safety program requirements related to the integrated safety analysis (ISA). These include the primary requirements that an ISA be conducted, and that it evaluate and show that the facility complies with the performance requirements of 10 CFR 70.61 (CFR, 2003c).

The commitments for each of the three elements of the safety program defined in 10 CFR 70.62(a) (CFR, 2003g) are addressed below.

3.1.8.1 Process Safety Information

A. LES has compiled and maintains up-to-date documentation of process safety information. Written process-safety information is used in updating the ISA and in identifying and understanding the hazards associated with the processes. The compilation of written process-safety information includes information pertaining to:

1. The hazards of all materials used or produced in the process, which includes information on chemical and physical properties such as are included on Material Safety Data Sheets meeting the requirements of 29 CFR 1910.1200(g) (CFR, 2003h).

2. Technology of the process which includes block flow diagrams or simplified process flow diagrams, a brief outline of the process chemistry, safe upper and lower limits for controlled parameters (e.g., temperature, pressure, flow, and concentration), and evaluation of the health and safety consequences of process deviations.

3. Equipment used in the process including general information on topics such as the materials of construction, piping and instrumentation diagrams (P&IDs), ventilation, design codes and standards employed, material and energy balances, IROFS (e.g., interlocks, detection, or suppression systems), electrical classification, and relief system design and design basis.

The process-safety information described above is maintained up-to-date by the configuration management program.

B. LES has developed procedures and criteria for changing the ISA. This includes implementation of a facility change mechanism that meets the requirements of 10 CFR 70.72 (CFR, 2003i).

C. LES uses personnel with the appropriate experience and expertise in engineering and process operations to maintain the ISA. The ISA Team for the various processes consists of individuals who are knowledgeable in the ISA method(s) and the operation, hazards, and safety design criteria of the particular process.

The ISA Team for the initial ISA development is described in Section 3.1.2, ISA Team.

3.1.8.2 Integrated Safety Analysis

A. LES has conducted an ISA for each process, such that it identifies (i) radiological hazards, (ii) chemical hazards that could increase radiological risk, (iii) facility hazards that could increase radiological risk, (iv) potential accident sequences, (v) consequences and likelihood of each accident sequence and (vi) IROFS including the assumptions and conditions under which they support compliance with the performance requirements of 10 CFR 70.61 (CFR, 2003c).

The results of the ISA are presented in Section 3.6, Process Hazards; Section 3.7, General Types of Accident Sequences, and Section 3.8, IROFS.

B. LES has implemented programs to maintain the ISA and supporting documentation so that it is accurate and up-to-date. Changes to the ISA Summary are submitted to the NRC, in accordance with 10 CFR 70.72(d)(1) and (3) (CFR, 2003i). The ISA update process accounts for any changes made to the facility or its processes. This update will also verify that initiating event frequencies and IROFS reliability values assumed in the ISA remain valid. Any changes required to the ISA as a result of the update process will be included in a revision to the ISA. Evaluation of any facility changes or changes in the process safety information that may alter the parameters of an accident sequence is by the ISA method(s) as described in the ISA Summary Document. For any revisions to the ISA, personnel having qualifications similar to those of ISA team members who conducted the original ISA are used.

C. Personnel used to update and maintain the ISA and ISA Summary are trained in the ISA method(s) and are suitably qualified.

D. Proposed changes to the facility or its operations are evaluated by the ISA method(s) described in Section 3.1, General ISA Information. New or additional IROFS and appropriate management measures are designated as required. The adequacy of existing IROFS and associated management measures are promptly evaluated to determine if they are impacted by changes to the facility and/or its processes. If a proposed change results in a new type of accident sequence or increases the consequences or likelihood of a previously analyzed accident sequence within the context of 10 CFR 70.61 (CFR, 2003c), the adequacy of existing IROFS and associated management measures are promptly evaluated and the necessary changes are made, if required.

E. Unacceptable performance deficiencies associated with IROFS are addressed that are identified through updates to the ISA.

F. Written procedures are maintained on site.

G. All IROFS are maintained so that they are available and reliable when needed.

3.1.8.3 Management Measures

Management measures are functions applied to IROFS, and any items that may affect the function of IROFS. IROFS management measures ensure compliance with the performance requirements assumed in the ISA documentation. The measures are applied to particular structures, systems, equipment, components, and activities of personnel, and may be graded commensurate with the reduction of the risk attributable to that IROFS. The IROFS management measures shall ensure that these structures, systems, equipment, components, and activities of personnel within the identified IROFS boundary are designed, implemented, and maintained, as necessary, to ensure they are available and reliable to perform their function when needed, to comply with the performance requirements assumed in the ISA documentation.

The following types of management measures are required by the 10 CFR 70.4 definition of management measures. The description for each management measure reflects the general requirements applicable to each IROFS. Any management measure that deviates from the general requirements described in this section, which are consistent with the performance requirements assumed in the ISA documentation, are discussed in Section 3.8.3, Basis for Enhanced or High Availability Failure Probability Index Number. A cross reference from the associated IROFS in Table 3.8-1 to the applicable subsection is provided in Table 3.8-1.

<u>Configuration Management</u>

The configuration management program is required by 10 CFR 70.72 and establishes a system to evaluate, implement, and track each change to the site, structures, processes, systems, equipment, components, computer programs, and activities of personnel. Configuration management of IROFS, and any items that may affect the function of IROFS, is applied to all items identified within the scope of the IROFS boundary. Any change to structures, systems, equipment, components, and activities of personnel within the identified IROFS boundary must be evaluated before the change is implemented. If the change requires an amendment to the License, Nuclear Regulatory Commission approval is required prior to implementation.

<u>Maintenance</u>

Maintenance of IROFS, and any items that may affect the function of IROFS, encompasses planned surveillance testing and preventative maintenance, as well as unplanned corrective maintenance. Implementation of approved configuration management changes to hardware is also generally performed as a planned maintenance function.

Planned surveillance testing (e.g., functional/performance testing, instrument calibrations) monitors the integrity and capability of IROFS, and any items that may affect the function of IROFS, to ensure they are available and reliable to perform their function when needed, to comply with the performance requirements assumed in the ISA documentation. All necessary periodic surveillance testing is performed on an annual frequency (any exceptions credited within the ISA are discussed in Section 3.8.3).

Planned preventative maintenance (PM) includes periodic refurbishment, partial or complete overhaul, or replacement of IROFS, as necessary, to ensure the continued availability and reliability of the safety function assumed in the ISA documentation. In determining the frequency of any PM, consideration is given to appropriately balancing the objective of preventing failures through maintenance, against the objective of minimizing unavailability of IROFS because of PM. In addition, feedback from PM and corrective maintenance and the results of incident investigations and identified root causes are used, as appropriate, to modify the frequency or scope of PM.

Planned maintenance on IROFS, or any items that may affect the function of IROFS, that do not have redundant functions available, will provide for compensatory measures to be put into place to ensure that the IROFS function is performed until it is put back into service.

Corrective maintenance involves repair or replacement of equipment that has unexpectedly degraded or failed. Corrective maintenance restores the equipment to acceptable performance through a planned, systematic, controlled, and documented approach for the repair and replacement activities.

Following any maintenance on IROFS, and before returning an IROFS to operational status, functional testing of the IROFS, as necessary, is performed to ensure the IROFS is capable of performing its intended safety function.

Training and Qualifications

IROFS, and any items that may affect the function of IROFS, require that personnel involved at each level (from design through and including any assumed process implementation steps or actions) have and maintain the appropriate training and qualifications. Employees are provided with formal training to establish the knowledge foundation and on-the-job training to develop work performance skills. For process implemented steps or actions, a needs/job analysis is performed and tasks are identified to ensure that appropriate training is provided to personnel working on tasks related to IROFS. Minimum training requirements are developed for those positions whose activities are relied on for safety. Initial identification of job-specific training requirements is based on experience. Entry-level criteria (e.g., education, technical background, and/or experience) for these positions are contained in position descriptions.

Qualification is indicated by successful completion of prescribed training, demonstration of the ability to perform assigned tasks, and where required by regulation, maintaining a current and valid license or certification.

Continuing training is provided, as required, to maintain proficiency in specific knowledge and skill related activities. For all IROFS, and any items that may affect the function of IROFS, involving process implemented steps or actions, annual refresher training or requalification is required (any exceptions credited within the ISA are discussed in Section 3.8.3).

Procedures

All activities involving IROFS, and any items that may affect the function of IROFS, are conducted in accordance with approved procedures. Each of the other IROFS management measures (e.g., configuration management, maintenance, training) is implemented via approved procedures. These procedures are intended to provide a pre-planned method of conducting the activity in order to eliminate errors due to on-the-spot analysis and judgments.

All procedures are sufficiently detailed that qualified individuals can perform the required functions without direct supervision. However, written procedures cannot address all contingencies and operating conditions. Therefore, they contain a degree of flexibility appropriate to the activities being performed. Procedural guidance exists to identify the manner in which procedures are to be implemented. For example, routine procedural actions may not require the procedure to be present during implementation of the actions, while complex jobs, or checking with numerous sequences may require valve alignment checks, approved operator aids, or in-hand procedures that are referenced directly when the job is conducted.

To support the requirement to minimize challenges to IROFS, and any items that may affect the function of IROFS, specific procedures for abnormal events are also provided. These procedures are based on a sequence of observations and actions to prevent or mitigate the consequences of an abnormal situation.

Audits and Assessments

Audits are focused on verifying compliance with regulatory and procedural requirements and licensing commitments. Assessments are focused on effectiveness of activities and ensuring that IROFS are reliable and are available to perform their intended safety functions as documented in the ISA. The frequency of audits and assessments is based upon the status and safety importance of the activities being performed and upon work history. However, at a minimum, all activities associated with maintaining IROFS will be audited or assessed on an annual basis (any exceptions credited within the ISA are discussed in Section 3.8.3).

Incident Investigations

Incident investigations are conducted within the Corrective Action Program (CAP). Incidents associated with IROFS, and any items that may affect the function of IROFS, encompass a range of items, including (a) processes that behave in unexpected ways, (b) procedural activities not performed in accordance with the approved procedure, (c) discovered deficiency, degradation, or non-conformance with an IROFS, or any items that may affect the function of IROFS. Additionally, audit and assessment results are tracked in the Corrective Action Program.

Feedback from the results of incident investigations and identified root causes are used, as appropriate, to modify management measures to provided continued assurance that the reliability and availability of IROFS remain consistent with the performance requirements assumed in the ISA documentation.

Records Management

All records associated with IROFS, and any items that may affect the function of IROFS, shall be managed in a controlled and systematic manner in order to provide identifiable and retrievable documentation. Applicable design specifications, procurement documents, or other documents specify the QA records to be generated by, supplied to, or held, in accordance with approved procedures are included.

Other Quality Assurance Elements

Other quality assurance elements associated with IROFS, or any items that may affect the function of IROFS, that are required to ensure the IROFS is available and reliable to perform the function when needed to comply with the performance requirements assumed in the ISA documentation, will be listed in Table 3.8-1 and discussed in Section 3.8.3.

3.1.9 References

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CFR, 2003d. Title 10, Code of Federal Regulations, Section 70.24, Criticality accident requirements, 2003.

CFR, 2003e. Title 10, Code of Federal Regulations, Section 70.64, Requirements for new facilities or new processes at existing facilities, 2003.

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NRC, 1998. Nuclear Criticality Safety Standards for Fuels and Materials Facilities, Regulatory Guide 3.71, Nuclear Regulatory Commission, August 1998.

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TABLES

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Table 3.1-1 HAZOP Guidewords

UF_6 PROCESS GUIDEWORDS			
Less Heat	Corrosion	Maintenance	No Flow
More Heat	Loss of Services	Criticality	Reverse Flow
Less Pressure	Toxicity	Effluents/Waste	Less Uranium
More Pressure	Contamination	Internal Missile	More Uranium
Impact/Drop	Loss of Containment	Less Flow	Light Gas
Fire (Process, internal, other)	Radiation	More Flow	External Event
NON UF_6 PROCESS GUIDEWORDS			
High Flow	Low Pressure	Impact/Drop	More Uranium
Low Flow	High Temperature	Corrosion	External Event
No Flow	Low Temperature	Loss of Services	Startup
Reverse Flow	Fire	Toxicity	Shutdown
High Level	High Contamination	Radiation	Internal Missile
Low Level	Rupture	Maintenance	
High Pressure	Loss of Containment	Criticality	
No Flow			
EXTERNAL EVENTS POTENTIAL CAUSES			
Construction on Site	Hurricane	Seismic	Transport Hazard Off-Site
Flooding	Industrial Hazard Off-site	Tornado	External Fire
Airplane	Snow/Ice	Local Intense Precipitation	

Table 3.1-2 ISA HAZOP Table Sample Format

Page 1 of 1

ISA HAZOP NODE:		DESCRIPTION :			DATE:	PAGE:
GUIDEWORD	HAZARD	CAUSE	CONSEQUENCE	SAFEGUARDS	MITIGATING FACTORS	COMMENTS

Table 3.1-3 Consequence Severity Categories Based on 10 CFR 70.61
Page 1 of 1

	Workers	Offsite Public	Environment
Category 3 High Consequence	Radiation Dose (RD) >1 Sievert (Sv) (100 rem) For the worker (elsewhere in room), except the worker (local), Chemical Dose (CD) > AEGL-3 For worker (local), CD > AEGL-3 for HF CD > * for U	RD > 0.25 Sv (25 rem) 30 mg sol U intake CD > AEGL-2	–
Category 2 Intermediate Consequence	0.25 Sv (25 rem) <RD≤ 1 Sv (100 rem) For the worker (elsewhere in room), except the worker (local), AEGL-2 < CD≤ AEGL-3 For the worker (local), AEGL-2 < CD ≤ AEGL-3 for HF ** < CD ≤ * for U	0.05 Sv (5 rem) < RD≤ 0.25 Sv (25 rem) AEGL-1 <CD≤ AEGL-2	Radioactive release > 5000 x Table 2 Appendix B of 10 CFR Part 20
Category 1 Low Consequence	Accidents of lower radiological and chemical exposures than those above in this column	Accidents of lower radiological and chemical exposures than those above in this column	Radioactive releases with lower effects than those referenced above in this column

Notes:

*NUREG-1391 threshold value for intake of soluble U resulting in permanent renal failure

**NUREG-1391 threshold value for intake of soluble U resulting in no significant acute effects to an exposed individual

Table 3.1-4 Chemical Dose Information

Page 1 of 1

	High Consequence (Category 3)	Intermediate Consequence (Category 2)
Worker (local)	> 40 mg U intake > 139 mg HF/m^3	> 10 mg U intake > 78 mg HF/m^3
Worker (elsewhere in room)	> 146 mg U/m^3 > 139 mg HF/m^3	> 19 mg U/m^3 > 78 mg HF/m^3
Outside Controlled Area (30-min exposure)	> 13 mg U/m^3 > 28 mg HF/m^3	> 2.4 mg U/m^3 > 0.8 mg HF/m^3

Table 3.1-5 Likelihood Categories Based on 10 CFR 70.61

	Likelihood Category	Probability of Occurrence*
Not Unlikely	3	More than 10^{-4} per-event per-year
Unlikely	2	Between 10^{-4} and 10^{-5} per-event per-year
Highly Unlikely	1	Less than 10^{-5} per-event per-year

*Based on approximate order-of-magnitude ranges

Table 3.1-6 Risk Matrix with Risk Index Values

Page 1 of 1

Severity of Consequences	Likelihood of Occurrence		
	Likelihood Category 1 Highly Unlikely (1)	Likelihood Category 2 Unlikely (2)	Likelihood Category 3 Not Unlikely (3)
Consequence Category 3 High (3)	Acceptable Risk 3	Unacceptable Risk 6	Unacceptable Risk 9
Consequence Category 2 Intermediate (2)	Acceptable Risk 2	Acceptable Risk 4	Unacceptable Risk 6
Consequence Category 1 Low (1)	Acceptable Risk 1	Acceptable Risk 2	Acceptable Risk 3

Table 3.1-7 (Not Used)

Table 3.1-8 Determination of Likelihood Category

Page 1 of 1

Likelihood Category	Likelihood Index T (= sum of index numbers)
1	$T \leq -5$
2	$-5 < T \leq -4$
3	$-4 < T$

Table 3.1-9 Failure Frequency Index Numbers

Frequency Index No.	Based On Evidence	Based On Type Of IROFS**	Comments
-6*	External event with freq. < 10^{-6} /yr		If initiating event, no IROFS needed.
-5*	Initiating event with freq. < 10^{-5}/yr		For passive safe-by-design components or systems, failure is considered highly unlikely when no potential failure mode (e.g., bulging, corrosion, or leakage) exists, as discussed in Section 3.1.1.3.2, significant margin exists*** and these components and systems have been placed under configuration management.
-4*	No failures in 30 years for hundreds of similar IROFS in industry	Exceptionally robust passive engineered IROFS (PEC), or an inherently safe process, or two independent active engineered IROFS (AECs), PECs, or enhanced admin. IROFS	Rarely can be justified by evidence. Further, most types of single IROFS have been observed to fail
-3*	No failures in 30 years for tens of similar IROFS in industry	A single IROFS with redundant parts, each a PEC or AEC	
-2*	No failure of this type in this facility in 30 years	A single PEC	
-1*	A few failures may occur during facility lifetime	A single AEC, an enhanced admin. IROFS, an admin. IROFS with large margin, or a redundant admin. IROFS	
0	Failures occur every 1 to 3 years	A single administrative IROFS	
1	Several occurrences per year	Frequent event, inadequate IROFS	Not for IROFS, just initiating events

Table 3.1-9 Failure Frequency Index Numbers

Page 2 of 2

Frequency Index No.	Based On Evidence	Based On Type Of IROFS**	Comments
2	Occurs every week or more often	Very frequent event, inadequate IROFS	Not for IROFS, just initiating events

*Indices less than (more negative than) –1 should not be assigned to IROFS unless the configuration management, auditing, and other management measures are of high quality, because, without these measures, the IROFS may be changed or not maintained.

**The index value assigned to an IROFS of a given type in column 3 may be one value higher or lower than the value given in column 1. Criteria justifying assignment of the lower (more negative) value should be given in the narrative describing ISA methods. Exceptions require individual justification.

***For components that are safe-by-volume, safe-by-diameter, or safe-by-slab thickness, significant margin is defined as a margin of at least 10%, during both normal and upset conditions, between the actual design parameter value of the component and the value of the critical design attribute. For components that require a more detailed criticality analysis, significant margin is defined as $k_{eff} < 0.95$, where $k_{eff} = k_{calc} + 3\sigma_{calc}$.

Table 3.1-10 Failure Probability Index Numbers

Probability Index No.	Probability of Failure on Demand	Based on Type of IROFS	Comments
-6*	10^{-6}		If initiating event, no IROFS needed.
-4 or -5*	10^{-4} - 10^{-5}	Exceptionally robust passive engineered IROFS (PEC), or an inherently safe process, or two redundant IROFS more robust than simple admin. IROFS (AEC, PEC, or enhanced admin.)	Can rarely be justified by evidence. Most types of single IROFS have been observed to fail
-3 or -4*	10^{-3} - 10^{-4}	A single passive engineered IROFS (PEC) or an active engineered IROFS (AEC) with high availability	
-2 or -3*	10^{-2} - 10^{-3}	A single active engineered IROFS, or an enhanced admin. IROFS, or an admin. IROFS for routine planned operations	
-1 or -2	10^{-1} - 10^{-2}	An admin. IROFS that must be performed in response to a rare unplanned demand	

*Indices less than (more negative than) –1 should not be assigned to IROFS unless the configuration management, auditing, and other management measures are of high quality, because, without these measures, the IROFS may be changed or not maintained.

Table 3.1-11 Failure Duration Index Numbers

Duration Index No.	Avg. Failure Duration	Duration in Years	Comments
1	More than 3 yrs	10	
0	1 yr	1	
-1	1 mo	0.1	Formal monitoring to justify indices less than -1
-2	A few days	0.01	
-3	8 hrs	0.001	
-4	1 hr	10^{-4}	
-5	5 min	10^{-5}	

- Midland-Odessa station (NOAA, 2002a) averages are based on a 30 year record (1961 to 1990) unless otherwise stated
- Roswell station (NOAA, 2002b) averages are based on a 30 year record (1961 to 1990) unless otherwise stated.

The WCS data was not used since it had not been fully verified by WCS. An analysis of the WCS data was performed and it was determined that the prevailing wind direction at the WCS facility agrees with the prevailing wind directions at Midland-Odessa and Roswell. Use of the Hobbs, Midland-Odessa, and Roswell observations for a general description of the meteorological conditions at the NEF was deemed appropriate as they are all located within the same region and have similar climates. Use of the Midland-Odessa data for predicting the dispersion of gaseous effluents was deemed appropriate. It is the closest first-order National Weather Service (NWS) station to the NEF site, and both Midland-Odessa and the NEF site have similar climates. In addition, wind direction frequency comparisons between Midland-Odessa and the closest source of meteorological measurements (WCS) to the NEF site show good agreement. Midland-Odessa and Roswell data were compiled and certified by the National Climatic Data Center. Hobbs data were compiled and certified by the Western Regional Climate Center.

3.2.3.1 Local Wind Patterns and Average and Maximum Wind Speeds

Monthly mean wind speeds and prevailing wind directions at Midland-Odessa are presented in Table 3.2-5, Midland-Odessa, Texas, Wind Data. The annual mean wind speed was 4.9 m/s (11.0 mi/hr) and the prevailing wind direction was 180 degrees with respect to true north. The maximum five-second wind speed was 31.3 m/s (70 mi/hr).

Monthly mean wind speeds and prevailing wind directions at Roswell are presented in Table 3.2-6, Roswell, New Mexico, Wind Data. The annual mean wind speed was 3.7 m/s (8.2 mi/hr) and the prevailing wind direction was wind from 160 degrees with respect to true north. The maximum five-second wind speed was 27.7 m/s (62 mi/hr).

Five years of data (1987-1991) from the Midland-Odessa NWS were used to generate joint frequency distributions of wind speed and direction. This data summary, for all Pasquill stability classes (A-F) combined, is provided in Table 3.2-7, Midland-Odessa Five Year (1987-1991) Annual Joint Frequency Distribution For All Stability Classes Combined.

Five years of data (1987-1991) from the Midland-Odessa NWS were used to generate joint frequency distributions of wind speed and direction as a function of Pasquill stability class (A-F). Stability class was determined using the solar radiation/cloud cover method. These data are given in Tables 3.2-8 through 3.2-13. The most stable classes, E and F, occur 18.3% and 13.6% of the time, respectively. The least stable class, A, occurs 0.4% of the time. Important conditions for atmospheric dispersion, stable (Pasquill class F) and low wind speeds 0.4-1.3 m/s (1.0-3.0 mi/hr), occur 2.2% of the time. The highest occurrences of Pasquill class F and low wind speeds, 0.4-1.3 m/s (1.0-3.0 mi/hr), with respect to wind direction are 0.28% and 0.23% with south and south-southeast winds.

3.2.3.2 Annual Amounts and Forms of Precipitation

The normal annual total rainfall as measured in Hobbs is 46.1 cm (18.15 in). Precipitation amounts range from an average of 1.2 cm (0.45 in) in March to 8 cm (3.1 in) in September. The record maximum and minimum monthly totals are 35.13 cm (13.83 in) and zero, respectively (WRCC, 2003). Table 3.2-14, Hobbs New Mexico Temperature and Precipitation Data, lists the monthly averages and extremes of precipitation for the Hobbs data. These precipitation summaries are based on 30 year records.

The normal annual total rainfall as measured in Midland-Odessa is 37.6 cm (14.8 in). Precipitation amounts range from an average of 1.1 cm (0.42 in) in March to 5.9 cm (2.31 in) in September. The record maximum and minimum monthly totals are 24.6 cm (9.70 in) and zero, respectively. The highest 24-hour precipitation total was 15.2 cm (6 in) in July 1968 (NOAA, 2002a). Table 3.2-15, Midland-Odessa, Texas, Precipitation Data, lists the monthly averages and extremes of precipitation for the Midland-Odessa data. These precipitation summaries are based on 30 year records.

The normal annual rainfall total as measured in Roswell, New Mexico, is 33.9 cm (13.34 in). The record maximum and minimum monthly totals are 17.5 cm (6.9 in) and zero, respectively (NOAA, 2002b, 2002a). The highest 24-hour precipitation total was 12.5 cm (4.91 in) in July 1981 (NOAA, 2002b). Table 3.2-16, Roswell, New Mexico, Precipitation Data, lists the monthly averages and extremes of precipitation for the Roswell data. These precipitation summaries are based on 30 year records.

3.2.3.3 Design Basis Values for Snow or Ice Load

Snowfall in Midland-Odessa, Texas, averages 13.0 cm (5.1 in) per year. Maximum monthly snowfall/ice pellets of 24.9 cm (9.8 in) fell in December 1998. The maximum amount of snowfall/ice pellets to fall in 24 hours was 24.9 cm (9.8 in) in December 1998 (NOAA, 2002a). Table 3.2-17, Midland-Odessa, Texas, Snowfall Data, lists the monthly averages and maximums of snowfall/ice pellets at Midland-Odessa, Texas. These snowfall summaries are based on 30 year records.

Snowfall in Roswell, New Mexico, averages 30.2 cm (11.9 in) per year. Maximum monthly snowfall/ice pellets of 53.3 cm (21.0 in) fell in December 1997. The maximum amount of snowfall/ice pellets to fall in 24 hours was 41.9 cm (16.5 in) in February 1988 (NOAA, 2002b). Table 3.2-18, Roswell, New Mexico, Snowfall Data, lists the monthly averages and maximums of snowfall/ice pellets at Roswell, New Mexico. These snowfall summaries are based on 30 year records.

The design basis snow load for the NEF was determined by combining the 100-year snowpack loading and 48 hour Probable Maximum Winter Precipitation (PMWP) loading for the area. Using the published 50 year snowpack loading of 48.8 kg/m^2 (10 lb/ft^2) (ASCE, 1998) and adjusting this value using the method described by ASCE, the 100 year snowpack loading is determined to be 58.6 kg/m^2 (12 lb/ft^2).

The 48-hour PMWP as determined by the methodology outlined in Hydrometeorlogical Report No. 33 (WB, 1956) is determined to be 483 mm (19 in), which corresponds to a loading of 96.6 kg/m^2 (19.8 lb/ft^2). These two values were used to develop a design basis snow loading of 156 kg/m^2 (32 lb/ft^2).

stratigraphy. In some locations, the caprock (caliche) overlies sand and gravel, with the red bed clay Chinle Formation at the base of the pit. In some areas the caprock is missing and the sand and gravel is exposed at the surface. The caprock is generally fractured and following precipitation events may allow infiltration that quickly bypasses any roots from surface vegetation. In addition, gravel outcrops may allow rapid infiltration of precipitation. These conditions have led to instances of minor amounts of perched groundwater at the base of the sand and gravel unit, atop the red bed Chinle Formation. The Chinle red bed clay has a very low permeability, about 1 x 10^{-8} cm/s (4 x 10^{-9} in/s) (Rainwater, 1996), and serves as a confining unit arresting downward percolation of localized recharge flux. This shallow perched zone is not pervasive throughout the area.

Conditions at the NEF site are different than at the Wallach Concrete site. Two differences are of particular importance. First, the caprock is not present at the NEF site. Therefore, rapid infiltration through fractured caliche does not contribute to localized recharge at the NEF site. Second, the surface soils at the NEF site are finer-grained than the sand and gravel at the Wallach Concrete site. There is a thin layer of sand and gravel just above the red bed Chinle clay unit on the NEF site, but based on recent investigations, it is not saturated.

Another instance of possible saturation above the Chinle clay may be seen at Baker Spring, just to the northeast of the NEF site. Baker Spring is located at the edge of an escarpment, where the caprock ends. Baker Spring is intermittent, and water typically flows from it only after precipitation events. There may be some water seeping from the sand and gravel unit beneath the caprock and into Baker Spring. The area where Baker Spring is located is underlain by the Chinle clay. Deep infiltration of water is impeded by the low permeability of the clay. Therefore, seepage and/or precipitation/runoff into the Baker Spring area appear to be responsible for the intermittent localized flow and ponding of water in this area. Flows from this feature are intermittent, unlike those supplying the Wallach Concrete pits. This condition does not exist at the NEF site due to the absence of the caprock and the low permeability surface soils.

A recent investigation of the Baker Spring area supports the conclusion that the feature is man-made and results from the historical excavation of gravel and caprock materials that are present above the redbed clay. As a result of the excavation, Baker Spring is topographically lower than the surrounding area. Following rainfall events, ponding on the excavation floor occurs. Because the excavation floor consists of very low permeability clay of the redbed, limited vertical migration of the ponded water occurs. Shading from the high wall and trees that have flourished in the excavated area retard the natural evaporation rates and water stands in the pond for sometime. It is also suspected that during periods of ponding, surface water infiltrates into the sands at the base of the excavated wall and is retained as bank storage. As the surface water level declines, the bank storage is discharged back to the excavation floor.

A third instance of localized shallow groundwater occurrence exists to the east of the NEF site where several windmills on the WCS property were used to supply water for stock tanks. These windmills tapped small saturated lenses above the Chinle Formation red beds. The amount of groundwater in these zones is limited. The source of recharge for these localized perched zones is likely to be "buffalo wallows," (playas) depressions located near the windmills. The buffalo wallows are substantial surface depressions that collect surface water runoff. Water collecting in these depressions is inferred to infiltrate below the root zone due to the ponding conditions. WCS has drilled monitoring wells in these areas to characterize the nature and extent of the saturated conditions. Some of these wells are dry, owing to the localized nature of the perched conditions. When water is encountered in the sand and gravel above the Chinle

Formation red beds, its level is slow to recover following sampling events due to the low permeability of the perched saturated zones. The discontinuity of this saturated zone and its low permeability argue against its definition as an aquifer. No buffalo wallows or related groundwater conditions occur on or near the NEF site.

The hydrologic conditions that occur in the shallow surface regime at the NEF site are substantiated by field investigations including geochemical and soil-physics based techniques, as well as computer modeling, and show that there is no recharge occurring in thick, desert vadose zones with desert vegetation (Walvoord, 2002). Precipitation that infiltrates into the subsurface is efficiently transpired by the native vegetation. Vapor-phase movement of soil-moisture may occur, but it is also intercepted by the vegetation. In a thick vadose zone, such as at the NEF site, the deeper part of that zone has a natural thermal gradient that induces upward vapor diffusion. As a result, a small flux of water vapor rises from depth to the base of the root zone, and any infiltration coming from the land surface is captured by the roots of the plants within the top several meters of the profile. Effectively, there is a maximum negative pressure potential at the base of the root zone that acts like a sink, where water is taken up by the plants and transpired. These deep desert soil systems have functioned in this manner for thousands of years, essentially since the time of the last glacial period when precipitation rates fell dramatically. It is expected that these conditions will remain for several thousand more years (until the next glacial period), unless the hydrology and vegetation is altered dramatically.

3.2.4.3 Floods

The NEF site is located above the 100 or 500-year flood elevation (WBG, 1998 and FEMA, 1978).

The NEF site is contained within the Landreth-Monument Draw Watershed. The closest water conveyance is Monument Draw, a typically dry, intermittent stream located about 4 km (2.5 mi) west of the site. The maximum historical flow for Monument Draw is 36.2 m^3/s (1,280 ft^3/s) measured June 10, 1972. All other historical maximum measurements are below 2.0 m^3/s (70 ft^3/s) (USGS, 2003a). Therefore, a flood is not considered to be a design basis event for the NEF site.

3.2.4.4 Groundwater Hydrology

A subsurface investigation was performed for the NEF site during September 2003 to delineate specific hydrologic conditions. Figure 3.2-5 shows the locations of subsurface borings and observation wells.

The WCS facility, located east of the site in Texas, has had numerous subsurface investigations performed for the purpose of delineating and monitoring site subsurface hydrogeologic conditions. Much of this information is directly pertinent to the NEF site. The WCS hydrogeologic data was used in planning the recent NEF site investigations. A recent evaluation of potential groundwater impacts in the area provides a good overview of the investigations performed for the WCS facility. (Rainwater, 1996)

The NEF site investigation initiated in September 2003 had two main objectives: 1) to delineate the depth to the top of the Chinle Formation red beds to assess the potential for saturated conditions above the red beds, and 2) to complete three monitoring wells in the siltstone layer

The Decontamination Workshop is maintained at a lower pressure than surrounding areas. Therefore any equipment or personnel entering this room must go through an air-lock.

This room is approximately 22.1 m (72.5 ft") x 20.0 m (65.6 ft) x 5.0 m (16.4 ft) high and contains 442 m^2 (4,758 ft^2). It is classified as a Special Purpose Industrial Occupancy area with a less than exempt amount of hazardous materials. This area is separated from the other Special Purpose Industrial Occupancy areas by one-hour fire-rated construction.

3.3.1.2.2.4 Ventilated Room

The Ventilated Room is designed to provide space for the maintenance of chemical traps and cylinders. The Ventilated Room is also used for the temporary storage of full and empty chemical traps and the contaminated chemicals used in the chemical traps.

The activities carried out within the Ventilated Room include receipt and storage of saturated chemical traps, chemical removal and temporary storage, contaminated cylinder pressure testing, and UF_6 cylinder pump out and valve maintenance.

The Ventilated Room is maintained at a lower pressure than surrounding areas. Therefore, any equipment or personnel entering this room must go through an air-lock.

This room is approximately 14.9 m (48.9 ft) x 20.0 m (65.6 ft) x 5.0 m (16.4 ft) high and contains 298 m^2 (3,208 ft^2). It is classified as a Special Purpose Industrial Occupancy area with a less than exempt amount of hazardous materials. This area is separated from the other Special Purpose Industrial Occupancy areas by one-hour fire-rated construction.

3.3.1.2.2.5 Cylinder Preparation Room

The Cylinder Preparation Room is designed for the purpose of testing and inspecting new or cleaned 30B, 48X, and 48Y cylinders for use in the facility.

This room is approximately 25.0 m (82 ft) x 20.0 m (65.6 ft) x 10 m (32.8 ft) high and totals 500 m^2 (5,382 ft^2). It is classified as a Special Purpose Industrial Occupancy area.

The Cylinder Preparation Room is maintained at a lower pressure than surrounding areas. Therefore any equipment or personnel entering this room must go through an air-lock.

3.3.1.2.2.6 Mechanical, Electrical and Instrumentation (ME&I) Workshop

The ME&I Workshop is designed to provide space for the normal maintenance of non-contaminated plant equipment. The facility also deals with faults associated with the pump motors, all instrument and control equipment, lighting, power, and associated process and services pipe work. It also provides space for the temporary storage of rebuilt equipment and other minor plant equipment.

This room is approximately 14.8 m (48.6 ft) x 20.0 m (65.6 ft) x 10.0 m (32.8 ft) high and totals 296 m^2 (3,186 ft^2). It is classified as a Special Purpose Industrial Occupancy area.

3.3.1.2.2.7 Liquid Effluent Collection and Treatment Room

The Liquid Effluent Collection and Treatment Room is designed for the collection of potentially contaminated liquid effluents produced on site, which are monitored for contamination prior to processing. These liquid effluents are stored in tanks prior to processing. The effluents are segregated into significantly contaminated effluent, slightly contaminated effluent or non-contaminated effluent. Liquid effluents produced by the facility include hydrolysed uranium hexafluoride and aqueous laboratory effluent, degreaser water, citric acid, laundry effluent water, floor washings, miscellaneous condensates and active area hand washings/shower water. The Liquid Waste Collection System is described in Section 3.5.12, Liquid Effluent Collection and Treatment System.

This room is approximately 19.8 m (64.9 ft) x 20.0 m (65.6 ft) x 10.0 m (32.8 ft) high and totals 396 m^2 (4,263 ft^2). It is classified as a Special Purpose Industrial Occupancy area. The Liquid Effluent Collection and Treatment Room is separated from adjacent areas by one-hour fire-rated construction.

3.3.1.2.2.8 Laundry

The Laundry is designed to clean contaminated and soiled clothing and other articles, which have been used throughout the facility. Laundry is sorted into two categories, articles with a high possibility of contamination and articles unlikely to have been contaminated. Those that are likely to be contaminated are further sorted into lightly and heavily soiled articles. Heavily soiled articles are transferred to the solid waste disposal system without having been washed.

The Laundry contains two industrial quality washing machines (75 kg (165 lb) capacity), two industrial quality dryers (75 kg (165 lb) capacity), one sorting hood to draw potentially contaminated air away, a sorting table and an inspection table. The Laundry System is described in Section 3.5.16, Laundry System. The Laundry also contains a small office and storage room.

This room is approximately 161.2 m^2 (1,735 ft^2). It is classified as a Special Purpose Industrial Occupancy area.

3.3.1.2.2.9 TSB Gaseous Effluent Vent System (GEVS) Room

The TSB GEVS is designed to remove UF_6, particulates containing uranium, and hydrogen fluoride (HF) from potentially contaminated process gas streams. Prefilters and High Efficiency Particulate Air filters remove particulates, including uranium particles, and impregnated and activated charcoal filters remove any residual traces of uranium and HF. The TSB GEVS is described in Section 3.4.9, Gaseous Effluent Vent System. The major components of the TSB GEVS are located in the TSB GEVS Room.

This room is approximately 9.6 m (31.5 ft) x 20.0 m (65.6 ft) x 10.0 m (32.8 ft) high and totals 192 m^2 (2,067 ft^2). It is classified as a Special Purpose Industrial Control area and is separated from the other Special Purpose Industrial Occupancy areas by one-hour fire-rated construction.

H. Postulated Pipe Break Loads

1. Pressure Differential (Pa) - Differential pressure load generated by a postulated pipe break. Load to be determined during final design based on line size and maximum pressure.
2. Jet Impingement Load (Y_j) - Jet impingement load generated by a postulated pipe break. Load to be determined during final design based on line size and maximum pressure.
3. Missile Impact Load (Y_m) - Missile impact load, including pipe whip, generated by a postulated pipe break. Load to be determined during final design based on line size and maximum pressure.
4. Pipe Reaction (Y_r) - Load generated by broken pipe during postulated pipe break. Load to be determined during final design based on line size and maximum pressure.

3.3.2.2.8.2 Extreme Environmental Loads

Extreme environmental loads are those loads that are credible but highly improbable. They include the following:

A. Design Basis Tornado (W_t)

The Design Basis Tornado loads are made up of 3 load components acting in various combinations. The load components are:

1. Tornado wind velocity pressure (W_w)
2. Tornado induced differential pressure (W_p)
3. Tornado generated missile load (W_m)

Items 1. and 2. are discussed in Section 3.3.2.2.2. Item 3. is discussed in Section 3.3.2.2.3.

The three load components can act in the following combinations as described in ACI 349-90 (ACI, 1990b).

a. $W_t = W_w$
b. $W_t = W_p$
c. $W_t = W_m$
d. $W_t = W_w + W_m$
e. $W_t = W_w + 0.5\, W_p$
f. $W_t = W_w + 0.5\, W_p + W_m$

B. Safe Shutdown Earthquake (E_s)

Loads from the Safe Shutdown Earthquake (i.e., DBE) are discussed in Section 3.3.2.2.5.

C. Design Basis Flood (DBFL)

Loads from the Design Basis Flood are discussed in Section 3.3.2.2.4.

D. Truck and Gas Pipeline Hazards

Explosion hazards from trucks (e.g., propane trucks) on highways near the NEF site are described in Section 3.2.1.2.1. Explosion hazards from gas pipelines near the NEF site are described in Section 3.2.2.4, Industrial Areas. During detailed design of specific buildings and areas, pressure loads due to postulated truck and pipeline explosions will be considered. The pressure loads will be developed in accordance with the underlying assumptions used in the explosion hazard assessments described in Sections 3.2.1.2.1 and 3.2.2.4. These buildings and areas include: Separations Building Modules (UF_6 Handling Area, Process Services Area and Cascade Halls), Blending and Liquid Sampling Area, Cylinder Receipt and Dispatch Building, Technical Services Building and the Centrifuge Test Facility. As described in Section 3.3.1, Buildings and Major Components, these buildings and areas are constructed of concrete.

3.3.2.2.8.3 Combined Load Applications

The load combinations defined in this section are applied to all structures, components and equipment supports.

A. Load Combinations For Structures Combining Factored Loads Using Strength Design (Concrete)

All of the following load combinations shall be satisfied for concrete structures for the safety significant areas:

1. $U = 1.4D + 1.4F + 1.7(L_R \text{ or } S \text{ or } R) + 1.7H + 1.4R_o$
2. $U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7Eo + 1.7Ro$
3. $U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7W + 1.7Ro$
4. $U = D + F + L + H + T + Ra + 1.25Pa$
5. $U = D + F + L + H + T + Ra + 1.15Pa + 1.0(Yr + Yj + Ym) + 1.15Eo$
6. $U = 1.05D + 1.05F + 1.3L + 1.3H + 1.05T + 1.3Ro$
7. $U = 1.05D + 1.05F + 1.3L + 1.3H + 1.3Eo + 1.05T + 1.3Ro$
8. $U = 1.05D + 1.05F + 1.3L + 1.3H + 1.3W + 1.05T + 1.3Ro$

For extreme environmental conditions the following load combinations are satisfied:

9. $U = D + F + L + H + T + R_o + E_s$
10. $U = D + F + L + H + T + R_o + W_t$
11. $U = D + F + L + H + T + R_a + 1.0P_a + 1.0(Y_r + Y_j + Y_m) + 1.0E_s$
12. U - Used for concrete structures, U is the required strength to resist factored loads or related internal moments, shears and forces, based on methods described in ACI 318 (ACI, 1999).

B. Load Combinations For Structures Combining Factored Loads Using Strength Design (Concrete)

All of the following load combinations shall be satisfied for all concrete structures:

1. $U = 1.4(D + F)$
2. $U = 1.2(D + F + T) + 1.6(L+H) + 0.5(L_r \text{ or } S \text{ or } R)$

the 48Y or 30B cylinder fill limit by the plant design and operating features. The moderation within the cylinder is controlled by a series of plant operating features. These features include, among others, checks that the cylinder is clean and empty prior to the commencement of fill. Also, the moderator (H_2O, HF) entering the cylinder is monitored during the time the cylinder is connected to the plant UF_6 systems.

Calculations were performed on infinite two-dimensional arrays of full 48Y or 30B product cylinders. Inside each cylinder a region of UO_2F_2/water mixture was located. The remainder of the interior of the cylinder was assumed to be filled with 6.0 $^w/_o$ ^{235}U enriched UF_6. Cylinders in the arrays were placed with the valve and base ends alternately in contact, so that the moderated region in a given cylinder was in the closest possible proximity to the moderated region in an adjacent cylinder. All cylinders were considered to be lying on a concrete pad one meter thick. Moderation was varied to obtain the optimum H/U ratio. Worst-case external reflection/moderation conditions were found by varying the density of the interstitial water between cylinders to simulate frost or snow. The calculation also assumed one cylinder above (touching) the array to simulate movement in/out/over the array.

For the 48Y cylinder, the condition that met the upper safety limit had an H/U ratio of 11.5 with an interstitial water density of 0.10 g/cm^3 (6.2 lb/ft^3). Thus, the maximum safe mass of hydrogen in each type product 48Y cylinder in an array was determined to be 1.05 kg (2.31 lb) present in the form of 9.5 kg (20.9 lb) of water.

For the 30B cylinder, the condition that met the upper safety limit had an H/U ratio of 10.5 with an interstitial water density of 0.25 g/cm^3 (15.6 lb/ft^3). Thus, the maximum safe mass of hydrogen in each type product 30B cylinder in an array was determined to be 0.95 kg (2.09 lb) present in the form of 8.5 kg (18.7 lb) of water.

Criticality safety of Type 48Y and 30B product cylinders depends on the control of moderator content. Criticality safety is achieved by ensuring that there is less than 1.05 kg (2.31 lb) of hydrogen present in a Type 48Y cylinder and less than 0.95 kg (2.09 lb) of hydrogen present in a Type 30B cylinder.

3.4.4.8.2 UF_6 Cold Traps

Although the cold traps have a large internal volume they are individually safe by shape, the trap body having an internal diameter of 20.3 cm (8.0 in). This compares with the safe diameter of 21.9 cm (8.6 in) for 6.0 $^w/_o$ enrichment. Individual cold traps are thus safe in isolation for any uranyl fluoride/water mixture. In practice the maximum H/U atom ratio in the cold traps will be 7; however, a sensitivity study is performed to determine the optimum H/U ratio, providing an additional margin of safety.

The cold trap and the standby cold trap are separated from each other by center-to-center separation of 110 cm (43.3 in). There is a minimum edge separation of 180 cm (70.9 in) from any other fixed plant vessels that can accumulate enriched uranium. The pair of traps can thus be considered to be neutronically isolated from other fixed vessels.

Calculations were performed on the isolated pair of cold traps and were found to be substantially subcritical with $k_{eff} = 0.8030$. The calculations assumed an enrichment of 6.0 $^w/_o$, H/U of 7 and 2.5 cm (0.984 in) water reflection placed at the model boundary to simulate spurious reflection.

According to the restrictions on movement of mobile vessels, one vessel can come into contact with a trap but any others have to be kept at 60 cm (23.6 in) separation.

MONK8A (SA, 2001) calculations have been performed in which a vacuum cleaner is in contact with one of the cold traps, and another vessel (a 14 L (3.7 gal) product vent vacuum pump) is at 60 cm (23.6 in) edge spacing from the same cold trap. These are typical of Separation Plant mobile vessels. Each mobile vessel was modeled with the appropriate uranic fill; the vacuum cleaner was filled with uranyl fluoride/water mixture with optimum moderation (H/U=12), and the vacuum pump (conservatively containing hydrocarbon oil) was filled with uranic breakdown of composition $UF_4 \cdot 10.5CH_2$. The resulting $k_{eff} = 0.8229$ shows a slight increase in reactivity with respect to the isolated pair of traps using the same conservative assumptions. The vacuum cleaner was assumed to be a cleaner of internal diameter 20.3 cm (8.0 in) and length 66 cm (26.0 in) and was assumed to be entirely filled with uranic material with an enrichment of 6.0 $^{w}/_{o}$. MONK8A (SA, 2001) calculations have been carried out for an isolated cylinder using these dimensions, filled with uranyl fluoride/water at optimum moderation and with 2.5 cm (0.984 in) water reflection. This gave a value for k_{eff} of 0.8037. The cleaner has high efficiency particulate air (HEPA) filtration on the exhaust, and will be dedicated for cleaning operations where uranic material is involved and will be marked clearly.

Additionally, calculations were performed in which it was assumed that there are no movement controls, and both the vacuum cleaner and pump were in contact with one of the cold traps. Even with 2.5 cm (0.984 in) spurious water reflection placed around each unit, and at enrichment of 6.0 $^{w}/_{o}$, the result remained substantially subcritical with $k_{eff} = 0.8673$.

The cold traps have therefore been determined to be safe both as a pair in isolation and while interacting with other fixed plant or vessels in movement for ^{235}U enrichments up to 6.0 $^{w}/_{o}$.

3.4.4.8.3 Vacuum Pump / Chemical Trap Sets

These chemical traps of the Product Vent Subsystem are individually safe by diameter (20.3 cm (8.0 in) compared with the safe diameter of 21.9 cm (8.6 in) calculated for 6.0 $^{w}/_{o}$ enrichment). However, calculations have been performed concerning the effect of possible neutron interaction with nearby (uranium bearing) equipment.

In the MONK8A (SA, 2001) calculations for the Product Vent Subsystem, the plant spacing to the edge of the standby vent system is assumed to be 50 cm (19.7 in). The standby vent system has been included in the model. The traps were both assumed to fill entirely with uranyl fluoride/water with no restriction on water content. This is conservative, as in practice the H/U ratio of the uranyl fluoride in the traps will have a limiting upper value of 7. Also, the space within the trap, which would normally be occupied by carbon or alumina, is modeled as being filled with uranic material. This maximizes the mass of fissile material within the traps and provides added conservatism. The pump, alumina traps, oil trap and exhaust filter are assumed to be filled with uranyl fluoride/water of unlimited water content. This is conservative, as virtually no uranium is expected in these components.

Calculations were performed to account for interaction with other vessels in movement. According to the restrictions on movement, one mobile vessel can come into contact with one of the fixed chemical absorber traps, but other mobile vessels are assumed to be at 60 cm (23.6 in) separation. The case modeled was for a vacuum cleaner (of diameter 20.3 cm (8.0 in) and length 66 cm (26.0 in)) to be brought into contact with the vacuum pump in the product vent array. One other item, a 14 L (3.7 gal) rotary vane pump, was placed at 60 cm (23.6 in) edge spacing from the vacuum cleaner. The vacuum cleaner was assumed to be a cleaner of internal diameter 20.3 cm (8.0 in) and length 66 cm (26.0 in) and was assumed to be entirely filled with uranic material with an enrichment of 6.0 $^{w}/_{o}$. MONK8A (SA, 2001) calculations have been carried out for an isolated cylinder using these dimensions, filled with uranyl fluoride/water at optimum moderation and with 2.5 cm (0.984 in) water reflection. This gave a value for k_{eff} of 0.8037. The cleaner has HEPA filtration on the exhaust, and will be dedicated for cleaning operations where uranic material is involved and will be marked clearly.

The MONK8A (SA, 2001) calculation for the worst case, where all vessels were assumed to be entirely filled with uranyl fluoride/water mixture at optimum moderation, a trap and a vacuum cleaner are in contact with one of the fixed pumps, and all pumps were modeled with volumes of 14 L (3.7 gal), yields a $k_{eff} = 0.9328$.

It should be noted that the above MONK8A (SA, 2001) model represents extreme accident conditions in terms of uranium accumulation and moderator ingress. It should also be noted that the simple MONK8A (SA, 2001) model used for the vacuum pump in all of the calculations is conservative. Since the real shape of the internal free volume is far from optimum, an explicit model of the pump is expected to result in a significant reduction in k_{eff}.

The vacuum pump/chemical trap sets have been shown to be safe under normal operating conditions and credible abnormal operating conditions, for ^{235}U enrichments up to 6.0 $^{w}/_{o}$.

3.4.4.8.4 Product Pumping Train UF_6 Pumps

More than 200 cm (78.7 in) separates each Product Pumping Train in the plant from other uranium containing vessels, so only interaction with mobile components needs be considered. Additionally, when being removed for repair or maintenance, a UF_6 pump might pass near to another similar pump.

The currently planned pump combination unit consists of two Leybold pumps, models WS2000 series and WS500 series, positioned in a fixed frame. The WS500 series has an internal free volume of 8.52 L (2.25 gal), which is less than half of the maximum safe volume of 18 L (4.8 gal) at 6.0 $^{w}/_{o}$ enrichment. Therefore the WS500 series pump can be modeled conservatively as an isometric cylinder of the same volume. However, the WS2000 series pump has an internal free volume of 33 L (8.7 gal), which considerably exceeds the safe volume, and even exceeds the minimum critical volume of 24 L (6.3 gal). Although the WS2000 series pump has a larger than critical internal free volume, the shape of the internal volume is far from the optimum. Therefore, the WS2000 pump was modeled in some detail based on drawings supplied by the manufacturer.

MONK8A (SA, 2001) calculations were initially performed for an isolated pump combination to assess the intrinsic safety of the combination. The maximum k_{eff} of 0.7479 was achieved using an enrichment of 6.0 $^{w}/_{o}$ and an optimum H/U ratio of 12. From this analysis, the pump combination in isolation can be regarded as being intrinsically safe. As mentioned above, there is potential for a second pump unit to approach when being removed for maintenance. Calculations were performed on pairs of pumps in contact with each other, either side by side, or touching at the gearbox ends. The most reactive case was with the gearbox ends touching ($k_{eff} = 0.8277$), assuming an enrichment of 6.0 $^{w}/_{o}$ and an optimum H/U ratio of 10.

To consider interaction of mobile vessels, calculations were performed which added a vacuum cleaner to the pair of pumps, either in contact with the gearbox end (with the pumps side by side) or alongside one of the pumps (with the pumps touching at the gearbox ends). The worst case was achieved with the latter arrangement giving a $k_{eff} = 0.8444$.

A 14 L (3.7 gal) isometric cylinder representing an additional pump in transit was then placed 60 cm (23.6 in) from the vacuum cleaner resulting in a $k_{eff} = 0.8743$. This increase reflects the fact that the 14 L (3.7 gal) pump is the most reactive unit in the array; over 80% of fission events occur inside the 14 L (3.7 gal) pump. The relative orientation of the product pumps and vacuum cleaner has little effect on the value of k_{eff} when the 14 L (3.7 gal) pump is present. The vacuum cleaner was assumed to be a cleaner of internal diameter 20.3 cm (8.0 in) and length 66 cm (26.0 in) and was assumed to be entirely filled with uranic material with an enrichment of 6.0 $^w/_o$. MONK8A (SA, 2001) calculations have been carried out for an isolated cylinder using these dimensions, filled with uranyl fluoride/water at optimum moderation and with 2.5 cm (0.984 in) water reflection. This gave a value for k_{eff} of 0.8037. The cleaner has HEPA filtration on the exhaust, and will be dedicated for cleaning operations where uranic material is involved and will be marked clearly.

Even assuming the most conservative geometry and moderation conditions, k_{eff} remains substantially subcritical. Note that the movement of vessels considered above is considered to be part of normal operating conditions. The abnormal operating condition pertaining to the vessels concerns the assumption that all the vessels are completely filled with uranic breakdown at optimum moderation. This would be extremely unlikely for a single vessel in the array, and even more unlikely for more than one vessel.

It can be concluded that:

- An array of two pump units is safe at any spacing. No restriction is placed on the moderator content of the pump units.
- One pump or pump unit may be moved, and may approach another similar pump unit or vacuum cleaner (of safe diameter) at any orientation, and without spacing restrictions. Other pumps (of 14 L (3.7 gal) internal volume or less) must not approach within 60 cm (23.6 in) of a product pumping train. No restriction is placed on the moderator content of any of the vessels.

3.4.5 Tails Take-off System

The NEF Tails Take-off System uses a process similar to the original LES plant. The NRC staff previously reviewed the Claiborne Enrichment Center license application relative to the Tails Take-off System and concluded that the descriptions, specifications or analyses provided an adequate basis for safety review of the facility operations and that the construction and operation of the facility would not pose an undue risk to public health and safety. The specific discussion on the Tails Take-off System is provided in NUREG-1491 (NRC, 1994), Section 3.5. The primary differences are as follows:

A. Tails Take-off Cylinder Operating Temperature

The Claiborne Enrichment Center cylinder temperature was maintained at +3.9°C (39°F) by spraying the cylinders with chilled water. The NEF chills the cylinders to –25°C (-13°F) by using cold air from refrigeration units.

3.4.6.8.2 UF_6 Cold Trap

Although the cold trap has a large internal volume it is individually safe by shape, the trap body having an internal diameter of 20.3 cm (8.0 in). This compares with the safe diameter of 21.9 cm (8.6 in) for 6.0 $^w/_o$ enrichment. Individual cold traps are thus safe in isolation for any uranyl fluoride/water mixture. In practice the maximum H/U atom ratio in a cold trap will be 7; however, a sensitivity study is performed to determine the optimum H/U ratio, providing an additional margin of safety.

The cold trap has a minimum edge separation of 180 cm (70.9 in) from any other fixed plant vessels that can accumulate enriched uranium. The cold trap can thus be considered to be neutronically isolated from other fixed vessels.

According to the restrictions on movement of mobile vessels, one vessel can come into contact with a trap but any others have to be kept at 60 cm (23.6 in) separation.

MONK8A (SA, 2001) calculations have been performed in which a vacuum cleaner is in contact with the cold trap, and another vessel (a 14 L (3.7 gal) product vent vacuum pump) is at 60 cm (23.6 in) edge spacing from the cold trap. These are typical of Separation Plant mobile vessels. Each mobile vessel was modeled with the appropriate uranic fill; the vacuum cleaner was filled with uranyl fluoride/water mixture with optimum moderation (H/U=12), and the vacuum pump (conservatively containing hydrocarbon oil) was filled with uranic breakdown of composition $UF_4 \cdot 10.5CH_2$. The resulting $k_{eff} = 0.8229$ shows a slight increase in reactivity with respect to the isolated cold trap using the same conservative assumptions. The vacuum cleaner was assumed to be a cleaner of internal diameter 20.3 cm (8.0 in) and length 66 cm (26.0 in) and was assumed to be entirely filled with uranic material with an enrichment of 6.0 $^w/_o$. MONK8A (SA, 2001) calculations have been carried out for an isolated cylinder using these dimensions, filled with uranyl fluoride/water at optimum moderation and with 2.5 cm (0.984 in) water reflection. This gave a value for k_{eff} of 0.8037. The cleaner has HEPA filtration on the exhaust, and will be dedicated for cleaning operations where uranic material is involved and will be marked clearly.

Additionally, calculations were performed in which it was assumed that there are no movement controls, and both the vacuum cleaner and pump were in contact with the cold trap. Even with 2.5 cm (0.984 in) spurious water reflection placed around each unit, and at enrichment of 6.0 $^w/_o$, the result remained substantially subcritical with $k_{eff} = 0.8673$.

The cold trap has therefore been determined to be safe both in isolation and while interacting with other fixed plant or vessels in movement for ^{235}U enrichments up to 6.0 $^w/_o$.

3.4.6.8.3 Vacuum Pump / Chemical Trap Set

These chemical traps of the Blending and Sampling Vent Subsystem are individually safe by diameter (20.3 cm (8.0 in) compared with the safe diameter of 21.9 cm (8.6 in) calculated for 6.0 $^w/_o$ enrichment). However, calculations have been performed concerning the effect of possible neutron interaction with nearby (uranium bearing) equipment.

In the MONK8A (SA, 2001) calculations, the traps were both assumed to fill entirely with uranyl fluoride/water with no restriction on water content. This is conservative, as in practice the H/U ratio of the uranyl fluoride in the traps will have a limiting upper value of 7. Also, the space within the trap, which would normally be occupied by carbon or alumina, is modeled as being filled with uranic material. This maximizes the mass of fissile material within the traps and provides added conservatism. The pump, alumina traps, oil trap and exhaust filter are assumed to be filled with uranyl fluoride/water of unlimited water content. This is conservative, as virtually no uranium is expected in these components.

Calculations were performed to account for interaction with other vessels in movement. According to the restrictions on movement, one mobile vessel can come into contact with one of the fixed chemical absorber traps, but other mobile vessels are assumed to be at 60 cm (23.6 in) separation. The case modeled was for a vacuum cleaner (of diameter 20.3 cm (8.0 in) and length 66 cm (26.0 in)) to be brought into contact with the vacuum pump in the product vent array. One other item, a 14 L (3.7 gal) rotary vane pump, was placed at 60 cm (23.6 in) edge spacing from the vacuum cleaner. The vacuum cleaner was assumed to be a cleaner of internal diameter 20.3 cm (8.0 in) and length 66 cm (26.0 in) and was assumed to be entirely filled with uranic material with an enrichment of 6.0 $^{w}/_{o}$. MONK8A (SA, 2001) calculations have been carried out for an isolated cylinder using these dimensions, filled with uranyl fluoride/water at optimum moderation and with 2.5 cm (0.984 in) water reflection. This gave a value for k_{eff} of 0.8037. The cleaner has HEPA filtration on the exhaust, and will be dedicated for cleaning operations where uranic material is involved and will be marked clearly.

The MONK8A (SA, 2001) calculation for the worst case, where all vessels were assumed to be entirely filled with uranyl fluoride/water mixture at optimum moderation, a trap and a vacuum cleaner are in contact with the fixed pump, and the pump volume is 14 L (3.7 gal), yields a $k_{eff} = 0.9328$.

It should be noted that the above MONK8A (SA, 2001) model represents extreme accident conditions in terms of uranium accumulation and moderator ingress. It should also be noted that the simple MONK8A (SA, 2001) model used for the vacuum pump in all of the calculations is conservative. Since the real shape of the internal free volume is far from optimum, an explicit model of the pump is expected to result in a significant reduction in k_{eff}.

The vacuum pump/chemical trap set has been shown to be safe under normal operating conditions and credible abnormal operating conditions, for ^{235}U enrichments up to 6.0 $^{w}/_{o}$.

3.4.7 Product Liquid Sampling System

The NEF Product Liquid Sampling System uses a process essentially the same as the Claiborne Enrichment Center. The NRC staff previously reviewed the Claiborne Enrichment Center license application relative to the Product Liquid Sampling System and concluded that the descriptions, specifications or analyses provided an adequate basis for safety review of the facility operations and that the construction and operation of the facility would not pose an undue risk to public health and safety. The specific discussion on the Product Liquid Sampling System is provided in NUREG-1491 (NRC, 1994), Section 3.6. The use of a dedicated vent system, the Blending and Sampling Vent Subsystem, rather than a mobile unit as in the Claiborne Enrichment Center, is the only appreciable difference.

directly from the cascade when operating in "Light Gas Evacuation." The temperature alarm provides an alarm function only on excessive UF_6 gas flow at the activated carbon trap. The carbon trap also has a weigh system. In addition to local weight display, this system will shut down the vacuum pump when the high weight set point is reached.

The Contingency Dump System interfaces with the Cascade System to provide the Control Room operator with cascade data in the event of a failure in the cascade control PLC.

The following cascade status conditions are monitored by the Contingency Dump System PLC:

A. The position of the cascade dump valve (open/closed)

B. Recipient temperature

C. Cascade header pressure.

The Contingency Dump System monitors the pressure of the cascade header by a single pressure transducer. This pressure transducer is used in conjunction with pressure control at the Contingency Dump System buffer volume to determine the availability of the Contingency Dump System. Contingency Dump System availability is maximized over the whole of the cascade run-down by a two stage monitoring of the cascade header pressure.

Due to the anticipated infrequent use of the Contingency Dump System, its availability is maintained by a regular testing program of both monitoring equipment and valves to ensure that a failure of the Contingency Dump System PLC is revealed.

3.4.8.8 Criticality Safety

The average enrichment of the UF_6 being dumped from a cascade depends on the product and tails enrichments. Within the ranges of product enrichment up to 5.0 $^{w}/_{o}$ ^{235}U and tails depletion to 0.34 $^{w}/_{o}$ ^{235}U, the average enrichment of the UF_6 being dumped is always less than 1.5 $^{w}/_{o}$ ^{235}U. Based on this, the contingency dump traps will be analyzed at an enrichment of 1.5 $^{w}/_{o}$ rather than 6.0 $^{w}/_{o}$. The contingency dump traps are sodium fluoride traps with an inside diameter of approximately 54 cm (21.3 in).

MONK8A (SA, 2001) calculations have been carried out first for an isolated trap with 2.5 cm (0.984 in) of water reflection around the trap body. The model assumed that adsorbed UF_6 within the trap is converted to $UO_2F_2{\cdot}3.5H_2O$, i.e., the accident condition with air inleakage. The uranium enrichment was 1.5 $^{w}/_{o}$ ^{235}U. The value of k_{eff} obtained was 0.6466. The model represents a UF_6 loading in the trap of approximately 220 kg (485 lb), which would require many dumps to achieve. Contingency dump traps are thus intrinsically safe by a very large margin.

Considering interaction between the three closely spaced traps, criticality safety is demonstrated by comparison with the MONK8A (SA, 2001) calculations for storage of contingency dump traps in unspaced linear arrays. The calculation modeled a linear array of seven touching dump traps with three other vessels at 60 cm (23.6 in) spacing from the array (a residue container, a vacuum cleaner cylinder and a UF_6 pump unit). An additional dump trap was also placed in contact with the center trap of the linear array. The value of k_{eff} obtained was 0.8537. The modeled arrangement is more conservative than three spaced traps interacting with the same mobile vessels and it can be concluded that contingency dump traps are safe when interacting with any mobile vessels that are likely to be present. The vacuum cleaner was assumed to be a cleaner of internal diameter 20.3 cm (8.0 in) and length 66 cm (26.0 in) and was assumed to be entirely filled with uranic material with an enrichment of 6.0 $^{w}/_{o}$. MONK8A (SA, 2001) calculations have been carried out for an isolated cylinder using these dimensions, filled with uranyl fluoride/water at optimum moderation and with 2.5 cm (0.984 in) water reflection. This gave a value for k_{eff} of 0.8037. The cleaner has HEPA filtration on the exhaust, and will be dedicated for cleaning operations where uranic material is involved and will be marked clearly.

3.4.9 Gaseous Effluent Vent Systems

The function of the GEVS is to remove particulates containing uranium, and HF from potentially contaminated process gas streams. Prefilters and absolute filters (HEPA) remove particulates and potassium carbonate impregnated activated carbon filters are used for the removal of any HF. Electrostatic filters remove oil vapor from the gaseous effluent associated with exhaust from vacuum pump/chemical trap set outlets wherever necessary.

The systems produce solid wastes from the periodic replacement of prefilters, absolute filters, and chemical filters. The systems produce no gaseous effluents of their own, but discharge effluents from other systems after treatment to remove hazardous materials.
There are two GEVSs for the plant. The Separations Building GEVS and the TSB GEVS. Applicable codes and standards are given in Table 3.4-14, Gaseous Effluent Vent System Codes and Standards.

3.4.9.1 Separations Building Gaseous Effluent Vent System

The GEVS for the Separations Building provides exhaust of potentially hazardous contaminants. The system is shown on Figure 3.4-17, Process Flow Diagram Gaseous Effluent Vent System Separations Building, Sheets 1 and 2.

The GEVS system serving the Separations Building is located in the TSB on the first floor. The system is operated from the Control Room.

3.4.9.1.1 Functional Description

The Separations Building GEVS interfaces with the following systems, auxiliary activities, and utilities:

A. UF_6 Feed System

B. Product Take-off System

C. Tails Take-off System

D. Product Blending System

E. Product Liquid Sampling System

F. Contingency Dump System

G. Compressed Air System

H. Electrical System

I. Control Room

The design requirements provide a large safety margin between normal and accident conditions so that no single failure could result in the release of significant hazardous material. The amounts of UF_6 in the system also preclude the release of significant quantities of hazardous material from a single failure or multiple failures. Instrumentation is provided to detect abnormal process conditions so that the process can be returned to normal by operator actions.

3.4.9.1.2 Major Components

The Separation Building GEVS consists of the following major components.

A. Duct system

B. Electrostatic filter

C. Prefilters

D. High Efficiency Particulate Air (HEPA) Filters

E. Activated carbon filters

F. Centrifugal Fans

G. Monitoring and controls (HF) before and after filters

H. Automatically controlled inlet and outlet isolation dampers

I. Exhaust stack

J. Gamma monitors and controls (prefilters, HEPA Filters, and electrostatic precipitator)

K. Monitoring and controls (alpha and HF) in exhaust stack

L. Stack sampling system.

3.4.9.1.3 Design Description

The design bases and specifications are given in Table 3.4-15, GEVS Design Bases (Separations Building).

One Separation Building GEVS serves the entire Separations Building. It consists of a duct network that serves all of the uranium processing systems and operates at negative pressure. It is sized to handle the flow from all permanently ducted process locations, as well as up to 13 flexible exhaust hose exhaust points at one time. The flexible exhaust hoses are used for cylinder connection/disconnection or maintenance procedures. A minimum velocity of 12.7 m/s (2500 ft/min) is maintained in the duct system in order to ensure that particulate contaminants are conveyed through the ductwork without settling. Each section of the duct system has an orifice plate to maintain a minimum air velocity. Each section also has a damper to balance the individual flows in the system. The flexible exhaust hoses will have a capture velocity of 0.75 m/s (148 ft/min).

The ductwork is connected to two parallel filter stations. Each is capable of handling 100% of the effluent. One is online and the other is a standby. Each station consists of an 85% efficient prefilter, a 99.97% efficient HEPA filter, and a 99% efficient activated carbon filter for removal of HF. Electrostatic filters have an efficiency of 97%. The filter stations vent through one of two fans. Each fan is capable of handling 100% of the effluent. One fan is online, and the other is a standby. A switch between the operational and standby systems can be made using automatically controlled dampers. The system capacity is estimated to be 11,000 m^3/hr (6,474 cfm). A differential pressure controller controls the fan speed and maintains negative pressure upstream of the filter station. Flow rates and capacity are preliminary and are subject to change during final design.

Gases from the UF_6 processing systems pass through the prefilter which removes dust and protects the HEPA filter, then through the HEPA filter which removes uranium aerosols (mainly UO_2F_2 particles), then through the potassium carbonate impregnated activated carbon filters which captures HF. The remaining clean gases pass through the fan, which maintains the negative pressure upstream of the filter stations. Finally, the clean gases are discharged through a roof top exhaust stack on the TSB. One exhaust stack is common to the operational system and the standby system.

The materials of construction, corrosion allowances, and fabrication specifications for the equipment and ductwork used in the GEVS are compatible with UF_6 and HF and are noncombustible.

The Separations Building GEVS provides the ventilation and hazardous contaminant removal for the following systems, equipment, and areas.

It is connected via permanently ducted locations to:

A. The UF_6 Feed System, The Product Take-off System, the Tails Take-off System, the Product Blending and Sampling Vent Subsystem and Contingency Dump System.

B. All Liquid Sampling System autoclaves.

C. All discharge lines from mobile vacuum pump sets.

It is connected via flexible exhaust hoses to places where piping is normally disconnected or equipment is opened, such as:

A. The Product Take-off System and Tails Take-off System pumping trains and the UF_6 Feed Purification Subsystem, Product Vent Subsystem, Tails Evacuation Subsystem and Product Blending and Sampling Vent Subsystem vacuum pump/ chemical trap sets.

B. The Liquid Sampling System autoclaves. The lines for the flexible duct are run to a point within approximately 0.9 m (3 ft) of each door opening. Approximately 1.8 m (6 ft) of flexible duct is connected to this point to enable access to all places where the autoclave UF_6 pipework is connected/disconnected.

C. The Product and Tails Low Temperature Take-off Stations.

D. The Solid Feed Stations and Feed Purification Low Temperature Take-off Stations.

E. The Blending Donor Stations and Blending Receiver Stations.

If the Separations Building GEVS stops operating, material within the duct will not be released into the building because each of the Separations Building GEVS connections has a P-trap to catch entrained material that could otherwise fall back into the building from the ductwork during system failure.

Mobile vacuum pump units that vent to the Separations Building GEVS are available in the UF_6 Handling Areas and the Product Blending and Liquid Sampling Area.

3.4.9.1.4 Design and Safety Features

The Separations Building GEVS is designed to protect plant personnel against uranium and HF exposure. Potential hazards include the release of UF_6 and HF to the building and/or environment, contaminated filters, and contaminated oil.

The system filters contaminated gases, and continuously monitoring exhaust gas flow to the atmosphere. HF monitors and alarms are installed upstream of the filtration systems and immediately upstream of the exhaust stack to avoid the release of hazardous materials to the environment. A fault alarm is generated, in the event of a fault occurring within any of the monitors. The alarms are monitored in the Control Room.

Gamma monitors measure the build up of ^{235}U on prefilters, HEPA filters and on the electrostatic filter. Upon detection of high-high gamma levels in the Separations Building GEVS filter, the operating Separations Building GEVS train trips. Upon detection of high-high gamma levels in the Separations Building GEVS electrostatic precipitator, the trip realigns dampers to bypass and isolate the electrostatic precipitator.

The Separations Building GEVS unit is located in a dedicated room with the GEVS from the TSB. The filters are bag-in/bag-out. The frequency of filter replacement will be determined during the design phase and this section will be revised accordingly.

The Separations Building GEVS provides for continuous monitoring and periodic sampling of the gaseous effluent in the exhaust stack in accordance with the guidance in Regulatory Guide 4.16 (NRC, 1985).

The Separations Building GEVS is designed to meet all applicable NRC requirements for public and plant personnel safety and effluent control and monitoring. The system designs also comply with applicable standards of OSHA, EPA, and state and local agencies.

The design and in-place testing of the Separations Building GEVS will be consistent with the applicable guidance in Regulatory Guide 1.140 (NRC, 2001), ASME AG-1-1997 (ASME, 1997), and ASME N510-1989 (ASME, 1989). The system includes potassium carbonate impregnated activated charcoal filters for HF removal. As such, the portions of Regulatory Guide 1.140 (NRC, 2001), ASME AG-1-1997 (ASME, 1997), and ASME N510-1989 (ASME, 1989), which address activated charcoal filters for radioiodine removal are not applicable. The prefilter efficiency (85%) is based on testing in accordance with ASME AG-1-1997 (ASME, 1997). The HEPA filter efficiency (99.97%) is based on removal of 0.3 micron particles when tested in accordance with ASME-AG-1 (ASME, 1997). The impregnated charcoal filter efficiency (99%) for removal of HF is based on Urenco specifications. In-place testing and inspections of the filters will be performed in accordance with the guidance in Regulatory Guidance 1.140 (NRC, 2001). The frequency for performance of in-place filter testing and the acceptance criteria for penetration and leakage (or bypass) will be consistent with the guidance in Regulatory Guide 1.140 (NRC, 2001). Qualification testing, to verify HF removal efficiency, of the impregnated charcoal will be performed using ASTM D6646-03 (ASTM, 2003), modified to reflect removal of HF instead of hydrogen sulfide. Laboratory testing of the impregnated charcoal filter of charcoal samples will be performed on an annual basis. Throughout the useful life of the impregnated charcoal, the impregnate is progressively consumed. The laboratory testing will determine the impregnant content within the sample. The amount of impregnant present in the sample is indicative of the remaining life of charcoal bed for removal of HF.

3.4.9.1.5 Instrumentation

The process variables, pressure, fan speed, and damper positioning are all controlled automatically. The fan speed is automatically controlled to maintain negative pressure in the system. HF monitors measure the concentration of the gas in the air stream. Also, devices are used to measure the level of radiological contamination (alpha only) present in the air stream located in the exhaust stack. Deviations from specified values are indicated by alarms. HF monitors and alarms are installed upstream of the filtration system and immediately upstream of the exhaust stack to avoid the release of hazardous materials. The HF and radiological monitoring devices have non-interruptible power supplies in order to continue to function during a general power failure.

HF monitors and alarms are installed upstream of the filtration systems and immediately upstream of the exhaust stack to prevent the release of hazardous materials.

The differential pressure across the prefilter and HEPA filter is monitored to indicate required filter changes.

The GEVS control system is mounted in a Local Control Center (LCC). This is a stand-alone system that does not generate alarms during normal operation. The LCC provides automatic control of the fans and dampers and provides local control via a Local Operator Interface (LOI) that is mounted in the LCC.

The Central Control System (CCS) has no supervisory control over the Separations Building GEVS control system. However, the Separations Building GEVS LCC communicates with the CCS via the dual redundant process network so that comprehensive monitoring of the GEVS status exists. Data that is monitored is fans status, filter and duct pressure measurements, damper status, and electrostatic precipitator status. System alarms are relayed to the CCS.

The Separations Building GEVS LCC has one PLC that provides all automatic control and protection required for the system, and also the communication interface to the PCS. All equipment related to the Separations Building GEVS is directly wired to the LCC.

The radiological activity and HF monitoring instruments are stand-alone and powered separately. These instruments interface with the Separations Building GEVS LCC via hardwired signals that indicate when alarm limits have been exceeded. These alarms are overridden during calibration.

3.4.9.1.6 Criticality Safety

There are two sources of uranic material to the Separations Building GEVS, flexible exhaust hoses and rotary pump exhausts.

The rotary pump exhaust gas arising from the Product Vent Subsystem passes from the UF_6 cold trap through the activated carbon trap and alumina trap and finally through the rotary pump.

Excessive carry over from the cold trap to the carbon trap is avoided by the closure of a valve in the interconnection by a low pressure or a high temperature trip in the cold trap. The exhaust gas then passes through a trap filled with carbon that reacts irreversibly with the UF_6 and then passes through an activated alumina to remove HF. The gas is then pumped out into the Separations Building GEVS for final clean up. These chemical traps are replaced at regular intervals or when the weight indicators show that there is significant build up of material. A weight trip on the carbon trap isolates the process line from the Separations Building GEVS when the traps are about to become saturated.

The flexible exhaust hoses will be used to support product (and feed and tails) cylinder and pump changeout and maintenance activities in the separations plant and trace enriched particulate matter may be released.

The potentially oil bearing inflow to the Separations Building GEVS from the rotary vacuum pumps exhausts is first passed through an electrostatic precipitator to remove the aerosol oil before joining the rest of the effluent gas. It then passes through pre filters, HEPA filters for particulates removal and impregnated carbon filters for removing HF. Prior to the HEPA filters there is a fluoride monitor that will alarm if the concentration of the fluorine compounds within the air being drawn into the filters exceeds a pre-determined level. This will provide assurance that accumulation of uranium in the filters is not occurring. The filters are equipped with differential pressure indicators and ^{235}U selective gamma monitors that will trip on blockage or build-up of material. The amount of uranium in the electrostatic precipitator will also be monitored for gamma radiation to ensure that any slow, chronic accumulation of fissile material does not pose a hazard.

The carbon trap weight trip and Separations Building GEVS filter gamma detector are installed to prevent any potential for criticality. In addition, the accumulation rate of uranium in the Separations Building GEVS is very low compared with the safe mass of 12.2 kg U (26.9 lb U) assuming double batching and all the uranium were enriched to 6.0 $^{w}/_{o}$. These low accumulations coupled with the weight trip and gamma detectors render a criticality accident in the Separations Building GEVS highly unlikely.

3.4.9.2 Technical Services Building GEVS

The TSB GEVS provides exhaust of potentially hazardous contaminants. The system is shown on Figure 3.4-18, Process Flow Diagram Gaseous Effluent Vent System Technical Services Building, Sheets 1 and 2.

The GEVS servicing the TSB is located on the first floor of the TSB and is monitored from the Control Room.

3.4.9.2.1 Functional Description

Potentially contaminated exhaust air comes from the following rooms and services within the TSB:

Ventilated Room	2,700 m^3/hr	(1,589 cfm)
Laundry	1,000 m^3/hr	(589 cfm)
Fomblin Oil Recovery System	2,000 m^3/hr	(1,177 cfm)
Decontamination Workshop	12,300 m^3/hr	(7,240 cfm)
Chemical Laboratories	1,000 m^3/hr	(589 cfm)
Cylinder Preparation Room	1,000 m^3/hr	(589 cfm)
Solid Waste Collection Room	700 m^3/hr	(412 cfm)

Air from the Fomblin Oil Recovery System is part of the Decontamination Workshop discharge. Thus, the total airflow to be handled by the TSB GEVS is 18,700 m^3/hr (11,000 cfm). Flow rates and capacities are preliminary and are subject to change during final design.

The design requirements for the facility provide a large safety margin between normal and accident conditions so that no single failure could result in the release of significant hazardous material. The amounts of UF_6 in the system also preclude the release of significant quantities of hazardous material from a single failure or multiple failures. Instrumentation is provided to detect abnormal process conditions so that the process can be returned to normal by operator actions.

These requirements and operating conditions also assure "as low as reasonably achievable" personnel exposure to hazardous materials and compliance with environmental and safety criteria.

3.4.9.2.2 Major Components

The TSB GEVS consists of the following major components.

A. Duct system

B. Prefilter

C. HEPA filter

D. Impregnated carbon filter (impregnated with potassium carbonate)

E. Centrifugal Fan

F. Monitoring and controls (HF) before and after filters

G. Automatically controlled inlet and outlet isolation dampers

H. Exhaust stack

I. Gamma monitor and controls (prefilter and HEPA filter)

J. Monitoring and controls (alpha and HF) in exhaust stack

K. Stack Sampling system.

3.4.9.2.3 Design Description

The design bases and specifications are given in Table 3.4-16, Gaseous Effluent Vent System Design Bases (Technical Services Building).

The GEVS serving the TSB consists of a duct network that serves all of the uranium processing systems and operates at negative pressure. The ductwork is connected to one filter station and vents through one fan. Both the filter station and the fan can handle 100% of the effluent. There is no standby filter station or fan. Operations that require the GEVS to be operational are shut down if the system shuts down. The system capacity is estimated to be 18,700 m^3/hr (11,000 cfm). A differential pressure controller controls the fan speed and maintains negative pressure in front of the filter station.

Gases from the UF_6 processing systems pass through the 85% efficient prefilter which removes dust and protects the HEPA filter, then through the 99.97% efficient HEPA filter which removes uranium aerosols (mainly UO_2F_2 particles). Finally the air passes through the 99% efficient activated carbon (potassium carbonate impregnated) filter which captures HF. The remaining clean gases pass through the fan, which maintains the negative pressure upstream of the filter stations. The clean gases are then discharged through the exhaust stack on the TSB.

A minimum velocity of 12.7 m/s (2,500 ft/min) is maintained in the duct system in order to ensure that particulate contaminants are conveyed through the ductwork without settling. Each section of the duct system has an orifice plate to maintain a minimum air velocity. Each section also has a damper to balance the individual flows in the system. Flexible exhaust hoses have a capture velocity of 0.75 m/s (150 ft/min). Fume hoods shall have a capture velocity of 0.5 m/s (100 ft/min).

The TSB GEVS provides ventilation and hazardous contaminant removal for the TSB through ductwork, via hoods vented by booster fans to the technical services area, the chemical laboratory, and the vacuum pump rebuild workshop.

The materials of construction, corrosion allowances, and fabrication specifications for the equipment and ductwork used in the GEVS are compatible with UF_6 and HF and are noncombustible.

3.4.9.2.4 Design and Safety Features

The TSB GEVS is designed to protect plant personnel against uranium and HF exposure.

The TSB GEVS is designed to meet all applicable NRC requirements for public and plant personnel safety and effluent control and monitoring. The system design also complies with applicable standards of OSHA, EPA, and state and local agencies.

The system filters contaminated gases, and continuously monitoring exhaust gas flow to the atmosphere. HF monitors and alarms are installed upstream of the filtration systems and immediately upstream of the exhaust stack to avoid the release of hazardous materials to the environment. The alarms are monitored in the Separation Plant Control Room.

The TSB GEVS provides for continuous monitoring and periodic sampling of the gaseous effluent in the exhaust stack in accordance with the guidance in Regulatory Guide 4.16 (NRC, 1985).

Gamma monitors measure the build-up of ^{235}U on prefilters and HEPA filter. Upon detection of high-high gamma levels in the TSB GEVS filter, the TSB GEVS trips.

The unit is located in a dedicated room in the TSB with the GEVS for the Separation Plant. The filters are bag-in/bag-out. The frequency of filter replacement will be determined during the design phase and this section will be revised accordingly.

If the TSB GEVS stops operating, material within the duct will not be released into the building because each of the TSB GEVS connections has a P-trap to catch entrained material that could otherwise fall back into the building from the ductwork during system failure.

The design and in-place testing of the TSB GEVS will be consistent with the applicable guidance in Regulatory Guide 1.140 (NRC, 2001), ASME AG-1-1997 (ASME, 1997), and ASME N510-1989 (ASME, 1989). The system includes a potassium carbonate impregnated activated charcoal filter for HF removal. As such, the portions of Regulatory Guide 1.140 (NRC, 2001), ASME AG-1-1997 (ASME, 1997), and ASME N510-1989 (ASME, 1989), which address activated charcoal filters for radioiodine removal are not applicable. The prefilter efficiency (85%) is based on testing in accordance with ASME AG-1-1997 (ASME, 1997). The HEPA filter efficiency (99.97%) is based on removal of 0.3 micron particles when tested in accordance with ASME-AG-1 (ASME, 1997). The impregnated charcoal filter efficiency (99%) for removal of HF is based on Urenco specifications. In-place testing and inspections of the filters will be performed in accordance with the guidance in Regulatory Guidance 1.140 (NRC, 2001). The frequency for performance of in-place filter testing and the acceptance criteria for penetration and leakage (or bypass) will be consistent with the guidance in Regulatory Guide 1.140 (NRC, 2001). Qualification testing, to verify HF removal efficiency, of the impregnated charcoal will be performed using ASTM D6646-03 (ASTM, 2003), modified to reflect removal of HF instead of hydrogen sulfide. Laboratory testing of the impregnated charcoal filter of charcoal samples will be performed on an annual basis. Throughout the useful life of the impregnated charcoal, the impregnate is progressively consumed. The laboratory testing will determine the impregnant content within the sample. The amount of impregnant present in the sample is indicative of the remaining life of charcoal bed for removal of HF.

3.4.9.2.5 Instrumentation

The process variables, pressure, fan speed, and damper positioning are all controlled automatically. The fan speed is automatically controlled to maintain negative pressure in the system. The differential pressure across the filters is monitored and the fan speed is adjusted to maintain the design airflow rates. When a high pressure drop is detected across the filters, an alarm alerts the personnel that a filter change may be necessary. HF monitors measure the concentration of the gas in the air stream. Also, devices are used to measure the level of radiological contamination (alpha only) present in the air stream located in the stack. Deviations from specified values are indicated by alarms. HF and alpha monitors and alarms are installed upstream of the filtration system and immediately upstream of the exhaust stack to avoid the release of hazardous materials. The HF and radiological monitoring devices have non-interruptible power supplies in order to continue to function during a general power failure.

Each area has an alarm that is activated in the event that the TSB GEVS or the fan fails.

The TSB GEVS control system is mounted in a Local Control Center (LCC). This is a stand-alone system that does not generate alarms during normal operation. The LCC provides automatic control of the fan and dampers and provides local control via a Local Operator Interface (LOI) that is mounted in the LCC.

The Central Control System (CCS) has no supervisory control over the TSB GEVS control system. However, the TSB GEVS LCC communicates with the CCS via the dual redundant process network so that comprehensive monitoring of the TSB GEVS status exists. Data that is monitored is fan status, filter and duct pressure measurements, and damper status.

The TSB GEVS LCC has one PLC that provides all automatic control and protection required for the system and also the communication interface to the PCS. All equipment related to the TSB GEVS is directly wired to the LCC.

The radiological activity and HF monitoring instruments are stand-alone and powered separately. These instruments interface with the TSB GEVS LCC via hardwired signals that indicate when alarm limits have been exceeded.

Any shutdown device for the filter train and fan is latched and requires local operator action to reset.

High-level environmental alarms will shut down the TSB GEVS.

3.4.9.2.6 Criticality Safety

Within the TSB Ventilated Room, chemical traps will be emptied and product cylinders may be brought into the room for valve changes and subsequent testing. In the case of the traps there will be a mixture of product, feed and dump traps with a few from the tails operations. The product traps will be 10 kg (22.0 lb) carbon traps with a maximum holdup of 12 kg (26.5 lb) UF_6. The traps will have been de-gassed prior to being removed from the plant and there will be very little of the UF_6 absorbed on the trap that could become airborne. There may be a small amount of carbon drawn into the TSB GEVS as a result of emptying the traps. With approximately 20 carbon traps processed per year it is not considered credible that kilogram quantities of uranium would be drawn into the TSB GEVS, before filters were changed out.

A possible scenario for the acute accumulation of enriched uranium from the Ventilated Room exists from the valve testing operations. For this operation a cylinder is taken into the room and the valve is removed. A new valve is fitted to the cylinder and the cylinder is then pressure tested. This involves pressurizing the container with nitrogen then evacuating. For this operation the cylinder is connected to a portable rig, which in turn exhausts to the TSB GEVS. Since all pumps are lubricated with a UF_6 compatible oil there is the remote possibility that UF_6 could be pumped directly from the cylinder to the TSB GEVS. Weight and temperature trips on the carbon trap in this rig prevent this transfer from occurring.

Within the TSB Decontamination System there are a number of cleaning tanks. Components entering these tanks will have either been cleaned or de-gassed. It is not considered likely that significant quantities of uranium would enter the TSB GEVS as a result of these decontamination operations or the subsequent processing of the residues. The facility also provides the plant with a sample bottle cleaning service. Type 1S sample bottles delivered to the facility will be cleaned provided that there is no more than 20 g (0.04 lb) of residual material within the bottles. Even if this was all UF_6 and the bottle was opened the operator would see white hydrogen fluoride fume and there may be some small quantity of UF_6 associated with the release. Many mal-operations would be required for the TSB GEVS to see the quantity of material that would be needed to initiate a criticality.

Before pumps enter the TSB Contaminated Workshop there is a requirement for them to be de-gassed prior to transfer. It would be unusual for pumps to enter the facility with significant quantities of UF_6 remaining within the pump, including UF_6 dissolved in the Fomblin oil. On entering the facility the pumps are taken to the outgas area where the oil is removed. If dissolved UF_6 were present in the oil then there would be some fuming this would mainly be as a result of the dissolution of the UF_6 from the oil reacting with the water in the air. This would produce UO_2F_2 and HF. The HF would be drawn into the TSB GEVS and the majority of the UO_2F_2 would remain with the oil. The number of product pumps that cannot be successfully de-gassed is small and it is not considered that a significant fraction of the uranium in the oil would enter the TSB GEVS. Once the pumps have been transferred to the hydraulic table there will be uranium associated with the residual oil in the pump and some in the form of dry breakdown products. It is not considered possible that significant quantities of these will become airborne during the cleaning operations.

For the activities in the TSB, the accumulation rate of uranium in the TSB GEVS is very low compared with the safe mass of 12.2 kg U (26.5 lb U) assuming double batching and all the uranium were enriched to 6.0 $^{w}/_{o}$. These low accumulations coupled with regular sampling of filters, the weight trips and temperature trips, render a criticality accident highly unlikely.

3.4.10 Centrifuge Test and Centrifuge Post Mortem Processes

This section describes the basic components, functional requirements, and utilities required for operation of the Centrifuge Test Facility (CTF) and Centrifuge Post Mortem Facility (CPMF). The CTF and CPMF are located in the Centrifuge Assembly Building (CAB) as shown in Figure 3.3-13, Centrifuge Assembly Building, First Floor. These two facilities are segregated within the CAB for two reasons; the presence of uranium hexafluoride results in the areas being classified as process areas and the sensitive operations undertaken within the facilities require personnel access control. The functional requirements for the Centrifuge Test Facility and the Centrifuge Post Mortem Facility are presented in Table 3.4-17, Functional Requirements for Centrifuge Test and Post Mortem Facilities. Utility requirements for the two facilities are presented in Table 3.4-18, Utility Requirements for Centrifuge Test and Post Mortem Facilities.

3.4.10.1 Centrifuge Test Facility

3.4.10.1.1 Functional Description

The principal functions of the Centrifuge Test Facility (CTF) are to provide a means of functionally testing the performance of production centrifuges to ensure compliance with design parameters and to investigate production and operational problems. The facility consists of two test positions.

Testing in the CTF is performed by feeding a stream of gaseous UF_6 into the centrifuge and removing enriched and depleted streams, Product and Tails, respectively. During this process, the centrifuge is maintained at the required operating frequency, temperature, and pressure, and samples are taken from the Product and Tails streams to enable determination of the separative capacity of the centrifuge under test.

The discharge line from the mobile vacuum pump set and flexible exhaust hose is provided to the Centrifuge Test and Post Mortem Facilities Exhaust Filtration System, see Section 3.4.10.3.

3.4.10.1.2 Major Components

The equipment located in the CTF comprises the following main components or sub-systems.

A. Centrifuge Cubicles

B. Centrifuge Inverter

C. Cooling Water System

D. UF_6 Feed and Take-off System

E. Chemical Trap and Vacuum Pump Sets

F. Supervisory Control and Data Acquisition System (SCADA)

G. Uninterruptible Power Supply (UPS)

H. Centrifuge Crash Detection System.

I. SCADA System.

J. Uninterruptible Power System (UPS).

K. Centrifuge Crash Detection System.

3.4.10.1.3 System Description

A. Centrifuge Cubicles.

The Centrifuge Cubicle consists of an insulated box manufactured from non-flammable insulating material. Each cubicle has front and top opening doors to facilitate access for loading and making process and utility connections.

A specially designed centrifuge mounting base plate and stand provides a solid mounting and attachment to the floor.

The test centrifuge is transported to a location immediately adjacent to the cubicle on a transport trolley. The centrifuge is then loaded into the cubicle using a jib crane with an electrically powered hoist. A platform is provided to make the process pipe work connections at the top of the centrifuge.

Air within the cubicle is maintained at a nominal operating set point, which is adjustable using an electrical heater located near the bottom of the cubicle, in conjunction with a circulating fan.

Cooling water is supplied through the wall of the Centrifuge Cubicle to the test centrifuge and subsequently returned to a local, dedicated Cooling Water System.

A flexible exhaust hose connected to the Centrifuge Test and Post Mortem Facilities Exhaust Filtration System is positioned close to the centrifuge flange to provide local exhaust in the working area during disconnection from the facility. Appropriate gloves and positive pressure face mask with appropriate filtration is used during disconnection of any UF_6 process connections.

B. Centrifuge Inverter.

Each test position is provided with a variable speed inverter. The inverter provides a drive signal to the centrifuge motor. Drive up and drive down sequences are controlled by the SCADA system.

C. Cooling Water System.

The cooling water system is composed of a proprietary stand-alone unit. Heating and chilling capacity is required to enable delivery of a stable flow of water to both test positions. Supply and return connections are made to the test centrifuges mounted in the Centrifuge Cubicles.

D. UF_6 Feed and Take-off System.

The feed and take-off system consists of two identical stainless steel vessels; the UF_6 capacity of the system is 50 kg (110 lb).

Each vessel is fitted with cooling coils which carry liquid nitrogen to maintain the temperature at –70°C (-94°F) when used in take-off mode and heat tracing which maintains the temperature at

20°C (68°F) when used in feed mode. The neck of each vessel has heat tracing that is set to 25°C (77°F), irrespective of feed or take-off mode, preventing UF_6 desublimation in the inlet and outlet.

E. UF_6 Feed Supply.

Gaseous UF_6 is generated by a process of sublimation from one of the vessels, nominated the feed vessel. Energy required for sublimation is supplied by electrical heat tracing controlled to 20°C (68°F).

The feed is delivered from the feed vessel to the centrifuge, via a system of control valves and orifice plates, to achieve the required centrifuge feed pressure and flow rate.

F. UF_6 Take-off.

The enriched and depleted UF_6 streams are drawn from the centrifuge. Each stream is passed through an automatic control valve and orifice plate for flow measurement purposes. The streams are then merged and desublimed in the second vessel, nominated the take-off vessel. This vessel is chilled to –70°C (-94°F) using liquid nitrogen.

The piping/valve configuration allows each take-off stream to be diverted along an alternative route to allow a dedicated sample to be taken. A flexible tube connected to the Centrifuge Test and Post Mortem Facilities Exhaust Filtration System is positioned close to the sample bottle during sample bottle connection and disconnection to provide local exhaust of the working area.

When all the UF_6 has been transferred to the take-off vessel, the previously heated feed vessel is cooled, and the previously cooled take-off vessel is heated, becoming the feed vessel, and allowing the UF_6 to be fed in the opposite direction.

The UF_6 can be recycled in this manner for approximately one year. A flexible tube connected to the Centrifuge Test and Post Mortem Facilities Exhaust Filtration System is positioned close to the vessel during replacement of the UF_6 inventory to provide local exhaust of the working area.

G. CTF Feed and Take-off Vessel Recharging.

As stated previously, after approximately one year's operation it is necessary to replenish the system charge of about 50 kg (110 lb) UF_6.

This is affected by initially transferring the full UF_6 inventory into a single vessel. After this has been completed, the vessels are isolated and allowed to return to ambient temperature.

The process pipe work is evacuated and purged with nitrogen gas several times in a cyclic manner. Operational experience has shown that this procedure minimizes the possibility of UF_6 or HF release.

A flexible exhaust hose connected to the Centrifuge Test and Post Mortem Facilities Exhaust Filtration System is positioned adjacent to the flange connection of the vessel isolation valve to provide local exhaust of the working area. The flange connection is then broken and blank flanges are fitted to the isolation valve and the facility process pipe work.

The vessel is emptied to an off-line UBC in the separation plant. The vessel is recharged from a feed cylinder and subsequently refitted to the centrifuge test facility.

H. Chemical Traps and Vacuum Pump Set.

The chemical traps and vacuum pump set are composed of a stainless steel trap filled with 10 kg (22.1 lb) of activated carbon, a stainless steel trap filled with 15 kg (33.1 lb) of aluminum oxide and a two stage rotary vane vacuum pump fitted with an nitrogen purge. The carbon trap of the chemical traps and vacuum pump set has a weighing system that will automatically trip the associated vacuum pump on high carbon trip weight.

The vacuum pump has upstream and downstream filters to prevent oil migration and discharges to the Centrifuge Test and Post Mortem Facilities Exhaust Filtration System. These items are located on a movable skid.

The chemical traps and vacuum pump set provides the following functionality:

1. Initial evacuation of the test centrifuge.
2. Removal of UF_6 from the centrifuge and connecting pipe work during testing in the event the normal take-off route becomes unavailable.
3. Removal of non-condensable gases, which accumulate in the chilled take-off vessel during testing.
4. System purging at the end of testing; the centrifuge is evacuated and purged several times with nitrogen gas through a control valve which limits the rate of pressure change.

I. SCADA System

The centrifuge test facility has a dedicated control and data acquisition system. Control functions are performed using a Programmable Logic Controller (PLC). Independent hard wired trips are used for safety related functions.

The operator interfaces with the SCADA system via a computer terminal. The operator interface displays real time values and trends of all instruments associated with the centrifuge test facility and allows selection of various process modes and initiation of sequences.

J. Uninterruptible Power System (UPS).

A UPS is required to provide backup power to the PLC, the operator interface, and the hardwired safety circuits.

K. Centrifuge Crash Detection System.

Each test position is fitted with a centrifuge Crash Detection System. This system consists of a shock sensor, that is strapped to the test centrifuge, and signal processing electronics. The signal processor provides a digital input to the SCADA system PLC that, in turn, initiates a system shutdown and provides an alarm signal.

3.4.10.1.4 Design and Safety Features

As stated previously, control of the Centrifuge Test Facility is undertaken via the SCADA system. All process states and sequences are initiated by the operator. The operator can override any sequence and take manual control of the facility.

There are few hazards associated with the facility. The principal hazards are centrifuge failure or heat tracing failure of the feed vessel resulting in overheating of the vessel.

The safety enclosure for the centrifuge containment is well established and underpinned with experimental evidence.

In the event of an electrical heating or heat trace control failure, the design is such that with continuous maximum power input to the heating elements, no damage to the equipment can occur.

The electrical heating and heat tracing circuits of the UF_6 feed and take-off vessels are each fitted with two resistance temperature devices (RTDs). One RTD is used for control. The second RTD provides an independent fail-safe, hardwired trip of the heat tracing, set at 35°C (95°F). An independent capillary temperature sensor for automatic, fail safe, high temperature trip of the heat tracing is also provided. This value has been selected to prevent the formation of UF_6 gas at above atmospheric pressure.

The power to these electrical circuits is also removed if the pressure at the UF_6 feed or take-off vessel exit rises above 120 mbar (1.74 psia).

3.4.10.2 Centrifuge Post Mortem Facility

3.4.10.2.1 Functional Description

The principal functions of the Centrifuge Post Mortem Facility (CPMF) are as follows:

A. Facilitate dismantling of contaminated centrifuges using equipment and processes that minimize the potential to contaminate personnel or adjacent facilities.

B. Collect potentially contaminated components for transfer to the Solid Waste Collection Room in the TSB prior to disposal.

Operational experience to-date has shown that the demand for centrifuge post mortems is infrequent.

Centrifuges are brought into the CPMF from the cascade hall on a specially designed transport cart. The CPMF is used for careful, diligent dismantling of centrifuges. The centrifuges will have been operating in UF_6 and are therefore contaminated. The facility is equipped with radiological monitoring devices (alpha in air), toilets and washing facilities, and hand, foot, and clothing personnel monitors to detect surface contamination. Wash water is collected and monitored for contamination prior to discharge. All ventilation exhausts are routed through the Centrifuge Test and Post Mortem Facilities Exhaust Filtration System. Flexible exhaust hoses, that are connected to the Centrifuge Test and Post Mortem Facilities Exhaust Filtration System, are positioned by the operator local to the centrifuge prior to commencing the dismantling process.

Atmospheric conditions within these two facilities require control. To facilitate this requirement, an airlock entry is employed. For additional functional and utility requirements see Table 3.4-17, Functional Requirements for Centrifuge Test and Post Mortem Facilities, and Table 3.4-18, Utility Requirements for Centrifuge Test and Post Mortem Facilities.

3.4.10.2.2 Major Components

The equipment located in the Centrifuge Post Mortem Facility consist of the following main components or sub-systems:

A. Centrifuge dismantling facility

B. Centrifuge manipulation equipment

C. Inspection facilities

D. Solid and liquid waste collection and segregation facilities.

3.4.10.2.3 System Description

A. CPMF Centrifuge Dismantling Facility.

The centrifuge dismantling facility is composed of a stand, onto which the centrifuge is mounted, a local jib crane, and miscellaneous tools.

The stand has an elevated working platform to allow access to the top of the centrifuge. The platform is large enough to accommodate two people, necessary tools to enable dismantling, and a lay down area for potentially contaminated components.

A jib crane is located over the stand to enable centrifuge removal from and replacement to the transport cart, and to facilitate loading and unloading the stand.

Miscellaneous tools are used to dismantle the centrifuge. These tools are solely for the purpose of centrifuge post mortem and are stored adjacent to the dismantling facility.

A flexible exhaust hose from the Centrifuge Test and Post Mortem Facilities Exhaust Filtration System is positioned adjacent to the centrifuge enclosure to provide local exhaust in the working area during dismantling.

The dismantling facility has to deal with both intact and crashed centrifuges. The dismantling processes are consequently different.

Dismantling of intact centrifuges is relatively easy. Removal of the internals is facilitated by use of the jib crane.

Crashed centrifuges, however, yield fragmented debris. To contain the spread of potentially contaminated debris, a dedicated vacuum cleaner is used to capture particulates. The dedicated vacuum cleaner complies with the requirement to be safe by shape to prevent the possibility of criticality. Removal of the internals often requires inversion of the centrifuge casing to retrieve component parts for subsequent inspection. This operation is undertaken using the centrifuge manipulation equipment.

Operational restrictions are placed on personnel undertaking post mortem activities. These are summarized as follows:

All personnel must utilize personal protection equipment that is identified via a risk assessment and follow operational procedures to undertake post mortem activities.

To minimize potential for criticality, only one centrifuge at a time can be dismantled within the facility. Aqueous and non-aqueous cleaning agents are not allowed in the centrifuge post mortem facility. Component cleaning can only be carried out using dry wipe techniques.

B. Centrifuge Manipulation Equipment.

The centrifuge manipulation equipment is a piece of mechanical handling equipment that provides for rotation of the centrifuge casing.

C. Inspection Facilities.

An inspection area is located within the centrifuge post mortem facility to facilitate collection of evidence to support failure hypotheses. The inspection facilities have an inspection bench, portable lighting, a microscope, an endoscope, and a digital video camera.

D. Solid and Liquid Waste Collection and Segregation Facilities.

Waste from centrifuge post mortem consists of small quantities of both non-aqueous liquid and dry solids.

The non-aqueous liquid waste is transferred into a 5 L (1.32 gal) plastic container. This container is stored in the centrifuge post mortem facility until it is full. The full container is subsequently transferred to the Solid Waste Collection Room in the TSB. It is then characterized, packaged, and sent for disposal.

The solid wastes are segregated into like materials prior to disposal. Some of the items are required to be broken down to reduce volume and ease handling. This is carried out using a mechanical bench saw. Wastes are then bagged and monitored to determine the level of surface contamination. The containerized wastes are sent to the Solid Waste Collection Room in the TSB for disposal.

3.4.10.2.4 Design and Safety Features

Historical operational experience in Europe has shown that centrifuge post mortems are infrequent events. It is envisioned that no post mortem activity is required during early operational life. Consequently, it is expected that no more than 20 post mortems would be undertaken over the life of the facility.

Waste material such as carbon fiber, metal (principally aluminum), oil, paper, wipes, gloves, and contaminated disposable clothing is generated. Operational experience in Europe has shown that uranium is found as surface contamination in the form of either UO_2F_2 or uranium tetrafluoride (UF_4).

3.4.10.3 Centrifuge Test and Post Mortem Facilities Exhaust Filtration System

The Centrifuge Test and Post Mortem Facilities Exhaust Filtration System provides exhaust of potentially hazardous contaminants from the Centrifuge Test and Post Mortem Facilities. The system also ensures the Centrifuge Post Mortem Facility is maintained at a negative pressure with respect to adjacent areas. The system is shown on Figure 3.4-19, Process Flow Diagram Centrifuge Test and Post Mortem Facilities Exhaust Filtration System.

The Centrifuge Test and Post Mortem Facilities Exhaust Filtration System is located in the Centrifuge Assembly Building and is monitored from the Control Room.

3.4.10.3.1 Functional Description

Potentially contaminated exhaust air comes from the Centrifuge Test and Post Mortem Facilities. The total airflow to be handled by the Centrifuge Test and Post Mortem Facilities Exhaust Filtration System is 9,345 m^3/hr (5,500 cfm). Flow rates and capacities are preliminary and are subject to change during final design.

The design requirements for the facility provide a large safety margin between normal and accident conditions so that no single failure could result in the release of significant hazardous material. The amounts of UF_6 in the system also preclude the release of significant quantities of hazardous material from a single failure or multiple failures. Instrumentation is provided to detect abnormal process conditions so that the process can be returned to normal by operator actions.

These requirements and operating conditions also assure "as low as reasonably achievable" personnel exposure to hazardous materials and compliance with environmental and safety criteria.

3.4.10.3.2 Major Components

The Centrifuge Test and Post Mortem Facilities Exhaust Filtration System consists of the following major components.

- Duct system
- Prefilter
- Impregnated carbon filter (impregnated with potassium carbonate)
- High Efficiency Particulate Air Filter (HEPA)
- Two exhaust filtration fans
- Exhaust stack
- Stack alpha monitor
- Stack HF monitor.

3.4.10.3.3 Design Description

The Centrifuge Test and Post Mortem Facilities Exhaust Filtration System consists of a duct network that serves the Centrifuge Test and Post Mortem Facilities and operates at negative pressure. The ductwork is connected to one filter station and vents through either of two 100% fans. Both the filter station and either of the fans can handle 100% of the effluent. One of the fans will normally be in standby. Operations that require the Centrifuge Test and Post Mortem Facilities Exhaust Filtration System to be operational are manually shut down if the system shuts down. The system capacity is estimated to be 9,345 m^3/hr (5,500 cfm).

Gases from the associated areas pass through the 85% efficient prefilter which removes dust and protects the carbon filter, then through the 99% efficient activated carbon (potassium carbonate impregnated) filter that captures HF. Remaining uranic particles (mainly UO_2F_2 particles) will be filtered by the 99.97% efficient HEPA filter. The remaining clean gases pass through a fan, which maintains the negative pressure upstream of the filter station. The clean gases are then discharged through the stack on the Centrifuge Assembly Building.

A minimum velocity is maintained in the duct system in order to ensure that particulate contaminates are conveyed through the ductwork without settling. Each section also has a damper to balance the individual flows in the system. Flexible exhaust hoses are provided in both the Centrifuge Test Facility and the Centrifuge Post Mortem Facility. A hood is also provided in the Centrifuge Post Mortem Facility.

The materials of construction, corrosion allowances, and fabrication specifications for the equipment and ductwork used in the GEVS are compatible with UF_6 and HF and are noncombustible.

3.4.10.3.4 Design and Safety Features

The Centrifuge Test and Post Mortem Facilities Exhaust Filtration System is designed to protect plant personnel against uranium and HF exposure.

The Centrifuge Test and Post Mortem Facilities Exhaust Filtration System is designed to meet all applicable NRC requirements for public and plant personnel safety and effluent control and monitoring. The system design also complies with applicable standards of OSHA, EPA, and state and local agencies.

The Centrifuge Test and Post Mortem Facilities Exhaust Filtration System provides for continuous monitoring and periodic sampling of the gaseous effluent in the exhaust stack in accordance with the guidance in Regulatory Guide 4.16 (NRC, 1985).

The system filters contaminated gases, and continuously monitoring exhaust gas flow to the atmosphere. The system also provides primary confinement for the Centrifuge Post Mortem Facility by maintaining the Centrifuge Post Mortem Facility at a negative pressure relative to adjacent areas. An HF monitor and associated alarm and an alpha radiation monitor and associated alarm are installed immediately upstream of the exhaust stack to avoid the release of hazardous materials to the environment. The frequency of filter replacement will be determined during the design phase and this section will be revised accordingly.

The design and in-place testing of the Centrifuge Test and Post Mortem Facilities Exhaust Filtration System will be consistent with the applicable guidance in Regulatory Guide 1.140 (NRC, 2001), ASME AG-1-1997 (ASME, 1997), and ASME N510-1989 (ASME, 1989). The system includes a potassium carbonate impregnated activated charcoal filter for HF removal. As such, the portions of Regulatory Guide 1.140 (NRC, 2001), ASME AG-1-1997 (ASME, 1997), and ASME N510-1989 (ASME, 1989), which address activated charcoal filters for radioiodine removal are not applicable. The prefilter efficiency (85%) is based on testing in accordance with ASME AG-1-1997 (ASME, 1997). The HEPA filter efficiency (99.97%) is based on removal of 0.3 micron particles when tested in accordance with ASME-AG-1 (ASME, 1997). The impregnated charcoal filter efficiency (99%) for removal of HF is based on Urenco specifications. In-place testing and inspections of the filters will be performed in accordance with the guidance in Regulatory Guidance 1.140 (NRC, 2001). The frequency for performance of in-place filter testing and the acceptance criteria for penetration and leakage (or bypass) will be consistent with the guidance in Regulatory Guide 1.140 (NRC, 2001). Qualification testing, to verify HF removal efficiency, of the impregnated charcoal will be performed using ASTM D6646-03 (ASTM, 2003), modified to reflect removal of HF instead of hydrogen sulfide. Laboratory testing of the impregnated charcoal filter of charcoal samples will be performed on an annual basis. Throughout the useful life of the impregnated charcoal, the impregnate is progressively consumed. The laboratory testing will determine the impregnant content within the sample. The amount of impregnant present in the sample is indicative of the remaining life of charcoal bed for removal of HF.

3.4.10.3.5 Instrumentation

The process variables, pressure, fan speed, and damper positioning are all controlled automatically. The fan speed is automatically controlled to maintain negative pressure in the system. The differential pressure across the filters is monitored to provide indication of when filter replacement is required. An HF monitor measures the concentration of the gas in the air stream. Also, a radiation detector is used to measure the level of radiological contamination (alpha only) present in the air stream located in the stack. Deviations from specified values for HF and alpha radiation are indicated by alarms. The HF and alpha radiation monitoring devices have non-interruptible power supplies in order to continue to function during a general power failure.

3.4.11 Material Handling Processes

The NRC staff previously reviewed the Claiborne Enrichment Center SAR application relative to the Material Handling Processes and concluded that the descriptions, specifications or analyses provided an adequate basis for safety review of the facility operations and that the construction and operation of the facility would not pose an undue risk to public health and safety. The specific discussion on the Material Handling Processes is provided in NUREG-1491 (NRC, 1994), Sections 3.1 and 3.2.

The NRC in Bulletin 2003-03 (NRC, 2003), Potentially Defective 1-in valves for Uranium Hexafluoride Cylinders, identified performance and safety concerns with 1-in valves for UF_6 cylinders manufactured by the Hunt Valve Company. In response to Bulletin 2003-03 (NRC, 2003), LES will not purchase UF_6 cylinders with the 1-in Hunt valves installed nor purchase any replacement 1-in valves from Hunt.

In the unlikely event that any cylinders are received at the NEF with the 1-in Hunt valves installed, the following actions will be taken.

- If the cylinder is empty, the valve will be replaced before the cylinder is used in the facility.
- If the cylinder is filled, a safety justification to support continued use of the cylinder until the valve can be replaced will be developed or the valve will be replaced in accordance with NEF procedures.

No cylinders with the 1-in Hunt valve installed will be used as UBCs.

3.4.11.1 Cylinder Receipt and Shipping

The Cylinder Receipt and Dispatch Building (CRDB) provides for handling of feed cylinders, product cylinders, semi-finished product cylinders, prepared empty cylinders and UBCs, and provides space for the following services:

- Cylinder loading and unloading
- Inventory weighing
- Secure internal storage (no UBC or empty feed storage in CRDB)

- Preparation and storage area for overpack/protective structural packaging.

The cylinders are received, shipped offsite, stored, and transferred to and from the UF_6 Handling Areas, Blending and Liquid Sampling Area, and UBC Storage Pad.

Prepared empty cylinders, semi-finished product cylinders, full feed cylinders, and final product cylinders are stored in the CRDB.

Full UBCs and empty feed cylinders are not stored in the CRDB. They are transported through the TSB and stored in the UBC Storage Pad.

The CRDB layout is shown on Figure 3.3-10, Cylinder Receipt and Dispatch Building, First Floor, Part A, and Figure 3.3-11, Cylinder Receipt and Dispatch Building, First Floor, Part B. The UF_6 Feed cylinder delivery and storage requirements are presented in Table 3.4-19, UF_6 Feed Cylinder Delivery and Storage Requirements.

3.4.11.1.1 Description

The majority of the floor area in the CRDB is used as a storage or staging area for feed and product cylinders. The cylinders are placed on concrete saddles to stabilize them while they are stored in this area. Different size saddles are provided for 48-in and 30-in cylinders. The cylinders are positioned such that access is possible from an overhead crane.

Trucks arrive at the building carrying feed cylinders, empty UBC or product cylinders, and enter through the main vehicle loading bay. This bay is equipped with vehicle access platforms that aid with cylinder loading and unloading operations.

Unloaded trucks either leave the site or remain in a staging area adjacent to the CRDB. Trucks in this staging area await cylinders that are to be shipped from the site.

3.4.11.1.2 Equipment

The following equipment is used for cylinder handling in the CRDB.

A. Vehicle Loading And Unloading Platform.

The vehicle loading and unloading platforms are located adjacent to the main transport vehicle access doorways. These platforms provide a safe method of transfer to the vehicle trailer while loading and unloading activities are in progress. Cylinders will be stored a minimum of one meter from the vehicle platform to eliminate the fire hazard associated with trucks in the CRDB.

B. Double Girder Bridge Cranes.

Two double girder bridge cranes handle the cylinders in the CRDB. The cranes span half the width and run the full length of the main storage building. They are operated by an automated control system and equipped with remotely operated grabs. Each hoist has a maximum lift of 9 m (29.5 ft). Crane movement requirements are presented in Table 3.4-20, Crane Movement Requirements. The minimum lift is based upon the following data:

- Floor to top height of a vehicle mounted ISO container 4.1 m (13.4 ft)
- Lift clearance between ISO container and underside of cylinder 0.6 m (2 ft)
- Allowance for a 48 in cylinder 1.2 m (3.9 ft)

- Typical length of a universal cylinder grab (including fixing) 2.0 m (6.6 ft)
- Allowance for unknown effect of a 48-in cylinder overpack 1.0 m (3.25 ft)
- Total 8.9 m (29.16 ft)

The crane specifications are as follows:

• Span	20 m	(65.6 ft)
• Capacity	20 MT	(44,100 lb)
• Hoist lift height	9 m	(29.5 ft)
• Hoist lift speed (Variable Frequency Drive (VFD))	6 m/min	(20 ft/min)
• Travel length	225 m	(708.67 ft)
• Bridge travel speed (VFD)	49 m/min	(161 ft/min)
• Brake type	Direct Current Disc	

ISO containers are International Organization for Standardization Series 1 freight containers that are supplied in accordance with the ISO 668:1995 (ISO, 1995) Standard. These containers are used for intercontinental shipping. They are 2,438 mm (8 ft) wide and are available in a variety of heights ranging from 2,438 mm (8 ft) to 2,896 mm (9.5 ft).

C. Scales.

Each cylinder that enters or exits the CRDB is weighed. Weigh scales capable of weighing a load of 17 MT (37,500 lb) and capable of accepting a load of 20 MT (44,100 lb) are required on each end of the CRDB. One set of scales is utilized in the area adjacent to the cylinder truck loading/unloading bay. The other set of scales is located in the area adjoining the Blending and Liquid Sampling Area. The scales are capable of weighing to a tolerance of ±2.5 kg (±5.5 lb). The scales have a reader and printout facilities, and are located in a pit such that the weigh table is flush with the finished building floor slab.

D. Flatbed Trucks And Rail Transporters.

After processing, the cylinders are transported between the CRDB, the UF_6 Handling Areas, and the UBC Storage Pad via flatbed trucks. A double girder Gantry crane is used to manage the cylinders in the UBC Storage Pad.

3.4.11.1.3 Cylinder Specifications

Cylinders stored and handled in the CRDB vary in size and weight from 30B cylinders to 48Y cylinders. The cylinders have the following characteristics:

30B Cylinder		
Weight of UF_6	2,277 kg	(5,020 lbs)
Gross cylinder weight	2,912 kg	(6,420 lbs)
Diameter	762 mm	(2.5 ft)
Length	2,070 mm	(6.8 ft)

<u>48Y Cylinder</u>		
Weight of UF_6	12,501 kg	(27,560 lbs)
Gross cylinder weight	14,860 kg	(32,761 lbs)
Diameter	1,232 mm	(4.08 ft)
Length	3,728 mm	(12.25 ft)

<u>48X Cylinder</u>		
Weight of UF_6	9,539 kg	(21,030 lbs)
Gross cylinder weight	11,580 kg	(25,530 lbs)
Diameter	1,220 mm	(4 ft)
Length	3,020 mm	(9.9 ft)

3.4.11.1.4 CRDB Storage Areas

The CRDB accommodates the following areas:

Final product storage	330 m^2	(3,552 ft^2)
Overpack storage (72 overpacks)	440m^2	(4,736 ft^2)

3.4.11.1.5 Product Cylinder Storage

Semi-finished product cylinder storage areas are shown on Figure 3.3-10, Cylinder Receipt and Dispatch Building, First Floor, Part A, and final product storage areas are shown on Figure 3.3-11, Cylinder Receipt and Dispatch Building, First Floor, Part B. The areas accommodate 125 semi-finished cylinders and 125 final product cylinders.

Site vehicle access/single loading bay	400 m^2	(4,306 ft^2)
Full feed cylinder storage	6,231 m^2	(67,070 ft^2)
Prepared (empty) cylinder storage	400 m^2	(4,306 ft^2)
Semi-finished product storage	330 m^2	(3,552 ft^2)
Preparation Area	400 m^2	(4,306 ft^2)

3.4.11.1.6 Feed Cylinder Storage

Feed cylinder storage areas are shown on Figure 3.3-10 and on Figure 3.3-11. Feed material is stored under vacuum in corrosion resistant Type 48Y or 48X cylinders. The CRDB provides enough space to store up to 708 cylinders. These cylinders can be stored without providing room for cylinder maintenance because they are only in temporary storage. Based on this type of design, the area allocated per feed cylinder is 8 m^2 (86 ft^2). Thus, the maximum storage area required is 5664 m^2 (60,967 ft^2). A 10% allowance is reserved for staging purposes, bringing the total required area to 6,231 m^2 (67,070 ft^2).

3.4.11.1.7 Cylinder Deliveries

Cylinder deliveries to and from the site generally consist of feed deliveries to the site, product transport from the site, and return of supplier empty feed cylinders. At the NEF, full 48X cylinders are delivered one cylinder per delivery vehicle. Full 48X cylinders may be delivered two cylinders per delivery vehicle. New empty 48-in cylinders are delivered nine cylinders per delivery vehicle. Empty washed out 48-in cylinders are delivered six cylinders per vehicle. The

30-in product cylinders are delivered four cylinders per 6 m (20 ft) of delivery vehicle. The number of product cylinders per vehicle can vary and a typical shipment frequency would be one vehicle per 3 days (122 shipments per year). This information for a total plant capacity of 3 million SWU per year is summarized below. The figures in the following table represent a maximum number of deliveries per year. An alternate cylinder management strategy whereby empty feed cylinders are refilled with tails and new empty 48Y cylinders are provided to the feed suppliers would reduce the number of NEF deliveries.

Delivery Description	Number cylinders per year	Number cylinders per vehicle	Number deliveries per year
Feed In	690	1	690
Empty Tails In	625	9	70
Product Out	350	4	88
Empty Feed Out	690	6	115
Total	-	-	963

3.4.11.2 Cylinder Transport within the Facility

3.4.11.2.1 Cylinder Transport Between CRDB and the Product Blending and Liquid Sampling Area

Two double girder bridge cranes in the CRDB are used to move cylinders to either of the two weighing stations at the end of the CRDB. Cylinders moving from the CRDB to the Blending and Liquid Sampling Area and vise versa may be weighed. Each of the weighing stations has a transporter to convey the cylinders from the CRDB to the Blending and Liquid Sampling Area. The transporters travel along rails embedded in the floor. At rail intersections, physical stops prevent the CRDB transporter from colliding with the UF_6 Handling Area transporter. The rail system is depicted on Figure 3.3-10, Cylinder Receipt and Dispatch Building, First Floor, Part A.

A total of two rail transporters for the CRDB to UF_6 Handling/Blending and Liquid Sampling are included in the facility. The transporters may be battery powered, or fed by an electric feeder.

Cylinders are empty product, product, empty feed, feed, empty UBCs, UBCs, or semi-finished product cylinders.

3.4.11.2.2 Cylinder Transport Between the Product Blending and Liquid Sampling Area and the TSB

Cylinders are transported between the Blending and Liquid Sampling/ UF_6 Handling transporter and the TSB by a rail transport device that travels along rails embedded in the floor. Once the cylinders are in the TSB, they are lifted and moved with a bridge crane hoist system located in the Cylinder Preparation Room.

One rail transporter between the UF_6 Handling/Blending and Liquid Sampling and the TSB is installed in the facility. The transporter may be battery powered, or fed by an electric feeder.

New or clean cylinders are empty product, empty feed or empty tails. See Section 3.3.1.2.2.5 for details of cylinder preparation.

3.4.11.2.3 Cylinder Testing

When cylinders are delivered without valves and plugs, an internal inspection of the washed out or new cylinders is made in the Cylinder Preparation Room using a conventional remote optical viewing device, called an Endoscope. 48-in cylinders that are supplied with fitted valves and plugs do not require testing. All 30-in cylinders are inspected internally for criticality safety purposes.

Cylinders are pressure tested using compressed air in accordance with ANSI N14-2001 (ANSI, 2001). This system is used for testing new and decontaminated empty cylinders only. The test procedure is automated and is performed after the valve and plug fitting activities have been completed. The pressure test is administered via a set of program controlled automatic valves.

3.4.11.2.4 Cylinder Transport Between the Product Blending and Liquid Sampling Area and the UF_6 Handling Areas

A rail system extends between the Blending and Liquid Sampling Area and all of the UF_6 Handling Areas. The rail has two independent rail transporters. Each of the transporters has a drawbridge that links the transporter to the appropriate station or adjoining transporter. The UF_6 rail transporters are depicted in Figure 3.4-20, Rail Transporter Area Equipment Drawing. Its function is the transfer of cylinders to the appropriate Product Blending System Donor Station, Product Blending System Receiver Station, Product Liquid Sampling Autoclave, Solid Feed Station, Product Low Temperature Take-off Station, Tails Low Temperature Take-off Station or Feed Purification Low Temperature Take-off Station.

Cylinders are empty product, product, empty feed, feed, empty UBCs, UBCs or semi-finished product cylinders. Each of the transporters may be battery powered or fed by an electric feeder embedded in the concrete.

3.4.11.3 UBC Storage Pad

The NEF utilizes an area outside of the Cylinder Receipt and Dispatch Building (CRDB) for storage of UBCs. The UBC Storage Pad is used for storage of cylinders containing UF_6 that is depleted in ^{235}U. It is also used for the storage of empty feed cylinders. Access to the cylinder storage pad is controlled and a fence is provided so that only authorized vehicles may enter the area. The tails storage requirements are presented in Table 3.4-21, UBC Storage System Requirements.

3.4.11.3.1 Description

Space is allocated to provide storage of UBCs for 30 years of output from the facility. The uranium byproduct material is stored under vacuum in corrosion resistant Type 48Y cylinders. Empty feed cylinders are also Type 48Y cylinders.

The UBC Storage pad can accommodate storage of up to 15,727 48Y cylinders. The cylinders are stacked two high. Concrete saddles are used to store the cylinders approximately 200 mm (8 in) above ground level.

3.4.11.3.2 Equipment

The UBC Storage Pad layout is based on moving the cylinders with cranes and either diesel or electric flatbed trucks. Two double girder bridge cranes are used to load the depleted UF_6 cylinders onto the flatbed trucks in the CRDB. The trucks transport the cylinders from the CRDB to the double girder Gantry crane in the UBC Storage Pad. The Gantry crane is used to remove the cylinders from the flatbed trucks and place them on the UBC Storage Pad. The Gantry crane is designed to double stack the cylinders.

The specifications for the double girder Gantry crane are as follows:

Span	43.6 m (143 ft)
Capacity	20 MT (44,100 lb)
Hoist lift height (maximum)	9 m (30 ft)
Hoist lift speed (VFD)	6 m/min (20 ft/min)
Travel length	641 m (2,100 ft)
Bridge travel speed (VFD)	49 m/min (160 ft/min)
Trolley travel speed (VFD)	24 m/min (80 ft/min)
Brake type	Direct Current Disc

3.4.11.3.3 UBC Storage

The selected storage option is a double-stacked cylinder storage using a Gantry crane and flatbed trucks for cylinder handling. This type of storage arrangement facilitates visual inspection and removal of the cylinders for maintenance.

The total area for UBC storage for facility operation is approximately 8.5 ha (21 acres). These areas include a 10% allowance for staging activities, but do not include allocated areas for access or perimeter roads.

3.4.11.3.4 Empty Feed Cylinder Storage

Empty feed cylinders require a radiological cooling period in storage prior to return to the customer. The cooling period is dependent upon the emitted dose, and is typically three months. No additional spacing is required for gamma reading purposes. The area allocated per empty feed cylinder is 8 m^2 (86 ft^2). An allowance has been made for six months of storage of empty feed cylinders. This requires a space large enough to accommodate 354 cylinders, a total of 2832 m^2 (30,483 ft^2). With the 10% allowance for staging purposes, a total area of 3,115 m^2 (33,530 ft^2) is required. The area allocated for empty feed cylinders is located in the UBC Storage Pad.

3.4.12 References

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NRC, 2003. Potentially Defective 1-Inch Valves for Uranium Hexafluoride Cylinders, NRC Bulletin 2003-03, U.S. Nuclear Regulatory Commission, August 2003.

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Table 3.4-13 Contingency Dump System Codes and Standards

Page 1 of 1

The equipment IROFS are designed, constructed, tested, and maintained to QA Level 1. IROFS design criteria are included in Section 3.8.1, IROFS.
Rotating equipment is designed in accordance with the appropriate industry codes and standards. There is no QA Level 1 rotating equipment in the Contingency Dump System.
Heat transfer equipment is designed in accordance with the appropriate industry codes and standards. There is no QA Level 1 heat transfer equipment in the Contingency Dump System.
All miscellaneous equipment is designed in accordance with the appropriate industry codes and standards. There is no QA Level 1 miscellaneous equipment in the Contingency Dump System.
All process piping in the Contingency Dump System meets or exceeds the requirements of American Society of Mechanical Engineers, Process Piping, ASME B31.3, current edition at the time of detail design.

Table 3.4-14 Gaseous Effluent Vent System Codes and Standards

Page 1 of 1

Equipment Type	Code or Standard
Air Handling Units	NFPA 90A, 1999 AMCA Pub. 99 – 1986 AMCA Pub. 261 – 1998 ARI 430 – 1980 NEMA MG – 1998 REV. 3
Fans/Motors	AMCA 210 – 1999 ASHRAE 51 – 1999 ASHRAE Systems and Equipment 2000 NEMA MG1 – 1998 REV. 3
Coils	ANSI/ARI 410 – 2001
Air Cleaning Devices	ASME AG-1-1997 ERDA 76-21 – 1976 ANSI/ASME N509 – 1989 (R1996) ANSI/ASME N510 – 1989 (R1995) ASME NQA-1 – 2001 ASTM D6646-03 ANSI/AWS-D9.1 – 2000
Dampers	UL-Building Materials Directory

Table 3.4-15 Gaseous Effluent Vent System Design Bases (Separations Building)

Equipment Requirements	
Item	Quantity
Filter Stations (prefilter, HEPA, activated carbon filter)	1 + 1 spare
Fans	1 + 1 spare
System Design Flow Rate	11,000 m^3/hr (6474 scfm)
Filter Specifications	
Prefilter (Dust removal)	85%
HEPA Filter (Removal of uranium aerosols, mainly UO_2F_2 particles)	99.97% (for ≥ 0.3 μm particle size)
Activated Carbon Filter (HF removal)	99%

Table 3.4-16 Gaseous Effluent Vent System Design Bases (Technical Services Building)
Page 1 of 1

Equipment Requirements	
Item	Quantity
Filter Stations (prefilter, HEPA, activated carbon filter)	1 (no spare)
Fans	1 (no spare)
System Design Flow Rate	18,700 m^3/hr (11,000 scfm)
Filter Specifications	
Prefilter (Dust removal)	85%
HEPA Filter (Removal of uranium aerosols, mainly UO_2F_2 particles)	99.97% (for ≥ 0.3 μm particle size)
Activated Carbon Filter (HF removal)	99%

procedural controls, and by systematic inspections of waste materials. Onsite spills, if they occur, remain contained within Restricted Areas. Shipment of wastes offsite strictly adheres to regulations for packaging and transportation. The mass limit of fissile material prepared for offsite shipment shall not exceed the fissile material limits of 10 CFR 71 (CFR, 2003f). Appropriate protective clothing and respiratory equipment is required for plant workers depending on the material being handled.

Controls on shape, mass, area density, and selection of waste containers prevent criticality events.

In addition, MONK8A (SA, 2001) calculations were performed for a single 12 L (3.2 gal) residue container holding charcoal/uranyl fluoride/water mixture over a range of H/U ratios. The container was modeled as an equiaxed cylinder of radius 12.4 cm (4.9 in) and height 24.8 cm (9.8 in) which was placed on a 20 cm (7.9 in) thick concrete layer with reflection beneath the lower face to simulate infinite depth of concrete. The cylinder volume was completely filled with the charcoal/uranic mixture. A 2.5 cm (0.984 in) thick water layer enclosed the cylinder sides and top surface. At the optimum H/U ratio of 24, the value of k_{eff} is 0.7025 compared with a maximum value for k_{eff} of 0.8570 for an isolated 12 L (3.2 gal) cylinder of oil/UF_4 mixture. This indicates that the charcoal mixture will be safe when stored in 12 L (3.2 gal) containers.

For the array, a 5x5 horizontal array of cylinders was modeled explicitly with an additional container in contact with the center cylinder of the 5x5 unit to simulate accidental movement of an extra container into a storage array. The containers were modeled resting on a 30 cm (11.8 in) thick concrete layer and a 2.5 cm (0.984 in) water reflector was placed around each container. The uranic/oil mix was at an H/U ratio of 21. The value of k_{eff} obtained for the array model was 0.9281.

Therefore, arrays of up to 5x5 12 L (3.2 gal) containers containing chemical absorber material are therefore safe under worst-case conditions with 60 cm (23.6 in) spacing between containers.

3.5.14 Decontamination Workshop

The Decontamination Workshop is located in the Technical Services Building. The layout is shown in Figure 3.5-38, Decontamination Workshop Equipment Arrangement. The decontamination systems in this workshop are designed to remove radiation from contaminated materials and equipment used in uranium hexafluoride systems, waste handling systems, and miscellaneous other areas of the plant. Space is provided to break down and strip contaminated equipment prior to decontamination. The workshop is also used for the temporary storage and dismantling of failed equipment.

The only significant forms of radioactive contamination found in the facility are uranium hexafluoride (UF_6), uranium tetrafluoride (UF_4), and uranyl fluoride (UO_2F_2).

3.5.14.1 System Description

The Decontamination System has three basic subsystems:

- Equipment decontamination

- Sample bottle and valve decontamination
- Flexible hose decontamination

Equipment decontamination takes place in the Equipment Decontamination Cabinet and includes larger equipment items such as pumps and trap bodies. Sample bottles, valves, and flexible hoses are decontaminated in separate cabinets because of the difficulty of handling the specific shapes. Sample bottles and valves are decontaminated in the Sample Bottle Decontamination Cabinet and flexible hoses are decontaminated in the Flexible Hose Decontamination Cabinet.

3.5.14.1.1 Equipment Preparation for Decontamination

Equipment and components are stored in critically-safe arrays upon delivery to the Decontamination Workshop. These items are then degassed and drained before being broken down and stripped. Once equipment and components are stripped, they are ready to be decontaminated.

3.5.14.1.2 Equipment Decontamination

Stripped equipment and components are put into baskets when they are ready to be decontaminated in the Equipment Decontamination Cabinet (Figure 3.5-39, Process Flow Diagram, Equipment Decontamination System). The baskets are submerged in multiple heated baths, including a degreasing water bath, a citric acid bath, and two rinse water baths to decontaminate items. After the items are dry, they go to the Vacuum Pump Rebuild Workshop for reassembly. Typical equipment items are vacuum pumps and pump components, but may include valves, piping, instruments, tools, and scrap metal.

3.5.14.1.3 Sample Bottle Decontamination

Sample bottles and valves are decontaminated in the Sample Bottle Decontamination Cabinet (Figure 3.5-40, Process Flow Diagram, Decontamination System for Sample Bottles). Valves are linked together and citric acid is pumped through them, followed by DI water. Sample bottles are individually rinsed with citric acid to decontaminate them, followed by a DI water rinse. The bottles are initially dried using heated, compressed air before being placed into an oven to insure total dryness. The sample bottles are returned to the laboratories in the TSB where they are used for analysis.

3.5.14.1.4 Decontamination of Flexible Hoses

In the Flexible Hose Decontamination Cabinet (Figure 3.5-41, Process Flow Diagram, Decontamination System for Flexible Hoses), flexible hoses are decontaminated by pumping a citric acid solution through them. DI water is then pumped through the hoses before they are dried using heated, compressed air. The dried hoses are moved into the Vacuum Pump Rebuild Workshop for reuse in the plant.

3.5.14.4.3 Sample Bottle Decontamination

The Decontamination Workshop has a separate area dedicated to sample bottle storage, disassembly, and decontamination, called the Sample Bottle Decontamination Cabinet (Figure 3.5-40, Process Flow Diagram, Decontamination System for Sample Bottles). Valves are also decontaminated in this cabinet. The decontamination system for valves and sample bottles requires a citric acid rinse and a DI water rinse for both items.

Used sample bottles are weighed to confirm the bottles are empty upon entry into the workshop. The sample bottle valves are loosened outside the cabinet and then are removed once inside the cabinet. A small open container is filled with a citric acid solution. The sample bottles are filled with a clean citric acid solution from this container. Any loose material inside the bottle is dissolved in the solution, which is then poured into a waste container. The sample bottles are then filled with DI water and left to stand for approximately an hour.

The removed valves are linked together in series before being placed downstream of a pump. The pump is fed from a small open container filled with citric acid solution. Citric acid is then recirculated in a closed loop through the valves for an hour. The valves are rinsed after the decontamination step using fresh DI water.

After the bottles and valves have a second DI water rinsing, they are dried manually using heated compressed air and inspected for contamination and rust.

The resulting waste solutions from cleaning the bottles and the valves are collected in 5-L citric acid/uranic waste containers. The solutions are then manually transferred to the Citric Acid Tank in the Equipment Decontamination Cabinet. Any liquid spillages / drips are soaked away with paper tissues that are disposed of in the Solid Waste Collection System.

During the process, air from the cabinet vents to the GEVS to ensure that airborne contamination is controlled. The bottles are then put into an electric oven to ensure total dryness, and on removal are ready for reuse. The cleaned components are transferred to a clean workshop for reassembly followed by pressure and vacuum testing.

3.5.14.4.4 Flexible Hose Decontamination

The decontamination of flexible hoses is performed in a Flexible Hose Decontamination Cabinet (Figure 3.5-41, Process Flow Diagram, Decontamination System for Flexible Hoses). This decontamination cabinet is designed to process only one flexible hose at a time and consists of recirculation loops of citric acid solution and of DI water.

The flexible hose is attached in a closed loop downstream of a closed citric acid tank and a recirculation pump. The flexible hose is flushed with a heated citric acid solution. After the citric acid wash, the hose is attached in a closed loop downstream of a closed DI water tank and a pump. It is then rinsed with heated DI water in a recirculation system. Each flexible hose is then dried in the cabinet using heated compressed air. The cleaned, dry flexible hose is then transferred to the Vacuum Pump Rebuild Workshop for reassembly and pressure testing prior to reuse in the plant.

Interlocks are provided in both recirculation loops such that the recirculation pumps cannot be started if the flexible hose has not been connected correctly at both ends. The cabinet doors are also on an interlock system to ensure that the pump does not start with the doors open. The tanks each have a temperature transmitter, a level transmitter with high and low alarms, and controls on the electric heating element. Both the citric acid and DI water recirculation pumps are equipped with 15-min timer devices. The two tanks are maintained at 60°C (140°F) when in operation.

The used solutions (citric acid and DI water) are transferred into the Citric Acid Tank in the Equipment Decontamination Cabinet for disposal. The exhaust air goes to the GEVS to ensure airborne contamination is controlled. Spillages from the drip tray are routed to either the citric acid tank or the hot water recirculation tank in the cabinet depending upon the decontamination cycle.

3.5.14.5 Safety Considerations

Failure of this system does not endanger the health and safety of the public. Design and operating features enhance public and worker safety.

To minimize worker exposure, airborne radiological contamination resulting from dismantling is vented to the GEVS. Air suits and portable ventilation units are available for further worker protection.

Containment of chemicals and wastes is provided by equipment and piping components, designated containers, and air filtration systems. All pipe work and vessels in the Decontamination Workshop are provided with design measures to protect against spillage or leakage. Hazardous wastes and materials are contained in tanks and other appropriate containers, and are strictly controlled by administrative procedures. Chemical reaction accidents are prevented by strict control on chemical handling procedures and physical segregation of chemicals in storage locations.

Personnel entry into the facility will be via a sub-change facility. This area has the required boot barrier access, washing and monitoring facilities.

Criticality is precluded through the control of geometry, mass, and the selection of appropriate storage containers. Administrative measures are applied to uranium concentrations in the Citric Acid Tank, Degreaser Tank, and Rinse Water Tanks in the Equipment Decontamination Cabinet to maintain these controls.

In addition, a MONK8A (SA, 2001) calculation was performed for a generic model of arrays of pumps of volume not exceeding 14 L (3.7 gal). The pumps were modeled simply as equiaxed cylinders of uranic material of 14 L (3.7 gal) volume surrounded by an iron annulus of 0.5 cm (0.2 in) thickness representing typical casing thickness for UF_6 pumps. The uranic material was uranyl fluoride/water mixture at an H/U atomic ratio of 7 and at 6.0 $^{w}/_{o}$ ^{235}U enrichment. The two pumps were modeled in contact along the cylinder wall and a 2.5 cm (0.984 in) water annulus was included around each pump to simulate spurious reflection. The pumps were positioned above a 20 cm (7.9 in) thick concrete layer but separated from this layer by the 2.5 cm (0.984 in) water thickness. Reflection was used to simulate an infinite linear array of pump pairs with 60 cm (23.6 in) edge spacing between pairs. The resulting value of k_{eff} was 0.8552.

The MONK8A (SA, 2001) model described above was modified to replace the two touching 14 L (3.7 gal) pumps with two pump sets in contact, each pump set assumed a combination of a Leybold WS2000 pump and a Leybold WS500 pump.

For the WS2000 pump, a detailed model was used based on the actual construction of the pump from information supplied by the manufacturer. Some conservative modeling simplifications were required mainly for the gearbox and motor assemblies. In the case of the WS500 pump, which has a free volume of 8.52 L (2.25 gal), the simple equiaxed cylinder model was used. To simulate spurious reflection, the two pumps were modeled as being separated vertically by the thickness of the 2.5 cm (0.984 in) water annulus around the cylinder of the WS500 pump. This spurious reflection assumption is less than the actual separation when the pumps are in their pump frame.

Two pump sets were explicitly modeled but rather than being side by side as was the case for the 14 L (3.7 gal) pumps, the pump sets were orientated in line such that the WS2000 pumps were in contact at the gearbox end. Sensitivity studies show this to be the most reactive configuration for the pump sets. It was also assumed that the pumps were filled with the same uranic mixture as for the 14 L (3.7 gal) pumps and the infinite linear array was again used. The resulting value of k_{eff} was 0.8202.

Therefore, a linear array of pump pairs with 60 cm (23.6 in) spacing is safe.

3.5.15 Fomblin Oil Recovery System

Fomblin oil is a highly fluorinated, inert oil selected especially for use in uranium hexafluoride (UF_6) systems to avoid reaction with UF_6. The Fomblin Oil Recovery Unit recovers used Fomblin oil from pumps used in UF_6 process systems. Used Fomblin oil is recovered by removing impurities that inhibit the oil's lubrication properties. The impurities collected are primarily uranyl fluoride (UO_2F_2) and uranium tetrafluoride (UF_4) particles. The recovery process also removes trace amounts of hydrocarbons, which if left in would react with UF_6. Flow through the Fomblin Oil Recovery System, located in the Decontamination Workshop is shown in Figure 3.5-42, Process Flow Diagram, Fomblin Oil Recovery System.

The process employed is essentially a laboratory scale unit that has been developed to a production level. Fomblin oil recovery is carried out as a batch operation, one batch being up to 12 L (3.2 gal) of oil, using the fully enclosed, self-contained Fomblin Oil Recovery Unit. Only one batch of oil is processed at any one time representing a maximum of 12 L (3.2 gal). The unit has a uranium removal section followed by a hydrocarbon removal section. Dimensions of the recovery unit are approximately 3 m (9.84 ft) long by 1 m (3.28 ft) wide by 2.2 m (7.22 ft) high.

3.5.15.1 System Description

The Fomblin oil recovery process consists of oil collection, uranium precipitation, trace hydrocarbon removal, oil sampling, and storage of cleaned oil for re-use. Each step is performed manually.

Fomblin oil is collected in the Decontamination Workshop as part of the pump disassembly process. The oil is transferred for processing to the Fomblin Oil Recovery Unit in criticality safe, 5 L (1.32 gal), plastic containers. The containers are labeled so each can be tracked through the process. The used oil awaiting processing is stored in the Fomblin oil receipt storage array to eliminate the possibility of accidental criticality. Each row of the array has 300 mm (0.984 ft) spacing between containers (edge to edge). The distance between rows is 600 mm (1.97 ft) (edge to edge). Containers are not accepted if there are no vacancies in the array.

Uranium compounds are removed from the Fomblin oil in the Fomblin Oil Recovery Unit to minimize personnel exposure to airborne contamination. Dissolved uranium compounds are removed by the addition of anhydrous sodium carbonate (Na_2CO_3) to the oil container which causes the uranium compounds to precipitate into sodium uranyl carbonate ($Na_4UO_2(CO_3)_3$). The mixture is agitated and then filtered through a coarse screen to remove metal particles and small parts such as screws and nuts. This waste is transferred to the Solid Waste Collection System. The oil is then heated to 90 °C (194 °F) and stirred for 90 minutes to speed the reaction. The oil is centrifuged to remove UF_4, sodium uranyl carbonate, and various metallic fluorides. The particulate that is removed from the oil is collected and transferred to the Solid Waste Collection System for subsequent offsite disposal.

After uranium compounds are removed, trace amounts of hydrocarbons are removed in the Fomblin Oil Recovery Unit by adding activated carbon to the Fomblin oil and heating the mixture to 100°C (212°F) for two hours. The activated carbon adsorbs the hydrocarbons, and the carbon in turn is removed by filtration through a bed of celite. The resulting sludge is transferred to the Solid Waste Collection System for disposal.

Recovered Fomblin oil is sampled, and the samples are dissolved and analyzed in the Chemical Laboratory to determine if the criteria for purity have been met. Oil that meets the criteria can be re-used in the UF_6 system while oil that does not meet the criteria is reprocessed. The following limits have been set for recovered Fomblin oil purity for re-use in the plant:

- Uranium - 50 ppm by volume.
- Hydrocarbons - 3 ppm by volume.

Recovered Fomblin oil is stored in 5 L (1.32 gal), plastic containers in the chemical storage area. No precautions are required to prevent criticality accidents during the handling and storage of clean Fomblin oil.

3.5.15.2 Major Components

The following major components are included in this system:

A. Fomblin Oil Recovery Unit. One Fomblin Oil Recovery Unit is provided to control the release of airborne radioactive contamination or HF during oil processing. Discharge air is filtered and is discharged from the plant via the Gaseous Effluent Ventilation System.

B. Fomblin Oil Centrifuge. One Fomblin oil centrifuge is provided within the recovery unit to remove particulate from the oil. The centrifuge capacity is approximately 60 L/hr (15 gph).

3.5.15.3 Interfaces

The Fomblin Oil Recovery System interfaces with the following plant systems and areas:

A. Gaseous Effluent Vent System. Exhaust from the fume hood of the Fomblin Oil Recovery Unit is filtered and discharged from the plant via the TSB Gaseous Effluent Vent System.

B. Solid Waste Collection System. The Solid Waste Collection System will receive uranic precipitate and filter cake resulting from the uranium and hydrocarbon removal processes, and solvent resulting from rinse-out of filters, tubing, and clean oil containers.

C. Decontamination Workshop. Fomblin oil collected in the pump disassembly areas of the Decontamination Workshop is transferred to the Fomblin Oil Recovery System – also in the Decontamination Workshop - for processing. The Fomblin oil centrifuge bowls and parts are transferred for decontamination in the Decontamination System - also in the Decontamination Workshop.

D. Vacuum Pump Rebuild Workshop. Cleaned Fomblin oil is transferred to the Vacuum Pump Rebuild Workshop to await reuse in rebuilt pumps.

3.5.15.4 Operating Characteristics

The total annual volume of oil processed in this system is approximately 530 L (140 gal). The above system description serves to describe operating characteristics as well since oil recovery is simply a series of manual steps.

3.5.15.5 Safety Considerations

Failure of this system will not endanger the health and safety of the public. Nevertheless, design and operating features are included which contribute to the safety of plant workers. Containment of chemicals and wastes is provided by components, designated containers, and air filtration systems. Chemical reaction accidents are prevented by strict control on chemical handling procedures and physical segregation of chemicals in storage locations. Fomblin oil is rated as non-combustible and is thermally stable up to 300°C (571°F). Strict control of oil temperatures during heating precludes threat of fire. To minimize worker exposure, the Fomblin Oil Recovery System fume hood extracts all airborne radiological contamination resulting from oil recovery. Where necessary, air suits and portable ventilation units are available for further worker protection.

Criticality associated with Fomblin oil recovery is precluded through the control of shape, mass, and the selection of appropriate storage containers.

The maximum volume of any vessel on the Fomblin Oil Recovery Unit is 12 L (3.2 gal) and is intrinsically safe. However, MONK8A (SA, 2001) calculations demonstrate that the unit would remain safe even if all vessels were completely filled with uranyl fluoride-water mixture at 6.0 $^w/_o$ enrichment and at optimum moderation. Uranyl fluoride/water mixture is more conservative than a Fomblin oil/UF_4 mixture. In the Fomblin oil/UF_4 mixture, dissolved HF provides the moderation and HF solubility in Fomblin oil is extremely low.

The MONK8A (SA, 2001) calculations for the Fomblin Oil Recovery Unit modeled the fixed vessels in their normal positions and included one 12 L (3.2 gal) container adjacent to the first mixing vessel to represent the batch of oil being moved to the unit. A 2.5 cm (0.984 in) water layer was modeled around the vessels to simulate spurious reflection. All vessels contained uranyl fluoride-water mixture as stated above, and a range of H/U atomic ratios were considered to determine the optimum moderation. The maximum value of k_{eff} for the calculations was 0.7976 at an H/U ratio of 14.

3.5.16 Laundry System

The Laundry System cleans contaminated and soiled clothing and other articles which have been used throughout the plant. It contains the resulting solid and liquid wastes for transfer to appropriate treatment and disposal facilities. The Laundry System receives the clothing and articles from the plant in plastic bin bags, taken from containers strategically positioned within the plant. Clean clothing and articles are delivered to storage areas located within the plant. The Laundry System components are located in the Laundry Room of the TSB.

3.5.16.1 System Description

The Laundry System collects, sorts, cleans, dries, and inspects clothing and articles used throughout the plant in Radiation Areas (RAs). The laundry system does not handle any articles from non-RAs. Laundry collection is divided into two main groups- articles with a low probability of contamination and articles with a high probability of contamination. Those articles unlikely to have been contaminated are further sorted into lightly soiled and heavily soiled groups. The sorting is done on a table underneath a vent hood that is connected to the GEVS in the TSB. All lightly soiled articles are cleaned in the laundry. Heavily soiled articles are inspected and any considered to be difficult to clean (i.e., those with significant amounts of grease or oil on them) are transferred to the Solid Waste Collection System without cleaning. Special containers and procedures are used for collection, storage, and transfer of these items as described in the Solid Waste Collection System section. Articles from one plant department are not cleaned with articles from another plant department.

Special water-absorbent bags are used to collect the articles that are more likely to be contaminated. These articles may include pressure suits and items worn when, for example, it is required to disconnect or "open up" an existing plant system. These articles that are more likely to be contaminated are cleaned separately. Expected contaminants on the laundry include slight amounts of uranyl fluoride (UO_2F_2) and uranium tetrafluoride (UF_4).

When sorting is completed, the articles are placed into the front-loading washing machine in batches. The cleaning process uses 80°C (176°F) minimum water, detergents, and non-chlorine bleach for dirt and odor removal, and disinfection of the laundry. Detergents and non-chlorine bleach are added by vendor-supplied automatic dispensing systems. No "dry cleaning" solvents are used. Wastewater from the washing machine is discharged to one of three Laundry Effluent Monitor Tanks in the Liquid Effluent Collection and Treatment System. The laundry effluent is then sampled, analyzed, and transferred to the TEEB for disposal (if uncontaminated) or to the Precipitation Treatment Tank for treatment as necessary.

When the washing cycle is complete, the wet laundry is placed in a front-loading, electrically heated dryer. The dryer has variable temperature settings, and the hot wet air is exhausted to the atmosphere through a lint drawer that is built into the dryer. The lint from the drawer is then sent to the Solid Waste Collection System as combustible waste.

Dry laundry is removed from the dryer and placed on the laundry inspection table for inspection and folding. Folded laundry is returned to storage areas in the plant.

adsorbs UF_6 which, is then assumed to be hydrated (by moist air inleakage) to form a uranyl fluoride/water mixture with a maximum H/U ratio of 7.

The traps are of internal diameter 20.3 cm (8.0 in) and height 105.8 cm (41.7 in). The diameter is less than the maximum safe diameter (21.9 cm (8.6 in)) for 6.0 $^w/_o$ enriched material for a single cylinder. However, it is possible that large numbers of traps (e.g., in storage arrays) are more reactive.

Arrays of chemical traps were modeled using MONK8A (SA, 2001). An array of 7x7 traps and a vacuum cleaner yields a k_{eff} of 0.9191 assuming 6.0 $^w/_o$ enrichment. This was modeled with the sidewalls of the traps touching, which could not happen in practice since there is a lip at the top. Taking account of one of these lips to give 5 cm (2.0 in) spacing between the traps an array of 11x11 traps and a vacuum cleaner was modeled and gave a reduced k_{eff} of 0.8665. The vacuum cleaner was assumed to be a cleaner of internal diameter 20.3 cm (8.0 in) and length 66 cm (26.0 in) and was assumed to be entirely filled with uranic material with an enrichment of 6.0 $^w/_o$. MONK8A (SA, 2001) calculations have also been carried out for an isolated cylinder using these dimensions, filled with uranyl fluoride/water at optimum moderation and with 2.5 cm (0.984 in) water reflection. This gave a value for k_{eff} of 0.8037. The cleaner has high efficiency particulate air (HEPA) filtration on the exhaust, and will be dedicated for cleaning operations where uranic material is involved and will be marked clearly.

It can be concluded that arrays of these chemical traps containing uranium of up to 6.0 $^w/_o$ enrichment are safe up to an11x11 array configuration with no spacing restriction. The only stipulation that needs to be made is that stacking of traps in an array is not allowed.

3.5.18 Chemical Laboratory

The prime function of the Chemical Laboratory is to analyze the product material to ensure that it meets the product purity specification. This involves the handling and storage of a large number of 1S sample bottles and the production of hydrolyzed UF_6 solutions for the subsequent analysis. There may also be a requirement for this laboratory to deal with other samples, for example, those from the Decontamination System's tanks. These samples will have uranium concentrations much less than the hydrolyzed UF_6 solutions considered below and as such can be treated in the same manner. There may be a requirement for other solid samples to be analyzed such as deposits removed from plant components prior to decontamination and these can be dealt with on a formal mass accountancy basis. The double batching mass limit of 45% of the minimum critical mass is used in the nuclear criticality safety for these samples.

Samples of UF_6 are typically received in 1S cylinder sample bottles. The storage system for 1S bottles is a rack system within two storage areas of approximate dimensions of 1 meter wide and 2.5 m (8.2 ft) high. These have a combined total of 168 slots and normally up to three bottles would be placed in one slot. The normal capacity is approximately 500 bottles.

3.5.18.1 System Description

Samples enter the Chemical Laboratory from across the plant for analysis. The samples are categorized as follows.

A. UF_6 product samples

B. Waste water samples

C. Samples from the Decontamination Workshop

D. Oil samples from compressors

E. Samples from chemical absorbers

F. Miscellaneous samples.

3.5.18.2 Major Components

The major components of the Chemical Laboratory include the following.

A. Inductively-coupled Plasma Mass Spectrometer

B. Inductively-coupled Plasma Optical Emission Spectrometer

C. Analytical Laboratory Equipment (UV Spectrometer, pH meter, conductivity meter, titrators, water bath, analytical balances)

D. Fume Collection and Exhaust Hoods

E. Ultra Pure Water Equipment

F. Sub-sampling Unit.

The sub-sampling unit allows smaller samples of UF_6 to be dispensed from plant sample containers (1S or 2S bottles) into P-10 tubes that are then used for analysis or shipment to customers. The unit consists of three independently heated dispensing stations mounted on a common base. It is located inside a fume collection exhaust hood.

Each dispensing station is contained in its own electrically heated, insulated hot box. A fan circulates the air inside the hot box. Instrumentation controls the temperature of the hot box and shuts off the heating system on high temperature or loss of vacuum. Two stations are capable of handling 1S sample bottles, and the third station can handle either 1S or 2S sample bottles.

Each station has the necessary piping and valves to transfer a specific quantity of UF_6 into the smaller type P-10 sub-sample tube. The sub-sample tube is located outside the hot box and is cooled with liquid nitrogen in a Dewar flask.

A common manifold connects the sample piping in each station to vacuum pumps via UF_6 cold traps. Three vacuum pumps are mounted on the unit base. For initial system pump down and to remove moisture, a set of two pumps in series is used. For normal operation of the unit a single pump installed in parallel to the dual pump set is used. The vacuum pumps exhaust into the fume collection exhaust hood.

Dual UF_6 cold traps, connected in series, precede the vacuum pumps. The UF_6 cold traps are cooled using liquid nitrogen in Dewar flasks. UF_6 in the exhaust gas is desublimed in the UF_6 cold traps before being exhausted through the vacuum pump.

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Table 3.7-1 Accident Sequence and Risk Index

Accident Identifier	Initiating Event Index	Preventive Safety Parameter 1 or IROFS 1 Failure Index	Preventive Safety Parameter 2 or IROFS 2 Failure Index	Mitigation IROFS Failure Index	Likelihood Index T Uncontrolled (U) / Controlled (C)	Likelihood Category	Conseq. Category (Type of Accident)	Risk Index (h=f x g) Uncontrolled (U) / Controlled (C)	Comments and Recommendations
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	
TT2-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
TT2-1	-2	(IROFS1) -2	(IROFS2) -2	N/A	-6 (C)	1	3 (T)	3 (C)	Acceptable Risk
TT2-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
TT2-2	-2	(IROFS38) -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
TT3-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
TT3-1	-2	(IROFS3) (Failure, -2)	N/A	(IROFS47b) (Failure, -3)	-7 (C)	1	3 (T)	3 (C)	Acceptable Risk
TT3-1	-2	(IROFS3) (Failure, -2)	N/A	(IROFS47b) (Success)	-4 (C)	2	2 (T)	4 (C)	Acceptable Risk
TT3-1	-2	(IROFS3) (Success)	N/A	(IROFS47b) (Failure, -3)	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
UF1-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
UF1-1	-2	(IROFS4) -2	(IROFS5) -2	N/A	-6 (C)	1	3 (T)	3 (C)	Acceptable Risk
UF2-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
UF2-1	-2	(IROFS1) -2	(IROFS2) -2	N/A	-6 (C)	1	3 (T)	3 (C)	Acceptable Risk
UF2-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
UF2-2	-2	(IROFS38) -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
UF3-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
UF3-1	-2	(IROFS3) (Failure, -2)	N/A	(IROFS47a) (Failure, -3)	-7 (C)	1	3 (T)	3 (C)	Acceptable Risk
UF3-1	-2	(IROFS3) (Failure, -2)	N/A	(IROFS47a) (Success)	-4 (C)	2	2 (T)	4 (C)	Acceptable Risk
UF3-1	-2	(IROFS3) (Success)	N/A	(IROFS47a) (Failure, -3)	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
PT2-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
PT2-1	-2	(IROFS1) -2	(IROFS2) -2	N/A	-6 (C)	1	3 (T)	3 (C)	Acceptable Risk

Type of Accident – T for Chemical

CR for Criticality

Table 3.7-1 Accident Sequence and Risk Index

Accident Identifier	Initiating Event Index	Preventive Safety Parameter 1 or IROFS 1 Failure Index	Preventive Safety Parameter 2 or IROFS 2 Failure Index	Mitigation IROFS Failure Index	Likelihood Index T Uncontrolled (U) / Controlled (C)	Likelihood Category	Conseq. Category (Type of Accident)	Risk Index (h=f x g) Uncontrolled (U) / Controlled (C)	Comments and Recommendations
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	
PT2-2	(IROFS6a) -1	N/A	N/A	N/A	-1 (U)	3	3 (CR)	9 (U)	IROFS Required
PT2-2	(IROFS6a) -1	(IROFS7) -3	(IROFS6b) -2	N/A	-6 (C)	1	3 (CR)	3 (C)	Acceptable Risk
PT2-3	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
PT2-3	-2	(IROFS16c) -2	(IROFS16d) -2	N/A	-6 (C)	1	3 (CR)	3 (C)	Acceptable Risk
PT2-4	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
PT2-4	-2	(IROFS38) -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
PT2-5	(IROFS30a) -1	N/A	N/A	N/A	-1 (U)	3	3 (CR)	9 (U)	IROFS Required
PT2-5	(IROFS30a) -1	(IROFS30b) -2	(IROFS30c) -2	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
PT3-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
PT3-1	-2	(IROFS3) -2	(IROFS8a) -2	N/A	-6 (C)	1	3 (CR)	3 (C)	Acceptable Risk
PT3-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
PT3-2	-2	(IROFS3) (Failure, -2)	N/A	(IROFS47a) (Failure, -3)	-7 (C)	1	3 (T)	3 (C)	Acceptable Risk
PT3-2	-2	(IROFS3) (Failure, -2)	N/A	(IROFS47a) (Success)	-4 (C)	2	2 (T)	4 (C)	Acceptable Risk
PT3-2	-2	(IROFS3) (Success)	N/A	(IROFS47a) (Failure, -3)	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
PT3-3	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
PT3-3	-2	(IROFS8a) -2	(IROFS9) -2	N/A	-6 (C)	1	3 (CR)	3 (C)	Acceptable Risk
PT3-5	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
PT3-5	-2	(IROFS15) -3	N/A	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
PB1-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
PB1-1	-2	(IROFS4) -2	(IROFS5) -2	N/A	-6 (C)	1	3 (T)	3 (C)	Acceptable Risk

Accident Identifier	Initiating Event Index	Preventive Safety Parameter 1 or IROFS 1 Failure Index	Preventive Safety Parameter 2 or IROFS 2 Failure Index	Mitigation IROFS Failure Index	Likelihood Index T Uncontrolled (U) / Controlled (C)	Likelihood Category	Conseq. Category (Type of Accident)	Risk Index (h=f x g) Uncontrolled (U) / Controlled (C)	Comments and Recommendations
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	
PB1-3	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
PB1-3	-2	(IROFS45) -3	N/A	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
PB2-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
PB2-1	-2	(IROFS1) -2	(IROFS2) -2	N/A	-6 (C)	1	3 (T)	3 (C)	Acceptable Risk
PB2-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
PB2-2	-2	(IROFS16a) -3	N/A	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
PB2-3	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
PB2-3	-2	(IROFS3) -2	(IROFS8a) -2	N/A	-6 (C)	1	3 (CR)	3 (C)	Acceptable Risk
PB2-4	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
PB2-4	-2	(IROFS38a) -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
PB2-5	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
PB2-5	-2	(IROFS16c) -2	(IROFS16d) -2	N/A	-6 (C)	1	3 (CR)	3 (C)	Acceptable Risk
PB2-6	(IROFS30a) -1	N/A	N/A	N/A	-1 (U)	3	3 (CR)	9 (U)	IROFS Required
PB2-6	(IROFS30a) -1	(IROFS30b) -2	(IROFS30c) -2	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
PB3-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
PB3-1	-2	(IROFS3) -2	(IROFS8a) -2	N/A	-6 (C)	1	3 (CR)	3 (C)	Acceptable Risk
PB3-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
PB3-2	-2	(IROFS9) -2	(IROFS8a) -2	N/A	-6 (C)	1	3 (CR)	3 (U)	Acceptable Risk
PB3-3	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
PB3-3	-2	(IROFS3) (Failure, -2)	N/A	(IROFS47a) (Failure, -3)	-7 (C)	1	3 (T)	3 (C)	Acceptable Risk
PB3-3	-2	(IROFS3) (Failure, -2)	N/A	(IROFS47a) (Success)	-4 (C)	2	2 (T)	4 (C)	Acceptable Risk
PB3-3	-2	(IROFS3)	N/A	(IROFS47a)	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk

Accident Identifier	Initiating Event Index	Preventive Safety Parameter 1 or IROFS 1 Failure Index	Preventive Safety Parameter 2 or IROFS 2 Failure Index	Mitigation IROFS Failure Index	Likelihood Index T Uncontrolled (U) / Controlled (C)	Likelihood Category	Conseq. Category (Type of Accident)	Risk Index (h=f x g) Uncontrolled (U) / Controlled (C)	Comments and Recommendations
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	
		(Success)		(Failure, -3)					
PB4-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
PB4-1	-2	(IROFS10) -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
PB4-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
PB4-2	-2	(IROFS11) -2	(IROFS12) -2	N/A	-6 (C)	1	3 (T)	3 (C)	Acceptable Risk
PB4-3	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
PB4-3	-2	(IROFS10) -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
PB4-4	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
PB4-4	-2	(IROFS42) -2	(IROFS10) -3	N/A	-7 (C)	1	3 (T)	3 (C)	Acceptable Risk
PB4-5	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
PB4-5	-2	(IROFS13) -2	(IROFS8b) -2	N/A	-6 (C)	1	3 (CR)	3 (C)	Acceptable Risk
VR1-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
VR1-1	-2	(IROFS3) -2	(IROFS21) -2	N/A	-6 (C)	1	3 (CR)	3 (C)	Acceptable Risk
VR1-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
VR1-2	-2	(IROFS22) -2	(IROFS21) -2	N/A	-6 (C)	1	3 (CR)	3 (C)	Acceptable Risk
VR1-3	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
VR1-3	-2	(IROFS23a) -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
VR1-5	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
VR1-5	-2	(IROFS3) (Failure, -2)	N/A	(IROFS47b) (Failure, -3)	-7 (C)	1	3 (T)	3 (C)	Acceptable Risk
VR1-5	-2	(IROFS3) (Failure, -2)	N/A	(IROFS47b) (Success)	-4 (C)	2	2 (T)	4 (C)	Acceptable Risk
VR1-5	-2	(IROFS3) (Success)	N/A	(IROFS47b) (Failure, -3)	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
VR2-1	-2	N/A	N/A	N/A	-2 (U)	3	2 (T)	6 (U)	IROFS Required
VR2-1	-2	(IROFS23b)	N/A	N/A	-4 (C)	2	2 (T)	4 (C)	Acceptable

Accident Identifier	Initiating Event Index	Preventive Safety Parameter 1 or IROFS 1 Failure Index	Preventive Safety Parameter 2 or IROFS 2 Failure Index	Mitigation IROFS Failure Index	Likelihood Index T Uncontrolled (U) / Controlled (C)	Likelihood Category	Conseq. Category (Type of Accident)	Risk Index (h=f x g) Uncontrolled (U) / Controlled (C)	Comments and Recommendations
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	
		-2							Risk
VR2-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
VR2-2	-2	(IROFS23b) -2	(IROFS24a) -2	N/A	-6 (C)	1	3 (T)	3 (C)	Acceptable Risk
VR2-7	(IROFS31a) -1	N/A	N/A	N/A	-1 (U)	3	3 (CR)	9 (U)	IROFS Required
VR2-7	(IROFS31a) -1	(IROFS31b) -2	(IROFS31c) -2	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
FR1-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
FR1-1	-2	(IROFS14a) -3	N/A	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
FR1-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
FR1-2	-2	(IROFS14b) -3	N/A	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
FR2-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
FR2-1	-2	(IROFS14a) -3	N/A	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
FR2-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (C)	IROFS Required
FR2-2	-2	(IROFS14b) -3	N/A	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
DS1-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
DS1-1	-2	(IROFS14a) -3	N/A	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
DS1-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
DS1-2	-2	(IROFS14b) -3	N/A	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
DS1-3	(IROFS19c) -1	N/A	N/A	N/A	-1 (U)	3	3 (CR)	9 (U)	IROFS Required
DS1-3	(IROFS19c) -1	(IROFS19a) -2	(IROFS19d) -2	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
DS2-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
DS2-1	-2	(IROFS14a)	N/A	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable

Accident Identifier	Initiating Event Index	Preventive Safety Parameter 1 or IROFS 1 Failure Index	Preventive Safety Parameter 2 or IROFS 2 Failure Index	Mitigation IROFS Failure Index	Likelihood Index T Uncontrolled (U) / Controlled (C)	Likelihood Category	Conseq. Category (Type of Accident)	Risk Index (h=f x g) Uncontrolled (U) / Controlled (C)	Comments and Recommendations
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	
		-3							Risk
DS2-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
DS2-2	-2	(IROFS14b) -3	N/A	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
DS2-3	(IROFS19c) -1	N/A	N/A	N/A	-1 (U)	3	3 (CR)	9 (U)	IROFS Required
DS2-3	(IROFS19c) -1	(IROFS19a) -2	(IROFS19d) -2	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
DS3-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
DS3-1	-2	(IROFS14a) -3	N/A	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
DS3-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
DS3-2	-2	(IROFS14b) -3	N/A	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
CL3-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
CL3-1	-2	(IROFS20) -2	(IROFS21) -2	N/A	-6 (C)	1	3 (CR)	3 (C)	Acceptable Risk
CL3-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
CL3-2	-2	(IROFS24b) -2	(IROFS46) -2	N/A	-6 (C)	1	3 (T)	3 (C)	Acceptable Risk
CL3-3	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
CL3-3	-2	(IROFS43) -2	(IROFS24b) -2	N/A	-6 (C)	1	3 (T)	3 (C)	Acceptable Risk
CP1-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
CP1-1	-2	(IROFS3) -2	(IROFS21) -2	N/A	-6 (C)	1	3 (CR)	3 (C)	Acceptable Risk
CP1-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
CP1-2	-2	(IROFS16a) -3	N/A	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
CP1-4	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
CP1-4	-2	(IROFS3) (Failure, -2)	N/A	(IROFS47b) (Failure, -3)	-7 (C)	1	3 (T)	3 (C)	Acceptable Risk
CP1-4	-2	(IROFS3) (Failure, -2)	N/A	(IROFS47b) (Success)	-4 (C)	2	2 (T)	4 (C)	Acceptable Risk

Table 3.7-1 Accident Sequence and Risk Index

Accident Identifier	Initiating Event Index	Preventive Safety Parameter 1 or IROFS 1 Failure Index	Preventive Safety Parameter 2 or IROFS 2 Failure Index	Mitigation IROFS Failure Index	Likelihood Index T Uncontrolled (U) / Controlled (C)	Likelihood Category	Conseq. Category (Type of Accident)	Risk Index (h=f x g) Uncontrolled (U) / Controlled (C)	Comments and Recommendations
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	
CP1-4	-2	(IROFS3) (Success)	N/A	(IROFS47b) (Failure, -3)	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
SW1-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
SW1-1	-2	(IROFS14a) -3	N/A	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
SW1-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
SW1-2	-2	(IROFS14b) -3	N/A	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
LW1-1	(IROFS19c) -1	N/A	N/A	N/A	-1 (U)	3	3 (CR)	9 (U)	IROFS Required
LW1-1	(IROFS19c) -1	(IROFS19a) –2	(IROFS19d) -2	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
LW1-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
LW1-2	-2	(IROFS14a) -3	N/A	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
LW1-3	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
LW1-3	-2	(IROFS14b) -3	N/A	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
LW2-1	(IROFS19c) -1	N/A	N/A	N/A	-1 (U)	3	3 (CR)	9 (U)	IROFS Required
LW2-1	(IROFS19c) -1	(IROFS19a) -2	(IROFS19d) -2	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
LW3-1	(IROFS19c) -1	N/A	N/A	N/A	-1 (U)	3	3 (CR)	9 (U)	IROFS Required
LW3-1	(IROFS19c) -1	(IROFS19a) -2	(IROFS19d) -2	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
LW5-1	(IROFS19c) -1	N/A	N/A	N/A	-1 (U)	3	3 (CR)	9 (U)	IROFS Required
LW5-1	(IROFS19c) -1	(IROFS19a) -2	(IROFS19d) -2	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
RD1-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
RD1-1	-2	(IROFS45) -3	N/A	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risik
DC1-1	0	N/A	N/A	N/A	0 (U)	3	3 (T)	9 (U)	IROFS Required
DC1-1	0	(IROFSC1b) -2	(IROFS3) –2,	N/A	-6 (U)	1	3 (T)	3 (C)	Acceptable Risk

Accident Identifier	Initiating Event Index	Preventive Safety Parameter 1 or IROFS 1 Failure Index	Preventive Safety Parameter 2 or IROFS 2 Failure Index	Mitigation IROFS Failure Index	Likelihood Index T Uncontrolled (U) / Controlled (C)	Likelihood Category	Conseq. Category (Type of Accident)	Risk Index (h=f x g) Uncontrolled (U) / Controlled (C)	Comments and Recommendations
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	
			(IROFSC18) -2						
DC1-2	0	N/A	N/A	N/A	0 (U)	3	2 (T)	6 (U)	IROFS Required
DC1-2	0	(IROFSC1b) -2	(IROFS3) –2	N/A	-4 (U)	2	2 (T)	4 (C)	Acceptable Risk
DC1-3	0	N/A	N/A	N/A	0 (U)	3	3 (T)	9 (U)	IROFS Required
DC1-3	0	(IROFSC1b) -2	(IROFS3) –2, (IROFSC18) -2	N/A	-6 (U)	1	3 (T)	3 (C)	Acceptable Risk
DC1-4	0	N/A	N/A	N/A	0 (U)	3	2 (T)	6 (U)	IROFS Required
DC1-4	0	(IROFSC1b) -2	(IROFS3) –2	N/A	-4 (U)	2	2 (T)	4 (C)	Acceptable Risk
DC1-5	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
DC1-5	-2	(IROFS3) -2	(IROFSC18) -2	N/A	-6 (U)	1	3 (T)	3 (C)	Acceptable Risk
DC1-6	-2	N/A	N/A	N/A	-2	3	2 (T)	6 (U)	IROFS Required
DC1-6	-2	(IROFS3) -2	N/A	N/A	-4	2	2 (T)	4 (C)	Acceptable Risk
DC1-7	-2	N/A	N/A	N/A	-2	3	3 (T)	9 (U)	IROFS Required
DC1-7	-2	(IROFS3) -2	(IROFSC18) -2	N/A	-6	1	3 (T)	3 (C)	Acceptable Risk
DC1-8	-2	N/A	N/A	N/A	-2	3	2 (T)	6 (U)	IROFS Required
DC1-8	-2	(IROFS3) -2	N/A	N/A	-4	2	2 (T)	4 (C)	Acceptable Risk
EC3-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
EC3-1	-2	(IROFSC6) -3	N/A	N/A	-5 (C)	1	3 (CR)	3 (C)	Acceptable Risk
EC4-1	-2	N/A	N/A	N/A	-2	3	3 (T)	9 (U)	IROFS Required
EC4-1	-2	(IROFS3) -2	(IROFSC18) -2	N/A	-6	1	3 (T)	3 (C)	Acceptable Risk
EC4-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
EC4-2	-2	(IROFS3) -2	(IROFS8a) -2	N/A	-6 (C)	1	3 (CR)	3 (C)	Acceptable Risk
TP8-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required

Table 3.7-1 Accident Sequence and Risk Index

Accident Identifier	Initiating Event Index	Preventive Safety Parameter 1 or IROFS 1 Failure Index	Preventive Safety Parameter 2 or IROFS 2 Failure Index	Mitigation IROFS Failure Index	Likelihood Index T Uncontrolled (U) / Controlled (C)	Likelihood Category	Conseq. Category (Type of Accident)	Risk Index (h=f x g) Uncontrolled (U) / Controlled (C)	Comments and Recommendations
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	
TP8-1	-2	(IROFSC15) -2	(IROFSC16) -2	N/A	-6 (C)	1	3 (T)	3 (C)	Acceptable Risk
TP8-2	-2	N/A	N/A	N/A	-2	3	3 (T)	9 (U)	IROFS Required
TP8-2	-2	(IROFS3) -2	(IROFSC18) -2	N/A	-6	1	3 (T)	3 (C)	Acceptable Risk
CHEM RELEASE-WORKER EVAC	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
CHEM RELEASE-WORKER EVAC	-2	N/A	N/A	IROFS39c -3	-5 (U)	1	1 (T)	1 (C)	Acceptable Risk
LOSS OF SAFE-BY-DESIGN ATTRIBUTE	-5	N/A	N/A	N/A	-5 (U)	1	3(CR)	3(U)	Acceptable Risk

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Accident Identifier: TT2-1

The initial failure (initiating event) is the tails low temperature take-off station cold box defrost heater controller failure, causing the cold box heater within the tails low temperature take-off station to remain on.

For the uncontrolled accident sequence, the tails cylinder over heats and the cylinder hydraulically ruptures due to the expansion of the UF_6. Upon tails cylinder rupture, the tails cylinder content of UF_6 is released within the tails low temperature take-off station. Since the station enclosure is not air tight, the UF_6 is released to the UF_6 Handling Area. This sequence, if uncontrolled, would require a significant time to cause a UF_6 release since the heat up rate is limited by heater capacity. This event is assumed to have a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) an automatic trip of defrost heater and fan on high air return temperature to ensure cylinder integrity (IROFS1) and (2) an automatic trip of defrost heater and fan on high station internal air temperature to ensure cylinder integrity (IROFS2).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria - no failures of this type in this facility in 30 yrs - applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS1. This corresponds to single active engineered IROFS per NUREG-1520.

A failure probability index of (-2) was selected for IROFS2. This corresponds to a single active engineered IROFS per NUREG-1520.

Accident Identifier: TT2-2

The initial failure (initiating event) is the failure of the tails low temperature take-off station load cell causing the tails cylinder to be over filled.

The over filled tails cylinder is then warmed to ambient and ruptures in the tails low temperature take-off station.

Upon tails cylinder rupture UF_6 is released to the tails low temperature take-off station. Since the station enclosure is not air tight, UF_6 is released to the UF_6 Handling Area. This event is assumed to have a high consequence to the worker and public.

For the controlled accident sequence, the preventive measure is administratively limit the cylinder fill mass to ensure cylinder integrity by verifying cylinder weight is within specified trending limits once per shift during filling of the cylinder (IROFS38). If the acceptance criterion is not met, then fill of the associated cylinder shall be terminated.

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 years – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 years, and have not had a failure of this type.

The failure probability index of (-3) was selected for IROFS38. This corresponds to an enhanced administrative IROFS per NUREG-1520. IROFS38 is enhanced by requiring independent verification of the IROFS safety function. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Accident Identifier: TT3-1

The initial failure (initiating event) is the tails carbon trap becomes saturated with UF_6 caused by a small UF_6 leak through various process valves.

For the uncontrolled accident sequence, a UF_6 plug forms on the discharge of the tails vacuum pump, causing high pressure and thus failing the tails vacuum pump discharge flange seal, causing a release of UF_6 to the UF_6 Handling Area. This event was calculated to result in a high consequence to the worker.

For the controlled accident sequence, the preventive measure is an automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6 (IROFS3) and the mitigative measure is a flow restriction to ensure, in the event of a postulated release, worker consequences of inhalation of uranic material and HF are low (IROFS47b). As a result of IROFS47b, the consequence analysis shows that the consequences have been mitigated to an intermediate category (2).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 years – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 years, and have not had a failure of this type.

The failure probability index of (-2) was selected for IROFS3. This corresponds to a single active engineered IROFS per NUREG-1520.

The failure probability index of (-3) was selected for IROF47b. This corresponds to a single passive engineered IROFS per NUREG-1520.

Accident Identifier: UF1-1

The initial failure (initiating event) is the solid feed station heater controller failure, causing the solid feed station heater within the solid feed station to remain on.

For the uncontrolled accident sequence, the feed cylinder over heats and the cylinder hydraulically ruptures due to the expansion of the UF_6. Upon cylinder rupture, the feed cylinder content of UF_6 is released within the solid feed station. Since the station enclosure is not air tight, the UF_6 is released to the UF_6 Handling Area. This sequence, if uncontrolled, would require a significant time to cause a UF_6 release since the heat up rate is limited by the heater capacity. This event is assumed to have a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) an automatic trip of station heaters on high cylinder temperature to ensure cylinder integrity (IROFS4) and (2) an automatic trip of station heaters on high station internal air temperature to ensure cylinder integrity (IROFS5).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

The failure probability index of (-2) was selected for IROFS4. This corresponds to a single active engineered IROFS per NUREG-1520.

The failure probability index of (-2) was selected for IROFS5. This corresponds to a single active engineered IROFS per NUREG-1520.

Accident Identifier: UF2-1

The initial failure (initiating event) is the feed purification low temperature take-off station defrost heater controller failure, causing the defrost heater within the feed purification low temperature take-off station to remain on.

For the uncontrolled accident sequence, the feed purification cylinder over heats and the cylinder hydraulically ruptures due to the expansion of the UF_6. Upon cylinder rupture, the feed purification cylinder content of UF_6 is released within the feed purification station. Since the station enclosure is not air tight, the UF_6 is released to the UF_6 Handling Area exposing workers and the public. This sequence, if uncontrolled, would require a significant time to cause a UF_6 release since the heat up rate is limited by heater capacity. This event is assumed to have a high consequence to the worker and to the public.

For the controlled accident sequence, the preventive measures are: (1) an automatic trip of the defrost heater and fan on high air return temperature to ensure cylinder integrity (IROFS1), and (2) an automatic trip of the defrost heater and fan on high station internal air temperature to ensure cylinder integrity (IROFS2).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

The failure probability index of (-2) was selected for IROFS1. This corresponds to a single active engineered IROFS per NUREG-1520.

The failure probability index of (-2) was selected for IROFS2. This corresponds to a single active engineered IROFS per NUREG-1520.

Accident Identifier: UF2-2

The initial failure (initiating event) is the failure of the feed purification low temperature take-off station load cell causing the cylinder to be over filled.

For the uncontrolled accident sequence, the over filled cylinder is warmed up to ambient and ruptures in the feed purification low temperature take-off station. Upon cylinder rupture, UF_6 is released to the feed purification low temperature take-off station. Since the station enclosure is not air tight, the UF_6 is released to the UF_6 Handling Area. This event is assumed to have a high consequence to the worker and public.

For the controlled accident sequence, the preventive measure is administratively limit the cylinder fill mass to ensure cylinder integrity by verifying cylinder weight is within specified trending limits once per shift during filling of the cylinder (IROFS38). If the acceptance criterion is not met, then fill of the associated cylinder shall be terminated.

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 years – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 years, and have not had a failure of this type.

The failure probability index of (-3) was selected for IROFS38. This corresponds to an enhanced administrative IROFS per NUREG-1520. IROFS38 is enhanced by requiring independent verification of the IROFS safety function. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Accident Identifier: UF3-1

The initial failure (initiating event) is the feed purification carbon trap becomes saturated with UF_6 caused by a small UF_6 leak through a cold trap outlet isolation valve.

For the uncontrolled accident sequence, a UF_6 plug forms on the discharge of the feed purification vacuum pump, causing high pressure and thus failing the feed purification vacuum pump discharge flange seal, causing a release of UF_6 to the UF_6 Handling Area. This event was calculated to have a high consequence to the worker.

For the controlled accident sequence, the preventive measure is an automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6 (IROFS3) and the mitigative measure is a flow restriction to ensure, in the event of a postulated release, worker consequences of inhalation of uranic material and HF are low (IROFS47a). As a result of IROFS47a, the consequence analysis shows that the consequences have been mitigated to an intermediate category (2).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

The failure probability index of (-2) was selected for IROFS3. This corresponds to a single active engineered IROFS per NUREG-1520.

The failure probability index of (-3) was selected for IROFS47a. This corresponds to a single passive engineered IROFS per NUREG-1520.

Accident Identifier: PT2-1

The initial failure (initiating event) is the product low temperature take-off station cold box defrost heater controller failure, causing the cold box heater within the product low temperature take-off station to remain on.

For the uncontrolled accident sequence, the product cylinder over heats and the cylinder hydraulically ruptures due to the expansion of the UF_6. Upon product cylinder rupture, the product cylinder content of UF_6 is released within the product low temperature take-off station. Since the station enclosure is not air tight, the UF_6 is released to the UF_6 Handling Area. This sequence, if uncontrolled, would require a significant time to cause a UF_6 release since the heat up rate is limited by heater capacity. This event is assumed to have a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) an automatic trip of defrost heater and fan on high air return temperature to ensure cylinder integrity (IROFS1), (2) an automatic trip of defrost heater and fan on high station internal air temperature to ensure cylinder integrity (IROFS2).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria - no failures of this type in this facility in 30 yrs - applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS1. This corresponds to single active engineered IROFS per NUREG-1520.

A failure probability index of (-2) was selected for IROFS2. This corresponds to a single active engineered IROFS per NUREG-1520.

Accident Identifier: PT2-2

The initial failure (initiating event) is a failure of IROFS6a, administrative verification of distinguishing visual markings/identification of 48X and 48Y cylinders within the UF_6 area to ensure that filled product cylinders are not placed on-line to the cascade. This failure could result in an operator attempting to insert a full 48Y product cylinder into a solid feed station with the potential of a criticality event.

For the uncontrolled accident sequence, a product cylinder (48Y) is placed in a feed station thus causing enrichment higher than licensed limits. A criticality event is assumed to result for this accident sequence. This event is assumed to result in a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) a design feature to physically prevent product cylinder within the UF_6 area from being placed in a Solid Feed Station (IROFS7) and (2) administrative verification of ^{235}U concentration in feed cylinders to ensure that product material is not used as feed material by sampling and assay analysis (IROFS6b) before the cylinder is placed on-line to the cascade. If the acceptance criterion from the sampling and assay analysis is not met, the cylinder shall not be placed on-line to the cascade.

The frequency index number for the initiating event (failure of IROFS6a) was determined to be (-1). This frequency probability index number corresponds to failure of an administrative IROFS with large margin per NUREG-1520.

The failure probability index number of (-2) was selected for IROFS6b. This corresponds to an administrative IROFS for routine planned operation per NUREG-1520.

The failure probability index number for (IROFS7) was determined to be (-3), a single passive engineered IROFS consistent with NUREG-1520.

Accident Identifier: PT2-3

The initial failure (initiating event) is excessive moderator being introduced into a product cylinder after the cylinder is put into the product take-off station with the potential for a criticality event. This excessive moderator is assumed to be a result of moisture laden air in-leakage to the process system.

For the uncontrolled accident sequence, moderator ingress (moisture in-leakage) via the product take-off system enters a product cylinder. A criticality event is assumed to result for this accident sequence. This event is assumed to result in a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) administratively limit addition of moderator from system venting to ensure subcriticality using an independent means of monitoring system venting from that used for IROFS16d (IROFS16c), administratively limit addition of moderator from system venting to ensure subcriticality (IROFS16d) using an independent means of monitoring system venting from that used for IROFS16c. For these preventive measures, if the acceptance criterion is not met, then venting of the associated cylinder shall be stopped and the cylinder filling processed terminated. Excessive venting is indicative of process system air in-leakage that may result in excessive moderator being introduced into a product cylinder.

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria - no failures of this type in this facility in 30 yrs - applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

The failure probability index number of (-2) was selected for IROFS16c. This frequency probability index number corresponds to an administrative IROFS per NUREG-1520.

The failure probability index number of (-2) was selected for IROFS16d. This frequency probability index corresponds to an administrative IROFS per NUREG-1520.

<u>Accident Identifier: PT2-4</u>

The initial failure (initiating event) is the failure of the product low temperature take-off station load cell causing the cylinder to be over filled.

For the uncontrolled accident sequence, the over filled cylinder is then warmed up to ambient and ruptures in the product low temperature take-off station. Upon cylinder rupture, UF_6 is released to the product low temperature take-off station. Since the station enclosure is not air tight, the UF_6 is released to the UF_6 Handling Area. This event is assumed to have a high consequence to the worker and public.

For the controlled accident sequence, the preventive measure is administratively limit the cylinder fill to ensure cylinder integrity by verifying cylinder weight is within specified trending limits once per shift during filling of the cylinder (IROFS38). If the acceptance criterion is not met, then fill of the associated cylinder shall be terminated.

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 years – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 years, and have not had a failure of this type.

A failure probability index of (-3) was selected for IROFS38. This corresponds to an enhanced administrative IROFS per NUREG-1520. IROFS38 is enhanced by requiring independent verification of the IROFS safety function. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Accident Identifier: PT2-5

The initial failure (initiating event) is hydrocarbon oil (a moderator) is used in place of perfluorinated polyether (PFPE) oil during maintenance of vacuum pumps associated with Product, Cylinder Preparation, Ventilated Room and Assay Sampling Systems. The hydrocarbon oil is assumed to enter the process stream and is deposited in a product cylinder.

The condition that needs to be fulfilled to result in a criticality event due to moderator ingress introduced in a product cylinder in the product take-off station is excessive moderator (hydrocarbon oil) is introduced in the product cylinder. The introduction of excessive moderator is due to a vacuum pump improperly filled with hydrocarbon oil.

For the uncontrolled accident sequence, the failure of IROFS30a, administratively limit hydrocarbon oil (moderator mass) in enriched uranium product to ensure moderation control assumptions are maintained by controlling the type of oil used in process vacuum pumps, is assumed. Excess moderator is deposited in a product cylinder in the product take-off station. A criticality event is assumed to result for this accident sequence. This event is assumed to result in a high consequence to the worker and the public.

For the controlled accident sequence, the preventive measures are (1) administratively limit hydrocarbon oil (moderator mass) in enriched uranium product to ensure moderation control assumptions are maintained by verifying, through test prior to addition of oil, that process vacuum pump oil is not hydrocarbon oil (IROFS30b) and (2) administratively limit hydrocarbon oil (moderator mass) in enriched uranium product to ensure moderator control assumptions are maintained by verifying, through test after oil addition prior to placing vacuum pumps in the process system, that process vacuum pump oil is not hydrocarbon oil (IROFS30c). If acceptance criterion is not met, then for IROFS30b, oil shall not be added to the associated process vacuum pump, and for IROFS30c, the associated vacuum pump shall not be placed in the process system.

The frequency index number for the initiating event (IROFS30a failure) was determined to be (-1) which is based on failure of an administrative IROFS with large margin per NUREG-1520.

A failure probability index of (-2) was selected for IROFS30b. This corresponds to an administrative IROFS for routine planned operation per NUREG-1520.

A failure probability index of (-2) was selected for IROFS30c. This corresponds to an administrative IROFS for routine planned operation per NUREG-1520.

Accident Identifier: PT3-1

The initial failure (initiating event) is the product vent system carbon trap becomes saturated with UF_6 caused by a small UF_6 leak through a product cold trap outlet valve. Continued UF_6 leakage to the product vent system carbon trap results in UF_6 being released into the Separations Building (SB) Gaseous Effluent Vent System (GEVS). The leak into the SB GEVS system is assumed to exist for a significant period of time to allow a sufficient amount of accumulation on the filters or electrostatic precipitators to form a critical mass.

The combination of these conditions, is assumed to lead to an accumulation of fissile material on the SB GEVS filters or electrostatic precipitator resulting in a criticality event.

For the uncontrolled accident sequence, UF_6 (product) is discharged to the SB GEVS and is collected on the SB GEVS HEPA filters or electrostatic precipitator forming a critical mass of fissile material on the filter over a long period of time. A criticality event is assumed to result for this accident sequence. This event is assumed to have a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6 (IROFS3) and (2) an automatic trip on ^{235}U selective high-high gamma to ensure no more than a subcritical mass deposited on the SB GEVS filter or precipitator (IROFS8a).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS3. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

A failure probability index of (-2) was selected for IROFS8a. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

Accident Identifier: PT3-2

The initial failure (initiating event) is the product vent subsystem carbon trap becoming saturated with UF_6 caused by a small UF_6 leak through a product cold trap valve.

For the uncontrolled accident sequence, a UF_6 plug forms on the discharge of the vacuum pump, causing high pressure in the vacuum pump and thus failing seals leading to a release of UF_6 to the UF_6 Handling Area. This event has been calculated to result in a high consequence to the worker.

For the controlled accident sequence, the preventive measure is an automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6 (IROFS3) and the mitigative measure is a flow restriction to ensure, in the event of a postulated release, worker consequences of inhalation of uranic material and HF are low (IROFS47a). As a result of IROFS47a, the consequence analysis shows that the consequences have been mitigated to an intermediate category (2).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 years – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 years, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS3. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

The failure probability index of (-3) was selected for IROF47a. This corresponds to a single passive engineered IROFS per NUREG-1520.

Accident Identifier: PT3-3

The initial failure (initiating event) is the UF_6 cold trap outlet valve fails open during the back gas mode and results in high UF_6 flow through the carbon trap. A high UF_6 flow through the carbon trap results in high temperature in the carbon trap and release of excessive UF_6 into the SB GEVS. The leak into the SB GEVS system is assumed to exist for a significant period of time to allow a sufficient amount of accumulation on the filters or electrostatic precipitators to form a critical mass.

The combination of these conditions, is assumed to lead to an accumulation of fissile material on the SB GEVS filters or electrostatic precipitator resulting in a criticality event.

For the uncontrolled accident sequence, UF_6 (product) is discharged to the SB GEVS and is collected on the SB GEVS HEPA filters or electrostatic precipitator forming a critical mass of fissile material on the filter over a long period of time. A criticality event is assumed to result for this accident sequence. This event is assumed to have a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) an automatic trip of the vacuum pump on carbon trap high temperature to ensure the carbon trap does not pass excessive UF_6 (IROFS9) and (2) an automatic trip on ^{235}U selective high-high gamma to ensure no more than a subcritical mass deposited on the SB GEVS filter or precipitator (IROFS8a).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS9. This corresponds to single active engineered IROFS per NUREG-1520 criteria.

A failure probability index of (-2) was selected for IROFS8a. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

Accident Identifier: PT3-5

The initial condition is initial transfer of enriched uranic material during decontamination/waste disposal into a non-safe-by-design container. The worker is required to initially transfer enriched uranic material into safe-by-design containers.

Note that subsequent liquid waste transfers between non-safe-by-design containers are addressed by accident sequences DS1-3, DS2-3, LW1-1, LW2-1, LW3-1, and LW5-1 and subsequent solid waste bulking operations are addressed by accident sequence VR2-7.

The description of this sequence (i.e., the uncontrolled sequence) is the following:

(1) The worker transfers enriched uranic material during decontamination/waste disposal (i.e., from washing flex hose, emptying carbon trap, draining oil from product pump, scraping breakdown materials from product pump internals) into a non-safe-by-design container.

(2) Multiple inappropriate decontamination/waste disposal activities and/or failures occur (e.g., multiple occurrences of failure to use safe-by-design containers).

For the controlled accident sequence, the preventive measure is administratively restrict an independent parameter of the criticality sequence to ensure subcritical configuration by preventing additional transfer of enriched uranic material to another container if that container contains enriched uranic material and is a non-safe-by-design container (IROFS15) prior to the transfer of the enriched uranic material into a container. If the acceptance criterion are not met, then the transfer of enriched uranic material to the container shall not be initiated.

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria - no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-3) was selected for IROFS15, an enhanced administrative IROFS consistent with NUREG-1520. IROFS15 is enhanced by requiring independent verification of the IROFS safety function. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Accident Identifier: PB1-1

The initial failure (initiating event) is the blending donor station heater controller fails causing the heater within the blending donor station to remain on.

For the uncontrolled accident sequence, the donor cylinder over heats and the cylinder hydraulically ruptures due to the expansion of the UF_6. Upon cylinder rupture, the donor cylinder content of UF_6 is released within the donor station. Since the station enclosure is not air tight, the UF_6 is released to the Blending and Liquid Sampling Area. This sequence, if uncontrolled, would require significant time to cause a UF_6 release since the heat up rate is limited by the heater capacity. This event is assumed to have a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) an automatic trip of station heaters on high cylinder temperature to ensure cylinder integrity (IROFS4), (2) an automatic trip of station heaters on high station internal air temperature to ensure cylinder integrity (IROFS5).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

The failure probability index of (-2) was selected for IROFS4. This corresponds to a single active engineered IROFS per NUREG-1520.

The failure probability index of (-2) was selected for IROFS5. This corresponds to a single active engineered IROFS per NUREG-1520.

Accident Identifier: PB1-2

This sequence was removed.

Sequence PB1-2 described a product blending donor cylinder and the moderator control by tracking venting operations. Donor cylinders are not vented.

Accident Identifier: PB1-3

The initiating event allows placing product 48Y and 30B cylinders into a non-safe criticality interaction arrangement (i.e., a non-analyzed condition). The initial condition is an operator would have stacked a product cylinder on another product cylinder in the Blending and Liquid Sampling Area

For the uncontrolled accident sequence, product cylinders are stacked more than one high next to another product cylinder . A criticality event is assumed to result for this accident sequence. This event is assumed to result in a high consequence to the worker and public.

For the controlled accident sequence, the preventive measure is (IROFS45) to ensure subcritical geometry, prior to moving a cylinder containing enriched uranium in the CRDB or the Blending and Liquid Sampling Area, verify that the stored cylinders containing enriched uranium in these areas are in a horizontal, co-planar (i.e., non-stacked), condition and that no other cylinder containing enriched uranium is in movement in the associated area. If the acceptance criterion are not met, then the cylinder containing enriched uranium shall not be moved.

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-3) was selected for IROFS45. This corresponds to an enhanced administrative IROFS per NUREG-1520. IROFS45 is enhanced by requiring independent verification of the IROFS safety function. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Accident Identifier: PB2-1

The initial failure (initiating event) is the blending receiver station cold box defrost heater controller failure, causing the heater within the receiver station to remain on.

For the uncontrolled accident sequence, the product cylinder over heats and the cylinder hydraulically ruptures due to the expansion of the UF_6. Upon product cylinder rupture, the product cylinder content of UF_6 is released within the receiver station. Since the station enclosure is not air tight, the UF_6 is released to the Blending and Liquid Sampling Area. This sequence, if uncontrolled, would require a significant time to cause a UF_6 release since the heat up is limited by heater capacity. This event is assumed to have a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) an automatic trip of defroster heater and fan on high air return temperature to ensure cylinder integrity (IROFS1), (2) an automatic trip of defroster heater and fan on high station internal air temperature to ensure cylinder integrity (IROFS2).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria - no failures of this type in this facility in 30 yrs - applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS1. This corresponds to single active engineered IROFS per NUREG-1520.

A failure probability index of (-2) was selected for IROFS2. This corresponds to a single active engineered IROFS per NUREG-1520.

Accident Identifier: PB2-2

The initial failure (initiating event) is excessive moderator introduced into the receiver cylinder before being put in the blending receiver station.

The condition that needs to be fulfilled to result in a criticality event due to moderator ingress introduced in a receiver cylinder before and subsequently placed into the blending receiver station is excessive moderator (hydrocarbon oil and water) present in the receiver cylinder.

For the uncontrolled accident sequence, excessive moderator (hydrocarbon and water) is present in the receiver cylinder before placed into a blending receiver station. This could be due to excessive hydrocarbon oil and water present in new or cleaned cylinders. The receiver cylinder is placed into the blending receiver station and placed online. This event is assumed to result in a high consequence to the worker and the public.

For the controlled sequence, the preventive measure is administratively limit moderator mass (oil and water) in cylinders containing enriched uranic material to ensure subcriticality by allowing no visible oil and by limiting cylinder vapor pressure prior to introducing product (IROFS16a). If the acceptance criteria are not met, then product shall not be introduced into the associated cylinder.

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

The failure probability index number of (-3) was selected for IROFS16a. This frequency probability index number corresponds to an enhanced administrative IROFS per NUREG-1520. IROFS16a is enhanced by requiring independent verification of the IROFS safety function. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Accident Identifier: PB2-3

The initial failure (initiating event) is the Blending and Sampling Vent carbon trap becomes saturated with UF_6 caused by a small UF_6 leak through the cold trap valve. Continued UF_6 leakage to the Blending and Sampling Vent carbon trap results in UF_6 being released into the SB GEVS. The leak into the SB GEVS system is assumed to exist for a significant period of time to allow a sufficient amount of accumulation on the filters or electrostatic precipitator to form a critical mass.

The combination of these conditions is assumed to lead to an accumulation of fissile material on the SB GEVS filters or electrostatic precipitator resulting in a criticality event.

For the uncontrolled accident sequence, UF_6 (product) is discharged to the SB GEVS and is collected on the SB GEVS HEPA filters or electrostatic precipitator forming a critical mass of fissile material on the filter over a long period of time. A criticality event is assumed to result for this accident sequence. This event is assumed to have a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6 (IROFS3) and (2) an automatic trip on ^{235}U selective gamma to ensure no more than a subcritical mass deposited on the SB GEVS filter or precipitator (IROFS8a).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS3. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

A failure probability index of (-2) was selected for IROFS8a. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

Accident Identifier: PB2-4

The initial failure (initiating event) is the failure of the blending receiver low temperature take-off station load cell causing the cylinder to be over filled.

For the uncontrolled sequence, the over filled cylinder is then warmed up to ambient and ruptures in the blending receiver low temperature take-off station. Upon cylinder rupture, UF_6 is released to the blending receiver low temperature take-off station. Since the station enclosure is not air tight, the UF_6 is released to the Blending and Liquid Sampling Area. This event is assumed to have a high consequence to the worker and public.

For the controlled accident sequence, the preventive measure is administratively limit the cylinder fill mass to ensure cylinder integrity by verifying cylinder weight is within specified trending limits once per shift during filling of the cylinder (IROFS38). If the acceptance criteria is not met, then fill of the associated cylinder shall be terminated.

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

The failure probability index of (-3) was selected for IROFS38. This corresponds to an enhanced administrative IROFS per NUREG-1520. IROFS38 is enhanced by requiring independent verification of the IROFS safety function. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Accident Identifier: PB2-5

The initial failure (initiating event) is excessive moderator being introduced into a product cylinder after the cylinder is put into the station with the potential for a criticality event. The excessive moderator is assumed to be a result of moisture laden air in-leakage to the process system.

For the uncontrolled accident sequence, moderator ingress (moisture in-leakage) via the product take-off system enters a product cylinder. A criticality event is assumed to result for this accident sequence. This event is assumed to result in a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) administratively limit addition of moderator from system venting to ensure cylinder subcriticality using an independent means of monitoring system venting from that used for IROFS16d (IROFS16c) and (2) administratively limit addition of moderator from system venting to ensure cylinder subcriticality (IROFS16d) using an independent means of monitoring system venting from that used for IROFS16c. For these preventive measures, if the acceptance criterion is not met, then venting of the associated cylinder shall be stopped and the cylinder filling process stopped. Excessive venting is indicative of process system air in-leakage that may result in excessive moderator being introduced into a product cylinder.

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

The failure probability index number of (-2) was selected for IROFS16c. This frequency probability index number corresponds to an administrative IROFS per NUREG-1520.

The failure probability index number of (-2) was selected for IROFS16d. This frequency probability index corresponds to an administrative IROFS per NUREG-1520.

Accident Identifier: PB2-6

The initial failure (initiating event) is hydrocarbon oil (a moderator) is used in place of perfluorinated polyether (PFPE) oil during maintenance of Cylinder Preparation, Ventilated Room and Blending and Liquid Sampling System vacuum pumps. The hydrocarbon oil is assumed to enter the process stream and is deposited in a product cylinder.

The condition that needs to be fulfilled to result in a criticality event due to moderator ingress introduced in a product cylinder in the product take-off station is excessive moderator (hydrocarbon oil) is introduced in the product cylinder. The introduction of excessive moderator is due to a vacuum pump improperly filled with hydrocarbon oil.

For the uncontrolled accident sequence, the failure of IROFS30a, administratively limit hydrocarbon oil (moderator mass) in enriched uranium product to ensure moderation control assumptions are maintained by controlling the type of oil used in process vacuum pumps, is assumed. Excess moderator is deposited in a product cylinder in plant into a product take-off station. A criticality event is assumed to result for this accident sequence. This event is assumed to result in a high consequence to the worker and the public.

For the controlled accident sequence, the preventive measures are (1) administratively limit hydrocarbon oil (moderator mass) in enriched uranium product to ensure moderation control assumptions are maintained by verifying, through test prior to addition of oil, that process vacuum pump oil is not hydrocarbon oil (IROFS30b) and (2) administratively limit hydrocarbon oil (moderator mass) in enriched uranium product to ensure moderator control assumptions are maintained by verifying, through test (after oil addition) prior to placing vacuum pumps in the process system, that process vacuum pump oil is not hydrocarbon oil (IROFS30c). If the acceptance criteria is not met, then for IROFS30b, oil shall not be added to the associated process vacuum pump, and for IROFS30c, the associated vacuum pump shall not be placed in the process system.

The frequency index number for the initiating event (IROFS30a failure) was determined to be (-1) which is based on failure of an administrative IROFS with large margin per NUREG-1520.

A failure probability index of (-2) was selected for IROFS30b. This corresponds to an administrative IROFS for routine planned operation per NUREG-1520.

A failure probability index of (-2) was selected for IROFS30c. This corresponds to an administrative IROFS for routine planned operation per NUREG-1520.

Accident Identifier: PB3-1

The initial failure (initiating event) is the blending vent system carbon trap becomes saturated with UF_6 caused by a small UF_6 leak through the cold trap valve. Continued UF_6 leakage to the blending vent system carbon trap results in UF_6 being released into the SB GEVS. The leak into the SB GEVS system is assumed to exist for a significant period of time to allow a sufficient amount of accumulation on the filters or electrostatic precipitator to form a critical mass.

The combination of these conditions is assumed to lead to an accumulation of fissile material on the SB GEVS filters or electrostatic precipitator resulting in a criticality event.

For the uncontrolled accident sequence, UF_6 (product) is discharged to the SB GEVS and is collected as UO_2F_2 on the SB GEVS HEPA filters or electrostatic precipitator forming a critical mass of fissile material on the filter or within the precipitator over a long period of time. A criticality event is assumed to result for this accident sequence. This event is assumed to have a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated (IROFS3) and (2) automatic trip on ^{235}U selective high-high gamma to ensure no more than a subcritical mass deposited on the SB GEVS filter or precipitator (IROFS8a).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS3. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

A failure probability index of (-2) was selected for IROFS8a. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

Accident Identifier: PB3-2

The initial failure (initiating event) is the UF_6 cold trap outlet valve fails open during the back gas mode and results in high UF_6 flow through the carbon trap. A high UF_6 flow to the carbon trap results in high temperature in the carbon trap, and release of excessive UF_6 into the SB GEVS. The leak into the SB GEVS system is assumed to exist for a significant period of time to allow a sufficient amount of accumulation on the filters or electrostatic precipitator to form a critical mass.

The combination of these conditions is assumed to lead to an accumulation of fissile material on the SB GEVS filters or electrostatic precipitator resulting in a criticality event.

For the uncontrolled accident sequence, UF_6 (product) is discharged to the SB GEVS and is collected as UO_2F_2 on the SB GEVS HEPA filters or electrostatic precipitator forming a critical mass of fissile material on the filter or within the precipitator over a long period of time. A criticality event is assumed to result for this accident sequence. This event is assumed to have a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) an automatic trip of the vacuum pump on carbon trap high temperature to ensure the carbon trap does not pass excessive UF_6 (IROFS9) and (2) an automatic trip on ^{235}U selective high-high gamma to ensure no more than a subcritical mass deposited on the SB GEVS filter or precipitator (IROFS8).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS9. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

A failure probability index of (-2) was selected for IROFS8a. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

Accident Identifier: PB3-3

The initial failure (initiating event) is the Blending and Sampling Vent carbon trap becomes saturated with UF_6 caused by a small UF_6 leak through a blending system cold trap valve.

For the uncontrolled accident sequence, a UF_6 plug forms on the discharge of the vacuum pump, causing high pressure in the vacuum pump and thus failing seals leading to a release of UF_6 to the Blending and Liquid Sampling Area. This event has been calculated to result in a high consequence to the worker.

For the controlled accident sequence, the preventive measure is an automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6 (IROFS3) and the mitigative measure is a flow restriction to ensure, in the event of a postulated release, worker consequences of inhalation of uranic material and HF are low (IROFS47a). As a result of IROFS47a, the consequence analysis shows that the consequences have been mitigated to an intermediate category (2).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS3. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

The failure probability index of (-3) was selected for IROF47a. This corresponds to a single passive engineered IROFS per NUREG-1520.

Accident Identifier: PB4-1

The initial failure (initiating event) is the product liquid sampling autoclave heater failure (heat off) followed by reheat. Solidification of UF_6 in the sampling manifold isolates pressure trips. Upon reheat, the sampling manifold ruptures.

For the uncontrolled accident sequence, (autoclave pressure boundary not credited) UF_6 from the sampling manifold and the liquid UF_6 in the product cylinder is released to the Blending and Liquid Sampling Area. This event is assumed to result in a high consequence to the worker and public.

For the controlled accident sequence, the preventive measure is a design feature to maintain Product Liquid Sampling Autoclave leak tight integrity (IROFS10).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-3) was selected for IROFS10. This corresponds to a single passive engineered IROFS per NUREG-1520.

Accident Identifier: PB4-2

The initial failure (initiating event) is the product liquid sampling autoclave heater controller failure causing the heater to remain on.

For the uncontrolled accident sequence (autoclave pressure boundary credited), the product cylinder over heats and the cylinder hydraulically ruptures due to the expansion of the UF_6. Upon cylinder rupture, the product cylinder content of UF_6 is released within the liquid sampling autoclave pressure boundary. The heater continues to input heat into the liquid sampling autoclave causing the autoclave pressure boundary to rupture. HF is released to the Blending and Liquid Sampling Area. This event is assumed to result in a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) an automatic trip of the autoclave heater and fan on autoclave high internal air temperature to ensure Product Liquid Sampling Autoclave integrity (IROFS11) and (2) an automatic trip of the autoclave heater and fan on autoclave high internal air pressure to ensure Product Liquid Sample Autoclave integrity (IROFS12).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS11. This corresponds to a single active engineered IROFS per NUREG-1520.

A failure probability index of (-2) was selected for IROFS12. This corresponds to a single active engineered IROFS per NUREG-1520.

Accident Identifier: PB4-3

The initial failure (initiating event) is the operator error of leaving the sampling manifold purge valve open and blind flange not fitted. Upon liquid sample heat up and tipping of the liquid sampling autoclave, the sampling manifold releases liquid UF_6 into the autoclave.

For the uncontrolled accident sequence (autoclave pressure boundary not credited), UF_6 from the sampling manifold and the liquid UF_6 in the product cylinder is released to the Blending and Liquid Sampling Area. This event is assumed to result in a high consequence to the worker and public.

For the controlled accident sequence, the preventive measure is a design feature to maintain Product Liquid Sampling Autoclave leak tight integrity (IROFS10).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from operator error history at similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-3) was selected for IROFS10. This corresponds to a single passive engineered IROFS per NUREG-1520.

Accident Identifier: PB4-4

The initial failure (initiating event) is an over filled product cylinder heated in the sampling autoclave.

For the uncontrolled accident sequence (autoclave pressure boundary not credited), the over filled product cylinder is heated in the sampling autoclave followed by cylinder rupture. Upon cylinder rupture, the product content of UF_6 cylinder is released to the Blending and Liquid Sampling Area. This event is assumed to result in a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) administratively limit the cylinder fill mass to ensure cylinder integrity of a product cylinder prior to placement and heating of the associated cylinder in the Product Liquid Sampling Autoclave (IROFS42) and (2) design feature to maintain Product Liquid Sampling Autoclave leak tight integrity (IROFS10). If the acceptance criteria are not met, then the associated product cylinder shall not be heated.

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS42. This corresponds to an administrative IROFS for routine planned operations per NUREG-1520.

A failure probability index of (-3) was selected for IROFS10. This corresponds to a single passive engineered IROFS per NUREG-1520.

Accident Identifier: PB4-5

The initial failure (initiating event) is a release of UF_6 from the product cylinder at the end of the liquid sampling cycle into the autoclave. Upon UF_6 release, HF and UO_2F_2 are generated. The flow path from the autoclave to the SB GEVS is then manually opened using the GEVS vent valve resulting in a release into the SB GEVS. The release to the SB GEVS is assumed to allow a sufficient amount of accumulation on the filters or electrostatic precipitator to form a critical mass. The combination of these conditions is assumed to lead to an accumulation of fissile material on the SB GEVS filters or electrostatic precipitator resulting in a criticality event.

For the uncontrolled accident sequence, UF_6 (product) is discharged to the SB GEVS and is collected as UO_2F_2 on the SB GEVS HEPA filters or electrostatic precipitator forming a critical mass of fissile material on the filter or within the precipitator. A criticality event is assumed to result for this accident sequence. This event is assumed to have a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) automatic inhibit opening of GEVS vent valve on high-high HF in the autoclave to ensure no more than a subcritical mass deposited on SB GEVS filter (IROFS13) and (2) automatic trip on ^{235}U selective high-high gamma to ensure no more than a subcritical mass deposited on the SB GEVS filter (IROFS8b).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS8b. This corresponds to a single active engineered IROFS per NUREG-1520.

A failure probability index of (-2) was selected for IROFS13. This corresponds to a single active engineered IROFS per NUREG-1520.

Accident Identifier: VR1-1

The initial failure (initiating event) is the carbon trap becomes saturated with UF_6 caused by a small UF_6 leak through a process valve in the vessel pressure test/valve change rig. Continued UF_6 leakage to the carbon trap results in UF_6 released into the Technical Services Building (TSB) GEVS. The leak into the TSB GEVS system is assumed to exist for a significant period of time to allow a sufficient amount of accumulation on the filters to form a critical mass.

The combination of these conditions is assumed to lead to an accumulation of fissile material on the TSB GEVS filters resulting in a criticality event.

For the uncontrolled accident sequence, UF_6 (product) is discharged to the TSB GEVS and is collected UO_2F_2 on the TSB GEVS HEPA forming a critical mass of fissile material on the filter over a long period of time. A criticality event is assumed to result for this accident sequence. This event is assumed to have a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6 (IROFS3) and (2) an automatic trip of the TSB GEVS on ^{235}U selective high-high gamma to ensure no more than a subcritical mass deposited on the filter (IROFS21).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS3. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

A failure probability index of (-2) was selected for IROFS21. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

Accident Identifier: VR1-2

The initial failure (initiating event) is an operator error in excessively opening the cold trap outlet throttle valve in the cylinder vent system which results in high UF_6 flow through the carbon trap. A high UF_6 flow to the carbon trap results in high temperature in the carbon trap and release of excessive UF_6 into the TSB GEVS. The leak into the TSB GEVS is assumed to exist for a significant period of time to allow a sufficient amount of accumulation on the filter to form a critical mass. The combination of these conditions is assumed to lead to an accumulation of fissile material on the TSB GEVS filter resulting in a criticality event.

For the uncontrolled accident sequence, UF_6 (product) is discharged to the TSB GEVS and is collected on the TSB GEVS HEPA filters forming a critical mass of fissile material on the filter over a long period of time. A criticality event is assumed to result for this accident sequence. This event is assumed to have a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) an automatic trip of the vacuum pump on carbon trap high temperature to ensure the carbon trap does not pass excessive UF_6 (IROFS22) and (2) an automatic trip of the TSB GEVS on ^{235}U selective high-high gamma to ensure no more than a subcritical mass deposited on the filter (IROFS21).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS22. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

A failure probability index of (-2) was selected for IROFS21. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

Accident Identifier: VR1-3

The initial failure (initiating event) is the failure of a cylinder superior valve or the flexible piping of a cylinder containing UF_6 undergoing a cylinder pressure test after repair/replacement of a leaking cylinder component.

For the uncontrolled accident sequence, a slight over pressure release of UF_6 exposes the worker. This event was calculated to result in a high intermediate consequence to the worker and low consequence to the public.

For the controlled accident sequence, the preventive measure is administrative use of personnel respiratory protection to ensure that inhalation of uranic material and HF consequences are low when performing positive pressure testing of a UF_6 cylinder after repair/replacement of a leaking cylinder component (IROFS23a). If personnel respiratory protection is not used, then the positive pressure testing of the UF_6 cylinder shall not be performed.

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria - no failures of this type in this facility in 30 yrs - applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-3) was selected for IROFS23a. This corresponds to an enhanced administrative IROFS per NUREG-1520 criteria. IROFS23a is enhanced by requiring independent verification of the IROFS safety function. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Accident Identifier: VR1-5

The initial failure (initiating event) is the vent subsystem carbon trap becoming saturated with UF_6 caused by a small UF_6 leak through a ventilated room mobile pump and trap rig cold trap valve.

For the uncontrolled accident sequence, a UF_6 plug forms on the discharge of the vacuum pump, causing high pressure in the vacuum pump and thus failing seals leading to a release of UF_6 to the Ventilated Room. This event has been calculated to result in a high consequence to the worker.

For the controlled accident sequence, the preventive measure is an automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6 (IROFS3) and the mitigative measure is a flow restriction to ensure, in the event of a postulated release, worker consequences of inhalation of uranic material and HF are low (IROFS47b). As a result of IROFS47b, the consequence analysis shows that the consequences have been mitigated to an intermediate category (2).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria - no failures of this type in this facility in 30 yrs - applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS3. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

The failure probability index of (-3) was selected for IROF47b. This corresponds to a single passive engineered IROFS per NUREG-1520.

Accident Identifier: VR2-1

The initial failure (initiating event) is a loss of containment of a chemical trap and pouring of the contents of the trap into the Ventilated Room. The cause could be operator error in unloading a carbon trap or impact to a carbon trap.

For the uncontrolled accident sequence, a release of carbon fines containing uranic material from the trap exposes the worker through inhalation of uranic material. This event was calculated to result in an intermediate consequence to the worker and low consequence to the public.

For the controlled accident sequence, the preventive measure is administrative use of personnel respiratory protection to ensure that inhalation of uranic material consequence are low when handling carbon trap material containing uranic material (IROFS23b). If personnel respiratory protection is not used, then carbon trap material containing uranic material shall not be handled.

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS23b. This corresponds to an administrative IROFS for routine planned operations per NUREG-1520 criteria.

Accident Identifier: VR2-2

The initial failure (initiating event) is a loss of containment of a chemical dump trap and pouring of the contents of the trap into the ventilated room. The cause could be operator error in unloading a chemical dump trap or impact to a chemical dump trap.

For the uncontrolled accident sequence, a release of sodium fluoride (NaF) fines containing uranic material from the trap exposes the worker through inhalation of uranic material. This event was calculated to result in a high consequence to the worker and low consequence to the public.

For the controlled accident sequence, the preventive measures are (1) administrative use of personnel respiratory protection to ensure that inhalation of uranic material consequence is low when handling NaF trap material containing uranic material (IROFS23b) and (2) administrative establishment of airflow away from the worker to ensure inhalation of uranic material consequences are low when handling NaF trap material containing uranic material (IROFS24a). If personnel respiratory protection is not used or if air flow away from the worker is not established, then NaF trap material containing uranic material shall not be handled.

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS23b. This corresponds to an administrative IROFS for routine planned operations per NUREG-1520 criteria.

A failure probability index of (-2) was selected for IROFS24a. This corresponds to an administrative IROFS for routine planned operations per NUREG-1520 criteria.

Accident Identifier: VR2-7

The initiating event allows the accumulation of sufficient uranic mass to cause criticality in a solid waste container. The initial condition is that the operator would transfer carbon containing enriched uranic material to a non-safe-by design solid waste container and fails to control the uranic matter in the waste container, (i.e., failure of IROFS31a: administratively limit ^{235}U mass in non-safe-by-design solid waste containers to ensure subcriticality by performing independent sampling and analysis).

For the uncontrolled accident sequence, sufficient uranium mass accumulates in the solid waste container through transfer of carbon containing enriched uranic material from the carbon chemical traps. A criticality event is assumed to result for this accident sequence. A criticality event is assumed to result in a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are: (1) administratively limit ^{235}U mass in non-safe-by-design solid waste containers to ensure a subcritical mass (IROFS31b, i.e., by independent sample and assay analysis to determine ^{235}U mass prior to transferring and bulk storing enriched uranic material in solid waste containers) and (2) administratively limit the calculated ^{235}U mass waste storage to ensure a subcritical mass (IROFS31c, i.e., using bookkeeping procedures to determine the ^{235}U mass prior to transferring and bulk storing enriched uranic material in solid waste containers). For each preventive measure, if the acceptance criterion is not met, the transfer of enriched uranic material shall not be initiated.

The frequency index number for the initiating event (IROFS31a) was determined to be (-1). This frequency probability index corresponds to a failure of redundant IROFS per NUREG-1520.

A failure probability index of (-2) was selected for IROFS31c. This corresponds to an administrative IROFS for planned routine operation per NUREG-1520.

A failure probability index of (-2) was selected for IROFS31b. This corresponds to an administrative IROFS for planned routine operation per NUREG-1520.

Accident Identifier: FR1-1

The accident sequence is the combination of numerous conditions assumed to lead to a criticality in a waste container being transported. This description of this sequence is the following:

(1) The fissile material in the waste container and interacting components would be a uranyl fluoride/water mixture at an H/U atomic ratio near optimum moderation,

(2) The waste container, as well as other interacting components, would be nearly or completely filled with the above material at a high enough enrichment to achieve a configuration favorable for criticality (Urenco European experience is that less than 10% of waste container enrichment is at product enrichment levels), and

(3) The waste container would have to interact (i.e., proximity limit not maintained) with greater than one component containing fissile material, as interaction of the waste container and one other component is subcritical.

The movement of waste containers is part of normal operations; the abnormal operating condition pertaining to the waste container concerns the assumption that the waste container and interacting component are filled with product UF_6 breakdown material at optimum moderation conditions. This would be extremely unlikely for a single waste container and even more unlikely for more than one component.

For the uncontrolled accident sequence, conditions (1) through (3) above must be met to result in a potential criticality event. For this accident sequence, a criticality event was assumed. A criticality event is assumed to result in a high consequence to the worker and public.

For the controlled accident sequence, the preventive measure is to administratively restrict proximity of vessels in non-designed locations containing enriched uranic material to ensure subcritical configuration by verifying the use of a safe-by-design transfer frame prior to movement of the associated waste container containing enriched uranic material (IROFS14a). If the acceptance criteria is not met, then the associated waste container containing enriched uranic material shall not be moved.

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-3) was selected for IROFS14a. This corresponds to an enhanced administrative IROFS per NUREG-1520. IROFS14a is enhanced by requiring independent verification of the IROFS safety function. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Accident Identifier: FR1-2

The accident sequence is the combination of numerous conditions assumed to lead to a criticality in a waste container being stored. This description of this sequence is the following:

(1) The fissile material in the waste container and interacting components would be a uranyl fluoride/water mixture at an H/U atomic ratio near optimum moderation,

(2) The waste container, as well as other interacting components, would be nearly or completely filled with the above material at a high enough enrichment to achieve a configuration favorable for criticality (Urenco European experience is that less than 10% of waste container enrichment is at product enrichment levels), and

(3) The waste container would have to interact (i.e., proximity limit not maintained) with greater than one component containing fissile material, as interaction of the waste container and one other component is subcritical.

For the uncontrolled accident sequence, conditions (1) through (3) above, above must be met to result in a potential criticality event. For this accident sequence, a criticality event was assumed. A criticality event is assumed to result in a high consequence to the worker and public.

For the controlled accident sequence, the preventive measure is administratively restrict proximity of vessels in non-designed locations containing enriched uranic material to ensure subcritical configuration by verifying, prior to moving a waste container containing enriched uranic material within 180 cm of the associated storage array, associated storage array condition is acceptable for storage of the waste container and no component containing enriched uranic material is in movement in the designated area (IROFS14b). If the acceptance criteria are not met, then the associated waste container shall not be moved.

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-3) was selected for IROFS14b. This corresponds to an enhanced administrative IROFS per NUREG-1520. IROFS14b is enhanced by requiring independent verification of the IROFS safety function. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Accident Identifier: FR2-1

This accident sequence is identical to sequence FR1-1, except it is located in the hydrocarbon removal portion of Fomblin Oil Recovery System.

Accident Identifier: FR2-2

This accident sequence is identical to sequence FR1-2, except it is located in the hydrocarbon removal portion of Fomblin Oil Recovery System.

Accident Identifier: DS1-1

This accident sequence is identical to sequence FR1-1, except it is located in the Equipment Decontamination System.

Accident Identifier: DS1-2

This accident sequence is identical to sequence FR1-2, except it is located in the Equipment Decontamination System.

Accident Identifier: DS1-3

The initial failure (initiating event) is the accumulation of sufficient uranium mass to cause criticality in the decontamination tank.

The initial set of conditions, or combination of conditions, that needs to be fulfilled to result in a criticality event in the decontamination tanks include the following:

(1) A significant number of components containing uranium with product enrichments would need to be processed to provide the uranium levels needed to create favorable conditions for criticality, and

(2) The operator would have to fail to notice the incremental rise in uranium concentration from the sampling of the tank (failure of IROFS19c, administratively limit the measured uranic mass inventory to ensure a subcritical mass by performing independent sampling and measurement).

For the uncontrolled accident sequence, sufficient uranium mass accumulates in the decontamination tank. A criticality event is assumed to result for this accident sequence. A criticality event is assumed to result in a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) administratively limit the calculated tank uranic mass inventory to ensure a subcritical mass (IROFS19a, i.e., using bookkeeping procedures to determine calculated tank uranic mass inventory prior to transfer of enriched uranic material to the associated tank) and (2) administratively limit measured uranic mass inventory to ensure a subcritical mass (IROFS19d, i.e., by independent sampling and measurement to determine tank uranic mass inventory prior to transfer of enriched uranic material to the associated tank). For each preventive measure, if the acceptance criterion is not met, then transfer of enriched uranic material shall not be initiated.

The frequency index number for the initiating event, failure of IROFS19c was determined to be (-1). This is based on failure of a redundant administrative IROFS per NUREG-1520.

A failure probability index of (-2) was selected for IROFS19a. This corresponds to an administrative IROFS for routine planned operations per NUREG-1520.

A failure probability index of (-2) was selected for IROFS19d. This corresponds to an administrative IROFS for routine planned operations per NUREG-1520.

Accident Identifier: DS2-1

This accident sequence is identical to sequence FR1-1, except it is located in the Flexible Hose Decontamination System.

Accident Identifier: DS2-2

This accident sequence is identical to sequence FR1-2, except it is located in the Flexible Hose Decontamination System.

Accident Identifier: DS2-3

The initial failure (initiating event) is the accumulation of sufficient uranium mass in the first rinse tank to cause criticality.

The initial set of conditions, or combination of conditions, that needs to be fulfilled to result in a criticality event in the first rinse tank include the following:

(1) A significant number of components containing uranium with product enrichments would need to be processed to provide the uranium levels needed to create favorable conditions for criticality, and

(2) The operator would have to fail to notice the incremental rise in uranium concentration from the sampling of the tank (failure of IROFS19c, administratively limit the measured uranic mass inventory to ensure a subcritical mass by performing independent sampling and measurement).

For the uncontrolled accident sequence, sufficient uranium mass accumulates in the first rinse tank. A criticality event is assumed to result in a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) administratively limit the calculated tank uranic mass inventory to ensure a subcritical mass (IROFS19a, i.e., using bookkeeping procedures to determine calculated tank uranic mass inventory prior to transfer of enriched uranic material to the associated tank) and (2) administratively limit measured uranic mass inventory to ensure a subcritical mass (IROFS19d, i.e., by independent sampling and measurement to determine tank uranic mass inventory prior to transfer of enriched uranic material of the associated tank). For each preventive measure, if the acceptance criteria is not met, the transfer of enriched uranic material shall not be initiated.

The frequency index number for the initiating event, failure of IROFS19c was determined to be (-1). This is based on failure of a redundant administrative IROFS per NUREG-1520.

A failure probability index of (-2) was selected for IROFS19a. This corresponds to an administrative IROFS for routine planned operation per NUREG-1520.

A failure probability index of (-2) was selected for IROFS19d. This corresponds to an administrative IROFS for routine planned operations per NUREG-1520.

Accident Identifier: DS3-1

This accident sequence is identical to sequence FR1-1.

Accident Identifier: DS3-2

This accident sequence is identical to sequence FR1-2.

Accident Identifier: CL3-1

The initial failure (initiating event) is an operator error, no liquid nitrogen in the Dewar cold trap of the sub-sampling System in the chemical laboratory which results in a cold trap temperature above the UF_6 desublimination temperature. During evacuation of the sub-sampling System in this condition, liquid UF_6 desublimes to gas and is pumped by the vacuum pump and is transferred to the TSB GEVS with the potential for a criticality event. The transfer of UF_6 into the TSB GEVS system must exist for a significant period of time to allow a sufficient amount of accumulation on the filters to form a critical mass. The combination of these conditions is assumed to lead to accumulation of fissile material on the TSB GEVS filters resulting in a criticality event.

For the uncontrolled accident sequence, UF_6 (product) is discharged to the TSB GEVS and is collected on the TSB GEVS HEPA filters forming a critical mass of fissile material on the filter over a long period of time. A criticality event is assumed to result for this accident sequence. This event is assumed to have a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) automatic isolation of cold trap on cold trap high temperature to ensure no more than a subcritical mass deposited on the TSB GEVS filter (IROFS20) and (2) an automatic trip of the TSB GEVS on ^{235}U selective high-high gamma to ensure no more than a subcritical mass deposited on the filter (IROFS21).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS20. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

A failure probability index of (-2) was selected for IROFS21. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

Accident Identifier: CL3-2

The initial failure (initiating event) is an operator error, no liquid nitrogen in the UF_6 cold trap which results in a cold trap temperature above the UF_6 desublimination temperature. During the process of transferring product samples for assay analysis, liquid UF_6 flashes to gas. This leads to a release of UF_6 to the atmosphere exposing the worker.

For the uncontrolled accident sequence, the release of liquid UF_6 (product) results in exposure of the worker. This event was calculated to result in a high consequence to the worker and low consequence to the public.

For the controlled accident sequence, the preventive measures are (1) the administrative establishment of airflow away from worker to ensure inhalation of uranic material and HF consequences are low during transfer of product samples for assay analysis (IROFS24b) and (2) the administrative verification that product samples are in a solid state, prior to transfer of product samples for assay analysis, to ensure worker consequences of inhalation of uranic material and HF are low (IROFS46). For these preventive measures, if the acceptance criteria are not met, then the transfer of product samples for assay analysis shall not be initiated.

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS24b. This corresponds to an administrative IROFS for routine planned operations per NUREG-1520 criteria.

The failure probability index of (-2) was selected for IROFS46. This corresponds to an administrative IROFS for routine planned operations per NUREG-1520 criteria.

Accident Identifier: CL3-3

The initial failure (initiating event) is the UF_6 sub-sampling unit heater controller failure, causing the heater within the UF_6 sub-sampling unit to remain on.

For the uncontrolled accident sequence, the sample bottle over heats and the bottle hydraulically ruptures due to the expansion of the UF_6. Upon bottle rupture, the sample bottle content of UF_6 is released within chemical laboratory hood. HF and uranic material are released to the chemical laboratory exposing workers. This event is calculated to result in a low consequence to the public and a high consequence to the worker.

For the controlled accident sequence, the preventive measures are (1) automatic trip of UF6 sub-sampling unit hotbox heater or high hotbox internal temperature to ensure sample bottle integrity (IROFS43) and (2) administrative establishment of air flow away from the worker to ensure inhalation of uranic material and HF consequences are low during heating of a sample bottle(s) within the UF_6 sub-samplng unit (IROFS24b). If air flow from the worker is not established, then sample bottle(s) in the UF_6 sampling unit shall not be heated.

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

The failure probability index number for IROFS43 was determined to be (-2), a single active engineered IROFS per NUREG-1520.

A failure probability index of (-2) was selected for IROFS24b. This corresponds to an administrative IROFS for routine planned operations per NUREG-1520 criteria.

Accident Identifier: CP1-1

The initial failure (initiating event) is that a full product cylinder is used erroneously in the cylinder preparation process and UF_6 is released to the TSB GEVS during the pump out of the cylinder with the potential for a criticality event in the TSB GEVS. The release of UF_6 into the TSB GEVS system must exist for a significant period of time to allow a sufficient amount of accumulation on the filters to form a critical mass. The combination of these conditions is assumed to lead to accumulation of fissile material on the TSB GEVS filters resulting in a criticality event.

For the uncontrolled accident sequence, UF_6 (product) is discharged to the TSB GEVS and is collected as UO_2F_2 on the TSB GEVS HEPA filter forming a critical mass of fissile material on the filter. A criticality event is assumed to result for this accident sequence. This event is assumed to have a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated (IROFS3) and (2) automatic trip of the TSB GEVS on ^{235}U selective high-high gamma to ensure no more than a subcritical mass deposited on the filter (IROFS21).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS3. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

A failure probability index of (-2) was selected for IROFS21. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

Accident Identifier: CP1-2

The initial failure (initiating event) is that a product cylinder arrives at the plant with excess moderator inside the cylinder. This failure results in the potential for a criticality event.

The combination of conditions, that needs to be fulfilled to result in a potential criticality event due to moderator being present in a cylinder include the following:

(1) During vacuum testing of the cylinder, after connection to the plant, the operator must fail to recognize the increased pressure in the cylinder due to the presence of moderator in the cylinder is within acceptable limits, and

(2) Visual inspection has failed to detect the presence of oil in the cylinder.

For the uncontrolled accident sequence, failures (1) or (2) occur (IROFS16a: administratively limit moderator mass (oil and water) in cylinders containing enriched uranic material to ensure subcriticality). A criticality event is assumed to result for this accident sequence when the cylinder is connected to the plant. This event is assumed to result in a high consequence to the worker and public.

For the controlled sequence, the preventive measure is administratively limit moderator mass (oil and water) in cylinders containing enriched uranic material to ensure subcriticality by allowing no visible oil and by limiting cylinder vapor pressure prior to introducing product (IROFS16a). If the acceptance criteria is not met, then product shall not be introduced into the associated cylinder.

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

The failure probability index number of (-3) was selected for IROFS16a. This frequency probability index number corresponds to an enhanced administrative IROFS per NUREG-1520. IROFS16a is enhanced by requiring independent verification of the IROFS safety function. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Accident Identifier: CP1-4

The initial failure (initiating event) is the cylinder preparation vent system carbon trap becomes saturated with UF_6 caused by a small UF_6 leak through the cold trap valve.

For the uncontrolled accident sequence, a UF_6 plug forms on the discharge of the vacuum pump, causing high pressure in the vacuum pump and thus failing seals leading to a release of UF_6 to the cylinder preparation room. This event has been calculated to result in a high consequence to the worker.

For the controlled accident sequence, the preventive measure is automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6 (IROFS3) and the mitigative measure is a flow restriction to ensure, in the event of a postulated release, worker consequences of inhalation of uranic material and HF are low (IROFS47b). As a result of IROFS47b, the consequence analysis shows that the consequences have been mitigated to an intermediate category (2).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS3. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

A failure probability index of (-3) was selected for IROF47b. This corresponds to a single passive engineered IROFS per NUREG-1520.

Accident Identifier: SW1-1

This accident sequence is identical to sequence FR1-1.

Accident Identifier: SW1-2

This accident sequence is identical to sequence FR1-2.

Accident Identifier: LW1-1

The initial failure (initiating event) is the accumulation of sufficient uranium mass in the degreaser water collection tank.

The initial condition that needs to be fulfilled to result in a criticality event in the degreaser water collection tank is that the operator would have to fail to control the uranium mass in the tank, including the operator failing to notice the incremental rise in uranium concentration from the sampling of the tank (failure of IROFS19c, administratively limit the measured uranic mass inventory to ensure a subcritical mass by performing independent sampling and measurement).

For the uncontrolled accident sequence, sufficient uranium mass accumulates in the degreaser tank to cause criticality. A criticality event is assumed to result for this accident sequence. A criticality event is assumed to result in a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) administratively limit the calculated tank uranic mass inventory to ensure a subcritical mass (IROFS19a, i.e., using bookkeeping procedures to determine calculated tank uranic mass inventory prior to transfer of enriched uranic material to the associated tank) and (2) administratively limit the measured tank uranic inventory to ensure a subcritical mass (IROFS19d, i.e., by independent sampling and measurement to determine tank uranic mass inventory prior to transfer of enriched uranic material to the associated tank). For each preventive measure, if the acceptance criterion is not met, then transfer of enriched uranic material shall not be initiated.

The frequency index number for the initiating event, failure of IROFS19c, was determined to be (-1). This is based on failure of a redundant IROFS per NUREG-1520.

A failure probability index of (-2) was selected for IROFS19a. This corresponds to an administrative IROFS for routine planned operation per NUREG-1520.

A failure probability index of (-2) was selected for IROFS19d. This corresponds to an administrative IROFS for routine planned operation per NUREG-1520.

Accident Identifier: LW1-2

This accident sequence is identical to sequence FR1-1.

Accident Identifier: LW1-3

This accident sequence is identical to sequence FR1-2.

Accident Identifier: LW2-1

The initial failure (initiating event) is the accumulation of sufficient uranium mass in the spent citric acid tank to cause criticality.

The initial condition that needs to be fulfilled to result in a criticality event in the spent citric acid tank is that the operator would have to fail to control the uranium mass in the tank, including the operator failing to notice the incremental rise in uranium concentration from the sampling of the tank (failure of IROFS19c, administratively limit the measured uranic mass inventory to ensure a subcritical mass by performing independent sampling and measurement).

For the uncontrolled accident sequence, sufficient uranium mass accumulates in the spent citric acid tank. A criticality event is assumed to result in a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) administratively limit the calculated tank uranic mass inventory to ensure a subcitical mass (IROFS19a, i.e., using bookkeeping procedures to determine calculated tank uranic mass inventory prior to transfer of enriched uranic material to the associated tank) and (2) administratively limit the measured tank uranic inventory to ensure a subcritical mass (IROFS19d, i.e., by independent sampling and measurement to determine tank uranic mass inventory prior to transfer of enriched uranic material to the associated tank). For each preventive measure, if the acceptance criterion is not met, then transfer of enriched uranic material shall not be initiated.

The frequency index number for the initiating event, failure of IROFS19c was determined to be (-1). This is based on failure of a redundant IROFS per NUREG-1520.

A failure probability index of (-2) was selected for IROFS19a. This corresponds to an administrative IROFS for routine planned operation per NUREG-1520.

A failure probability index of (-2) was selected for IROFS19d. This corresponds to an administrative IROFS for routine planned operation per NUREG-1520.

Accident Identifier: LW3-1

The initial failure (initiating event) is the accumulation of sufficient uranium mass in the miscellaneous effluent collection tank to cause criticality.

The initial condition that needs to be fulfilled to result in a criticality event in the miscellaneous effluent collection tank is that the operator would have to fail to control the uranium mass in the tank, including the operator failing to notice the incremental rise in uranium concentration from the sampling of the tank (failure of IROFS19c, administratively limit the measured uranic mass inventory to ensure a subcritical mass by performing independent sampling and measurement).

For the uncontrolled accident sequence, sufficient uranium mass accumulates in the miscellaneous effluent collection tank. A criticality event is assumed to result for this accident sequence. A criticality event is assumed to result in a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) administratively limit the calculated tank uranic mass inventory to ensure a subcitical mass (IROFS19a, i.e., using bookkeeping procedures to determine calculated tank uranic mass inventory prior to transfer of enriched uranic material to the associated tank) and (2) administratively limit the measured tank uranic inventory to ensure a subcritical mass (IROFS19d, i.e., by independent sampling and measurement to determine tank uranic mass inventory prior to transfer of enriched uranic material to the associated tank). For each preventive measure, if the acceptance criterion is not met, then transfer of enriched uranic material shall not be initiated.

The frequency index number for the initiating event, failure of IROFS19c, was determined to be (-1). This is based on failure of a redundant IROFS per NUREG-1520.

A failure probability index of (-2) was selected for IROFS19a. This corresponds to an administrative IROFS for routine planned operation per NUREG-1520.

A failure probability index of (-2) was selected for IROFS19d. This corresponds to an administrative IROFS for routine planned operation per NUREG-1520.

Accident Identifier: LW5-1

The initial failure (initiating event) is the accumulation of sufficient uranium mass in the precipitation treatment tank to cause criticality.

The initial condition that needs to be fulfilled to result in a criticality event in the precipitation treatment tank is that the operator would have to fail to control the uranium mass in the tank, including the operator failing to notice the incremental rise in uranium concentration from the sampling of the tank (failure of IROFS19c, administratively limit the measured uranic mass inventory to ensure a subcritical mass by performing independent sampling and measurement).

For the uncontrolled accident sequence, sufficient uranium mass accumulates in the precipitation treatment tank. A criticality event is assumed to result for this accident sequence. A criticality event is assumed to result in a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) administratively limit the calculated tank uranic mass inventory to ensure a subcitical mass (IROFS19a, i.e., using bookkeeping procedures to determine calculated tank uranic mass inventory prior to transfer of enriched uranic material to the associated tank) and (2) administratively limit the measured tank uranic inventory to ensure a subcritical mass (IROFS19d, i.e., by independent sampling and measurement to determine tank uranic mass inventory prior to transfer of enriched uranic material to the associated tank). For each preventive measure, if the acceptance criterion is not met, then transfer of enriched uranic material shall not be initiated.

The frequency index number for the initiating event, failure of IROFS19c was determined to be (-1). This is based on failure of a redundant IROFS per NUREG-1520.

A failure probability index of (-2) was selected for IROFS19a. This corresponds to an administrative IROFS for routine planned operation per NUREG-1520.

A failure probability index of (-2) was selected for IROFS19d. This corresponds to an administrative IROFS for routine planned operation per NUREG-1520.

Accident Identifier: RD1-1

The initiating event allows the placement of product 48Y and 30B cylinders into a non-safe criticality interaction arrangement (i.e., a non-analyzed condition). The initial condition is an operator would have stacked a product cylinder on another product cylinder in the CRDB

For the uncontrolled accident sequence, product cylinders are stacked more than one high next to another product cylinder. A criticality event is assumed to result for this accident sequence. This event is assumed to result in a high consequence to the worker and public.

For the controlled accident sequence, the preventive measure is (IROFS45) to ensure subcritical geometry, prior to moving a cylinder containing enriched uranium in the CRDB or the Blending and Liquid Sampling Area, verify that the stored cylinders containing enriched uranium in these areas are in a horizontal, co-planar (i.e., non-stacked), condition and that no other cylinder containing enriched uranium is in movement in the associated area. If the acceptance criteria are not met, then the cylinder containing enriched uranium shall not be moved.

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-3) was selected for IROFS45. This corresponds to an enhanced administrative IROFS for routine operation per NUREG-1520. IROFS45 is enhanced by requiring independent verification of the IROFS safety function. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Accident Identifier: DC1-1

The initial failure (initiating event) is the carbon traps become saturated with UF_6 caused by the operation of Contingency Dump System dumping to sodium fluoride (NaF) traps, which have not been filled correctly, coincident with a worker located near the contingency dump vacuum pump.

For the uncontrolled accident sequence, a UF_6 plug forms on the discharge line of the contingency dump vacuum pump discharge flange seal, causing high pressure and thus failing the contingency dump vacuum pump discharge flange seal, causing a release of UF_6 to the process services corridor. This event was calculated to result in a high consequence to the worker. Impact to the public is evaluated in accident sequence DC1-2.

For the controlled accident sequence, the preventive measures are (1) administratively maintain contingency dump NaF trap fill and use to ensure carbon trap does not saturate on operation of contingency dump by maintaining appropriate fill of the NaF traps prior to placing the associated NaF trap in service after filling (IROFSC1b), (2) automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6 (IROFS3), and (3) automatic trip of the vacuum pump on high pressure at the vacuum pump set outlet to prevent a release (IROFSC18). For IROFSC1b, if the acceptance criterion is not met, then the associated NaF trap shall not be placed in service.

The frequency index number for the initiating event was determined to be (0). This frequency index is based on an annual frequency of one for the Contingency Dump System discharge to the NaF traps. This assumption is based on an assessment of the NEF annual Contingency Dump System actuation potential.

The failure probability index of (-2) was selected for IROFSC1b. This corresponds to an administrative IROFS for routine planned operation per NUREG-1520.

A failure probability index of (-2) was selected for IROFS3. This corresponds to a single active engineered IROFS per NUREG-1520.

A failure probability index of (-2) was selected for IROFSC18. This corresponds to a single active engineered IROFS per NUREG-1520.

Accident Identifier: DC1-2

The initial failure (initiating event) is the carbon traps become saturated with UF_6 caused by the operation of Contingency Dump System dumping to sodium fluoride (NaF) traps which have not been filled correctly.

For the uncontrolled accident sequence, a UF_6 plug forms on the discharge line of the contingency dump vacuum pump discharge flange seal, causing high pressure and thus failing the contingency dump vacuum pump discharge flange seal, causing a release of UF_6 to the process services corridor. This event was calculated to result in an intermediate consequence to the public.

For the controlled accident sequence, the preventive measures are (1) administratively maintain contingency dump NaF trap fill and use to ensure carbon trap does not saturate on operation of contingency dump by maintaining appropriate fill of the NaF traps prior to placing the associated NaF trap in service after filling (IROFSC1b) and (2) automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF6 (IROFS3). For IROFSC1b, if the acceptance criterion is not met, then the associated NaF trap shall not be placed in service.

The frequency index number for the initiating event was determined to be (0). This frequency index is based on an annual frequency of one for the Contingency Dump System discharge to the NaF traps. This assumption is based on an assessment of the NEF annual Contingency Dump System actuation potential.

The failure probability index of (-2) was selected for IROFSC1b. This corresponds to an administrative IROFS for routine planned operation per NUREG-1520.

A failure probability index of (-2) was selected for IROFS3. This corresponds to a single active engineered IROFS per NUREG-1520.

Accident Identifier: DC1-3

The initial failure (initiating event) is the carbon traps become saturated with UF_6 caused by the operation of Contingency Dump System dumping to sodium fluoride (NaF) traps which have been saturated through excessive use coincident with a worker located near the contingency dump vacuum pump.

For the uncontrolled accident sequence, a UF_6 plug forms on the discharge line of the contingency dump vacuum pump discharge flange seal, causing high pressure and thus failing the contingency dump vacuum pump discharge flange seal, causing a release of UF_6 to the process services corridor. This event was calculated to result in a high consequence to the worker. Impact to the public is evaluated in accident sequence DC1-4.

For the controlled accident sequence, the preventive measures are (1) administratively maintain contingency dump NaF trap fill and use to ensure carbon trap does not saturate on operation of contingency dump by replacement of the NaF trap prior to the NaF fill becoming spent due to excessive dump operation (IROFSC1b), (2) automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6 (IROFS3), and (3) automatic trip of the vacuum pump on high pressure at the vacuum pump set outlet to prevent a release (IROFSC18). For IROFSC1b, if the acceptance criterion is not met, then the NaF trap shall be isolated from the associated cascade.

The frequency index number for the initiating event was determined to be (0). This frequency index is based on an annual frequency of one for the Contingency Dump System discharge to the NaF traps. This assumption is based on an assessment of the NEF annual Contingency Dump System actuation potential.

The failure probability index of (-2) was selected for IROFSC1b. This corresponds to an administrative IROFS for routine planned operation per NUREG-1520.

A failure probability index of (-2) was selected for IROFS3. This corresponds to a single active engineered IROFS per NUREG-1520.

A failure probability index of (-2) was selected for IROFSC18. This corresponds to a single active engineered IROFS per NUREG-1520.

Accident Identifier: DC1-4

The initial failure (initiating event) is the carbon traps become saturated with UF_6 caused by the operation of Contingency Dump System dumping to sodium fluoride (NaF) traps which have which have been saturated through excessive use.

For the uncontrolled accident sequence, a UF_6 plug forms on the discharge line of the contingency dump vacuum pump discharge flange seal, causing high pressure and thus failing the contingency dump vacuum pump discharge flange seal, causing a release of UF_6 to process services corridor. This event was calculated to result in an intermediate consequence to the public.

For the controlled accident sequence, the preventive measures are (1) administratively maintain contingency dump NaF trap fill and use to ensure carbon trap does not saturate on operation of contingency dump by replacement of the NaF trap prior to the NaF fill becoming spent due to excessive dump operation (IROFSC1b), and (2) automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6 (IROFS3). For IROFSC1b, if the acceptance criterion is not met, then the NaF trap shall be isolated from the associated cascade.

The frequency index number for the initiating event was determined to be (0). This frequency index is based on an annual frequency of one for the Contingency Dump System discharge to the NaF traps. This assumption is base on an assessment of the NEF annual Contingency Dump System actuation potential.

The failure probability index of (-2) was selected for IROFSC1b. This corresponds to an administrative IROFS for routine planned operation per NUREG-1520.

A failure probability index of (-2) was selected for IROFS3. This corresponds to a single active engineered IROFS per NUREG-1520.

Accident Identifier: DC1-5

The initial failure (initiating event) is the carbon traps become saturated with UF_6 caused by the operation of Contingency Dump System bypassing the NaF traps due to operation of the bypass valve coincident with a worker located near the contingency dump vacuum pump.

For the uncontrolled accident sequence, a UF_6 plug forms on the discharge line of the contingency dump vacuum pump discharge flange seal, causing high pressure and thus failing the contingency dump vacuum pump discharge flange seal, causing a release of UF_6 to the process services corridor. This event was calculated to result in a high consequence to the worker. Impact to the public is evaluated in accident sequence DC1-6.

For the controlled accident sequence, the preventive measures are (1) automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6 (IROFS3) and (2) automatic trip of the vacuum pump on high pressure at the vacuum pump set outlet to prevent a release (IROFSC18).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS3. This corresponds to a single active engineered IROFS per NUREG-1520.

A failure probability index of (-2) was selected for IROFSC18. This corresponds to a single active engineered IROFS per NUREG-1520.

Accident Identifier: DC1-6

The initial failure (initiating event) is the carbon traps become saturated with UF_6 caused by the operation of Contingency Dump System bypassing the NaF traps due to operation of the bypass valve.

For the uncontrolled accident sequence, a UF_6 plug forms on the discharge line of the contingency dump vacuum pump discharge flange seal, causing high pressure and thus failing the contingency dump vacuum pump discharge flange seal, causing a release of UF_6 to the process services corridor. This event was calculated to result in an intermediate consequence to the public.

For the controlled accident sequence, the preventive measure is automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6 (IROFS3).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS3. This corresponds to a single active engineered IROFS per NUREG-1520.

Accident Identifier: DC1-7

The initial failure (initiating event) is the occurrence of a dump operation following a period of time where the contingency dump valve has been exhibiting a small continuous leak. The leak would cause UF_6 from the cascade to enter the dump system, causing the NaF traps and the pump's carbon trap to become spent. Contingency dump operation is assumed to occur coincident with a worker located near the contingency dump vacuum pump.

For the uncontrolled accident sequence, a UF_6 plug forms on the discharge line of the contingency dump vacuum pump discharge flange seal, causing high pressure and thus failing the contingency dump vacuum pump discharge flange seal, causing a release of UF_6 to the process services corridor. This event was calculated to result in a high consequence to the worker. Impact to the pubic is evaluated in accident sequence DC1-8.

For the controlled accident sequence, the preventive measures are (1) automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6 (IROFS3) and (2) automatic trip of the vacuum pump on high pressure at the vacuum pump set outlet to prevent a release (IROFSC18).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS3. This corresponds to a single active engineered IROFS per NUREG-1520.

A failure probability index of (-2) was selected for IROFSC18. This corresponds to a single active engineered IROFS per NUREG-1520.

Accident Identifier: DC1-8

The initial failure (initiating event) is the occurrence of a dump operation following a period of time where the contingency dump valve has been exhibiting a small continuous leak. The leak would cause UF_6 from the cascade to enter the dump system, causing the NaF traps and the pump's carbon trap to become spent.

For the uncontrolled accident sequence, a UF_6 plug forms on the discharge line of the contingency dump vacuum pump discharge flange seal, causing high pressure and thus failing the contingency dump vacuum pump discharge flange seal, causing a release of UF_6 to the process services corridor. This event was calculated to result in an intermediate consequence to the public.

For the controlled accident sequence, the preventive measure is automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6 (IROFS3).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS3. This corresponds to a single active engineered IROFS per NUREG-1520.

Accident Identifier: EC3-1

The initial failure (initiating event) is failure of criticality enrichment control by failing to properly control the UF_6 enrichment process. The maximum enrichment of a single cascade is limited by mechanical enrichment control devices. This failure is initiated by the improper setting of the cascade enrichment control devices. In addition, other failures are assumed to occur such as (1) a leak must exist within the product system to cause breakdown build-up in an otherwise safe by geometry component, or allow moderator into the product cylinder and (2) a significant period of time is required to allow a significant build-up of product, breakdown and/or moderator. The combination of these conditions is assumed to result in a criticality event.

For the uncontrolled accident sequence there is a failure of criticality enrichment control by failing to properly control the UF_6 enrichment process. A criticality event is assumed to result for this accident sequence. A criticality event is assumed to result in a high consequence to the worker and public.

For the controlled accident sequence, the preventive measure is: calculate and set the cascade enrichment control device in accordance with the calculation to ensure $\leq 5\ ^{w}/_{o}\ ^{235}U$ enrichment to ensure subcriticality within the designed process (IROFSC6). If the acceptance criterion is not met and the cascade enrichment control device setting has not been changed, then the cascade enrichment control device setting shall not be changed. If the acceptance criterion is not met and the cascade enrichment control device setting has been changed, then the associated cascade shall be isolated such that no additional UF_6 can enter or exit the cascade.

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-3) was selected for IROFSC6. This corresponds to an enhanced administrative IROFS per NUREG-1520. IROFSC6 is enhanced by requiring independent verification of the IROFS safety function. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Accident Identifier: EC4-1

The initial failure (initiating event) is an operator error that results in an incorrect sampling sequence. This causes excessive flow of UF_6 resulting in the evacuating rig carbon trap becoming saturated.

For the uncontrolled accident sequence, a UF_6 plug forms on the discharge line of the vacuum pump, causing high pressure in the vacuum pump and thus failing seals leading to a release of UF_6 to the process services corridor. This event has been calculated to result in a high consequence to the worker.

For the controlled accident sequence, the preventive measures are (1) automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6 (IROFS3) and (2) automatic trip of the vacuum pump on high pressure at the vacuum pump set outlet to prevent a release (IROFSC18).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS3. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

A failure probability index of (-2) was selected for IROFSC18. This corresponds to a single active engineered IROFS per NUREG-1520.

Accident Identifier: EC4-2

The initial failure (initiating event) is inadvertent alignment of the cascade sampling rig to the cascade product header when performing cascade sampling. The carbon trap would fill up with UF_6 and eventually overflow to the vacuum pump where it may get pumped into the SB GEVS, mixing with moist air, forming solid UO_2F_2 that collects on the SB GEVS filters. The release of UF_6 to the SB GEVS is assumed to exist for a significant period of time to allow a sufficient amount of accumulation of the filters to form a critical mass. The combination of these conditions is assumed to lead to an accumulation of fissile material of the SB GEVS filters resulting in a criticality event.

In the uncontrolled accident sequence, it is assumed that an operator error occurs related to the sampling sequence and the vacuum pump, rather than evacuating rig, is connected to the cascade product header. UF_6 is released into the SB GEVS and is collected on the SB GEVS HEPA filters forming a critical mass of fissile material on the filters over a long period of time. A criticality event is assumed to result for this accident sequence. This event is assumed to have a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6 (IROFS3) and (2) automatic trip signal on ^{235}U selective high-high gamma monitor to ensure no more than a subcritical mass deposited on the SB GEVS filter or precipitator (IROFS8a).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS3. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

A failure probability index of (-2) was selected for IROFS8a. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

Accident Identifier: TP8-1

The initial failure (initiating event) is a one of the two Centrifuge Test Facility UF_6 vessels heater controller failure, causing a vessel high temperature.

For the uncontrolled accident sequence, the UF_6 test vessel overheats and the vessel hydraulically ruptures due to the expansion of UF_6. Upon vessel rupture, the UF_6 content is released into the Centrifuge Test Facility. This sequence, if uncontrolled, would require significant time to cause a UF_6 release since the heat up rate is limited by the heater capacity. In addition, failure of a single heating circuit is not sufficient to cause the temperatures required for a hydraulic rupture. This event is assumed to have a high consequence to the worker and public.

For the controlled accident sequence, the preventive measures are (1) automatic trip of the centrifuge Test Facility Feed/take-off vessel heat tracing on high temperature to ensure feed/take-off vessel integrity (IROFSC15) and (2) automatic trip of the Centrifuge Test Facility Feed/take-off vessel heat tracing on high temperature to ensure feed/take-off vessel integrity (IROFSC16).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFSC15. This corresponds to a single active engineered IROFS per NUREG-1520.

A failure probability index of (-2) was selected for IROFSC16. This corresponds to a single active engineered IROSF per NUREG-1520.

Accident Identifier: TP8-2

The initial failure (initiating event) is the Centrifuge Test Facility vent carbon trap becomes saturated with UF_6 caused by operator mis-alignment of the vacuum pump to the feed vessel.

For the uncontrolled accident sequence, a UF_6 plug forms on the discharge of the vacuum pump, causing high pressure in the vacuum pump and thus failing seals leading to a release of UF_6 to the Centrifuge Test Facility. This event has been calculated to result in a high consequence to the worker.

For the controlled accident sequence, the preventive measures are (1) automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6 (IROFS3) and (2) automatic trip of the vacuum pump on high pressure at the vacuum pump set outlet to prevent a release (IROFSC18).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

A failure probability index of (-2) was selected for IROFS3. This corresponds to a single active engineered IROFS per NUREG-1520 criteria.

A failure probability index of (-2) was selected for IROFSC18. This corresponds to a single active engineered IROFS per NUREG-1520.

Accident Identifier: CHEM RELEASE-WORKER EVAC

The initial failure is a release of UF_6 of a magnitude that would require worker evacuation. The systems involved in the associated accident sequences that may lead to this magnitude of release are as follows.

> Tails, Feed, Feed Purification, Product, Blending and Sampling, Ventilated Room, UF_6 Sub-sampling Unit, Cylinder Preparation Room, UBC Storage Pad, Decontamination Workshop, and CRDB.

The uncontrolled event is a release of a magnitude that results in worker consequences of inhalation of uranic material and HF that are greater than a low category (1). The subsequent release from this event is assumed to have high consequences to the worker present in the area.

For the controlled event, the mitigative measure is to administratively limit exposure by requiring worker action to evacuate the area(s) of concern during a chemical release to ensure that the consequences of inhalation of uranic material and HF are low (IROFS39c). Sufficient time is available for the worker to detect and to evacuate the area(s) of concern. As a result of IROFS39c, the consequence analysis shows that the consequence has been mitigated to a low category (1).

The frequency index number for each initiating event of the associated accident sequences was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was selected based on evidence from history of similarly designed Urenco European plants, which have a combined plant history of greater than 30 yrs, and have not had a failure of this type.

The failure probability index for the administrative controls/procedures of IROFS39c was determined to be (-3). This corresponds to an administrative IROFS that must be performed in response to a rare unplanned demand per NUREG-1520. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Accident Identifier: LOSS OF SAFE-BY-DESIGN ATTRIBUTE

The accident sequence is a criticality resulting from loss of a feature associated with safe-by-design components containing enriched Uranium material. The criticality event is assumed to have a high consequence to the worker and the public. The safe-by-design components addressed in this accident sequence are as follows.

> Safe-by-design components in the following systems, Cascade, Product, Tails, Product Blending, Product Liquid Sampling, Contingency Dump, Centrifuge Test, Centrifuge Post Mortem, Liquid Effluent Collection and Treatment, Solid Waste, Decontamination Workshop, Fomblin Oil Recovery, Ventilated Room, Chemical Laboratory, Mass Spectrometry, and Cylinder Preparation Room Systems. These safe-by-design components are identified in Tables 3.7-6 through 3.7-21.

The passive, safe-by-design features of these components do not rely on human interface to perform the criticality safety function. These features also meet the criterion that the only potential means to effect a change that might result in a failure to function, would be to implement a design change (i.e., geometry deformation as a result of a credible process deviation or event does not adversely impact the performance of the safety function). The evaluation of the potential to adversely impact the safety function of the passive design features (which includes consideration of potential mechanisms to cause bulging, corrosion, and breach of confinement/leakage and subsequent accumulation of material) is presented in Tables 3.7-6 through 3.7-21, and includes consideration of adequate controls to ensure the double contingency principle is met. For the identified components, Tables 3.7-6 through 3.7-21 summarize the rationale for the conclusion that there is no credible means to effect a change to the safe-by-design feature that might result in a failure of the safety function. Tables 3.7-6 through 3.7-21 also support the conclusion that significant margin exists. For components that are safe-by-volume, safe-by-diameter, or safe-by-slab thickness, significant margin is defined as a margin of at least 10%, during both normal and upset conditions, between the actual design parameter value of the component and the value of the corresponding critical design attribute. For components that require a more detailed criticality analysis, significant margin is defined as $k_{eff} < 0.95$, where $k_{eff} = k_{calc} + 3\sigma_{calc}$. These passive, safe-by-design features are considered items which may affect IROFS. As a result, QA level 1 requirements apply to these features. In addition, the configuration management system required by 10 CFR 70.72 (implemented by the NEF Configuration Management Program) adequately ensures maintaining the safety function of the subject component features and assures compliance with the double contingency principle, as well as the defense-in-depth criterion required by 10 CFR 70.64(b).

Conclusion: Based on 1) the lack of credible means to effect an adverse change to the safe-by-design feature of these passive design components, 2) the significant margins of safety that exist, 3) the application of the 10 CFR 70.72 configuration management system to preserve the safety design features, and 4) the relative low risk of a criticality event at low enriched uranium enrichment facilities, the frequency for the criticality initiating event was determined to be "highly unlikely." Therefore, an initiating event index of (-5) is appropriate, the risk of such an event is judged to be low and no IROFS are needed.

Table 3.7-3 External Events and Fire Accident Sequences And Risk Index
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Accident Identifier	Initiating Event Index	Preventive Safety Parameter 1 or IROFS 1 Failure Index	Preventive Safety Parameter 2 or IROFS 2 Failure Index	Mitigation IROFS Failure Index	Likelihood Index T Uncontrolled (U) / Controlled (C)	Likelihood Category	Consequence Category (Type of Accident)	Risk Index (h= f x g) Uncontrolled (U) / Controlled (C)	Comments and Recommendations
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	
EE-Aircraft	-6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Not Credible Event
EE-Pipeline	-5	N/A	N/A	N/A	-5 (U)	1	3 (T)	3 (U)	Acceptable Risk
EE-Highway	-5	N/A	N/A	N/A	-5 (U)	1	3 (T)	3 (U)	Acceptable Risk
EE-Other Nearby Facilities	-6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Not Credible Event
EE-Railroad	-6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Not Credible Event
EE-CUB-GAS	-5	N/A	N/A	N/A	-5 (U)	1	3 (T)	3 (U)	Acceptable Risk
EE-Flood	-6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Not Credible Event
EE-LP-BLD(T)	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
EE-LP-BLD(T)	-5	IROFS27c -3	N/A	N/A	-8 (C)	1	3 (T)	3 (C)	Acceptable Risk
EE-LP-BLD (CR)	-2	N/A	N/A	N/A	-2 (U)	3	3 (CR)	9 (U)	IROFS Required
EE-LP-BLD (CR)	-5	IROFS27a -3	IROFS27b -3	N/A	-11 (C)	1	3 (CR)	3 (C)	Acceptable Risk
EE-LP-PAD	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
EE-LP-PAD	-5	IROFS27d -3	N/A	N/A	-8 (C)	1	3 (T)	3 (C)	Acceptable Risk
EE-Snow	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
EE-Snow	-5	IROFS27c -3	N/A	N/A	-8 (C)	1	3 (T)	3 (C)	Acceptable Risk
EE-Tornado, Tornado Missile & High Wind	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required

Accident Identifier	Initiating Event Index	Preventive Safety Parameter 1 or IROFS 1 Failure Index	Preventive Safety Parameter 2 or IROFS 2 Failure Index	Mitigation IROFS Failure Index	Likelihood Index T Uncontrolled (U) / Controlled (C)	Likelihood Category	Consequence Category (Type of Accident)	Risk Index (h= f x g) Uncontrolled (U) / Controlled (C)	Comments and Recommendations
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	
EE-Tornado, Tornado Missile & High Wind	-5	IROFS27c -3	N/A	N/A	-8 (C)	1	3 (T)	3 (C)	Acceptable Risk
EE-SEISMIC-WORKER EVAC	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
EE-SEISMIC-X WORKER EVAC	-2	N/A	N/A	IROFS39a -3	-5 (U)	1	1 (T)	1 (C)	Acceptable Risk
SEISMIC-1a (UF_6 Areas)	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
SEISMIC-1b (UF_6 Areas)	-2	N/A	N/A	IROFS27c	-2 (C)	3	2 (T)	6 (C)	Additional IROFS Required
SEISMIC-1c (UF_6 Areas)	-2	N/A	N/A	IROFS27c IROFS26 (Success)	-2 (C)	3	2 (T)	6 (C)	Additional IROFS Required
SEISMIC-1d (UF_6 Areas)	-2	N/A	N/A	IROFS27c IROFS26 (Failure, -3)	-5 (C)	1	2 (T)	2 (C)	Acceptable Risk
SEISMIC-1e (UF_6 Areas)	-2	N/A	N/A	IROFS27c IROFS26 (Success) IROFS41 (Success)	-2 (C)	3	1 (T)	3 (C)	Acceptable Risk

Accident Identifier	Initiating Event Index	Preventive Safety Parameter 1 or IROFS 1 Failure Index	Preventive Safety Parameter 2 or IROFS 2 Failure Index	Mitigation IROFS Failure Index	Likelihood Index T Uncontrolled (U) / Controlled (C)	Likelihood Category	Consequence Category (Type of Accident)	Risk Index (h= f x g) Uncontrolled (U) / Controlled (C)	Comments and Recommendations
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	
SEISMIC-1f (UF_6 Areas)	-2	N/A	N/A	IROFS27c IROFS26 (Success) IROFS41 (Failure, -2)	-4 (C)	2	2 (T)	4 (C)	Acceptable Risk
SEISMIC-2a (Cascades)	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
SEISMIC-2b (Cascades)	-2	N/A	N/A	IROFS27c	-2 (C)	3	3 (T)	9 (C)	Additional IROFS Required
SEISMIC-2c (Cascades)	-2	N/A	N/A	IROFS27c IROFS26 (Success)	-2 (C)	3	2 (T)	6 (C)	Additional IROFS Required
SEISMIC-2d (Cascades)	-2	N/A	N/A	IROFS27c IROFS26 (Failure, -3)	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
SEISMIC-2e (Cascades)	-2	N/A	N/A	IROFS27c IROFS26 (Success) IROFS41 (Success)	-2 (C)	3	1 (T)	3 (C)	Acceptable Risk

Table 3.7-3 External Events And Fire Accident Sequences And Risk Index

Accident Identifier	Initiating Event Index	Preventive Safety Parameter 1 or IROFS 1 Failure Index	Preventive Safety Parameter 2 or IROFS 2 Failure Index	Mitigation IROFS Failure Index	Likelihood Index T Uncontrolled (U) / Controlled (C)	Likelihood Category	Consequence Category (Type of Accident)	Risk Index (h= f x g) Uncontrolled (U) / Controlled (C)	Comments and Recommendations
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	
SEISMIC-2f (Cascades)	-2	N/A	N/A	IROFS27c IROFS26 (Success) IROFS41 (Failure, -2)	-4 (C)	2	2 (T)	4 (C)	Acceptable Risk
SEISMIC-3a (Blending & Liquid Sampling)	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
SEISMIC-3b (Blending & Liquid Sampling)	-2	N/A	N/A	IROFS27c	-2 (C)	3	2 (T)	6 (C)	Additional IROFS Required
SEISMIC-3c (Blending & Liquid Sampling)	-2	N/A	N/A	IROFS27c IROFS26 (Success)	-2 (C)	3	2 (T)	6 (C)	Additional IROFS Required
SEISMIC-3d (Blending & Liquid Sampling)	-2	N/A	N/A	IROFS27c IROFS26 (Failure, -3)	-5 (C)	1	2 (T)	2 (C)	Acceptable Risk
SEISMIC-3e (Blending & Liquid Sampling)	-2	N/A	N/A	IROFS27c IROFS26 (Success) IROFS41 (Success)	-2 (C)	3	1 (T)	3 (C)	Acceptable Risk

Table 3.7-3 External Events And Fire Accident Sequences And Risk Index

Accident Identifier	Initiating Event Index	Preventive Safety Parameter 1 or IROFS 1 Failure Index	Preventive Safety Parameter 2 or IROFS 2 Failure Index	Mitigation IROFS Failure Index	Likelihood Index T Uncontrolled (U) / Controlled (C)	Likelihood Category	Consequence Category (Type of Accident)	Risk Index (h= f x g) Uncontrolled (U) / Controlled (C)	Comments and Recommendations
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	
SEISMIC-3f (Blending & Liquid Sampling)	-2	N/A	N/A	IROFS27c IROFS26 (Success) IROFS41 (Failure, -2)	-4 (C)	2	2 (T)	4 (C)	Acceptable Risk
SEISMIC -5 (Liquid Sampling Autoclave)	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
SEISMIC -5 (Liquid Sampling Autoclave)	-5	IROFS28 -3	N/A	N/A	-8 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF1-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF1-1	-2	IROFS35 -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF1-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF1-2	-2	IROFS36a -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF5-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF5-1	-2	IROFS36b -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF5-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF5-2	-2	IROFS36h -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF6-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF6-1	-2	IROFS35 -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk

Accident Identifier	Initiating Event Index	Preventive Safety Parameter 1 or IROFS 1 Failure Index	Preventive Safety Parameter 2 or IROFS 2 Failure Index	Mitigation IROFS Failure Index	Likelihood Index T Uncontrolled (U) / Controlled (C)	Likelihood Category	Consequence Category (Type of Accident)	Risk Index (h= f x g) Uncontrolled (U) / Controlled (C)	Comments and Recommendations
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	
FF6-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF6-2	-2	IROFS36a -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF7-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF7-1	-2	IROFS36c -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF8-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF8-1	-2	IROFS35 -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF8-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF8-2	-2	IROFS36a -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF11-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF11-1	-2	IROFS35 -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF11-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF11-2	-2	IROFS36a -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF15-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF15-1	-2	IROFS35 -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF16-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF16-1	-2	IROFS36a -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF16-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF16-2	-2	IROFS36a -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF21-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required

Accident Identifier	Initiating Event Index	Preventive Safety Parameter 1 or IROFS 1 Failure Index	Preventive Safety Parameter 2 or IROFS 2 Failure Index	Mitigation IROFS Failure Index	Likelihood Index T Uncontrolled (U) / Controlled (C)	Likelihood Category	Consequence Category (Type of Accident)	Risk Index (h= f x g) Uncontrolled (U) / Controlled (C)	Comments and Recommendations
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	
FF21-1	-2	IROFS35 -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF21-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF21-2	-2	IROFS36d -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF23-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF23-1	-2	IROFS35 -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF23-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF23-2	-2	IROFS36d -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF24-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF24-1	-2	IROFS35 -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF25-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF25-1	-2	IROFS36d -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF25-2a	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF25-2b	-2	IROFS36d (Success)	N/A	N/A	-2 (C)	3	2 (T)	6 (C)	Additional IROFS Required
FF25-2c	-2	IROFS36d (Success)	N/A	IROFS37 (Success)	-2 (C)	3	1 (T)	3 (C)	Acceptable Risk
FF25-2d	-2	IROFS36d (Success)	N/A	IROFS37 -2 (Failure)	-4 (C)	2	2 (T)	4 (C)	Acceptable Risk
FF25-2e	-2	IROFS36d (Failure, -3)	N/A	IROFS37 (Success)	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF25-2f	-2	IROFS36d (Failure, -3)	N/A	IROFS37 (Failure, -2)	-7 (C)	1	3 (T)z	3 (C)	Acceptable Risk

Accident Identifier	Initiating Event Index	Preventive Safety Parameter 1 or IROFS 1 Failure Index	Preventive Safety Parameter 2 or IROFS 2 Failure Index	Mitigation IROFS Failure Index	Likelihood Index T Uncontrolled (U) / Controlled (C)	Likelihood Category	Consequence Category (Type of Accident)	Risk Index (h= f x g) Uncontrolled (U) / Controlled (C)	Comments and Recommendations
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	
FF38-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF38-1	-2	IROFS35 -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF38-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF38-2	-2	IROFS36a -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF42-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF42-1	-2	IROFS36c -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF43-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF43-1	-2	IROFS36e -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF43-2	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF43-2	-2	IROFS36f -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF44-1	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF44-1	-2	IROFS36g -3	N/A	N/A	-5 (C)	1	3 (T)	3 (C)	Acceptable Risk
FF-WORKER EVAC	-2	N/A	N/A	N/A	-2 (U)	3	3 (T)	9 (U)	IROFS Required
FF-WORKER EVAC	-2	N/A	N/A	IROFS39b -3	-5 (U)	1	1 (T)	1 (C)	Acceptable Risk

Accident Identifier: EE-AIRCRAFT

Aircraft crash into facility from local airport traffic and commercial or military routes in the vicinity of the facility meets the definition of not credible. Based on detailed probabilistic analysis, the annual probability of an aircraft crash onto the site is less than 1.0E-6 (see Section 3.2.1.2.4). This yields an initiating event index of (-6). This probability meets definition of "not credible;" therefore, no IROFS are needed.

Accident Identifier: EE-PIPELINE

Oil industry pipelines located near the facility. Based on detailed probabilistic analyses, the hazards due to thermal radiation, missile generation and plant contamination by gas and/or explosion were shown to have an annual probability less than 1.0E-5 (see Section 3.2.2.4) and an initiating index of (-5) is appropriate. This meets the definition of "highly unlikely," therefore, no IROFS are needed. Consequence category conservatively assumed as high.

Accident Identifier: EE-HIGHWAY

Potential adverse impact to the facility from chemical releases or explosions from trucks on nearby highway was evaluated. Detailed probabilistic analyses show the annual probability of an explosion adversely impacting the plant is less than 1.0E-5 (see Section 3.2.1.2) and an initiating event index of (-5) is appropriate. This meets the definition of "highly unlikely," therefore, no IROFS are needed. Consequence category conservatively assumed as high.

Accident Identifier: EE-OTHER NEARBY FACILITIES

Potential adverse impact to the facility from chemical releases/explosions from nearby industrial or military facilities. No such facilities identified within proximity to enrichment plant. Therefore, an initiating event index of (-6) is appropriate which meets the definition of "not credible" and no IROFS are needed.

Accident Identifier: EE-RAILROAD

Potential adverse impact to the facility from chemical releases/explosions from nearby railroad traffic. Rail spur to the Waste Control Specialists facility along north side of NEF site does not transport explosive materials. No other railroads identified within proximity to the facility (see Section 3.2.1.2.2). Therefore, an initiating event index of (-6) is appropriate which meets the definition of "not credible" and no IROFS are needed.

Accident Identifier: EE-CUB-GAS

Potential adverse impact to the facility from natural gas release in the Central Utilities Building (CUB) and subsequent explosion. Natural gas used to fire plant boiler.

The initiating event is an assumed explosion in the CUB that could potentially impact nearby UF_6 areas in nearby adjacent buildings. Hazard shown by probabilistic analysis to be less than 1E-05 which meets definition of "highly unlikely," therefore, an initiating event index of (-5) is appropriate and no IROFS are needed. Consequence category conservatively assumed as high.

Accident Identifier: EE-FLOOD

No credible sources of river or upstream dam flooding exist at the site. This yields an initiating event index of (-6). This probability meets definition of "not credible," therefore, no IROFS are needed.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: EE-LP-BLD (T)

Flooding due to local intense precipitation of areas containing UF_6 process systems and potential UF_6 release from process systems. Scenarios include: (1) excessive roof ponding beyond design capacity of roof and (2) interior building flooding from flood waters flowing and/or ponded around plant structures.

The initiating event is an uncontrolled flood with assumed high consequences to the worker and public. Without explicit design basis, conservatively assumed initiating event index of (-2) which would be typical of normal building code requirements.

For the controlled accident sequence, the preventive measure is a design feature of buildings containing UF_6 process systems for seismic, tornado, tornado missile, high wind, roof snow load, and roof ponding and site flooding due to local intense precipitation, to ensure UF_6 process systems integrity (IROFS27c)

The frequency index number for the controlled accident initiating frequency was assigned a (-5) to meet the definition of "highly unlikely." The design basis will demonstrate the highly unlikely frequency of the associated local intense precipitation (see Section 3.2.3.4.4).

The failure probability index of (-3) was selected for IROFS27c. This corresponds to a single passive engineered IROFS per NUREG-1520.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: EE-LP-BLD (CR)

Flooding due to local intense precipitation of areas containing enriched uranic material and a potential criticality event. Scenarios include: (1) excessive roof ponding beyond design capacity of roof and (2) interior building flooding from flood waters flowing and/or ponded around plant structures.

The initiating event is an uncontrolled flood with assumed high consequences to the worker and public. Without explicit design basis, conservatively assumed initiating event index of (-2) which would be typical of normal building code requirements.

For the controlled accident sequence, the preventive measures are (1) a design feature of buildings containing enriched uranic material for roof ponding and site flooding due to local intense precipitation, to ensure associated building area subcriticality (IROFS27a) and (2) a design feature of buildings containing enriched uranic material for roof ponding and site flooding due to local intense precipitation, to ensure associated building area subcriticality (IROFS27b).

The frequency index number for the controlled accident initiating frequency was assigned a (-5) to meet the definition of "highly unlikely." The design basis will demonstrate the highly unlikely frequency of the associated local intense precipitation (see Section 3.2.3.4.4).

The failure probability index of (-3) was selected for IROFS27a. This corresponds to a single passive engineered IROFS per NUREG-1520.

The failure probability index of (-3) was selected for IROFS27b. This corresponds to a single passive engineered IROFS per NUREG-1520.

Accident Identifier: EE-LP-PAD

Flooding due to local intense precipitation of the UBC storage pad and potential for impact with a UF_6 release.

The initiating event is an uncontrolled flood with assumed high consequences to the worker and public. Without explicit design basis, conservatively assumed initiating event index of (-2) which is typical of normal design requirements.

For the controlled accident sequence, the preventive measure is a design feature of the UBC storage pad for site flooding due to local intense precipitation to ensure UBC integrity (IROFS27d)

The frequency index number for the controlled accident initiating frequency was assigned a (-5) to meet the definition of "highly unlikely." The design basis will demonstrate the highly unlikely frequency of the associated local intense precipitation (see Section 3.2.3.4.4).

The failure probability index of (-3) was selected for IROFS27d. This corresponds to a single passive engineered IROFS per NUREG-1520.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: EE-SNOW

Excessive snow load on roofs of areas containing UF_6 process systems leading to roof failures and potential UF_6 release from process systems.

The uncontrolled event is an excessive snow load above normal building code design loads leading to roof failure and impacts on UF_6 process systems leading to UF_6 release. The event is assumed to have high consequences to the worker and public. Without explicit design basis, conservatively assumed initiating event index of (-2) which is appropriate for normal building code design.

For the controlled accident sequence, the preventive measure is a design feature of buildings containing UF_6 process systems for seismic, tornado, tornado missile, high wind, roof snow load, and roof ponding and site flooding due to local intense precipitation, to ensure UF_6 process systems integrity (IROFS27c).

The frequency index number for the controlled accident initiating frequency was assigned a (-5) to meet the definition of "highly unlikely." The design basis will demonstrate the highly unlikely frequency of the associated local snow loading (see Section 3.2.3.3).

The failure probability index of (-3) was selected for IROFS27c. This corresponds to a single passive engineered IROFS per NUREG-1520.

Accident Identifier: EE-TORNADO, TORNADO MISSILE & HIGH WIND

Excessive tornado, tornado missile and high wind loads leading to building failure at areas containing UF_6 process systems and potential UF_6 release from process systems.

The uncontrolled event is excessive tornado loads, tornado missile loads and high wind loads above normal building code design levels leading to building failure and impacts on UF_6 process systems leading to UF_6 release. The event is assumed to have high consequences to the worker and public. Without explicit design basis, conservatively assumed initiating event index of (-2) which is appropriate for normal building code design.

For the controlled event, buildings are designed to tornado, tornado missile and wind loads shown to be "highly unlikely." Details on the development of the tornado, tornado missile and high wind loads are provided in Section 3.2.3.4.1. These loads have an annual probability of exceedance of 1E-05 and an initiating event index of (-5) is appropriate. The design basis for tornado, tornado missiles and high wind is IROFS27c.

The failure probability index of (-3) was selected for IROFS27c. This corresponds to a single passive engineered IROFS per NUREG-1520.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: EE-SEISMIC-1 (UF_6 Areas)

Excessive seismic motions imposed on non-seismically qualified buildings, beyond normal building code design, and beyond the capacity of UF_6 piping systems could lead to building collapse, breaching of UF_6 systems, and ultimately a UF_6 release.

The UF_6 cascades and piping systems do not have an explicit seismic design basis. An initiating event index of (-2) has been conservatively assumed. Information on the annual frequency of earthquakes is provided in Section 3.2.6.4. The peak horizontal ground acceleration at an annual frequency of 1E-02 is approximately 0.01g. The peak horizontal ground acceleration at an annual frequency of 1E-03 is approximately 0.05g. The seismic capacity of the UF_6 piping systems is assumed to be capable of maintaining UF_6 confinement to at least a 0.01g earthquake. Actual seismic capacity of the piping is likely to be higher than 0.01g. Therefore, it is conservative to assign an initiating event index to UF_6 piping failure of (-2).

The uncontrolled event is for the UF_6 Areas. The seismic event leads to building failure and impacts on UF_6 process systems leading to UF_6 release. The event is assumed to have high consequences.

For the controlled event, buildings are designed to a seismic level with an annual probability of 1.0E-4. Details of the development of the seismic design basis are provided in Section 3.2.6. The seismic design basis selected for the facility is based on a site-specific seismic hazard assessment for the NEF site.

The design basis earthquake (DBE) has been selected as the 10,000-yr (1.0E-4 mean annual probability) earthquake. This DBE will be used in the detailed design process to demonstrate compliance with the overall ISA performance requirements. This will be accomplished by confirmatory seismic performance calculations for the seismic IROFS during detailed design. The objective will be to demonstrate that use of this DBE will achieve a likelihood of unacceptable performance of less than approximately 1.0E-5 per year. The difference between the mean annual probabilities for design (1.0E-4) and performance (1.0E-5) is achieved through conservatism in the design (factors of safety), elasticity in the structures, and conservatism in the evaluation of the design. Use of this approach will result in a "highly unlikely" event likelihood for exceeding the seismic capacity of the buildings and an initiating event index of (-5) is appropriate.

Since the initiating event index for the UF_6 piping (-2) is more limiting than the seismic capacity of the buildings (-5), the (-2) is used as the initiating event index for all seismic cases.

Accident Identifier SEISMIC-1a: Uncontrolled case; initiating event index (-2) as described above. As discussed above, this is a high consequence category of (3). Risk index becomes (9). Therefore, IROFS required.

Design feature of buildings containing UF_6 process systems for seismic, tornado, tornado missile, high wind, roof snow load, and roof ponding and site flooding due to local intense precipitation, to ensure UF_6 process systems integrity (seismic portion, 1.0E-4 and likelihood of unacceptable performance 1.0E-5) is IROFS27c.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: EE-SEISMIC-1 (UF_6 Areas) (continued)

Accident Identifier SEISMIC-1b: Add IROFS27c, initiating event index (-2) as described above. As a result of IROFS27c, the consequence analysis shows that the consequences have been mitigated to an intermediate category (2). The risk index is (6), therefore, additional IROFS are required.

The HVAC system will also be designed to automatically trip on a seismic event. Automatic Building HVAC system trip on detection of seismic event to ensure offsite exposures from building outflow maintain consequence low is IROFS26.

Accident Identifier SEISMIC-1c: Add IROFS26, initiating event index (-2) as described above. As a result of the addition of IROFS26, consequence analysis shows that the consequences have been further mitigated but still at an intermediate category (2). The resulting risk index is (6), therefore, additional IROFS are required.

Accident Identifier SEISMIC-1d: Evaluate failure of IROFS26. A failure probability index of (-3) was selected for IROFS26. This corresponds to a single active engineered IROFS per NUREG-1520. The IROFS justification for high availability is discussed in Section 3.8.3. Consequence category is intermediate (2), same as for Accident Identifier SEISMIC-1b. The resulting risk index is (4) which is acceptable risk.

Building leakage to outside following HVAC trip is limited by design features. Design features to ensure building leak integrity is IROFS41.

Accident Identifier SEISMIC-1e: Add IROFS41, initiating event index (-2) as described above. As a result of the addition of IROFS41, consequence analysis shows that consequences have been further mitigated to low (1), yielding a risk index of (3). This is acceptable risk.

Accident Identifier SEISMIC-1f: Evaluate failure of IROFS41 with success of IROFS26. A failure probability index of (-2) was conservatively selected for IROFS41, which is a single passive engineered IROFS per NUREG-1520. The resulting consequence category is intermediate (2), same as for Accident Identifier SEISMIC-1c. Risk index is (4) which is acceptable.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: EE-SEISMIC-2 (Cascades)

Excessive seismic motions imposed on non-seismically qualified buildings, beyond normal building code design, and beyond the capacity of UF_6 piping and cascade systems could lead to building collapse, breaching of UF_6 systems, and ultimately a UF_6 release.

The UF_6 cascades and piping systems do not have an explicit seismic design basis. An initiating event index of (-2) has been conservatively assumed. Information on the annual frequency of earthquakes is provided in Section 3.2.6.4. The peak horizontal ground acceleration at an annual frequency of 1E-02 is approximately 0.01g. The peak horizontal ground acceleration at an annual frequency of 1E-03 is approximately 0.05g. The seismic capacity of the UF_6 piping systems is assumed to be capable of maintaining UF_6 confinement to at least a 0.01g earthquake. Actual seismic capacity of the piping is likely to be higher than 0.01g. Therefore, it is conservative to assign an initiating event index to UF_6 piping failure of (-2).

The uncontrolled event is for the Cascade Halls. The seismic event leads to building failure and impacts on centrifuges leading to UF_6 release. The event is assumed to have high consequences.

For the controlled event, buildings are designed to a seismic level with an annual probability of 1.0E-4. Details of the development of the seismic design basis are provided in Section 3.2.6. The seismic design basis selected for the facility is based on a site-specific seismic hazard assessment for the NEF site.

The design basis earthquake (DBE) has been selected as the 10,000-yr (1.0E-4 mean annual probability) earthquake. This DBE will be used in the detailed design process to demonstrate compliance with the overall ISA performance requirements. This will be accomplished by confirmatory seismic performance calculations for the seismic IROFS during detailed design. The objective will be to demonstrate that use of this DBE will achieve a likelihood of unacceptable performance of less than approximately 1.0E-5 per year. The difference between the mean annual probabilities for design (1.0E-4) and performance (1.0E-5) is achieved through conservatism in the design (factors of safety), elasticity in the structures, and conservatism in the evaluation of the design. Use of this approach will result in a "highly unlikely" event likelihood for exceeding the seismic capacity of the buildings and an initiating event index of (-5) is appropriate.

Since the initiating event index for the UF_6 piping (-2) is more limiting than the seismic capacity of the buildings (-5), the (-2) is used as the initiating event index for all seismic cases.

Accident Identifier SEISMIC-2a: Uncontrolled case; initiating event index (-2) as described above. As discussed above, this is a high consequence category of (3). Risk index becomes (9). Therefore, IROFS required.

Design feature of buildings containing UF_6 process systems for seismic, tornado, tornado missile, high wind, roof snow load, and roof ponding and site flooding due to local intense precipitation, to ensure UF_6 process systems integrity (seismic portion, 1.0E-4 and likelihood of unacceptable performance 1.0E-5) is IROFS27c.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: EE-SEISMIC-2 (Cascades) (continued)

Accident Identifier SEISMIC-2b: Add IROFS27c, initiating event index (-2) as described above. As a result of IROFS27c, the consequence analysis shows that the consequences remain high category (3). The risk index is (9), therefore, additional IROFS are required.

The HVAC system will also be designed to automatically trip on a seismic event. Automatic Building HVAC system trip on detection of seismic event to ensure offsite exposures from building outflow maintain consequence low is IROFS26.

Accident Identifier SEISMIC-2c: Add IROFS26, initiating event index (-2) as described above. As a result of the addition of IROFS26, consequence analysis shows that the consequences have been mitigated to an intermediate category (2). The resulting risk index is (6), therefore, additional IROFS are required.

Accident Identifier SEISMIC-2d: Evaluate failure of IROFS26. A failure probability index of (-3) was selected for IROFS26. This corresponds to a single active engineered IROFS per NUREG-1520. The IROFS justification for high availability is discussed in Section 3.8.3. Consequence category is high (3), same as for Accident Identifier SEISMIC-2b. The resulting risk index is (3) which is acceptable risk.

Building leakage to outside following HVAC trip is limited by design features. Design features to ensure building leak integrity is IROFS41.

Accident Identifier SEISMIC-2e: Add IROFS41, initiating event index (-2) as described above. As a result of the addition of IROFS41, consequence analysis shows that consequences have been further mitigated to low (1), yielding a risk index of (3). This is acceptable risk.

Accident Identifier SEISMIC-2f: Evaluate failure of IROFS41 with success of IROFS26. A failure probability index of (-2) was conservatively selected for IROFS41, which is a single passive engineered IROFS per NUREG-1520. The resulting consequence category is intermediate (2), same as for Accident Identifier SEISMIC-2c. Risk index is (4) which is acceptable.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: EE-SEISMIC-3 (Blending & Liquid Sampling)

Excessive seismic motions imposed on non-seismically qualified buildings, beyond normal building code design, and beyond the capacity of UF_6 piping systems could lead to building collapse, breaching of UF_6 systems, and ultimately a UF_6 release.

The UF_6 cascades and piping systems do not have an explicit seismic design basis. An initiating event index of (-2) has been conservatively assumed. Information on the annual frequency of earthquakes is provided in Section 3.2.6.3. The peak horizontal ground acceleration at an annual frequency of 1E-02 is approximately 0.01g. The peak horizontal ground acceleration at an annual frequency of 1E-03 is approximately 0.05g. The seismic capacity of the UF_6 piping systems is assumed to be capable of maintaining UF_6 confinement to at least a 0.01g earthquake. Actual seismic capacity of the piping is likely to be higher than 0.01g. Therefore, it is conservative to assign an initiating event index to UF_6 piping failure of (-2).

The uncontrolled event is for the Blending & Liquid Sampling Area. The seismic event leads to building failure and impacts on UF_6 process systems leading to UF_6 release. The event is assumed to have high consequences.

For the controlled event, buildings are designed to a seismic level with an annual probability of 1.0E-4. Details of the development of the seismic design basis are provided in Section 3.2.6. The seismic design basis selected for the facility is based on a site-specific seismic hazard assessment for the NEF site.

The design basis earthquake (DBE) has been selected as the 10,000-yr (1.0E-4 mean annual probability) earthquake. This DBE will be used in the detailed design process to demonstrate compliance with the overall ISA performance requirements. This will be accomplished by confirmatory seismic performance calculations for the seismic IROFS during detailed design. The objective will be to demonstrate that use of this DBE will achieve a likelihood of unacceptable performance of less than approximately 1.0E-5 per year. The difference between the mean annual probabilities for design (1.0E-4) and performance (1.0E-5) is achieved through conservatism in the design (factors of safety), elasticity in the structures, and conservatism in the evaluation of the design. Use of this approach will result in a "highly unlikely" event likelihood for exceeding the seismic capacity of the buildings and an initiating event index of (-5) is appropriate.

Since the initiating event index for the UF_6 piping (-2) is more limiting than the seismic design of the buildings (-5), the (-2) is used as the initiating event index for all seismic cases.

Accident Identifier SEISMIC-3a: Uncontrolled case; initiating event index (-2) as described above. As discussed above, this is a high consequence category of (3). Risk index becomes (9). Therefore, IROFS required.

Design feature of buildings containing UF_6 process systems for seismic, tornado, tornado missile, high wind, roof snow load, and roof ponding and site flooding due to local intense precipitation, to ensure UF_6 process systems integrity (seismic portion, 1.0E-4 and likelihood of unacceptable performance 1.0E-5) is IROFS27c.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: EE-SEISMIC-3 (Blending & Liquid Sampling) (continued)

Accident Identifier SEISMIC-3b: Add IROFS 27c, initiating event index (-2) as described above. As a result of IROFS27c, the consequence analysis shows that the consequences have been mitigated to an intermediate category (2). The risk index is (6), therefore, additional IROFS are required.

The HVAC system will also be designed to automatically trip on a seismic event. Automatic Building HVAC system trip on detection of seismic event to ensure offsite exposures from building outflow maintain consequence low is IROFS26.

Accident Identifier SEISMIC-3c: Add IROFS26, initiating event index (-2) as described above. As a result of the addition of IROFS26, consequence analysis shows that the consequences have been further mitigated but still at an intermediate category (2). The resulting risk index is (6), therefore, additional IROFS are required.

Accident Identifier SEISMIC-3d: Evaluate failure of IROFS26. A failure probability index of (-3) was selected for IROFS26. This corresponds to a single active engineered IROFS per NUREG-1520. The IROFS justification for high availability is discussed in Section 3.8.3. Consequence category is intermediate (2), same as for Accident Identifier SEISMIC-3b. The resulting risk index is (4) which is acceptable risk.

Building leakage to outside following HVAC trip is limited by design features. Design features to ensure building leak integrity is IROFS41.

Accident Identifier SEISMIC-3e: Add IROFS41, initiating event index (-2) as described above. As a result of the addition of IROFS41, consequence analysis shows that consequences have been further mitigated to low (1), yielding a risk index of (3). This is acceptable risk.

Accident Identifier SEISMIC-3f: Evaluate failure of IROFS41 with success of IROFS26. A failure probability index of (-2) was conservatively selected for IROFS41, which is a single passive engineered IROFS per NUREG-1520. The resulting consequence category is intermediate (2), same as for Accident Identifier SEISMIC-3c. Risk index is (4) which is acceptable.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: EE-SEISMIC-5 (Liquid Sampling Autoclave)

Excessive seismic motions beyond the seismic capacity of the liquid sampling autoclave in the horizontal or tipped position containing liquified UF_6 could lead to liquid sampling autoclave failure and a liquid UF_6 release.

For the uncontrolled case, the liquid sampling autoclave is assumed not to have an explicit seismic design basis. An initiating event index of (-2) has been conservatively assumed. Information on the annual frequency of earthquakes is provided in Section 3.2.6.4. The peak horizontal ground acceleration at an annual frequency of 1E-02 is approximately 0.01g. The peak horizontal ground acceleration at an annual frequency of 1E-03 is approximately 0.05g. The seismic capacity of the liquid sampling autoclave is assumed to be capable of maintaining UF_6 confinement to at least a 0.01g earthquake. Actual seismic capacity of the liquid sampling autoclave is likely to be higher than 0.01g. Therefore, it is conservative to assign an initiating event index to the liquid sampling autoclave failure of (-2). The uncontrolled event is a seismic-induced loss of containment for a liquid sampling autoclave containing liquified UF_6. The event is assumed to have high consequences.

For the controlled event, the liquid sampling autoclave is seismically designed in both operating positions (i.e., cylinder horizontal and cylinder tipped) to a seismic level with an annual probability of 1.0E-4. Details of the development of the seismic design basis are provided in Section 3.2.6. The seismic design basis selected for the facility, including the liquid sampling autoclave, is based on a site-specific seismic hazard assessment for the NEF site.

The design basis earthquake (DBE) has been selected as the 10,000-yr (1.0E-4 mean annual probability) earthquake. This DBE will be used in the detailed design process to demonstrate compliance with the overall ISA performance requirements. This will be accomplished by confirmatory seismic performance calculations for the seismic IROFS during detailed design. The objective will be to demonstrate that use of this DBE will achieve a likelihood of unacceptable performance of less than approximately 1.0E-5 per year. The difference between the mean annual probabilities for design (1.0E-4) and performance (1.0E-5) is achieved through conservatism in the design (factors of safety), elasticity in the components, and conservatism in the evaluation of the design. Use of this approach will result in a "highly unlikely" event likelihood for exceeding the seismic capacity of the liquid sampling autoclave and an initiating event index of (-5) is appropriate.

The liquid sampling autoclave seismic design is IROFS28. Seismic design level considers the duration that the liquid sampling autoclave is in a particular position (horizontal or tipped). For the horizontal position, the seismic design is based on the 1.0E-4 annual probability DBE (0.15g) peak horizontal and vertical acceleration and likelihood of unacceptable performance (1.0E-5). An initiating event index of (-5) is appropriate.

Seismic design in the tipped position is adjusted for the short exposure period to maintain "highly unlikely" likelihood. Based on a detailed analysis considering the number of annual liquid sampling evolutions, duration while the liquid sampling autoclave is in the tipped position, and the seismic hazard for the site (see Section 3.2.6.4), a seismic design basis for the liquid sampling autoclave of 0.04g (peak horizontal and vertical acceleration) while in the tipped position is appropriate. This design applies to all positions except for full horizontal. The 0.04g tipped design level was determined based on an initiating event index of (-5).

The failure probability index of (-3) was selected for IROFS28. This corresponds to a single passive engineered IROFS per NUREG-1520.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: EE-SEISMIC-WORKER EVAC

The initial failure (initiating event) is excessive seismic motions imposed beyond the capacity of UF_6 piping systems leading to breaching of UF_6 systems, and ultimately a UF_6 release exposing workers in the area.

The uncontrolled event is the seismic event that leads to failure of the UF_6 process systems and UF_6 release. The event is assumed to have high consequences to the worker present in the area.

For the controlled event, the mitigative measure is to administratively limit exposure by requiring worker action to evacuate the area(s) of concern during a seismic event to ensure that the consequences of inhalation of uranic material and HF are low (IROFS39a). Sufficient time is available for the worker to detect and to evacuate the area(s) of concern. As a result of IROFS39a, the consequence analysis shows that the consequence has been mitigated to a low category (1).

The index number for the initiating event was conservatively assumed to be (-2). The UF_6 cascades and piping systems do not have an explicit seismic design basis. Information on the annual frequency of earthquakes is provided in Section 3.2.6.4. The peak horizontal ground acceleration at an annual frequency of 1E-02 is approximately 0.01g. The seismic capacity of the UF_6 piping systems is assumed to be capable of maintaining UF_6 confinement to at least a 0.01g earthquake. Actual seismic capacity of the piping is likely to be higher than 0.01g. Therefore, it is conservative to assign an initiating event index to UF_6 piping failure of (-2).

The failure probability index for the administrative controls/procedures of IROFS39a was determined to be (-3). This corresponds to an administrative IROFS that must be performed in response to a rare unplanned demand per NUREG-1520. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: FF1-1 (Centrifuge Test Facility)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was based on evidence from similarly designed Urenco European plants which have a combined plant history of greater than 30 yrs in which no fire events have occurred in any uranium areas.

The uranium inventory in the area is 50 kg (110 lb) of UF_6 contained in sealed stainless steel components and piping.

The uncontrolled event is fire propagating into this area from other areas within the Centrifuge Assembly Building that could result in a release of the UF_6 inventory (failure of IROFS35: automatic closure of fire-rated barrier opening protectives (e.g., doors, dampers, penetration seals) to ensure the integrity of area fire barriers prevents fire from propagating into areas containing uranic material). This event was assumed to have a high consequence.

For the controlled event, fire would not propagate into the area due to automatic closure of fire-rated barrier opening protectives (e.g., doors, dampers, penetration seals) to ensure the integrity of area fire barriers prevents fire from propagating into areas containing uranic material.

The failure probability index for fire barriers was determined to be (-3). This corresponds to an active engineered IROFS per NUREG-1520. The IROFS justification for high availability is discussed in Section 3.8.3.

Accident Identifier: FF1-2 (Centrifuge Test Facility)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory in the area is 50 kg (110 lb) which is contained in sealed stainless steel components and piping.

The uncontrolled event is a fire involving excessive transient combustibles within the room that could result in a release of the UF_6 inventory (failure of IROFS36a: administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low). This event was assumed to have a high consequence.

For the controlled event, a fire considering expected in-situ and transient combustibles would be a low consequence event. The UF_6 inventory was discounted as not being released during a fire due to insufficient combustibles being present to cause failure of sealed stainless steel components used in the test assembly and test piping. The preventive measures are to administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low (IROFS36a).

The failure probability index for administrative controls/procedures of IROFS36a was determined to be (-3). The NUREG-1520 criteria – a routine administrative IROFS - applies. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: FF5-1 (CRDB Loading Dock)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory is UF_6 contained in 48Y, 48X, and/or 30B cylinders located on the loading dock and scales adjacent to the CRDB Truck Unloading Bay and Dock.

The uncontrolled event is a fire involving excessive transient combustibles in the adjacent truck bay that could result in a release of the UF_6 inventory (failure of IROFS36b: administratively limit storage of UF_6 cylinders in the CRDB to ensure $\geq$ 1 m (3 ft) setback from the edge of the loading dock). This event was assumed to have a high consequence.

For the controlled event, a fire considering expected in-situ and transient combustibles would be a low consequence event. The UF_6 inventory was discounted as not being released during a fire due to insufficient combustibles being present to cause failure of the cylinders. In order to prevent exposure to a potential service vehicle fire in the drive through bay, preventive measures are to administratively limit storage of UF_6 cylinders in the CRDB to ensure $\geq$ 1 m (3 ft) setback from the edge of the loading dock.

The failure probability index for administrative controls/procedures of IROFS36b was determined to be (-3). The NUREG-1520 criteria – a routine administrative IROFS - applies. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: FF5-2 (CRDB Truck Bay)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory is UF_6 contained in 48Y and/or 30B cylinders located on the semi-tractor trailers during receipt of incoming feed cylinders, shipment of outgoing product cylinders, or shipment of outgoing UBCs while on the semi-tractor trailer or being transported to/from the loading dock.

The uncontrolled event is a fire involving the transient combustibles and fuel load of a truck located in the truck bay that could result in a release of the UF_6 inventory (failure of IROFS36h: administratively limit fire exposure to feed cylinders, product cylinders, and UBCs containing $\geq$ 0.1 kg of UF_6 due to a semi-tractor trailer fire during the receipt and shipping process). This event was assumed to have a high consequence.

For the controlled event, a fire considering expected in-situ and transient combustibles would be a low consequence event. The UF_6 inventory was discounted as not being released during a fire due to insufficient combustibles being present to cause failure of the cylinders. In order to prevent cylinder exposure to a semi-tractor trailer fire in the drive through bay, preventive measures are to receive UF_6 feed cylinders in their U.S. Department of Transportation (DOT) required protective assemblies and to offload the cylinder/protective assemblies to the loading dock. Outgoing product cylinders will be placed into their DOT required overpacks on the loading dock or in the CRDB prior to the cylinder/overpacks being placed on the semi-tractor trailer. Similarly, the DOT required protective assemblies would be installed on outgoing UBCs on the loading dock or in the CRDB prior to the cylinder/protective assemblies being placed on the semi-tractor trailer.

A theoretical truck fire in the CRDB loading bay was analyzed and shown to not pose a threat of rupturing cylinders in the building or on the loading dock applying a minimum of 1 meter (3 feet) spatial separation. This theoretical truck fire aggregated the cumulative combustible load of the vehicle (i.e., 500 liters (132 gallons) of diesel fuel and 744 liters (196 gallons) of fuel equivalent to other content) into a pool fire of 5 meters (16 feet) in diameter. The duration of this fire was calculated to be approximately 22 minutes. This fire severity is less than that required by 10 CFR 71.73(c)(4) for qualification of the cylinder thermal overpack/protective assemblies (i.e., full engulfment of the cylinder in an 800°C (1475°F) hydrocarbon fire for 30 minutes). Additionally, there are conservative assumptions in the analysis that make exposure from this theoretical fire more severe than would be expected to realistically occur (e.g., the bulk fuel load of the tractor is actually spatially separated from the trailer holding the cylinders, three-fifths of the fuel load cannot physically "pool," and cylinders would not be "engulfed"). As a result, the cylinder handling practices, including use of cylinder overpack/thermal protective assemblies, of IROFS36h will ensure that cylinders containing UF_6 on a semi-tractor trailer will be protected from a theoretical truck fire.

The failure probability index for administrative controls/procedures of IROFS36h was determined to be (-3). The NUREG-1520 criteria – a routine administrative IROFS - applies. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: FF6-1 (CRDB General Areas)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory is up to 9.43E6 kg (2.08E7 lb) and consists of UF_6 contained in 48Y, 48X, and 30B cylinders located in storage or transit into and out of the area via overhead crane or on a cylinder transporter (to and from the UF_6 Handling Area).

The uncontrolled event is fire propagating into this area from other areas that could result in a release of the UF_6 inventory (failure of IROFS35: automatic closure of fire-rated barrier opening protectives (e.g., doors dampers, penetration seals) to ensure the integrity of area fire barriers prevents fire from propagating into areas containing uranic material). This event was assumed to have a high consequence.

For the controlled event, fire would not propagate into the area due to automatic closure of fire-rated barrier opening protectives (e.g., doors dampers, penetration seals) to ensure the integrity of area fire barriers prevents fire from propagating into areas containing uranic material (IROFS35).

The failure probability index for fire barriers was determined to be (-3). This corresponds to an active engineered IROFS per NUREG-1520. The IROFS justification for high availability is discussed in Section 3.8.3.

Accident Identifier: FF6-2 (CRDB General Areas)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory is up to 9.43E6 (2.08E7 lb) and consists of UF_6 contained in 48Y, 48X, and 30B cylinders located in storage or transit into and out of the area via overhead crane or on a cylinder transporter (to and from the UF_6 Handling Area).

The uncontrolled event is a fire involving excessive transient combustibles within the CRDB that could result in a release of the UF_6 inventory (failure of IROFS36a: administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic materials at risk to ensure consequences to the public are low). This event was assumed to have a high consequence.

For the controlled event, a fire considering expected in-situ and transient combustibles would be a low consequence event. The UF_6 inventory was discounted as not being released during a fire due to insufficient combustibles being present to cause failure of a cylinder. Preventive measures are to administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic materials at risk to ensure consequences to the public are low (IROFS36a).

The failure probability index for administrative controls/procedures of IROFS36a was determined to be (-3). The NUREG-1520 criteria – a routine administrative IROFS - applies. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: FF7-1 (Cylinder Transporters/Movers)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory would be one UF_6 cylinder (a 48X, 48Y, or a 30B) in transit.

The uncontrolled event is a fire involving excessive combustibles on any onsite cylinder transporter/mover that could result in a release of the UF_6 inventory (failure of IROFS36c: administratively limit onsite UF_6 cylinder transporters/movers to ensure only use of electric drive or diesel powered with a fuel capacity of less than 280 L (74 gal). This event was assumed to have a high consequence.

For the controlled event, a fire considering expected in-situ and transient combustibles would be a low consequence event. The UF_6 inventory was discounted as not being released during a fire due to insufficient combustibles being present to cause failure of a cylinder. Cylinder transporter/mover design will be limited to be either electric drive or diesel drive with a fuel capacity of less than 280 L (74 gallons). Diesel driven onsite UF_6 cylinder transporters/movers are not used for cylinder transport inside NEF buildings. Since filled 30B cylinders are stored inside the NEF buildings, only electric driven onsite UF_6 cylinder transporters/movers are used for transport of filled 30B product cylinders inside NEF buildings. When filled 30B product cylinders are transported outside of NEF buildings, they are in DOT required overpacks as described in accident sequence FF5-2. Empty 30B cylinders may be stored outside NEF buildings and, as a result, may be transported by diesel driven onsite UF_6 cylinder transporters/movers. The preventive measure is to administratively limit onsite UF_6 cylinder transporters/movers to ensure only use of electric drive or diesel powered with a fuel capacity of less than 280 L (74 gal) (IROFS36c).

The failure probability index for administrative controls/procedures of IROFS36c was determined to be (-3). The NUREG-1520 criteria – a routine administrative IROFS - applies. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Accident Identifier: FF8-1 (Cascade Hall Inside Assay Thermal Enclosure - typical for 6 halls)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory consists of UF_6 in piping and centrifuges. The inventory in an assay (8 cascades) is 128 kg (282 lb).

The uncontrolled event is fire propagating into this area from other areas that could result in a release of the UF_6 inventory (failure of IROFS35: automatic closure of fire-rated barrier opening protectives (e.g., doors, dampers, penetration seals) to ensure the integrity of area fire barriers prevents fire from propagating into areas containing uranic material). This event was assumed to have a high consequence.

For the controlled event, fire would not propagate into the area due to automatic closure of fire-rated barrier opening protectives (e.g., doors, dampers, penetration seals) to ensure the integrity of area fire barriers prevents fire from propagating into areas containing uranic material (IROFS35).

The failure probability index for fire barriers was determined to be (-3). This corresponds to an active engineered IROFS per NUREG-1520. The IROFS justification for high availability is discussed in Section 3.8.3.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: FF8-2 (Cascade Hall Inside Assay Thermal Enclosure - typical for 6 halls)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The inventory consists of UF_6 in piping and centrifuges. The inventory in an assay (8 cascades) is 128 kg (282 lb).

The uncontrolled event is a fire involving excessive transient combustibles within the Cascade Hall inside the assay enclosure that could result in a release of the UF_6 inventory (failure of IROFS36a: administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low). This event was assumed to have a high consequence.

For the controlled event, a fire considering expected in-situ and transient combustibles would be a low consequence event. The fire presumes that ignition occurs in cabling feeding the centrifuge drive motors. It was conservatively presumed that this fire could result in the release of 1.3 kg (2.87 lb) of UF_6. The preventive measures are to administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low (IROFS36a).

The failure probability index for administrative controls/procedures of IROFS36a was determined to be (-3). The NUREG-1520 criteria – a routine administrative IROFS - applies. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Accident Identifier: FF11-1 (Process Services Area)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory is 13.8 kg (30.4 lb) which consists of UF_6 in feed, product, and tails piping manifolds. Additionally, there is a possibility of uranic material being present in the sodium fluoride traps which are part of the contingency dump system. Assuming this system has been charged to capacity, there could be up to 2400 kg (5290 lb) (16 cascades with three traps per cascade – 50 kg/trap (110 lb/trap)).

The uncontrolled event is fire propagating into this area from other areas that could result in a release of the uranium inventory (failure of IROFS35: automatic closure of fire-rated barrier opening protectives (e.g., doors, dampers, penetration seals) to ensure the integrity of area fire barriers prevents fire from propagating into areas containing uranic material). This event was assumed to have a high consequence.

For the controlled event, fire would not propagate into the area due to automatic closure of fire-rated barrier opening protectives (e.g., doors, dampers, penetration seals) to ensure the integrity of area fire barriers prevents fire from propagating into areas containing uranic material (IROFS35).

The failure probability index for fire barriers was determined to be (-3). This corresponds to an active engineered IROFS per NUREG-1520. The IROFS justification for high availability is discussed in Section 3.8.3.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: FF11-2 (Process Services Area)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory is 13.8 kg (30.4 lb) which consists of UF_6 in feed, product, and tails piping manifolds. Additionally, there is a possibility of uranic material being present in the sodium fluoride traps which are part of the contingency dump system. Assuming this system has been charged to capacity, there could be up to 2400 kg (5290 lb) (16 cascades with three traps per cascade – 50 kg/trap (110 lb/trap)).

The uncontrolled event is a fire involving excessive transient combustibles within the area that could result in a release of the uranium inventory (failure of IROFS36a: administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low). This event was assumed to have a high consequence.

For the controlled event, a fire considering expected in-situ and transient combustibles would be a low consequence event. It is assumed that fire could cause failures in the aluminum piping manifolds and that 50% of the inventory of the manifolds (6.88 kg) (15.2 lb) would be released even though this piping is at subatmospheric pressure. Continuing release from these manifolds was not considered since the cascade centrifuges and connected cylinders are at lower elevations and gravity pouring would be necessary for additional UF_6 to escape. The remaining uranic material inventory that could potentially be present was discounted as not being released during this fire due to insufficient combustibles being present to cause failure of the sealed aluminum chemical traps. The preventive measures are to administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low (IROFS36a).

The failure probability index for administrative controls/procedures of IROFS36a was determined to be (-3). The NUREG-1520 criteria – a routine administrative IROFS - applies. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: FF15-1 (UF_6 Handling Area - typical for 3 modules/ Blending and Liquid Sampling Area)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory is up to 4.00E5 kg (8.82E5 lb) in the UF_6 Handling Area and 1.46E5 kg (3.22E5 lb) in the Blending and Liquid Sampling Area and consists of UF_6 contained in cylinders, piping, manifolds, and hoses. Additional uranic material/HF inventory could be present on the carbon/alumina traps that capture UF_6 from the various feed, product, and tails system cold traps.

The uncontrolled event is fire propagating into this area from other areas that could result in a release of the uranium inventory (failure of IROFS35: automatic closure of fire-rated barrier opening protectives (e.g., doors, dampers, penetration seals) to ensure the integrity of area fire barriers prevents fire from propagating into areas containing uranic material). This event was assumed to have a high consequence.

For the controlled event, fire would not propagate into the area due to automatic closure of fire-rated barrier opening protectives (e.g., doors, dampers, penetration seals) to ensure the integrity of area fire barriers prevents fire from propagating into areas containing uranic material (IROFS35).

The failure probability index for fire barriers was determined to be (-3). This corresponds to an active engineered IROFS per NUREG-1520. The IROFS justification for high availability is discussed in Section 3.8.3.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: FF16-1 (UF_6 Handling Area - typical for 3 modules/ Blending and Liquid Sampling Area)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory is up to 4.00E5 kg (8.82E5 lb) in the UF_6 Handling Area and 1.46E5 kg (3.22E5 lb) in the Blending and Liquid Sampling Area and consists of UF_6 contained in cylinders, piping, manifolds, and hoses. Additional uranic material/HF inventory could be present on the carbon/alumina traps that capture residual traces of UF_6 from the various feed, product, and tails system cold traps.

The uncontrolled event is a fire involving excessive transient combustibles within the area could result in a release of the uranium inventory (failure of IROFS36a: administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low). This event was assumed to have a high consequence.

For the controlled event, a fire considering expected in-situ and transient combustibles would be a low consequence event. It is assumed that a fire in improperly placed transient combustibles could cause failure of a single cylinder hose. This could result in a pouring feed cylinder release (feed selected as bounding – highest pressure) of 1.3 kg of UF_6 over a 30-minute period. The remaining uranic material/HF inventory was discounted as not being released during this fire due to insufficient combustibles being present to cause failures of adjacent hoses, cylinders, piping, manifolds, or stainless steel chemical traps. The preventive measures are to administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low (IROFS36a).

The failure probability index for administrative controls/procedures of IROFS36a was determined to be (-3). The NUREG-1520 criteria – a routine administrative IROFS - applies. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: FF16-2 (UF_6 Handling Area – typical for 3 modules/ Blending and Liquid Sampling Area)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory is up to 4.00E5 kg (8.82E5 lb) in the UF_6 Handling Area and 1.46E5 kg (3.22E5 lb) in the Blending and Liquid Sampling Area and consists of UF_6 contained in cylinders, piping, manifolds, and hoses. Additional uranic material/HF inventory could be present on the carbon/alumina traps that capture residual traces of UF_6 from the various feed, product, and tails system cold traps.

The uncontrolled event is a fire involving excessive transient combustibles within the area could result in a release of the uranium inventory (failure of IROFS36a: administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low). This event was assumed to have a high consequence.

For the controlled event, a fire considering expected in-situ and transient combustibles would be a low consequence event. It is assumed that fire could cause failures in the aluminum piping manifold and that 50% of the inventory feeding one assay (3.44 kg) (7.6 lb) would be released even though this piping is at subatmospheric pressure. Continuing release from these manifolds was not considered since connected cylinders are at lower elevations and gravity pouring would be necessary for additional UF_6 to escape. The remaining uranic material/HF was discounted as not being released during this fire due to insufficient combustibles being present to cause failure of the cylinders or stainless steel chemical traps. The preventive measures are to administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low (IROFS36a).

The failure probability index for administrative controls/procedures of IROFS36a was determined to be (-3). The NUREG-1520 criteria – a routine administrative IROFS - applies. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: FF21-1 (TSB Solid Waste Collection Room)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory is up to 500 kg (1100 lb) of uranic material contained in 12 L (3.2 gal) metal containers and 210 L (55 gal) metal drums.

The uncontrolled event is fire propagating into this area from other areas that could result in a release of the uranium inventory (failure of IROFS35: automatic closure of fire-rated barrier opening protectives (e.g., doors, dampers, penetration seals) to ensure the integrity of area fire barriers prevents fire from propagating into areas containing uranic material). This event was assumed to have a high consequence.

For the controlled event, fire would not propagate into the area due to automatic closure of fire-rated barrier opening protectives (e.g., doors, dampers, penetration seals) to ensure the integrity of area fire barriers prevents fire from propagating into areas containing uranic material (IROFS35).

The failure probability index for fire barriers was determined to be (-3). This corresponds to an active engineered IROFS per NUREG-1520. The IROFS justification for high availability is discussed in Section 3.8.3.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: FF21-2 (TSB Solid Waste Collection Room)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 years – applies. (See FF1-1 for justification.)

The uranium inventory is up to 500 kg (1100 lb) of uranic material contained in 12 L (3.2 gal) metal containers and 210 L (55 gal) metal drums.

The uncontrolled event is a fire involving excessive transient combustibles within the room that could result in a release of the uranium inventory (failure of IROFS36d: administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low). This event was assumed to have a high consequence.

For the controlled event, a fire considering expected in-situ and transient combustibles would be a low consequence event. The fire presumes that up to 4 kg (8.8 lb) worth of uranic material (no HF) could be present in open 12 L (3.2 gal) containers or drums during transfer/packing operations and driven off in the event of a fire even though this material is typically bound on other material. The remaining uranic material inventory in the sealed metal drums and waste containers was discounted as not being released during this fire due to insufficient combustibles being present to cause failure of the metal containers. Preventive measures are to administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low (IROFS36d).

The failure probability index for administrative controls/procedures of IROFS36d was determined to be (-3). The NUREG-1520 criteria – a routine administrative IROFS - applies. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: FF23-1 (TSB Decontamination Workshop)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory is up to 48 kg (106 lb) contained in up to three 12 L (3.2 gal) metal containers and three steel tanks.

The uncontrolled event is fire propagating into this area from other areas that could result in a release of the uranium inventory (failure of IROFS35: automatic closure of fire-rated barriers opening protectives (e.g., doors, dampers, penetration seals) to ensure the integrity of area fire barriers prevents fire from propagating into areas containing uranic material). This event was assumed to have a high consequence.

For the controlled event, fire would not propagate into the area due to automatic closure of fire-rated barriers opening protectives (e.g., doors, dampers, penetration seals) to ensure the integrity of area fire barriers prevents fire from propagating into areas containing uranic material (IROFS35).

The failure probability index for fire barriers was determined to be (-3). This corresponds to an active engineered IROFS per NUREG-1520. The IROFS justification for high availability is discussed in Section 3.8.3.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: FF23-2 (TSB Decontamination Workshop)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory is up to 48 kg (106 lb) contained in up to three 12 L (3.2 gal) metal containers and three steel tanks.

The uncontrolled event is a fire involving excessive transient combustibles within the room that could result in a release of the uranium inventory (failure of IROFS36d: administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low). This event was assumed to have a high consequence.

For the controlled event, a fire considering expected in-situ and transient combustibles would be a low consequence event. The fire presumes that up to 4 kg (8.8 lb) worth of uranic material (no HF) could be present in open 12 L (3.2 gal) containers during transfer/charging operations and driven off in the event of a fire. The remaining uranic material inventory is in closed metal tanks, sealed metal containers, and/or is suspended in liquid and was discounted as not being released during this fire due to insufficient combustibles being present to cause failures/release. Preventive measures are to administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low (IROFS36d).

The failure probability index for administrative controls/procedures of IROFS36d was determined to be (-3). The NUREG-1520 criteria – a routine administrative IROFS - applies. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: FF24-1 (TSB Ventilated Room)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory is up to 500 kg (1100 lb) contained in 12 L (3.2 gal) metal containers and 210 L (55 gal) drums. Additional uranium inventory is present (periodically) in the form of a single 48Y, 48X, or 30B cylinder present in the room for valve maintenance/change-out.

The uncontrolled event is fire propagating into this area from other areas that could result in a release of the uranium inventory (failure of IROFS35: automatic closure of fire-rated barriers opening protectives (e.g., doors, dampers, penetration seals) to ensure the integrity of area fire barriers prevents fire from propagating into areas containing uranic material). This event was assumed to have a high consequence.

For the controlled event, fire would not propagate into the area due to automatic closure of fire-rated barriers opening protectives (e.g., doors, dampers, penetration seals) to ensure the integrity of area fire barriers prevents fire from propagating into areas containing uranic material (IROFS35).

The failure probability index for fire barriers was determined to be (-3). This corresponds to an active engineered IROFS per NUREG-1520. The IROFS justification for high availability is discussed in Section 3.8.3.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: FF25-1 (TSB Ventilated Room)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

TSB Ventilated Room – The uranium inventory is up to 500 kg (1100 lb) contained in 12 L (3.2 gal) metal containers and 210 L (55 gal) drums. Additional uranium inventory is present (periodically) in the form of a single 48Y, 48X, or 30B cylinder present in the room for valve maintenance/change-out.

The uncontrolled event is a fire involving excessive transient combustibles within the area that could result in a release of the uranium inventory (failure of IROFS36d: administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low). This event was assumed to have a high consequence.

For the controlled event, a fire considering expected in-situ and transient combustibles would be a low consequence event. It is assumed that a fire in improperly placed transient combustibles could cause failure of the nitrogen hose or vent line piping used to bleed gas from cylinders during valve servicing and/or subsequent nitrogen pressure test. The resulting release would be bounded by a feed or tails cylinder (48Y has the largest inventory) which results in a puff release at the 1.4 bar (20.3 psia) valve test pressure with a subsequent pouring cylinder release at room temperature. The puff releases 3.83 kg of UF_6 and the continuing release is a cumulative 0.42 kg of UF_6 over 30 minutes. The remaining uranic material/HF inventory in the cylinder, sealed metal drums, chemical traps, and waste containers was discounted as not being released during this fire due to insufficient combustibles being present to cause failure of the cylinder or metal containers. Preventive measures are to administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low (IROFS36d).

The failure probability index for administrative controls/procedures of IROFS36d was determined to be (-3). The NUREG-1520 criteria – a routine administrative IROFS - applies. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: FF25-2 (TSB Ventilated Room)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory is up to 500 kg (1100 lb) contained in 12 L (3.2 gal) metal containers and 210 L (55 gal) drums. Additional uranium inventory is present (periodically) in the form of a single 48Y, 48X, or 30B cylinder present in the room for valve maintenance/change-out.

The uncontrolled event is a fire involving excessive transient combustibles within the area that could result in a release of the uranium inventory (failure of IROFS36d: administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low). This event was assumed to have a high consequence.

For the controlled event, a fire considering expected in-situ and transient combustibles would be an intermediate consequence event. The fire presumes that up to 50 kg (110 lb) of uranic material/HF could be present in open 12 L (3.2 gal) containers and the bulking drum during transfer/bulking operations and driven off in the event of a fire. In order to mitigate the severity to low consequence, the IROFS required is smoke detection (area-wide in the room or in the ventilation system) interlocked to isolate the room ventilation systems with limited leakage from the building (IROFS37).

The remaining uranic material/HF inventory in the cylinder, sealed metal drums, chemical traps, and waste containers was discounted as not being released during this fire due to insufficient combustibles being present to cause failure of the cylinder or metal containers. The preventive measures are to administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low (IROFS36d).

Accident Identifier FF25-2a: The uncontrolled case is initiating event index (-2) with a consequence category (3). Risk index is (9) and IROFS are needed.

Accident Identifier FF25-2b: Preventive measures are to administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low (IROFS 36d). The controlled case consequences analysis shows that the resulting consequence is intermediate category (2). Risk index is (6) and additional IROFS are needed.

Accident Identifier FF25-2c: Preventive measures are (1) to administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low (IROFS36d) and (2) automatic trip of the Ventilated Room HVAC and isolation from TSB GEVS on smoke detection and Ventilated Room design leakage limited to ensure offsite exposure from building out flow maintains consequences to the public low (IROFS37). This is a controlled event with a mitigation to reduce the severity of the consequence (smoke detection trip of the room ventilation with limited leakage) with a failure probability of (-2). The resulting risk index is (3) which is acceptable risk.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: FF25-2 (TSB Ventilated Room) (continued)

Accident Identifier FF25-2d: Preventive measures are (1) to administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low (IROFS36d) and (2) automatic trip of the Ventilated Room HVAC and isolation from TSB GEVS on smoke detection and Ventilated Room design leakage limited to ensure offsite exposure from building out flow maintains consequences to the public low (IROFS37). However, in this event, the failure of IROFS37 is evaluated. This is a controlled event without mitigation to reduce the severity of the consequence. The resulting likelihood index is (–4) which is combined with the intermediate consequence (the controlled case consequences analysis shows that the resulting consequence is intermediate) and results in a risk index of (4) which is acceptable risk.

Accident Identifier FF25-2e: Preventive measures are (1) to administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low (IROFS36d) and (2) automatic trip of the Ventilated Room HVAC and isolation from TSB GEVS on smoke detection and Ventilated Room design leakage limited to ensure offsite exposure from building out flow maintains consequences to the public low (IROFS37). However, in this event, the failure of IROFS36d is evaluated. This is an evaluation of the event with mitigation. The initiating event is –2 with a failure probability index of –3. The event is assumed to have high consequences (category 3). This results in a risk index of (3) which is acceptable risk.

Accident Identifier FF25-2f: Preventive measures are (1) to administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low (IROFS36d) and (2) automatic trip of the Ventilated Room HVAC and isolation from TSB GEVS on smoke detection and Ventilated Room design leakage limited to ensure offsite exposure from building out flow maintains consequences to the public low (IROFS37). However, in this event, the failure of both IROFS36d and IROFS37 are evaluated. This is an evaluation of the event with a failure of mitigation. The initiating event is –2 with a failure probability index of –3 combined with a failure probability of –2. The event is assumed to have high consequences (category 3). This results in a risk index of (3) which is acceptable risk.

The failure probability index for smoke detection trip of the room ventilation and limited building leakage was determined to be (-2). The NUREG-1520 criteria – a single active engineered IROFS – applies.

The failure probability index for administrative controls/procedures of IROFS36d was determined to be (-3). The NUREG-1520 criteria – a routine administrative IROFS - applies. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: FF38-1 (TSB Chemical Lab Sample Storage Room)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory is up to 250 kg (550 lb) of UF_6.

The uncontrolled event is fire propagating into this area from other areas that could result in a release of the UF_6 inventory (failure of IROFS35: automatic closure of fire-rated barriers opening protectives (e.g., doors, dampers, penetration seals) to ensure the integrity of area fire barriers prevents fire barriers prevents fires from propagating into areas containing uranic material). This event was assumed to have a high consequence.

For the controlled event, fire would not propagate into the area due automatic closure of fire-rated barriers opening protectives (e.g., doors, dampers, penetration seals) to ensure the integrity of area fire barriers prevents fire barriers prevents fires from propagating into areas containing uranic material (IROFS35).

The failure probability index for fire barriers was determined to be (-3). This corresponds to an active engineered IROFS per NUREG-1520. The IROFS justification for high availability is discussed in Section 3.8.3.

Accident Identifier: FF38-2 (TSB Chemical Lab Sample Storage Room)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory is up to 250 kg (550 lb) of UF_6 (up to 0.5 kg (1.1 lb) in 500 1S sample cylinders)

The uncontrolled event is a fire involving excessive transient combustibles within the room that could result in a release of the UF_6 inventory (failure of IROFS36a: administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low). This event was assumed to have a high consequence.

For the controlled event, a fire considering expected in-situ and transient combustibles would be a low consequence event. The UF_6 inventory was discounted as not being released during a fire due to insufficient combustibles being present to cause failure of a sample cylinder. Preventive measures are to administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low (IROFS36a).

The failure probability index for administrative controls/procedures of IROFS36a was determined to be (-3). The NUREG-1520 criteria – a administrative IROFS - applies. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: FF42-1 (UBC Storage Pad Transporter/Mover)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory would be one UF_6 cylinder (a 48Y) in transit.

The uncontrolled event is a fire involving excessive combustibles on any UBC storage pad cylinder transporter/mover that could result in a release of the UF_6 inventory (failure of IROFS36c: administratively limit onsite UF_6 cylinder transporters/movers to ensure only use of electric drive or diesel powered with a fuel capacity of less than 280 L (74 gal). This event was assumed to have a high consequence.

For the controlled event, a fire considering expected in-situ and transient combustibles would be a low consequence event. The UF_6 inventory was discounted as not being released during a fire due to insufficient combustibles being present to cause failure of a cylinder. Onsite cylinder transporter/mover design will be limited to be either electric drive or diesel drive with a fuel capacity of less than 280 L (74 gal). The preventive measure is to administratively limit onsite UF_6 cylinder transporters/movers to ensure only use of electric drive or diesel powered with a fuel capacity of less than 280 L (74 gal) (IROFS36c).

The failure probability index for administrative controls/procedures of IROFS36c was determined to be (-3). The NUREG-1520 criteria – a routine administrative IROFS - applies. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Accident Identifier: FF43-1 (Uranium Byproduct Cylinders (UBC) Storage Pad)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory is up to 1.97E8 kg (4.34E8 lb) of UF_6 contained in 48Y cylinders located on the UBC Storage Pad.

The uncontrolled event is a fire involving excessive transient combustibles on the UBC Storage Pad (failure of IROFS36e: administratively limit transient combustible loading on the UBC Storage Pad to ensure cylinder integrity). This event was assumed to have a high consequence.

For the controlled event, a fire considering expected in-situ and transient combustibles would be a low consequence event. The UF_6 inventory was discounted as not being released during a fire due to insufficient combustibles being present to cause failure of the cylinders. In order to prevent exposure to pooled flammable fuel fire on the pad, vehicles to be driven onto the storage pad itself will be limited in fuel capacity to less than 280 L (74 gal) of flammable or combustible fuel. The preventive measure is to administratively limit transient combustible loading on the UBC Storage Pad to ensure cylinder integrity (IROFS36e).

The failure probability index for administrative controls/procedures of IROFS36e was determined to be (-3). The NUREG-1520 criteria – a routine administrative IROFS - applies. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: FF43-2 (UBC Storage Pad)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory is up to 1.97E8 kg (4.34E8 lb) of UF_6 contained in 48Y cylinders located on the UBC Storage Pad.

The uncontrolled event is a fire involving excessive transient combustibles adjacent to the UBC Storage Pad (failure of IROFS36f: administratively limit designated routes for bulk fueling vehicles onsite to ensure UBC cylinder integrity). This event was assumed to have a high consequence.

For the controlled event, a fire considering expected in-situ and transient combustibles would be a low consequence event. The UF_6 inventory was discounted as not being released during a fire due to insufficient combustibles being present to cause failure of the cylinders. A typical service vehicle fire on the UBC Storage Pad perimeter road was evaluated and shown to not result in failure of the UBC cylinders. The preventive measure is to administratively limit designated routes for bulk fueling vehicles onsite to ensure UBC cylinder integrity (IROFS36f).

The failure probability index for administrative controls/procedures of IROFS36f was determined to be (-3). The NUREG-1520 criteria – a routine administrative IROFS - applies. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Accident Identifier: FF44-1 (UBC Storage Pad)

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. (See FF1-1 for justification.)

The uranium inventory is up to 1.97E8 kg (4.34E8 lb) of UF_6 contained in 48Y cylinders located on the UBC Storage Pad.

The uncontrolled event is a wildland fire spreading onto the property and exposing the UBC Storage Pad (failure of IROFS36g: administratively limit onsite vegetation fire sources to ensure integrity of important targets). This event was assumed to have a high consequence.

For the controlled event, a fire would be a low consequence event. Off property vegetation is of a low density and the fenceline is over 100 m (328 ft) away. An off-property wildland fire will not cause failure of cylinders. The preventive measure is to administratively limit onsite vegetation fire sources to ensure integrity of important targets (IROFS36g).

The failure probability index for administrative controls/procedures of IROFS36g was determined to be (-3). The NUREG-1520 criteria – a routine administrative IROFS - applies. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Type of Accident – T for Chemical
CR for Criticality

Accident Identifier: FF-WORKER EVAC

The initial failure (initiating event) is a fire of sufficient magnitude to result in a release of UF_6 or uranic material.

The uncontrolled event is a fire that leads to failure of the mechanical systems or components containing UF_6 or uranic material. The subsequent release from this event is assumed to have high consequences to the worker present in the area.

For the controlled event, the mitigative measure is to administratively limit exposure by requiring worker action to evacuate the area(s) of concern during a fire to ensure that the consequences of inhalation of uranic material and HF are low (IROFS39b). Sufficient time is available for the worker to detect and to evacuate the area(s) of concern. As a result of IROFS39b, the consequence analysis shows that the consequence has been mitigated to a low category (1).

The frequency index number for the initiating event was determined to be (-2). The NUREG-1520 criteria – no failures of this type in this facility in 30 yrs – applies. This failure frequency index was based on evidence from similarly designed Urenco European plants which have a combined plant history of greater than 30 yrs in which no fire events have occurred in any uranium areas.

The failure probability index for the administrative controls/procedures of IROFS39b was determined to be (-3). This corresponds to an administrative IROFS that must be performed in response to a rare unplanned demand per NUREG-1520. The IROFS justification for enhanced administrative control is discussed in Section 3.8.3.

Type of Accident – T for Chemical
CR for Criticality

Table 3.7-5 Uranic Material Assumptions for Criticality Accident Sequences

Page 1 of 2

Accident Sequences	Assumed Mass of ^{235}U (kg)	Assumed ^{235}U Enrichment ($^w/_o$)
PT2-2	600.1	6.0
PT2-3	600.1	6.0
PT2-5	600.1	6.0
PT3-1	1.6	6.0
PT3-3	1.6	6.0
PT3-5	1.6	6.0
PB1-3	(1)	6.0
PB2-2	92.9	6.0
PB2-3	1.6	6.0
PB2-5	600.1	6.0
PB2-6	600.1	6.0
PB3-1	1.6	6.0
PB3-2	1.6	6.0
PB4-5	1.6	6.0
VR1-1	1.6	6.0
VR1-2	1.6	6.0
VR2-7	1.6	6.0
FR1-1	22.1	6.0
FR1-2	22.1	6.0
FR2-1	22.1	6.0
FR2-2	22.1	6.0
DS1-1	22.1	6.0
DS1-2	22.1	6.0
DS1-3	7.2	6.0
DS2-1	22.1	6.0
DS2-2	22.1	6.0
DS2-3	7.2	6.0
DS3-1	22.1	6.0
DS3-2	22.1	6.0
CL3-1	1.6	6.0
CP1-1	1.6	6.0
CP1-2	600.1	6.0
SW1-1	22.1	6.0
SW1-2	22.1	6.0
LW1-1	6.7	6.0
LW1-2	22.1	6.0
LW1-3	22.1	6.0
LW2-1	6.7	6.0
LW3-1	6.7	6.0

Table 3.7-5 Uranic Material Assumptions for Criticality Accident Sequences
Page 2 of 2

Accident Sequences	Assumed Mass of ^{235}U (kg)	Assumed ^{235}U Enrichment ($^w/_o$)
LW5-1	6.7	6.0
RD1-1	(1)	6.0
EC3-1	(2)	(2)
EC4-2	1.6	6.0
EE-LP-BLD (CR)	(3)	6.0

Notes:

(1) 38 cylinders, each with 600.1 kg ^{235}U

(2) Accident sequence EC3-1 considers the potential for a criticality in the facility resulting from the enrichment control being lost. In the accident sequence, it is assumed that all enrichment controls have failed, allowing enrichments in excess of the normal 5 $^w/_o$ ^{235}U limit. An exact upper bound enrichment and ^{235}U mass are not calculated. Instead, it is assumed that:

- previously geometrically favorable components no longer can be relied upon to prevent criticality; and
- moderation controls used to prevent criticality in the product cylinder may be inadequate, given the reduced levels of moderator that could result in criticality if enrichment levels were higher.

While the availability of moderating materials is not certain, the accident sequence conservatively assumes that operating with product enrichment in excess of 5 $^w/_o$ ^{235}U will result in a criticality somewhere within the facility. Criticality is considered in all cases to be a high consequence event. The identified IROFS are considered to provide adequate protection against this high consequence event.

(3) Sufficient mass of ^{235}U was assumed to be available to cause a criticality event.

Table 3.7-6 Cascade System
(Note 1)

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
Cascade Piping				
Cascade Piping Arrangement				
Cascade Centrifuge				
Cascade Valve Frame Piping				
Cascade Valve Frame Piping Arrangement				
Cascade Evacuation Roots Vacuum Pump				
Cascade Evacuation Rotary Vane Evacuation Pump				
Cascade Evacuation Cold Trap				
Cascade Evacuation Carbon Trap				
Cascade Evacuation Chemical Absorber Oil Trap				
Cascade Evacuation Oil Trap				
Cascade Evacuation Pump/ChemicalTrap Set				
Cascade Sampling Gravimetric Sample Bottle				
Cascade Sampling Finger Type Sample Bottle				
Cascade Sampling Roots Vacuum Pump				
Cascade Sampling Evacuation Rotary Vane Pump				
Cascade Sampling Carbon Trap				
Cascade Sampling Chemical Absorber Oil Trap				

Table 3.7-6 Cascade System
(Note 1)

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
Cascade Sampling Oil Trap				
Cascade Sampling Pump/Chemical Trap Set				
Pump Transport Device				
Chemical Trap Transport Device				
Mobile Rig				
Vacuum Cleaner				

Table 3.7-6 Note:

1. The system is considered classified. As such, specific information regarding design of components has been intentionally excluded to protect the classified nature of the information.

Column Descriptions:

Column A: This column provides a brief description of each component.

Column B: This column identifies the accident sequence associated with the passive component.

Column C: This column identifies the critical design attribute under consideration along with the conservative values used in the criticality analysis.

Column D: This column identifies the applicable guidewords from the ISA HAZOP procedure that are used to assess the criticality design margin. Additional guidewords are addressed as applicable in the detailed assessment.

Column E: This column provides any notes, comments and concluding statements.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
Product Piping (largest pipe ID in system)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	DIAMETER 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of pipe diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of piping system confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
Product Piping Arrangement	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of piping system confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Product Pump Set	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Product Pump Set confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Product Evacuation Pump	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Product Evacuation Pump volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion / Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Product Evacuation Pump confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Product Cold Trap	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of component diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of cold trap confinement or leakage and will not result in any appreciable accumulation of material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Carbon Trap (Product Evacuation)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Carbon Trap diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Carbon Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Aluminum Oxide Trap (Product Evacuation)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Aluminum Oxide Trap diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Aluminum Oxide Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Chemical Absorber Oil Trap (Product Evacuation)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Chemical Absorber Oil Trap volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Chemical Absorber Oil Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Oil Trap (Product Evacuation)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Oil Trap diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Oil Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Vacuum Cleaner	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter value at normal operating conditions of Vacuum Cleaner diameter and the conservative design/analysis value for this parameter assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter value.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter value.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Vacuum Cleaner confinement or leakage will not result in any appreciable accumulation of ^{235}U. As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
			Impact/Drop	Components shall be protected from Impact/Drop to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from Construction on Site to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Tanks)	Components shall be protected from Failure of Above-Ground Liquid Tanks to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from Hurricane events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Seismic)	Components shall be protected from Seismic events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Tornado)	Components shall be protected from Tornado events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from Local Intense Precipitation events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from Snow/Ice events to ensure the critical design attribute of diameter is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Product Evacuation Pump/Chemical Trap Set	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Product Evacuation Pump/Chemical Trap Set confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Pump Transport Device	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Chemical Trap Transport Device	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Assay Sampling Evacuation Pump	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Assay Sampling Evacuation Pump volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Assay Sampling Evacuation Pump confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Assay Sampling Rig	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Assay Sampling Rig confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Carbon Trap (Assay Sampling Rig)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Carbon Trap diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Carbon Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Chemical Absorber Oil Trap (Assay Sampling Rig)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Chemical Absorber Oil Trap volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Chemical Absorber Oil Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Oil Trap (Assay Sampling Rig)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	DIAMETER 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Oil Trap diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Oil Catch Pot confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Assay Sampling Piping (largest pipe ID in system)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of pipe diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.

Table 3.7-7 Product System

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of piping system confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Assay Sampling Piping Arrangement	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment; it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of piping system confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Mobile UF_6 Rig	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Mobile UF_6 Rig confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Finger Sample Bottle	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Finger Sample Bottle diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Finger Sample Bottle confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Column Descriptions:

Column A: This column provides a brief description of each component.

Column B: This column identifies the accident sequence associated with the passive component.

Column C: This column identifies the critical design attribute under consideration along with the conservative values used in the criticality analysis.

Column D: This column identifies the applicable guidewords from the ISA HAZOP procedure that are used to assess the criticality design margin. Additional guidewords are addressed as applicable in the detailed assessment.

Column E: This column provides any notes, comments and concluding statements.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
Tails Piping (largest piping diameter in the system)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of pipe diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of piping system confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Tails Piping Arrangement	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of piping system confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
Tails Pump Set	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Tails Pump Set confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Tails Evacuation Pump	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	VOLUME 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Tails Evacuation Pump volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Tails Evacuation Pump confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
Carbon Trap (Tails Evacuation)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Carbon Trap diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Carbon Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Aluminum Oxide Trap (Tails Evacuation)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Aluminum Oxide Trap diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Aluminum Oxide Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Chemical Absorber Oil Trap (Tails Evacuation)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Chemical Absorber Oil Trap volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Chemical Absorber Oil Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Oil Trap (Tails Evacuation)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Oil Trap diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Oil Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Vacuum Cleaner	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	DIAMETER 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter value at normal operating conditions of Vacuum Cleaner diameter and the conservative design/analysis value for this parameter assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter value.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter value.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Vacuum Cleaner confinement or leakage will not result in any appreciable accumulation of ^{235}U. As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
			Impact/Drop	Components shall be protected from Impact/Drop to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from Construction on Site to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Tanks)	Components shall be protected from Failure of Above-Ground Liquid Tanks to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from Hurricane events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Seismic)	Components shall be protected from Seismic events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Tornado)	Components shall be protected from Tornado events to ensure the critical design attribute of diameter is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Local Intense Precipitation)	Components shall be protected from Local Intense Precipitation events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from Snow/Ice events to ensure the critical design attribute of diameter is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Tails Evacuation Pump/Chemical Trap Set	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Tails Evacuation Pump/Chemical Trap Set confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Pump Transport Device	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Chemical Trap Transport Device	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Mobile UF_6 Rig	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Mobile UF_6 Rig confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Finger Sample Bottle	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	DIAMETER 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Finger Sample Bottle diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Finger Sample Bottle confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Column Descriptions:

Column A: This column provides a brief description of each component.

Column B: This column identifies the accident sequence associated with the passive component.

Column C: This column identifies the critical design attribute under consideration along with the conservative values used in the criticality analysis.

Column D: This column identifies the applicable guidewords from the ISA HAZOP procedure that are used to assess the criticality design margin. Additional guidewords are addressed as applicable in the detailed assessment.

Column E: This column provides any notes, comments and concluding statements.

Table 3.7-9 Product Blending System

Criticality Assessment of Passive Safe By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
Product Blending Piping (largest pipe ID in the system)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of pipe diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of piping system confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Criticality Assessment of Passive Safe By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
Product Blending Piping Arrangement	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of piping system confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Cold Trap (Product Blending Evacuation)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of component diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

Criticality Assessment of Passive Safe By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of cold trap confinement or leakage and will not result in any appreciable accumulation of material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Product Blending Evacuation Pump	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Product Blending Evacuation Pump volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.

Criticality Assessment of Passive Safe By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Product Blending Evacuation Pump confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Criticality Assessment of Passive Safe By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
Carbon Trap (Product Blending Evacuation)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Carbon Trap diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Carbon Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Criticality Assessment of Passive Safe By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
Aluminum Oxide Trap (Product Blending Evacuation)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Aluminum Oxide Trap diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Aluminum Oxide Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Criticality Assessment of Passive Safe By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
Chemical Absorber Oil Trap (Product Blending Evacuation)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Chemical Absorber Oil Trap volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Chemical Absorber Oil Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.

Criticality Assessment of Passive Safe By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Oil Trap (Product Blending Evacuation)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Oil Trap diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Oil Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.

Criticality Assessment of Passive Safe By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Vacuum Cleaner	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter value at normal operating conditions of Vacuum Cleaner diameter and the conservative design/analysis value for this parameter assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter value.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter value.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Vacuum Cleaner confinement or leakage will not result in any appreciable accumulation of ^{235}U. As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
			Impact/Drop	Components shall be protected from Impact/Drop to ensure the critical design attribute of diameter is not adversely impacted.

Criticality Assessment of Passive Safe By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Construction on Site)	Components shall be protected from Construction on Site to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Tanks)	Components shall be protected from Failure of Above-Ground Liquid Tanks to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from Hurricane events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Seismic)	Components shall be protected from Seismic events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Tornado)	Components shall be protected from Tornado events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from Local Intense Precipitation events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from Snow/Ice events to ensure the critical design attribute of diameter is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Product Blending Evacuation Pump/ Chemical Trap Set	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

Criticality Assessment of Passive Safe By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Product Blending Evacuation Pump/ Chemical Trap Set confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Pump Transport Device	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Chemical Trap Transport Device	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Mobile UF_6 Rig	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

Criticality Assessment of Passive Safe By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Mobile UF_6 Rig confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
1S Sample Bottle	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of 1S Sample Bottle diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.

Criticality Assessment of Passive Safe By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of 1S Sample Bottle confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Column Descriptions:

Column A: This column provides a brief description of each component.

Column B: This column identifies the accident sequence associated with the passive component.

Column C: This column identifies the critical design attribute under consideration along with the conservative values used in the criticality analysis.

Column D: This column identifies the applicable guidewords from the ISA HAZOP procedure that are used to assess the criticality design margin. Additional guidewords are addressed as applicable in the detailed assessment.

Column E: This column provides any notes, comments and concluding statements.

Table 3.7-10 Product Liquid Sampling

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
Product Liquid Sampling Piping (largest pipe ID in the system)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of pipe diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of piping system confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
Product Liquid Sampling Piping Arrangement	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of piping system confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Vacuum Cleaner	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter value at normal operating conditions of Vacuum Cleaner diameter and the conservative design/analysis value for this parameter assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter value.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter value.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Vacuum Cleaner confinement or leakage will not result in any appreciable accumulation of ^{235}U. As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
			Impact/Drop	Components shall be protected from Impact/Drop to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from Construction on Site to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Tanks)	Components shall be protected from Failure of Above-Ground Liquid Tanks to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from Hurricane events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Seismic)	Components shall be protected from Seismic events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Tornado)	Components shall be protected from Tornado events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from Local Intense Precipitation events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from Snow/Ice events to ensure the critical design attribute of diameter is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Mobile UF_6 Rig	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Mobile UF_6 Rig confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.

Table 3.7-10 Product Liquid Sampling

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
1S Sample Bottle	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	DIAMETER 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of pipe diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

Table 3.7-10 Product Liquid Sampling

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of 1S Sample Bottle confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Column Descriptions:

Column A: This column provides a brief description of each component.

Column B: This column identifies the accident sequence associated with the passive component.

Column C: This column identifies the critical design attribute under consideration along with the conservative values used in the criticality analysis.

Column D: This column identifies the applicable guidewords from the ISA HAZOP procedure that are used to assess the criticality design margin. Additional guidewords are addressed as applicable in the detailed assessment.

Column E: This column provides any notes, comments and concluding statements.

Table 3.7-11 Contingency Dump System
(Note 1)

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
Contingency Dump Trap				
Contingency Dump Piping				
Contingency Dump Piping Arrangement				
Contingency Dump Buffer Volume Arrangement				
Contingency Dump Roots Pump				
Carbon Trap (Contingency Dump)				
Aluminum Oxide Trap (Contingency Dump)				
Chemical Absorber Oil Trap (Contingency Dump)				
Rotary Vane Vacuum Pump (Contingency Dump)				
Oil Trap (Contingency Dump)				
Contingency Dump Pump/Chemical Trap Set				
Vacuum Cleaner				
Pump Transport Device				
Chemical Trap Transport Device				
Mobile UF_6 Rig				

Table 3.7-11 Note:

1. The system is considered classified. As such, specific information regarding design of components has been intentionally excluded to protect the classified nature of the information.

Table 3.7-11 Contingency Dump System
(Note 1)

Column Descriptions:

Column A: This column provides a brief description of each component.

Column B: This column identifies the accident sequence associated with the passive component.

Column C: This column identifies the critical design attribute under consideration along with the conservative values used in the criticality analysis.

Column D: This column identifies the applicable guidewords from the ISA HAZOP procedure that are used to assess the criticality design margin. Additional guidewords are addressed as applicable in the detailed assessment.

Column E: This column provides any notes, comments and concluding statements.

Table 3.7-12 Centrifuge Test System
(Note 1)
Page 1 of 2

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
Centrifuge Test System Piping (largest pipe ID in system)				
Centrifuge Test System Piping Arrangement				
Centrifuge Test System Test Centrifuge				
1S Sample Bottle				
Centrifuge Test System Carbon Trap				
Centrifuge Test System Aluminum Oxide Trap				
Centrifuge Test System Chemical Absorber Oil Trap				
Centrifuge Test System Evacuation Rotary Vane Pump				
Centrifuge Test System Evacuation System Oil Trap				
Centrifuge Test System Pump/Chemical Trap Set				
Centrifuge Test System Pump Transport Device				
Centrifuge Test System Chemical Trap Transport Device				
Vacuum Cleaner				

Table 3.7-12 Note:

1. The system is considered classified. As such, specific information regarding design of components has been intentionally excluded to protect the classified nature of the information.

Table 3.7-12 Centrifuge Test System
(Note 1)
Page 2 of 2

Column Descriptions:

Column A: This column provides a brief description of each component.

Column B: This column identifies the accident sequence associated with the passive component.

Column C: This column identifies the critical design attribute under consideration along with the conservative values used in the criticality analysis.

Column D: This column identifies the applicable guidewords from the ISA HAZOP procedure that are used to assess the criticality design margin. Additional guidewords are addressed as applicable in the detailed assessment.

Column E: This column provides any notes, comments and concluding statements.

Table 3.7-13 Centrifuge Post Mortem
(Note 1)

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Component Description (A)	Component Description (A)	Component Description (A)	Component Description (A)
Centrifuge Post Mortem Centrifuge				
Vacuum Cleaner				

Table 3.7-13 Note:

1. The system is considered classified. As such, specific information regarding design of components has been intentionally excluded to protect the classified nature of the information.

Column Descriptions:

Column A: This column provides a brief description of each component.

Column B: This column identifies the accident sequence associated with the passive component.

Column C: This column identifies the critical design attribute under consideration along with the conservative values used in the criticality analysis.

Column D: This column identifies the applicable guidewords from the ISA HAZOP procedure that are used to assess the criticality design margin. Additional guidewords are addressed as applicable in the detailed assessment.

Column E: This column provides any notes, comments and concluding statements.

Table 3.7-14 Liquid Effluent Collection and Treatment System
Page 1 of 32

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
Waste Container Transport Device	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Waste Container	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter value at normal operating conditions of Waste Container volume and the conservative design/analysis value for this parameter assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Waste Container confinement or leakage will not result in any appreciable accumulation of ^{235}U material. As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Waste Container Storage Array	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Degreaser Water Centrifuge	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Degreaser Water Centrifuge volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Degreaser Water Centrifuge shall be protected from loss of confinement or leakage with a curbed area to ensure subcriticality.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
			Impact/Drop	Components shall be protected from impact/drop to ensure the criticality design attribute of volume is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the criticality design attribute of volume is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Degreaser Water Tank Unloading Pump	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Degreaser Water Unloading Pump volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Degreaser Water Tank Unloading Pump shall be protected from loss of confinement or leakage with a curbed area to ensure subcriticality.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
			Impact/Drop	Components shall be protected from impact/drop to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the criticality design attribute of volume is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Seismic)	Components shall be protected from seismic events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the criticality design attribute of volume is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Degreaser Water Transfer Pump	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Degreaser Water Transfer Pump volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Degreaser Water Transfer Pump shall be protected from loss of confinement or leakage with a curbed area to ensure subcriticality.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
			Impact/Drop	Components shall be protected from impact/drop to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the criticality design attribute of volume is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the criticality design attribute of volume is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Degreaser Water Centrifuge Feed Pump	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Degreaser Water Centrifuge Feed Pump volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Degreaser Water Centrifuge Feed Pump shall be protected from loss of confinement or leakage with a curbed area to ensure subcriticality.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			Impact/Drop	Components shall be protected from impact/drop to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the criticality design attribute of volume is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Degreaser Water Piping (largest pipe ID in subsystem)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of pipe diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Piping system shall be protected from loss of confinement or leakage with a confinement area to ensure subcriticality.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
			Impact/Drop	Components shall be protected from impact/drop to ensure the criticality design attribute of diameter is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the criticality design attribute of diameter is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the criticality design attribute of diameter is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the criticality design attribute of diameter is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Seismic)	Components shall be protected from seismic events to ensure the criticality design attribute of diameter is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the criticality design attribute of diameter is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the criticality design attribute of diameter is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the criticality design attribute of diameter is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the criticality design attribute of diameter is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Degreaser Water Piping Arrangement	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.

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Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Loss of Confinement or Leakage	Piping system shall be protected from loss of confinement or leakage with a confinement area to ensure subcriticality.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Spent Citric Acid Piping (largest pipe ID in subsystem)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of pipe diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Piping system shall be protected from loss of confinement or leakage with a confinement area to ensure subcriticality.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
			Impact/Drop	Components shall be protected from impact/drop to ensure the criticality design attribute of diameter is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the criticality design attribute of diameter is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the criticality design attribute of diameter is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the criticality design attribute of diameter is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the criticality design attribute of diameter is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the criticality design attribute of diameter is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the criticality design attribute of diameter is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the criticality design attribute of diameter is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the criticality design attribute of diameter is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Spent Citric Acid Piping Arrangement	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

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Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Loss of Confinement or Leakage	Piping system shall be protected from loss of confinement or leakage with a confinement area to ensure subcriticality.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Spent Citric Acid Transfer Pump	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	VOLUME 24. liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Spent Citric Acid Transfer Pump volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Spent Citric Acid Transfer Pump shall be protected from loss of confinement or leakage with a confinement area to ensure subcriticality.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.

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Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
			Impact/Drop	Components shall be protected from impact/drop to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the criticality design attribute of volume is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
Spent Citric Acid Unloading Pump	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Spent Citric Acid Unloading Pump volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Spent Citric Acid Unloading Pump shall be protected from loss of confinement or leakage with a confinement area to ensure subcriticality.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
			Impact/Drop	Components shall be protected from impact/drop to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the criticality design attribute of volume is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the criticality design attribute of volume is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Laboratory Waste Pump	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Laboratory Waste Pump volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Laboratory Waste Pump shall be protected from loss of confinement or leakage with a confinement area to ensure subcriticality.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
			Impact/Drop	Components shall be protected from impact/drop to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the criticality design attribute of volume is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the criticality design attribute of volume is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Miscellaneous Effluent Transfer Pump	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Miscellaneous Effluent Transfer Pump volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Miscellaneous Effluent Transfer Pump shall be protected from loss of confinement or leakage with a confinement area to ensure subcriticality.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
			Impact/Drop	Components shall be protected from impact/drop to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the criticality design attribute of volume is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
Miscellaneous Effluent Piping (largest pipe ID in system))	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	DIAMETER 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of pipe diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Piping system shall be protected from loss of confinement or leakage with a confinement area to ensure subcriticality.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
			Impact/Drop	Components shall be protected from impact/drop to ensure the criticality design attribute of diameter is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the criticality design attribute of diameter is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the criticality design attribute of diameter is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the criticality design attribute of diameter is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the criticality design attribute of diameter is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the criticality design attribute of diameter is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the criticality design attribute of diameter is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the criticality design attribute of diameter is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the criticality design attribute of diameter is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Miscellaneous Effluent Piping Arrangement	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

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Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Loss of Confinement or Leakage	Piping system shall be protected from loss of confinement or leakage with a confinement area to ensure subcriticality.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Precipitation Treatment Tank Filter Press Feed Pump	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Precipitation Treatment Tank Filter Press Feed Pump volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Precipitation Treatment Tank Filter Press Feed Pump shall be protected from loss of confinement or leakage with a confinement area to ensure subcriticality.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
			Impact/Drop	Components shall be protected from impact/drop to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the criticality design attribute of volume is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
Precipitation Treatment Tank Transfer Pump	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Precipitation Treatment Tank Transfer Pump volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Precipitation Treatment Tank Transfer Pump shall be protected from loss of confinement or leakage with a confinement area to ensure subcriticality.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
			Impact/Drop	Components shall be protected from impact/drop to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the criticality design attribute of volume is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the criticality design attribute of volume is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the Criticality Design is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the criticality design attribute of volume is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Curbed Area, Liquid Effluent Collect and Treatment Room	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	SLAB 11.5 cm Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of the curb area shape, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe shape and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe shape and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe shape.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of the curbed area confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of the robust construction of the curbed area.
			Fire	Components shall be protected from fire to ensure the critical design attribute of shape is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of shape.
			Impact/Drop	Components shall be protected from impact/drop to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the criticality design attribute of shape is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the criticality design attribute of shape is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Column Descriptions:

Column A: This column provides a brief description of each component.

Column B: This column identifies the accident sequence associated with the passive component.

Column C: This column identifies the critical design attribute under consideration along with the conservative values used in the criticality analysis.

Column D: This column identifies the applicable guidewords from the ISA HAZOP procedure that are used to assess the criticality design margin. Additional guidewords are addressed as applicable in the detailed assessment.

Column E: This column provides any notes, comments and concluding statements.

Table 3.7-15 Solid Waste Collection System
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Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
12 Liter Container Storage Array	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Table 3.7-15 Solid Waste Collection System

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
12 Liter Canister	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter value at normal operating conditions of 12 Liter Canister volume and the conservative design/analysis value for this parameter assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of 12 Liter Canister confinement or leakage will not result in any appreciable accumulation of ^{235}U material. As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
12 Liter Container Transport Device	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.

Table 3.7-15 Solid Waste Collection System

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Column Descriptions:

Column A: This column provides a brief description of each component.

Column B: This column identifies the accident sequence associated with the passive component.

Column C: This column identifies the critical design attribute under consideration along with the conservative values used in the criticality analysis.

Column D: This column identifies the applicable guidewords from the ISA HAZOP procedure that are used to assess the criticality design margin. Additional guidewords are addressed as applicable in the detailed assessment.

Column E: This column provides any notes, comments and concluding statements.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
Fomblin Oil Storage Array	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Table 3.7-16 Decontamination Workshop

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Product Pump Storage Array	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Oil Drip Tray	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter value at normal operating conditions of Oil Drip Tray volume and the conservative design/analysis value for this parameter assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter value.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter value.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Oil Drip Tray confinement or leakage will not result in any appreciable accumulation of ^{235}U material. As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
6 Liter Residue Container	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter value at normal operating conditions of 6 Liter Residue Container volume and the conservative design/analysis value for this parameter assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of 6 Liter Residue Container confinement or leakage will not result in any appreciable accumulation of ^{235}U material. As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
6 Liter Residue Container Storage Array	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Flexible Hoses Storage Array	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Citric Acid Holding Tank (Decon System for Flexibles)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**SLAB** 11.5 cm Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Citric Acid Holding Tank (Decontamination System for Flexibles) shape, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe shape and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe shape and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe shape. Materials are corrosion/erosion resistant.
			Loss of Confinement or Leakage	Citric Acid Holding Tank (Decontamination System for Flexibles) shall be protected from loss of confinement or leakage with a confinement area (Flexible Hose Decontamination Cabinet) to ensure the critical design.
			Fire	Components shall be protected from fire to ensure the critical design attribute of shape is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of shape.
			Impact/Drop	Components shall be protected from impact/drop to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the criticality design attribute of shape is not adversely impacted.

Table 3.7-16 Decontamination Workshop

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the criticality design attribute of shape is not adversely impacted.
			External. Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the criticality design attribute of shape is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Vacuum Cleaner	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter value at normal operating conditions of Vacuum Cleaner diameter and the conservative design/analysis value for this parameter assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter value.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter value.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Vacuum Cleaner confinement or leakage will not result in any appreciable accumulation of ^{235}U. As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
			Impact/Drop	Components shall be protected from Impact/Drop to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from Construction on Site to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Tanks)	Components shall be protected from Failure of Above-Ground Liquid Tanks to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from Hurricane events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Seismic)	Components shall be protected from Seismic events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Tornado)	Components shall be protected from Tornado events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from Local Intense Precipitation events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from Snow/Ice events to ensure the critical design attribute of diameter is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Sample Bottle Wash Drip Tray	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**SLAB** 11.5 cm Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Sample Bottle Wash Drip Tray shape, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe shape and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe shape and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe shape.. Materials are corrosion/erosion resistant.
			Loss of Confinement or Leakage	Sample Bottle Wash Drip Tray shall be protected from loss of confinement or leakage with a confinement area (Sample Bottle Decontamination Cabinet) to ensure subcriticality.
			Fire	Components shall be protected from fire to ensure the critical design attribute of shape is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of shape.
			Impact/Drop	Components shall be protected from impact/drop to ensure the criticality design attribute of shape is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the criticality design attribute of shape is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Fomblin Oil 6 Liter Container	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter value at normal operating conditions of 6 Liter Residue Container volume and the conservative design/analysis value for this parameter assumed for criticality.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of 6 Liter Residue Container confinement or leakage will not result in any appreciable accumulation of ^{235}U material. As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Product Pump Transport Device	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Residue Container Transport Device	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Flexible Hose Transport Device	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Flexible Hose Decontamination Cabinet	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**SLAB** 11.5 cm Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Flexible Hose Decontamination Cabinet shape, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe shape and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe shape and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe shape. Materials are corrosion/erosion resistant.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of the Flexible Hose Decontamination Cabinet or leakage will not result in any appreciable accumulation of ^{235}U material because of the robust construction of the curbed area.
			Fire	Components shall be protected from fire to ensure the critical design attribute of shape is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of shape.
			Impact/Drop	Components shall be protected from impact/drop to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the criticality design attribute of shape is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Sample Bottle Decontamination Cabinet	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	SLAB 11.5 cm Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Sample Bottle Decontamination Cabinet shape, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe shape and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe shape and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe shape. Materials are corrosion/erosion resistant.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of the Sample Bottle Decontamination Cabinet or leakage will not result in any appreciable accumulation of ^{235}U material because of the robust construction of the curbed area.
			Fire	Components shall be protected from fire to ensure the critical design attribute of shape is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of shape.
			Impact/Drop	Components shall be protected from impact/drop to ensure the criticality design attribute of shape is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the criticality design attribute of shape is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Contaminated Components Hydraulic Bench	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Column Descriptions:

Column A: This column provides a brief description of each component.

Column B: This column identifies the accident sequence associated with the passive component.

Column C: This column identifies the critical design attribute under consideration along with the conservative values used in the criticality analysis.

Column D: This column identifies the applicable guidewords from the ISA HAZOP procedure that are used to assess the criticality design margin. Additional guidewords are addressed as applicable in the detailed assessment.

Column E: This column provides any notes, comments and concluding statements.

Table 3.7-17 Fomblin Oil Recovery System
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Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
Fomblin Oil Recovery Rig	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Loss of Confinement or Leakage	Fomblin Oil Recovery Rig shall be protected from loss of confinement or leakage with a confinement area, the Fomblin Oil Recovery Rig Cabinet, to ensure the critical design.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute *(C)***	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Fomblin Oil Recovery Rig Cabinet	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**SLAB** 11.5 cm Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Fomblin Oil Recovery Rig Cabinet shape and the conservative design/analysis value for this parameter assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe shape and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter .
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe shape and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe shape. Materials are corrosion/erosion resistant.

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Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of the Fomblin Oil Recovery Rig Cabinet or leakage will not result in any appreciable accumulation of ^{235}U material because of the robust construction of the Fomblin Oil Recovery Rig Cabinet.
			Fire	Components shall be protected from fire to ensure the critical design attribute of shape is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of shape.
			Impact/Drop	Components shall be protected from impact/drop to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the criticality design attribute of shape is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the criticality design attribute of shape is not adversely impacted.

Table 3.7-17 Fomblin Oil Recovery System

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Column Descriptions:

Column A: This column provides a brief description of each component.

Column B: This column identifies the accident sequence associated with the passive component.

Column C: This column identifies the critical design attribute under consideration along with the conservative values used in the criticality analysis.

Column D: This column identifies the applicable guidewords from the ISA HAZOP procedure that are used to assess the criticality design margin. Additional guidewords are addressed as applicable in the detailed assessment.

Column E: This column provides any notes, comments and concluding statements.

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Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
Cylinder Pressure Test & Pump Out Piping (largest pipe ID in the system)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of pipe diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of piping system confinement or leakage will not result in any appreciable accumulation of ^{235}U material. As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
Cylinder Pressure Test & Pump Out Piping Arrangement		**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of piping system confinement or leakage will not result in any appreciable accumulation of ^{235}U material. As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Cold Trap (Cylinder Pressure Test & Pump Out Evacuation)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of component diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of cold trap confinement or leakage and will not result in any appreciable accumulation of material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Cylinder Pressure Test & Pump Out Evacuation Pump	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Cylinder Pressure Test & Pump Out Evacuation Pump volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Cylinder Pressure Test & Pump Out Evacuation Pump confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
Carbon Trap (Cylinder Pressure Test & Pump Out Evacuation)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	DIAMETER 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Carbon Trap diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Carbon Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

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Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
Aluminum Oxide Trap (Cylinder Pressure Test & Pump Out Evacuation)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Aluminum Oxide Trap diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Aluminum Oxide Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change in Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Chemical Absorber Oil Trap (Cylinder Pressure Test & Pump Out Evacuation)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Chemical Absorber Oil Trap volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Chemical Absorber Oil Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Oil Trap (Cylinder Pressure Test & Pump Out Evacuation)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Oil Trap diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Oil Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Vacuum Cleaner	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter value at normal operating conditions of Vacuum Cleaner diameter and the conservative design/analysis value for this parameter assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter value.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter value.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Vacuum Cleaner confinement or leakage will not result in any appreciable accumulation of ^{235}U. As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.

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Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Impact/Drop	Components shall be protected from Impact/Drop to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from Construction on Site to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Tanks)	Components shall be protected from Failure of Above-Ground Liquid Tanks to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from Hurricane events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Seismic)	Components shall be protected from Seismic events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Tornado)	Components shall be protected from Tornado events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from Local Intense Precipitation events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from Snow/Ice events to ensure the critical design attribute of diameter is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Cylinder Pressure Test & Pump Out Evacuation Pump/ Chemical Trap Set	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Cylinder Pressure Test & Pump Out Evacuation Pump/ Chemical Trap Set confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.

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Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Pump Transport Device	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Chemical Trap Transport Device	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
1S Sample Bottle	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of 1S Sample Bottle diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of 1S Sample Bottle confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Chemical Trap Storage Array	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Dump Trap Storage Array	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.

Table 3.7-18 Ventilated Room System

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Dump Trap Interals	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Dump Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
12 Liter Canister Storage Array	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
12 Liter Canister	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter value at normal operating conditions of 12 Liter Canister volume and the conservative design/analysis value for this parameter assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of 12 liter canister confinement or leakage will not result in any appreciable accumulation of ^{235}U material. As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
12 Liter Canister Transport Device	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Column Descriptions:

Column A: This column provides a brief description of each component.

Column B: This column identifies the accident sequence associated with the passive component.

Column C: This column identifies the critical design attribute under consideration along with the conservative values used in the criticality analysis.

Column D: This column identifies the applicable guidewords from the ISA HAZOP procedure that are used to assess the criticality design margin. Additional guidewords are addressed as applicable in the detailed assessment.

Column E: This column provides any notes, comments and concluding statements.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
1S Sample Bottle	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	DIAMETER 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of 1S Sample Bottle diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of 1S Sample Bottle confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
1S Sample Bottle Storage Array	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.

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Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Cold Trap	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of component diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

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Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of cold trap confinement or leakage and will not result in any appreciable accumulation of material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
UF_6 Sampling System Pump	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of UF_6 Sampling System Pump volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

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Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of UF_6 Sampling System Pump confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
P10 Sample Bottle	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	DIAMETER 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of P10 Sample Bottle diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of P10 Sample Bottle confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Column Descriptions:

Column A: This column provides a brief description of each component.

Column B: This column identifies the accident sequence associated with the passive component.

Column C: This column identifies the critical design attribute under consideration along with the conservative values used in the criticality analysis.

Column D: This column identifies the applicable guidewords from the ISA HAZOP procedure that are used to assess the criticality design margin. Additional guidewords are addressed as applicable in the detailed assessment.

Column E: This column provides any notes, comments and concluding statements.

Table 3.7-20 Mass Spectrometry

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Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
Mass Spectrometry	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	VOLUME 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Mass Spectrometry volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Mass Spectrometry confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Table 3.7-20 Mass Spectrometry

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
Finger Sample Bottle	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Finger Sample Bottle diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Finger Sample Bottle confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Column Descriptions:

Column A: This column provides a brief description of each component.

Column B: This column identifies the accident sequence associated with the passive component.

Column C: This column identifies the critical design attribute under consideration along with the conservative values used in the criticality analysis.

Column D: This column identifies the applicable guidewords from the ISA HAZOP procedure that are used to assess the criticality design margin. Additional guidewords are addressed as applicable in the detailed assessment.

Column E: This column provides any notes, comments and concluding statements.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
Cylinder Preparation Test & Pump Out Piping (largest pipe ID in system)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of pipe diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of piping system confinement or leakage will not result in any appreciable accumulation of ^{235}U material. As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
Cylinder Preparation Test & Pump Out Piping Arrangement	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**PHYSICAL ARRANGEMENT**		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of piping system confinement or leakage will not result in any appreciable accumulation of ^{235}U material. As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Cylinder Preparation Test & Pump Out Evacuation Pump	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Cylinder Pressure Test & Pump Out Evacuation Pump volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Cylinder Pressure Test & Pump Out Evacuation Pump confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Carbon Trap (Cylinder Preparation Test & Pump Out Evacuation)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Carbon Trap diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

Table 3.7-21 Cylinder Preparation System

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Carbon Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Aluminum Oxide Trap (Cylinder Preparation Test & Pump Out Evacuation)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Aluminum Oxide Trap diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

Table 3.7-21 Cylinder Preparation System

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Aluminum Oxide Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Chemical Absorber Oil Trap (Cylinder Preparation Test & Pump Out Evacuation)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**VOLUME** 24 liters Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Chemical Absorber Oil Trap volume, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe volume and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe volume. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe volume.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Chemical Absorber Oil Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of volume is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of volume.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Oil Trap (Cylinder Preparation Test & Pump Out Evacuation)	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter values at normal operating conditions of Oil Trap diameter, amount of ^{235}U and enrichment and the conservative design/analysis values for these parameters assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Oil Trap confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Vacuum Cleaner	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	**DIAMETER** 24.4 cm (ID) Keff = 1.0 @ 6 wt %		Based on qualitative assessment, there is margin between the parameter value at normal operating conditions of Vacuum Cleaner diameter and the conservative design/analysis value for this parameter assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter value.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would cause an approach to the critical safe diameter and to adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter value.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would cause an approach to the critical safe diameter. Materials are corrosion/erosion resistant and postulated complete wall erosion would not exceed the critical safe diameter.
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Vacuum Cleaner confinement or leakage will not result in any appreciable accumulation of ^{235}U. As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of diameter is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of diameter.
			Impact/Drop	Components shall be protected from Impact/Drop to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from Construction on Site to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Tanks)	Components shall be protected from Failure of Above-Ground Liquid Tanks to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from Hurricane events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Seismic)	Components shall be protected from Seismic events to ensure the critical design attribute of diameter is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Tornado)	Components shall be protected from Tornado events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from Local Intense Precipitation events to ensure the critical design attribute of diameter is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from Snow/Ice events to ensure the critical design attribute of diameter is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Cylinder Preparation Test & Pump Out Evacuation Pump/ Chemical Trap Set	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			More Heat	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more heat condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			More Pressure	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a more pressure condition that would adversely affect the maintenance of margin to criticality associated with design and maximum operating parameter values for amount of ^{235}U and enrichment.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			Loss of Confinement or Leakage	Based on qualitative assessment, postulated loss of Cylinder Pressure Test & Pump Out Evacuation Pump/ Chemical Trap Set confinement or leakage will not result in any appreciable accumulation of ^{235}U material because of physical limitations of the process (sub-atmospheric). As a result, loss of confinement does not result in a potential for criticality and therefore its consequence is low.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Pump Transport Device	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	**Sequence ID (B)**	**Critical Design Attribute (C)**	**Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)**	**Notes/Comments (E)**
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.
Chemical Trap Transport Device	LOSS OF SAFE-BY-DESIGN ATTRIBUTE	PHYSICAL ARRANGEMENT		Based on qualitative assessment, there is margin between the normal operating conditions and the conservative design/analysis conditions assumed for criticality.
			Corrosion/ Erosion	Based on qualitative assessment, it is highly unlikely for a process deviation to result in a corrosion/erosion condition that would affect the maintenance of margin to criticality associated with design and maximum operating parameter values for physical arrangement.
			Fire	Components shall be protected from fire to ensure the critical design attribute of physical arrangement is not adversely impacted.
			Maintenance	Configuration Management shall ensure that maintenance does not adversely impact the critical design attribute of physical arrangement.
			Impact/Drop	Components shall be protected from impact/drop to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Construction on Site)	Components shall be protected from construction on-Site to ensure the critical design attribute of physical arrangement is not adversely impacted.

Criticality Assessment of Passive Safe-By-Design Components				
Component Description (A)	Sequence ID (B)	Critical Design Attribute (C)	Review of Up-Set Conditions to Change Geometry (Applicable HAZOP Guidewords) (D)	Notes/Comments (E)
			External Events (Failure of Above-Ground Liquid Storage Tanks)	Components shall be protected from external flooding (Failure of Above-Ground Liquid Storage Tanks) to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Hurricane)	Components shall be protected from hurricane events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Seismic)	Components shall be protected from seismic events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Tornado)	Components shall be protected from tornado events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Local Intense Precipitation)	Components shall be protected from local intense precipitation events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (External Fire)	Components shall be protected from external fire events to ensure the critical design attribute of physical arrangement is not adversely impacted.
			External Events (Snow/Ice)	Components shall be protected from external ice/snow events to ensure the critical design attribute of physical arrangement is not adversely impacted.
				Double Contingency Principle is satisfied as follows. The geometry is criticality safe and no single credible event or failure has been identified whereby the geometry could become unsafe. The enrichment is also controlled such that no single credible failure could result in loss of enrichment control.

Column Descriptions:

Column A: This column provides a brief description of each component.

Column B: This column identifies the accident sequence associated with the passive component.

Column C: This column identifies the critical design attribute under consideration along with the conservative values used in the criticality analysis.

Column D: This column identifies the applicable guidewords from the ISA HAZOP procedure that are used to assess the criticality design margin. Additional guidewords are addressed as applicable in the detailed assessment.

Column E: This column provides any notes, comments and concluding statements.

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3.8 ITEMS RELIED ON FOR SAFETY (IROFS)

This section of the Integrated Safety Analysis (ISA) Summary lists all of the Items Relied On For Safety (IROFS) designated for high-and intermediate-consequence accident sequences.

3.8.1 IROFS

Table 3.8-1, Items Relied On For Safety (IROFS), provides the IROFS designated for the National Enrichment Facility (NEF). Those IROFS designated with "C" (e.g., IROFSC1) are from the classified ISA. All other IROFS (e.g., IROFS1) are from the non-classified ISA. These IROFS either reduce the likelihood of occurrence, or the consequences, of the accident scenarios such that the associated risks are acceptable. The IROFS, which reduce the likelihood of occurrence, are termed "preventive" whereas the IROFS, which reduce the consequences, are termed "mitigative." The majority of the IROFS designated for this facility are preventive. The IROFS designated for the NEF ensure that the hazards identified for this facility result in potential accident sequences that are of acceptable risk, as defined in Table 3.1-6, Risk Matrix with Risk Index Values. There are no IROFS that are frequently or continuously challenged.

Table 3.8-1, describes each IROFS, identifies its expected safety function, and references the accident sequence (as found in Table 3.7-2, Accident Sequence Descriptions and Table 3.7-4, External Events and Fire Accident Descriptions) that describes the conditions needed for the IROFS to reliably perform its function and the effects of its failure. The Table 3.8-1 description of each IROFS also identifies the Failure Probability Index Numbers. For indices that are more negative than the lower absolute value nominally assigned to the type of IROFS indicated from Table 3.1-10, a reference is made to Section 3.8.3, Basis for Enhanced or High Availability Failure Probability Index Number, to justify the index value used. The reliability for an IROFS is proportionate to the amount of risk reduction relied on in the ISA. Thus, the level of the reliability management measures applied to an IROFS is commensurate with the required reliability. Management measures will ensure that IROFS are designed, implemented, and maintained, as necessary, to be available and reliable to perform their safety function when needed. The degree of reliability and availability of IROFS ensured by these measures are consistent with the evaluations of accident likelihood in the ISA. As described in Section 3.8.1.3, general high-quality Management Measures are applied to all IROFS. However, certain IROFS evaluated in the ISA may require "enhanced" administrative controls or may require automatic engineered controls to have "high availability." The basis for these evaluations is presented in Section 3.8.3, as referenced from Table 3.8-1.

For accident sequences postulated to result in nuclear criticality, IROFS are specified to ensure subcriticality under all normal and credible abnormal conditions. In order to identify IROFS, it was conservatively assumed that initiating events would result in criticality. The IROFS associated with criticality accident sequences have been specified consistent with the definition of "Items relied on for safety" in 10 CFR 70.4, "Definitions" (CFR, 2003a).

IROFS will be designed, constructed, tested and maintained to QA Level 1. IROFS will comply with design requirements established by the ISA and the applicable codes and standards (current approved version at the time of design). IROFS components and their designs will be of proven technology for their intended application. These IROFS components and systems will be qualified to perform their required safety functions under normal and accident conditions, e.g., pressure, temperature, humidity, seismic motion, electromagnetic interference, and radio-frequency interference, as required by the ISA. IROFS components and systems will be qualified using the applicable guidance in Institute of Electrical and Electronics Engineers (IEEE) standard IEEE-323, 1983, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations" (IEEE, 1983). Furthermore, IROFS components and systems will be designed, procured, installed, tested, and maintained using the applicable guidance in Regulatory Guide 1.180, "Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems," Revision 1, dated October 2003 (NRC, 2003). IROFS systems will be designed and maintained consistent with the reliability assumptions in the ISA. Redundant IROFS systems will be separate and independent from each other. IROFS systems will be designed to be fail-safe. In addition, IROFS systems will be designed such that process control system failures will not affect the ability of the IROFS systems to perform their required safety functions. Plant control systems will not be used to perform IROFS functions. Installation of IROFS systems will be in accordance with engineering specifications and manufacturer's recommendations. Required testing and calibration of IROFS will be consistent with the assumptions of the ISA and setpoint calculations, as applicable. For hardware IROFS involving instrumentation which provides automatic prevention or mitigation of events, setpoint calculations are performed in accordance with a setpoint methodology, which is consistent with the applicable guidance provided in Regulatory Guide 1.105, "Setpoints for Safety-Related Instrumentation," Revision 3, dated December 1999 (NRC, 1999).

In addition, for those IROFS requiring operator actions, a human factors engineering review of the human-system interfaces shall be conducted using the applicable guidance in NUREG-0700, "Human-System Interface Design Review Guidelines," Revision 2, dated May 2002 (NRC, 2002), and NUREG-0711, "Human Factors Engineering Program Review Model," Revision 2, dated February 2004 (NRC, 2004).

For IROFS and IROFS with Enhanced Failure Probability Index Numbers (i.e., enhanced IROFS) that require "independent verification" of a safety function, the independent verification shall be independent with respect to personnel and personnel interface. Specifically, a second qualified individual, operating independently (e.g., not at the same time or not at the same location) of the individual assigned the responsibility to perform the required task, shall, as applicable, verify that the required task (i.e., safety function) has been performed correctly (e.g., verify a condition), or re-perform the task (i.e., safety function), and confirm acceptable results before additional action(s) can be taken which potentially negatively impact the safety function of the IROFS. The required task and independent verification shall be implemented by procedure and documented by initials or signatures of the individuals responsible for each task. In addition, the individuals performing the tasks shall be qualified to perform, for the particular system or process (as applicable) involved, the tasks required and shall possess operating knowledge of the particular system or process (as applicable) involved and its relationship to facility safety. The requirements for independent verification are consistent with the applicable guidance provided in ANSI/ANS-3.2-1994 (ANSI, 1994).

The following information related to IROFS will be available onsite in the ISA documentation once final design is completed.

- Hardware IROFS design details, such as system schematics and/or descriptive lists, sufficient to determine the structures, system, equipment or component included within the hardware IROFS' boundary
- Identification of essential utilities and support systems on which the IROFS depends to perform the intended safety functions
- Operating ranges and limits for measured process variables, e.g., temperature, pressure, associated with IROFS
- Basis for establishing the average vulnerable outage time to maintain acceptable IROFS availability
- Safety limits and safety margins, as applicable.

3.8.2 Sole IROFS List

The sole IROFS for the NEF are provided in Table 3.8-2, Sole Items Relied On For Safety (IROFS). Table 3.8-2 identifies the sole IROFS titles, IROFS identifier, and references the accident sequence (in Table 3.7-2, Accident Sequence Descriptions, and Table 3.7-4, External Events and Fire Accident Descriptions) that describes the conditions needed for the IROFS to reliably perform its function and effects of its failure. The description of the sole IROFS associated safety functions is provided in Table 3.8-1. Sole IROFS are those designated as Class A on Table 3.8-1.

A sole IROFS is a single item or feature that is relied upon to prevent or mitigate an accident for which the consequences could exceed the performance requirements in 10 CFR 70.61 (CFR, 2003b). It is acceptable to rely on these sole IROFS for non-criticality accident sequences because these IROFS will reliably provide sufficient preventive and mitigative features to ensure that the associated accident sequence results in an acceptable risk.

3.8.3 Basis for Enhanced or High Availability Failure Probability Index Number

For Failure Probability Index Number (FPIN) indices that are more negative than the lower absolute value nominally assigned to the type of IROFS indicated from Table 3.1-10, the following bases are provided. These IROFS reflect "enhanced" administrative controls and/or active engineered controls with "high availability." The following Sections are referenced from Table 3.8-1 for these IROFS. The nominal Management Measures outlined in Section 3.1.8.3 that apply to all IROFS, continue to also provide high quality assurance that these IROFS will be maintained, however, the following additional Management measures provided the basis for assigning the more negative value.

(Note subsection numbering is not contiguous. Subsections numbered to correspond to applicable IROFS number.)

3.8.3.14a IROFS14a Basis for Enhanced FPIN

The enhanced (i.e., Index of "-3") administrative control to restrict proximity of vessels in non-designed locations containing enriched uranic material to ensure subcritical configuration by verifying the use of a safe-by-design transfer frame is based on the following factors:

The failure to use a safe-by-design transfer frame will be precluded by independent verification prior to the movement of associated vessels containing enriched uranic material. This enhancement shall meet the requirements for independent verification identified in Section 3.8.1.

3.8.3.14b IROFS14b Basis for Enhanced FPIN

The enhanced (i.e., Index of "-3") administrative control to restrict proximity of vessels in non-designed locations containing enriched uranic material to ensure subcritical configuration by verifying the associated storage array condition is acceptable for storing the vessel and no other component containing enriched uranic material is in movement in the designated area is based on the following factors:

The failure to ensure that the required conditions are met for subcritical configuration will be precluded by independent verification prior to the movement of associated vessel containing enriched uranic material. This enhancement shall meet the requirements for independent verification identified in Section 3.8.1.

3.8.3.15 IROFS15 Basis for Enhanced FPIN

The enhanced (i.e., Index of "-3") administrative control to restrict an independent parameter of the criticality sequence to ensure subcritical configuration by preventing additional transfer of enriched uranic material to another container if that container contains enriched uranic material and is a non-safe-by-design container is based on the following factors:

Transfer of enriched uranic material into another container that contains enriched uranic material and is a non-safe-by-design container will be precluded by independent verification prior to the transfer of the enriched uranic material into a container. This enhancement shall meet the requirements for independent verification identified in Section 3.8.1.

3.8.3.16a IROFS16a Basis for Enhanced FPIN

The enhanced (i.e., Index of "-3") administrative control to limit moderator mass (oil and water) in cylinders containing enriched uranic material to ensure subcriticality by allowing no visible oil and limiting cylinder vapor pressure is based on the following factors:

The presence of visible oil in a cylinder and cylinder vapor pressure above required limits will be precluded by independent verification prior to the introducing product into a cylinder. This enhancement shall meet the requirements for independent verification identified in Section 3.8.1.

3.8.3.23a IROFS23a Basis for Enhanced FPIN

The enhanced (i.e., Index of "-3") administrative control for use of personal respiratory protection to ensure that inhalation of uranic material and HF consequences are low is based on the following factors:

The failure to use personal respiratory protection will be precluded by independent verification prior to the performing positive pressure testing of UF_6 cylinder after repair/replacement of a leaking cylinder component. This enhancement shall meet the requirements for independent verification identified in Section 3.8.1.

3.8.3.26 IROFS26 Basis for High Availability FPIN

The high availability (i.e., Index of "-3") of the seismic trip of building area HVAC is based on a requirement for increased frequency of functional testing of the trip function. To limit the potential duration of unavailability of the trip function, a monthly functional test is required.

3.8.3.35 IROFS35 Basis for Enhanced FPIN

The high availability (i.e., Index of "-3") of the fire barriers, which include active engineered control associated with automatic closure of fire doors and dampers, is based on the following factors:

(1) Barriers shall be designed with adequate safety margin such that the total combustible loading (in situ and transients) allowed to expose the barrier will not exceed 80% of the hourly fire resistance rating of the barrier.

(2) Doors shall be automatic, self-closing and maintained in the closed position during normal operation or they will be provided with passive actuation mechanisms (e.g., fusible links) to affect closure in the event of a fire.

(3) Fire dampers in openings or HVAC duct penetrations shall be provided with passive actuation mechanisms (e.g., fusible links) to affect closure in the event of a fire.

(4) Routine (at least weekly) visual inspection of accessible areas ensures fire doors are closed or not inhibited from closing and latching in the closed position.

(5) Periodic visual inspection of dampers and through-penetration seal systems and functional testing of doors and dampers equipped with passive actuation devices confirms functionality.

(6) Spatial separation of not less than 3 meters (10 feet) is provided between interim storage of transient combustibles and critical components. The separation criteria will not apply during an individual operation or maintenance activity in this area due to the presence of personnel in the area performing the operation or activity. These personnel would be able to readily detect a fire in the proximity. This provides added margin to potential fire loading that is not credited in transient combustible allowance.

3.8.3.36a IROFS36a Basis for Enhanced FPIN

The enhanced (i.e., Index of "-3") administrative control to limit transient combustible loading is based on the following factors:

(1) Routine (at least weekly) visual inspection of accessible areas ensures no transient combustibles (other than may be appropriately labeled as accepted by Fire Safety Review) stored within any areas of concern.

(2) Areas of concern shall be appropriately posted to require consideration of entry with transient combustibles only in accordance with approved procedures, including a permitting system as appropriate.

3.8.3.36b IROFS36b Basis for Enhanced FPIN

The enhanced (i.e., Index of "-3") administrative control to limit storage of UF_6 cylinders in the CRDB to ensure a minimum 1 m (3 ft) setback from the edge of the loading dock is based on the following factors:

(1) Routine (at least daily) visual inspection to verify appropriate cylinder storage.

(2) Visual markings on loading dock floor to designate non-storage area.

(3) Additional verification prior to truck entering CRDB that cylinders are properly stored at > 1 m (3 ft).

3.8.3.36c IROFS36c Basis for Enhanced FPIN

The enhanced (i.e., Index of "-3") administrative control to limit onsite UF_6 cylinder transporters/movers to ensure only use of electric drive or diesel powered with a fuel capacity of less than 280 L (74 gal) is based on the following factors:

(1) The designed cylinder transporters/movers shall be electric drive or diesel powered with a fuel capacity of less than 280 L (74 gal).

(2) Transportation of cylinders by means other than the designed transporters/ movers will be precluded by independent verification.

3.8.3.36d IROFS36d Basis for Enhanced FPIN

The enhanced (i.e., Index of "-3") administrative control to limit transient combustible loading in the fire area of concern to ensure integrity of uranic material containers and to ensure the quantity of uranic material at risk results in consequences to the public that are low, is based on the following factors:

(1) Routine (at least weekly) visual inspection of accessible areas ensures no transient combustibles (other than may be appropriately labeled as accepted by Fire Safety Review) stored within any areas of concern.

(2) Routine (at least daily) visual inspection verifies no excessive open containers and that all stored waste is contained in metal containers.

(3) Areas of concern shall be appropriately posted to require consideration of entry with transient combustibles only in accordance with approved procedures, including a permitting system as appropriate.

3.8.3.36e IROFS36e Basis for Enhanced FPIN

The enhanced (i.e., Index of "-3") administrative control to limit transient combustible loading on the UBC pad to ensure the presence of only electric drive vehicles or diesel powered vehicles with a fuel capacity of less than 280 L (74 gal), is based on the following factors:

(1) Routine (at least weekly) visual inspection ensures no transient combustibles (other than may be appropriately labeled as accepted by Fire Safety Review) stored on the UBC pad.

(2) The designed cylinder transporters/movers shall be electric drive or diesel powered with a fuel capacity of less than 280 L (74 gal).

(3) Access to the UBC pad with vehicles other than the designed cylinder transporters/movers will require verification that vehicle fuel capacity is less than 280 L (74 gal).

3.8.3.36f IROFS36f Basis for Enhanced FPIN

The enhanced (i.e., Index of "-3") administrative control to limit bulk fueling vehicles onsite to ensure UBC cylinder integrity is based on the following factors:

(1) Diesel fuel deliveries shall require escort to diesel fuel offload station following designated route that ensures adequate distance from UBC pad and buildings of concern.

(2) NEF site design shall provide surface gradient at the diesel fuel offload station away from UBC pad, or shall provide appropriate containment features.

(3) Design location for diesel fuel offloading will assure adequate distance from UBC to preclude challenge to cylinder integrity.

3.8.3.36g IROFS36g Basis for Enhanced FPIN

The enhanced (i.e., Index of "-3") administrative control to limit onsite vegetation fire sources to ensure integrity of important targets, is based on the following factors:

(1) Routine landscaping upkeep results in potential fire loading margins to cylinder and building wall fire ratings of such magnitude as to make this event highly unlikely.

(2) Routine (at least daily) visual inspection by security personnel provides enhanced monitoring.

3.8.3.36h IROFS36h Basis for Enhanced FPIN

The enhanced (i.e., Index of "-3") administrative control to limit fire exposure to feed cylinders, product cylinders, and UBCs containing $\geq$ 0.1 kg of UF_6 due to a semi-tractor trailer fire during the receipt and shipping process, is based on the following factors:

(1) Routine (at least daily) visual inspection to verify appropriate cylinder load/unload practices, including installation of required U.S. Department of Transportation (DOT) cylinder overpacks/protective assemblies.

(2) Additional verification, through manifest/shipping inspection of receipt/delivery vehicles at CRDB entry and departure, that incoming and outgoing cylinders have the required DOT protective assemblies properly installed or are in the required DOT overpacks.

3.8.3.38 IROFS38 Basis for Enhanced FPIN

The enhanced (i.e., Index of "-3") administrative control to limit the cylinder fill mass to ensure cylinder integrity is based on the following factors:

Exceeding the cylinder fill mass limit will be precluded by independent verification (i.e., second verification) performed on the next shift following the completion of the IROFS38 periodic verification on the previous shift (i.e., first verification). This enhancement shall meet the requirements for independent verification identified in Section 3.8.1.

3.8.3.39a IROFS39a Bases for Enhanced FPIN

The enhanced (i.e., Index of "3") administrative control to limit worker exposure by requiring evacuation of area(s) of concern in the event of a seismic event, is based on the following factors:

(1) Worker detection of ground motion associated with a seismic event is immediate (i.e., the worker will immediately sense and recognize ground motion associated with the seismic event of concern).

(2) Heightened awareness will allow immediate response to the seismic event. Training recall is greatly enhanced. Worker response for any release is expected to be immediate.

(3) Any release from UF_6 systems/cylinders at the NEF would predominantly consist of HF with some potential entrainment of uranic particulate. An HF release would predominately cause a visible cloud and a pungent odor which is detectable at concentrations less than 1 ppm. This odor threshold is well below the concentration that could cause permanent injury or produce escape-impairing symptoms. Inhalation of HF causes an intolerable prickling, burning sensation in the nose and throat, with cough and pain beneath the sternum. Ocular exposure to HF causes a burning sensation, redness and secretion. As a result, worker desire to promptly vacate the area will be high.

(4) Workers away from the immediate area of release would detect the release by the vapor cloud produced. The release will involve both white UF_6 (solid) and yellow uranyl fluoride reaction products. Visual clues as well as odor gradient will provide adequate assurance that the worker exposure time is less than that used in the consequence calculation.

(5) Sufficient time is available for the worker to reliably detect the event and evacuate the area(s) of concern.

3.8.3.39b IROFS39b Bases for Enhanced FPIN

The enhanced (i.e., Index of "3") administrative control to limit worker exposure by requiring evacuation of area(s) of concern in the event of a fire, is based on the following factors:

(1) Worker detection of a fire in the area is prompt and will occur prior to the fire reaching the magnitude necessary to cause a release (i.e., visual clues and odor are sufficient to allow prompt detection of a fire by workers in the area).

(2) Heightened awareness will allow immediate worker response to the fire. Training recall is greatly enhanced.

(3) Any release from UF_6 systems/cylinders at the NEF would predominantly consist of HF with some potential entrainment of uranic particulate. An HF release, in the event of a fire, would have a pungent odor which is detectable even in the presence of products of combustion. The odor threshold is well below the concentration that could cause permanent injury or produce escape-impairing symptoms. Inhalation of HF causes an intolerable prickling, burning sensation in the nose and throat, with cough and pain beneath the sternum. Ocular exposure to HF causes a burning sensation, redness and secretion. As a result, worker desire to promptly vacate the area will be high.

(4) Workers away from the immediate area of release would detect the release by the visible products of combustion, the odor from the products of combustion, and/or the odor of HF from the release. Visual clues as well as odor will provide adequate assurance that the worker exposure time is less than that used in the consequence calculation.

(5) Sufficient time is available for the worker to reliably detect the event and evacuate the area(s) of concern.

3.8.3.39c IROFS39c Bases for Enhanced FPIN

The enhanced (i.e., Index of "3") administrative control to limit worker exposure by requiring evacuation of area(s) of concern in the event of a release, is based on the following factors:

(1) Worker detection of a release is immediate (i.e., the local worker will immediately sense and recognize a release, the worker elsewhere in the area will promptly detect the release by visual clues and odor associated with the release).

(2) Heightened awareness will allow immediate response to an event resulting from a release. Training recall is greatly enhanced. Worker response for any release is expected to be immediate.

(3) Any release from UF_6 systems/cylinders at the NEF would predominantly consist of HF with some potential entrainment of uranic particulate. An HF release would predominately cause a visible cloud and a pungent odor which is detectable at concentrations less than 1 ppm. This odor threshold is well below the concentration that could cause permanent injury or produce escape-impairing symptoms. Inhalation of HF causes an intolerable prickling, burning sensation in the nose and throat, with cough and pain beneath the sternum. Ocular exposure to HF causes a burning sensation, redness and secretion. As a result, worker desire to promptly vacate the area will be high.

(4) Workers away from the immediate area of release would detect the release by the vapor cloud produced. The release will involve both white UF_6 (solid) and yellow uranyl fluoride reaction products. Visual clues as well as odor gradient will provide adequate assurance that the worker exposure time is less than that used in the consequence calculation.

(4) Sufficient time is available for the worker to reliably detect the event and evacuate the area(s) of concern.

3.8.3.45 IROFS45 Basis for Enhanced FPIN

The enhanced (i.e., Index of "-3") administrative control to ensure subcritical geometry, by verifying that the stored cylinders containing enriched uranium in the CRDB and Blending and Liquid Sampling Areas are in a horizontal, co-planar (i.e., non-stacked), condition and that no other cylinder containing enriched uranium is in movement in the associated area, is based on the following factors:

The failure to ensure that the required conditions are met for subcritical geometry will be precluded by independent verification prior to moving a cylinder containing enriched uranium in the CRDB or the Blending and Liquid Sampling Area. This enhancement shall meet the requirements for independent verification identified in Section 3.8.1.

3.8.3.C6 IROFSC6 Basis for Enhanced FPIN

The enhanced (i.e., Index of "-3") administrative control to calculate and set the cascade enrichment control device in accordance with the calculation to ensure ^{235}U enrichment $\leq$ 5 $^{w}/_{o}$ to ensure subcriticality within the designed process and analyzed activities is based on the following factors:

Exceeding the ^{235}U enrichment license limit of 5 $^{w}/_{o}$ will be precluded by independent verification of the cascade enrichment control device setting calculation prior to changing the cascade enrichment control device setting and independent verification of implementation of the enrichment control device setting within 1 hour after changing the cascade enrichment control setting. This enhancement shall meet the requirements for independent verification identified in Section 3.8.1.

3.8.4 References

ANSI, 1994. Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants, ANSI/ANS-3.2-1994, American National Standards Institute/American Nuclear Society, 1994.

CFR, 2003a. Title 10, Code of Federal Regulations, Section 70.4, Definitions, 2003.

CFR, 2003b. Title 10, Code of Federal Regulations, Section 70.61, Performance Requirements, 2003.

IEEE, 1983. Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations, IEEE-323, Institute of Electrical and Electronics Engineers, 1983.

NRC, 1999. Setpoints for Safety-Related Instrumentation, Regulatory Guide 1.105, U.S. Nuclear Regulatory Commission, Revision 3, December 1999.

NRC, 2002. Human-System Interface Design Review Guidelines, NUREG-0700, U.S. Nuclear Regulatory Commission, Revision 2, May 2002.

NRC, 2003. Regulatory Guide 1.180, Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems, Revision 1, October 2003.

NRC, 2004. Human Factors Engineering Program Review Model, NUREG-0711, U.S. Nuclear Regulatory Commission, Revision 2, February 2004.

TABLES

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IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS1	TT2-1 UF2-1 PT2-1 PB2-1	Chemical	AEC	B	Automatic trip of defrost heater and fan on high air return temperature to ensure cylinder integrity. This is implemented with a hardwired temperature sensor for automatic, fail-safe, high air return temperature trip of defrost heaters and fans at Tails Low Temperature Take-off Stations, Feed Purification Low Temperature Take-off Stations, Product Low Temperature Take-off Stations, and Product Blending Receiver Stations. Setpoint conservative with respect to assuring cylinder integrity.	-2	N/A
IROFS2	TT2-1 UF2-1 PT2-1 PB2-1	Chemical	AEC	B	Automatic trip of defrost heater and fan on high station internal air temperature to ensure cylinder integrity. This is implemented with a capillary temperature sensor for automatic, hardwired, fail-safe, high station internal air temperature trip (independent and diverse from IROFS1) of defrost heaters and fans at Tails Low Temperature Take-off Stations, Feed Purification Low Temperature Take-off Stations, Product Low Temperature Take-off Stations and Product Blending Receiver Stations. Setpoint conservative with respect to assuring cylinder integrity.	-2	N/A

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS3	DC1-6 DC1-8	Chemical	AEC	A	Automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6. This is implemented with an automatic hardwired, fail-safe, trip of the vacuum pump on high weight of the evacuation skid carbon trap in the Tails Evacuation System, Feed Purification Subsystem, Product Vent Subsystem, Blending and Sampling Vent Subsystem, Ventilated Room Cylinder Pressure Test & Pump Out Rig, Cylinder Preparation Vacuum Pump and Trap Set System, and Contingency Dump System. Setpoint conservative with respect to saturated carbon trap weight.	-2	N/A
IROFS3	TT3-1 UF3-1 PB3-3 CP1-4 PT3-2 VR1-5 EC4-1 DC1-1 DC1-2 DC1-3 DC1-4 DC1-5 DC1-7 TP8-2	Chemical	AEC	B	Automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6. This is implemented with an automatic hardwired, fail-safe, trip of the vacuum pump on high weight of the evacuation skid carbon trap in the Cascade Sampling Rig, the Contingency Dump System and the Centrifuge Test Facility Vent Subsystem. Setpoint conservative with respect to saturated carbon trap weight.	-2	N/A

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS3	PB2-3 PB3-1 VR1-1 CP1-1 EC4-2 PT3-1	Criticality	AEC	B	Automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6. This is implemented with an automatic hardwired, fail-safe, trip of the vacuum pump on high weight of the evacuation skid carbon trap in the Product Vent Subsystem, Blending and Sampling Vent Subsystem, Ventilated Room Cylinder Pressure Test & Pump Out Rig, Cylinder Preparation Vacuum Pump and Trap Set System, Cascade Sampling Rig and Contingency Dump. Setpoint conservative with respect to saturated carbon trap weight.	-2	N/A
IROFS4	UF1-1 PB1-1	Chemical	AEC	B	Automatic trip of station heaters on high cylinder temperature to ensure cylinder integrity. This is implemented with a hardwired temperature sensor for automatic, fail-safe, trip on high cylinder temperature of Solid Feed Station and Blending Donor Station heaters. Setpoint conservative with respect to assuring cylinder integrity.	-2	N/A
IROFS5	UF1-1 PB1-1	Chemical	AEC	B	Automatic trip of station heaters on high station internal air temperature to ensure cylinder integrity. This is implemented with a capillary temperature sensor for automatic, fail-safe, trip (independent and diverse from IROFS4) on high internal air temperature of Solid Feed Station and Blending Donor Station heaters. Setpoint conservative with respect to assuring cylinder integrity.	-2	N/A

Table 3.8-1 Items Relied On For Safety (IROFS)

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS6a	PT2-2	Criticality	AC	N/A	Administrative verification of distinguishing visual markings/ identification of 48X and 48Y cylinders within the UF_6 area to ensure that cylinders containing product are not placed on-line to the cascade. Each 48X and 48Y cylinder will have distinguishing feature(s) that identifies product cylinders as not feed cylinders.	N/A	N/A
IROFS6b	PT2-2	Criticality	AC	B	Administrative verification of ^{235}U concentration in feed cylinders to ensure that product material is not used as feed material by sampling and assay analysis. This is implemented by sampling and assay analysis of feed cylinder contents for uranic enrichment and verification that it is not a product cylinder before being placed on-line to the cascade consistent with the assumptions in the Nuclear Criticality Safety Analyses. If the established acceptance criterion is not met, the cylinder shall not be placed on-line to the cascade.	-2	N/A
IROFS7	PT2-2	Criticality	PEC	B	Design feature to physically prevent product cylinder within the UF_6 area from being placed in a Solid Feed station. This is implemented by design features unique to feed cylinders and unique to product cylinders to preclude inter-changing feed and product cylinders.	-3	N/A

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS8a	PT3-1 PT3-3 PB2-3 PB3-1 PB3-2 EC4-2	Criticality	AEC	B	Automatic trip on ^{235}U selective high-high gamma to ensure no more than a subcritical mass deposited on the SB GEVS filter or precipitator. Upon detection of ^{235}U selective high-high gamma levels in the SB GEVS filter by hardwired, fail-safe, instrumentation, the operating SB GEVS train trips. Upon detection of high-high gamma levels in the SB GEVS precipitator, the trip realigns dampers to bypass and isolate the electrostatic precipitator. Setpoint conservative with respect to assuring subcritical mass as determined from Nuclear Criticality Safety Analyses.	-2	N/A
IROFS8b	PB4-5	Criticality	AEC	B	Automatic trip on ^{235}U selective high-high gamma to ensure no more than a subcritical mass deposited on the SB GEVS filter. Upon detection of ^{235}U selective high-high gamma levels in the SB GEVS filter by hardwired, fail-safe, instrumentation, the operating SB GEVS train trips. Setpoint conservative with respect to assuring subcritical mass as determined from Nuclear Criticality Safety Analyses.	-2	N/A
IROFS9	PT3-3 PB3-2	Criticality	AEC	B	Automatic trip of the vacuum pump on carbon trap high temperature to ensure the carbon trap does not pass excessive UF_6. This is implemented with a hardwired, fail-safe, temperature sensor for automatic trip of the Product Vent Subsystem and Blending and Sampling Vent Subsystem vacuum pumps on carbon trap high temperature. Setpoint conservative with respect to temperatures that reflect excessive UF_6 flowrate.	-2	N/A

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS10	PB4-1 PB4-3	Chemical	PEC	A	Design feature to maintain Product Liquid Sampling Autoclave leak tight integrity. Total autoclave leakage is limited to that assumed in the consequence analyses.	-3	N/A
IROFS10	PB4-4	Chemical	PEC	B	Design feature to maintain Product Liquid Sampling Autoclave leak tight integrity. Total autoclave leakage is limited to that assumed in the consequence analyses.	-3	N/A
IROFS11	PB4-2	Chemical	AEC	B	Automatic trip of the autoclave heater and fan on autoclave high internal air temperature to ensure Product Liquid Sampling Autoclave integrity. This is implemented with an automatic fail-safe hardwired temperature sensor for trip (independent from IROFS12) of the heater and fan on high internal air temperature for the Product Liquid Sampling Autoclave integrity. Setpoint conservative with respect to assuring cylinder and autoclave integrity.	-2	N/A
IROFS12	PB4-2	Chemical	AEC	B	Automatic trip of the autoclave heater and fan on autoclave high internal air pressure to ensure Product Liquid Sampling Autoclave integrity. This is implemented with an automatic fail-safe hardwired pressure sensor for trip (independent of IROFS11) of the heater and fan on high air pressure for the Product Liquid Sampling Autoclave integrity. Setpoint conservative with respect to assuring autoclave integrity.	-2	N/A

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS13	PB4-5	Criticality	AEC	B	Automatic inhibit prevents opening of GEVS vent valve on high-high HF in the autoclave to ensure no more than a subcritical mass deposited on SB GEVS filter. This is implemented with a hardwired, fail-safe, HF sensor to automatically inhibit retraction of the shotbolt in the Product Liquid Sampling Autoclave (preventing opening the GEVS vent valve) on high-high HF. Setpoint conservative with respect to assuring subcritical mass as determined from Nuclear Criticality Safety Analyses.	-2	N/A

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS14a	FR1-1 FR2-1 DS1-1 DS2-1 DS3-1 SW1-1 LW1-2	Criticality	AC	A	Administratively restrict proximity of vessels in non-designed locations containing enriched uranic material to ensure subcritical configuration. This is implemented by verifying the use of a safe-by-design transfer frame prior to movement of the associated waste container containing enriched uranic material. The proximity limit, enforced by the safe-by-design transfer frame, is based on assumptions in the Nuclear Criticality Safety Analyses. If the acceptance criterion is not met, then the associated waste container shall not be moved.	-3	3.8.3.14b
IROFS14b	FR1-2 FR2-2 DS1-2 DS2-2 DS3-2 SW1-2 LW1-3	Criticality	AC	A	Administratively restrict proximity of vessels in non-designed locations containing enriched uranic material to ensure subcritical configuration. This is implemented by verifying, prior to moving a waste container containing enriched uranic material within 180 cm of the associated storage array, the associated storage array condition is acceptable for storing the associated waste container (i.e., the storage array is the correct array for storage of the associated waste container, no component containing enriched uranic material is stored within 180 cm of the storage array (except in storage array locations), components are correctly stored in the array, and a vacant location is available for storage of the associated waste container) and no component containing enriched uranic material is in movement n the designated area. If the acceptance criteria are not met, then the associated waste container containing enrich uranic material shall not be moved.	-3	3.8.3.14b

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS15	PT3-5	Criticality	AC	A	Administratively restrict an independent parameter of the criticality sequence to ensure subcritical configuration by preventing additional transfer of enriched uranic material to another container if that container contains enriched uranic material and is a non-safe-by-design container. This will be implemented by establishing controls independent from other IROFS in applicable accident sequences. Specifically, IROFS15 will require verification that the associated container, into which enriched uranic material will be transferred, either contains no enriched uranic material or is a safe-by-design container prior to the transfer of the enriched uranic material into a container. If the acceptance criteria are not met, then the transfer of the enriched uranic material to the container shall not be initiated.	-3	3.8.3.15

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS16a	PB2-2 CP1-2	Criticality	AC	A	Administratively limit moderator mass (oil and water) in cylinders containing enriched uranic material to ensure subcriticality by allowing no visible oil and by limiting cylinder vapor pressure. This is implemented by allowing no visible oil and by limiting cylinder vapor pressure prior to introducing product, which is based on moderator limitations in the Nuclear Criticality Safety Analyses for product and receiver cylinders. If the acceptance criteria are not met, then product shall not be introduced into the associated cylinder.	-3	3.8.3.16a
IROFS16c	PT2-3 PB2-5	Criticality	AC	B	Administratively limit addition of moderator from system venting to ensure cylinder subcriticality using an independent means of monitoring system venting from that used for IROFS16d. This is implemented by monitoring instrumentation that provides indication of system vent operations and the operator limiting the total vent-count based on moderator limitations in the Nuclear Criticality Safety Analyses for product and receiver cylinders. This monitoring instrumentation shall be independent of the instrumentation used for IROFS16d and shall monitor a different parameter than is monitored for IROFS16d. If the acceptance criterion is not met, then venting of the associated cylinder shall be stopped and the cylinder filling process terminated.	-2	N/A

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS16d	PT2-3 PB2-5	Criticality	AC	B	Administratively limit addition of moderator from system venting to ensure cylinder subcriticality using an independent means of monitoring system venting from that used for IROFS16c. This is implemented by a second independent, operator monitoring instrumentation that provides indication of system vent operations and verifying the total vent-count is within required limits based on moderator limitations in the Nuclear Criticality Safety Analyses for product and receiver cylinders. This monitoring instrumentation shall be independent of the instrumentation used for IROFS16c and shall monitor a different parameter than is monitored for IROFS16c. If the acceptance criterion is not met, then venting of the associated cylinder shall be stopped and the cylinder filling process terminated.	-2	N/A

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS19a	DS1-3 DS2-3 LW1-1 LW2-1 LW3-1 LW5-1	Criticality	AC	B	Administratively limit the calculated tank uranic mass inventory to ensure a subcritical mass using bookkeeping procedures. This is implemented by bookkeeping procedures to limit calculated uranic mass to that assumed in the Nuclear Criticality Safety Analyses for the following Equipment Decontamination and Liquid Effluent Collection and Treatment Systems tanks: degreaser, citric acid, rinse water (2), spent citric acid, degreaser water collection, miscellaneous effluent collection, and the precipitation treatment. The calculated tank uranic mass inventory shall be determined using bookkeeping procedures prior to transfer of enriched uranic material to the associated tank. If the acceptance criterion is not met, then the enriched uranic material shall not be transferred to the associated tank.	-2	N/A
IROFS19c	DS1-3 DS2-3 LW1-1 LW2-1 LW3-1 LW5-1	Criticality	AC	N/A	Administratively limit measured tank uranic mass inventory to ensure a subcritical mass by performing independent sampling and measurement. This is implemented by independent sampling and measurement, prior to transfer of enriched uranic material to the associated tank, to limit tank uranic mass to that assumed in the Nuclear Criticality Safety Analyses for the following Equipment Decontamination and Liquid Effluent Collection and Treatment Systems tanks: degreaser, citric acid, rinse water (2), spent citric acid, degreaser water collection, miscellaneous effluent collection, and the precipitation treatment. IROFS19c is independent of IROFS19d. If the acceptance criterion is not met, then enriched uranic material shall not be transferred to the associated tank.	N/A	N/A

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS19d	DS1-3 DS2-3 LW1-1 LW2-1 LW3-1 LW5-1	Criticality	AC	B	Administratively limit measured tank uranic mass inventory to ensure a subcritical mass by performing independent sampling and measurement. This is implemented by independent sampling and measurement, prior to transfer of enriched uranic material to the associated tank, to limit tank uranic mass to that assumed in the Nuclear Criticality Safety Analyses for the following Equipment Decontamination and Liquid Effluent Collection and Treatment Systems tanks: degreaser, citric acid, rinse water (2), spent citric acid, degreaser water collection, miscellaneous effluent collection, and the precipitation treatment. IROFS19d is independent of IROFS19c. If the acceptance criterion is not met, then enriched uranic material shall not be transferred to the associated tank.	-2	N/A
IROFS20	CL3-1	Criticality	AEC	B	Automatic isolation of cold trap on cold trap high temperature to ensure no more than a subcritical mass deposited on the TSB GEVS filter. This is implemented with an automatic hardwired, fail-safe, high temperature sensor that will close the Cold Trap No. 2 Valve, which is in line to the sub-sampling rig vacuum pump. This will prevent potential flow of UF_6 product to the TSB GEVS in the event that the associated UF_6 cold trap is above a conservative desublimation temperature. Setpoint conservative with respect to assuring desublimation temperature.	-2	N/A

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS21	VR1-1 VR1-2 CL3-1 CP1-1	Criticality	AEC	B	Automatic trip of the TSB GEVS on ^{235}U selective high-high gamma to ensure no more than a subcritical mass deposited on the filter. Upon detection of ^{235}U selective high-high gamma levels in the TSB GEVS filter by hardwired, fail-safe, instrumentation, the TSB GEVS trips. Setpoint conservative with respect to assuring critical mass as determined from Nuclear Criticality Safety Analyses.	-2	N/A
IROFS22	VR1-2	Criticality	AEC	B	Automatic trip of the vacuum pump on carbon trap high temperature to ensure the carbon trap does not pass excessive UF_6. This is implemented with an automatic hardwired, fail-safe, trip of the Ventilated Room evacuation skid vacuum pump on carbon trap high temperature. Setpoint conservative with respect to temperatures that reflect excessive UF_6 flowrate.	-2	N/A

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS23a	VR1-3	Chemical	AC	A	Administrative use of personal respiratory protection to ensure that inhalation of uranic material and HF consequences are low. This is implemented through the use of personal respiratory protection when performing positive pressure testing of UF_6 cylinder after repair/replacement of a leaking cylinder component such that assumptions of the consequence analysis are maintained. If personnel respiratory protection is not used, then the positive pressure test of the UF_6 cylinder shall not be performed.	-3	3.8.3.23a
IROFS23b	VR2-1	Chemical	AC	A	Administrative use of personal respiratory protection to ensure that inhalation of uranic material consequence is low. This is implemented through the use of personal respiratory protection when handling carbon trap material containing uranic material, such that assumptions in the consequence analyses are maintained. If personnel respiratory protection is not used, then carbon trap material containing uranic material shall not be handled.	-2	N/A
IROFS23b	VR2-2	Chemical	AC	B	Administrative use of personal respiratory protection to ensure that inhalation of uranic material consequence is low. This is implemented through the use of personal respiratory protection when handling sodium fluoride (NaF) trap material containing Uranic material such that assumptions in the consequence analyses are maintained. If personnel respiratory protection is not used, then NaF trap material containing uranic material shall not be handled.	-2	N/A

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS24a	VR2-2	Chemical	AC	B	Administrative establishment of airflow away from the worker to ensure inhalation of uranic material consequences are low. This is implemented through the use of the Technical Services Building GEVS connected to the assembly when handling sodium fluoride (NaF) trap material containing uranic material. The TSB GEVS shall be operating during this operation, consistent with assumption of the consequence calculation. If airflow away from the worker is not established, then NaF trap material containing uranic material shall not be handled.	-2	N/A
IROFS24b	CL3-2 CL3-3	Chemical	AC	B	Administrative establishment of airflow away from the worker to ensure inhalation of uranic material and HF consequences are low. This is implemented through TSB GEVS connected to Chemical Lab Hood when UF_6 Sub-sampling Unit is operated during transfer of product samples for assay analysis or during heating of a sample bottle(s) within the UF_6 Sub-sampling Unit. The TSB GEVS shall be operating during this operation, consistent with assumption of the consequence calculation. If airflow away from the worker is not established, then transfer of product samples shall not be initiated and sample bottle(s) in the UF_6 Sub-sampling Unit shall not be heated.	-2	N/A

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS26	SEISMIC-1 SEISMIC-2 SEISMIC-3	Chemical	AEC	A	Automatic Building HVAC system trip on detection of seismic event to ensure offsite exposures from building out flow maintain consequences low. This is implemented with an automatic hardwired, fail-safe, seismic trip of the HVAC Systems in the following areas: Process Services Area, Link Corridor Area, Above Cascade Area, UF_6 Handling Area, and Blending and Liquid Sampling Area, consistent with assumptions of the consequence calculation.	-3	3.8.3.26
IROFS27a IROFS27b	LP-BLD (CR)	Criticality	PEC	B	Design feature of buildings containing enriched uranic material for roof ponding and site flooding due to local intense precipitation, to ensure associated building area subcriticality. This is implemented by designing the building structures (IROFS27a and IROFS27b are required to be independent passive design features) to withstand the effects of local intense precipitation, thus ensuring lack of moderation consistent with the assumptions in the Nuclear Criticality Analyses.	-3	N/A
IROFS27c	SEISMIC-1 SEISMIC-2 SEISMIC-3 TORNADO SNOW LP-BLD (T)	Chemical	PEC	A	Design feature of buildings containing UF_6 process systems for seismic, tornado, tornado missile, high wind, roof snow load, and for roof ponding and site flooding due to local intense precipitation, to ensure UF_6 process systems integrity. This is implemented by designing the building structures to withstand the effects of seismic, tornado, tornado missile, high wind, roof snow load, and local intense precipitation, consistent with the assumptions in the bases for the consequence calculations.	-3	N/A

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS27d	LP-PAD	Chemical	PEC	A	Design feature of the uranium byproduct cylinders (UBC) storage pad for site flooding due to local intense precipitation, to ensure UBC integrity. This is implemented by designing the UBC storage pad to protect the UBCs from the effects of local intense precipitation, consistent with the assumptions in the bases for the consequence calculations.	-3	N/A
IROFS28	SEISMIC-5	Chemical	PEC	A	Design feature to maintain Product Liquid Sampling Autoclave leak tight integrity. This is implemented by providing a seismic design of the Product Liquid Sampling Autoclave such that post-event total autoclave leakage is limited to that assumed in the consequence analyses.	-3	N/A
IROFS30a	PT2-5 PB2-6	Criticality	AC	N/A	Administratively limit hydrocarbon oil (moderator mass) in enriched uranium product to ensure moderation control assumptions are maintained by controlling the type of oil used in process vacuum pumps. This is implemented by controlling the type of oil used in all process vacuum pumps to only perfluorinated polyether (PFPE) oil, consistent with moderation assumptions in the Nuclear Criticality Safety Analyses. If the acceptance criterion are not met, then action shall be initiated to remove the associated vacuum pumps from process systems.	N/A	N/A

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS30b	PT2-5 PB2-6	Criticality	AC	B	Administratively limit hydrocarbon oil (moderator mass) in enriched uranium product to ensure moderation control assumptions are maintained by verifying, through test prior to addition of oil, that process vacuum pump oil is not hydrocarbon oil. This is implemented by testing the oil prior to addition to any process vacuum pump to verify the oil is not hydrocarbon oil, consistent with moderation assumptions in the Nuclear Criticality Safety Analyses. If the acceptance criteria are not met, then the associated oil shall not be added to the process vacuum pump.	-2	N/A

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS30c	PT2-5 PB2-6	Criticality	AC	B	Administratively limit hydrocarbon oil (moderator mass) in enriched uranium product to ensure moderation control assumptions are maintained by verifying, through test (after oil addition) prior to placing vacuum pumps in process system, that process vacuum pump oil is not hydrocarbon oil. This is implemented by testing the oil in all process vacuum pumps for hydrocarbons after bench testing, but before placing vacuum pumps in process systems to verify lack of hydrocarbon oil. This assures operation consistent with moderation assumptions in the Nuclear Criticality Safety Analyses. If the acceptance criteria are not met, then the associated vacuum pump shall not be placed in the process system.	-2	N/A
IROFS31a	VR2-7	Criticality	AC	N/A	Administratively limit ^{235}U mass in non-safe-by-design solid waste containers to ensure subcriticality by performing independent sampling and assay analysis. This is implemented by independent sampling and assay analysis of waste container contents for ^{235}U mass and limiting mass to that assumed in the Nuclear Criticality Safety Analyses before enriched uranic material is transferred and bulk stored in solid waste containers. IROFS31a is independent of IROFS31b. If the acceptance criterion is not met, then enriched uranic material shall not be transferred and bulk stored in solid waste containers.	N/A	N/A

IROFS31b	VR2-7	Criticality	AC	B	Administratively limit ^{235}U mass in non-safe-by-design solid waste containers to ensure subcriticality by performing independent sampling and assay analysis. This is implemented by independent sampling and assay analysis of waste container contents for ^{235}U mass and limiting mass to that assumed in the Nuclear Criticality Safety Analyses before enriched uranic material is transferred and bulk stored in solid waste containers. IROFS31b is independent of IROFS31a. If the acceptance criterion is not met, then enriched uranic material shall not be transferred and bulk stored in solid waste containers.	-2	N/A
IROFS31c	VR2-7	Criticality	AC	B	Administratively limit ^{235}U mass in non-safe-by-design solid waste containers to ensure subcriticality using bookkeeping procedures. This is implemented by bookkeeping procedures to limit calculated uranic mass in solid waste containers to that assumed in the Nuclear Criticality Safety Analyses for solid waste bulking operations. The calculated ^{235}U mass in solid waste containers shall be determined using bookkeeping procedures before enriched uranic material is transferred and bulk stored in solid waste containers. If the acceptance criterion is not met, then enriched uranic material shall not be transferred and bulk stored in solid waster containers.	-2	N/A

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS35	FF1-1 FF6-1 FF8-1 FF11-1 FF15-1 FF21-1 FF23-1 FF24-1 FF38-1	Chemical	AEC	A	Automatic closure of fire-rated barrier opening protectives (e.g., doors, dampers, penetration seals) to ensure the integrity of area fire barriers prevents fires from propagating into areas containing uranic material. Barriers and protectives will be closed or self-closing (e.g., utilizing fusible links).	-3	3.8.3.35
IROFS36a	FF1-2 FF6-2 FF8-2 FF11-2 FF16-1 FF16-2 FF38-2	Chemical	AC	A	Administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low. Transients will be controlled to limit aggregate combustible load (transient and in-situ) in the area of concern.	-3	3.8.3.36a
IROFS36b	FF5-1	Chemical	AC	A	Administratively limit storage of UF_6 cylinders in the CRDB to ensure $\geq$ 1 m (3 ft) setback from the edge of the loading dock.	-3	3.8.3.36b
IROFS36c	FF7-1 FF42-1	Chemical	AC	A	Administratively limit onsite UF_6 cylinder transporters/movers to ensure only use of electric drive or diesel powered with a fuel capacity of less than 280 L (74 gal).	-3	3.8.3.36c

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS36d	FF21-2 FF23-2 FF25-1 FF25-2	Chemical	AC	A	Administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low. Transients will be controlled to limit aggregate combustible load (transient and in-situ) in the area of concern. Liquid and solid waste transfer and packing containers (except as noted below) are limited to metal only. Transfer and packing container restriction does not apply to packaging within these containers (e.g., plastic liners), to bags for transporting laundry and similar non- or low-contamination solids, or to laboratory size sample containers (required for maintaining sample purity).	-3	3.8.3.36d
IROFS36e	FF43-1	Chemical	AC	A	Administratively limit transient combustible loading on the UBC Storage Pad to ensure cylinder integrity. This is implemented by limiting vehicles allowed onto the pad to cylinder movers and essential vehicles with a fuel capacity limit of less than 280 L (74 gal) and maintaining storage pad drain-off to ensure no excessive fuel pooling.	-3	3.8.3.36e
IROFS36f	FF43-2	Chemical	AC	A	Administratively limit designated routes for bulk fueling vehicles onsite to ensure UBC cylinder integrity. This is implemented by limiting diesel fuel deliveries to designated routes. Diesel fuel delivery vehicles will be prohibited from entering the UBC Storage Pad perimeter road.	-3	3.8.3.36f

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS36g	FF44-1	Chemical	AC	A	Administratively limit onsite vegetation fire sources to ensure integrity of important targets. This is implemented by requiring clear cutting of vegetation onsite proximate to buildings and cylinders containing uranic material.	-3	3.8.3.36g
IROFS36h	FF5-2	Chemical	AC	A	Administratively limit fire exposure to feed cylinders, product cylinders, and UBCs containing $\geq$ 0.1 kg of UF_6 due to a semi-tractor trailer fire during the receipt and shipping process. This is implemented by ensuring that all received feed cylinder/protective assemblies are unloaded from the semi-tractor trailer to the loading dock prior to removal of the required DOT protective assemblies, that all outgoing product cylinders are loaded into their required DOT overpacks prior to placement on the semi-tractor trailer, and that all outgoing UBCs have their required DOT protective assemblies installed prior to placement on the semi-tractor trailer.	-3	3.8.3.36h
IROFS37	FF25-2	Chemical	AEC	A	Automatic hardwired, fail-safe, trip of the Ventilated Room HVAC and isolation from TSB GEVS on smoke detection and Ventilated Room design leakage limited to ensure offsite exposure from building out flow maintains consequences to the public low.	-2	N/A

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS38	TT2-2 UF2-2 PT2-4 PB2-4	Chemical	AC	A	Administratively limit the cylinder fill mass to ensure cylinder integrity. This is implemented at Tails Low Temperature Take-off Stations, Feed Purification Low Temperature Take-off Stations, Product Low Temperature Take-off Stations, and Product Blending Receiver Stations by verifying that cylinder weight is within specified trending limits once per shift during filling of the cylinder. Weight limit conservative with respect to assuring cylinder integrity. If the acceptance criterion is not met, then fill of the associated cylinder shall be terminated.	-3	3.8.3.38
IROFS39a	EE-SEISMIC-WORKER EVAC	Chemical	AC	A	Administratively limit exposure by requiring worker action to evacuate the area(s) of concern to ensure worker consequences of inhalation of uranic material and HF are low. This is implemented by worker evacuation from area(s) of concern in the event of a seismic event consistent with assumptions of the consequence analyses.	-3	3.8.3.39a
IROFS39b	FF-WORKER EVAC	Chemical	AC	A	Administratively limit exposure by requiring worker action to evacuate the area(s) of concern to ensure worker consequences of inhalation of uranic material and HF are low. This is implemented by worker evacuation from area(s) of concern in the event of a fire consistent with assumptions of the consequence analyses.	-3	3.8.3.39b

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS39c	CHEM RELEASE-WORKER EVAC	Chemical	AC	A	Administratively limit exposure by requiring worker action to evacuate the area(s) of concern to ensure worker consequences of inhalation of uranic material and HF are low. This is implemented by worker evacuation from area(s) of concern in the event of a release consistent with assumptions of the consequence analyses.	-3	3.8.3.39c
IROFS41	SEISMIC-1 SEISMIC-2 SEISMIC-3	Chemical	PEC	A	Design features to ensure building leak integrity. This is implemented by design considerations applied to the UF_6 Area, Cascade Halls and Blending & Liquid Sampling Area that require building integrity during a seismic event (IROFS27c) and limiting building leakage to outside areas (in conjunction with IROFS26 HVAC trip) to ensure offsite exposure from building outflow maintains consequences to the public low.	-3	N/A
IROFS42	PB4-4	Chemical	AC	B	Administratively limit the cylinder fill mass to ensure cylinder integrity. This is implemented by determining the weight of product cylinders before placement and heating in the Product Liquid Sampling Autoclave. Weight limit conservative with respect to assuring cylinder integrity. If the acceptance criterion is not met, then the associated product cylinder shall not be heated.	-2	N/A
IROFS43	CL3-3	Chemical	AEC	B	Automatic trip of UF_6 sub-sampling unit hotbox heater on high hotbox internal temperature to ensure sample bottle integrity. This is implemented with a temperature switch for automatic, hardwired, fail-safe, high temperature trip of hotbox heater at UF_6 sub-sampling unit. Setpoint conservative with respect to assuring sample bottle integrity.	-2	N/A

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS45	PB1-3 RD1-1	Criticality	AC	A	To ensure subcritical geometry, prior to moving a cylinder containing enriched uranium in the CRDB or the Blending and Liquid Sampling Area, verify that the stored cylinders containing enriched uranium in these areas are in a horizontal, co-planar (i.e., non-stacked), condition and that no other cylinder containing enriched uranium is in movement in the associated area. Physical separation as assumed in the Nuclear Criticality Safety Analyses is implemented by only storing Product cylinders in a horizontal co-planar (i.e., one high) array. Maintaining conditions such that only one cylinder could be inadvertently placed on horizontal storage array of other product cylinders provides a subcritical geometry as assumed in the Nuclear Criticality Safety Analyses (which analyzes one stacked cylinder as a subcritical array). This is implemented by restriction of movement and storage of product cylinders such that no more than one product cylinder could be inadvertently or accidentally stacked. If the acceptance criteria are not met, then the cylinder containing enriched uranium shall not be moved.	-3	3.8.3.45
IROFS46	CL3-2	Chemical	AC	B	Administratively verify that product samples are in a solid state, prior to transfer of product samples for assay analysis, to ensure worker consequences of inhalation of uranic material and HF are low. This is implemented by visual inspection of the product sample, prior to transfer from the sample rig, to ensure the sample material is in a solid state. If the acceptance criterion is not met, then the transfer of product samples for assay analysis shall not be initiated.	-2	N/A

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFS47a	UF3-1 PT3-2 PB3-3	Chemical	PEC	B	Flow restriction to ensure, in the event of postulated release, worker consequences of inhalation of uranic material and HF are low. This is implemented by a valve, on the suction of the vacuum pump, with a maximum flow rate that is less than the flow rate assumption of the consequence analyses.	-3	N/A
IROFS47b	TT3-1 VR1-5 CP1-4	Chemical	PEC	B	Flow restriction to ensure, in the event of postulated release, worker consequences of inhalation of uranic material and HF are low. This is implemented by a valve, on the suction of the vacuum pump, blocked such that the maximum flow rate is less than the flow rate assumption of the consequence analyses.	-3	N/A
IROFSC1b	DC1-1 DC1-2 DC1-3 DC1-4	Chemical	AC	B	Administratively maintain contingency dump NaF trap fill and use to ensure carbon trap does not saturate on operation of contingency dump. This is implemented by maintaining appropriate fill of NaF in the traps, prior to placing the associated NaF trap in service after filling, and replacement of the NaF trap prior to NaF trap fill becoming spent due to excessive dump operation to limit the accumulation of UF_6 in the contingency dump carbon trap such that assumptions in the consequence analyses are maintained. If the acceptance criteria are not met, then the associated NaF trap shall not be placed in service or, if the NaF trap is in service, the NaF trap shall be isolated from the associated cascade.	-2	N/A

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFSC6	EC3-1	Criticality	AC	A	Administratively calculate and set the cascade enrichment control device in accordance with the calculation to ensure ^{235}U enrichment $\leq 5\ {}^{w}/_{0}$ to ensure subcriticality within the designed process and analyzed activities. This is implemented by ensuring the calculation performed accurately, and the associated cascade enrichment control device setting is implemented in accordance with the calculation. The 5 $^{w}/_{0}$ limit is based on the NEF Materials License limit and consistent with the Nuclear Criticality Safety Analyses to ensure subcriticality within the designed process and analyzed activities. If the acceptance criterion is not met and the cascade enrichment control device setting has not been changed, then the cascade enrichment control device setting shall not be changed. If the acceptance criterion is not met and the cascade enrichment control device setting has been changed, then the associated cascade shall be isolated such that no additional UF_6 can enter or exit the cascade.	-3	3.8.3.C6
IROFSC15	TP8-1	Chemical	AEC	B	Automatic trip of the Centrifuge Test Facility feed/take-off vessel heat tracing on high temperature to ensure feed/take-off vessel integrity. This is implemented with a capillary temperature sensor for automatic, hardwired, fail-safe, high temperature trip of the Centrifuge Test Facility feed/take-off vessel heat trace. Setpoint based on centrifuge integrity calculation.	-2	N/A

IROFS	Accident Sequence	Type of Accident	Type (1)	Class (2)	Description of Safety Function	FPIN (3)	FPIN Basis (4)
IROFSC16	TP8-1	Chemical	AEC	B	Automatic trip of the Centrifuge Test Facility feed/take-off vessel heat tracing on high temperature to ensure feed/take-off vessel integrity. This is implemented with a temperature sensor for automatic, hardwired, fail-safe, high temperature trip of the Centrifuge Test Facility feed/take-off vessel heat trace. Setpoint conservative with respect to assuring feed/take-off vessel integrity.	-2	N/A
IROFSC18	EC4-1 TP8-2 DC1-1 DC1-3 DC1-5 DC1-7	Chemical	AEC	B	Automatic trip of the vacuum pump on high pressure at the vacuum pump set outlet to prevent a release. This is implemented with an automatic hardwired, fail-safe, trip of the vacuum pump on high pressure at the vacuum pump set outlet in the Centrifuge Test Facility, Cascade Sampling Rig and Contingency Dump System. Setpoint conservative with respect to system design pressure.	-2	N/A

NOTES:

1. Type of IROFS:

   PEC – Passive Engineered Control: A device that uses only fixed physical design features to maintain safe process conditions without any required human action.

   AEC – Active Engineered Control: A physical device that uses active sensors, electrical components, or moving parts to maintain safe process conditions without any required human action.

   AC – Administrative Control: A procedural human action that is prohibited or required to maintain safe process conditions.

2. Class of IROFS

   "A" – Sole IROFS. Refer to Section 3.8.2 and Table 3.8-2.

   "B" – An IROFS which is one of two preventive or mitigative IROFS for the identified sequence(s). Refer to the applicable accident sequences in Table 3.7-2 or Table 3.7-4 for identification of other IROFS relied upon.

   "N/A" – IROFS is not expressly associated with a preventive or mitigative control for the identified sequence(s).

3. FPIN – Failure Probability Index Numbers from ISA, based on Risk Indexing Methodology described in Section 3.1. When IROFS is not expressly associated with a preventive or mitigative control for the identified sequence(s), "N/A" is specified. Refer to the applicable accident sequence description in Table 3.7-2 or Table 3.7-4 for initiating event frequency index number.

4. Section referenced provides basis for IROFS Type AC that is considered "enhanced" and for IROFS Type AEC that is considered to have "high availability." "N/A" indicates that the FPIN reflects the lower absolute value nominally assigned to the Type of IROFS as indicated in Table 3.1-10 that is supported by the general Management Measures applicable to all IROFS (refer to Section 3.1.8.3).

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Table 3.8-2 Sole Items Relied On For Safety (IROFS)
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IROFS Identifier	Accident Sequence	Type of Accident	Type of IROFS	Title
IROFS3	DC1-6 DC1-8	Chemical	AEC	Automatic trip of the vacuum pump on carbon trap high weight to ensure the carbon trap does not become saturated with UF_6.
IROFS10	PB4-1 PB4-3	Chemical	PEC	Design feature to maintain Product Liquid Sampling Autoclave leak tight integrity.
IROFS14a	FR1-1 FR2-1 DS1-1 DS2-1 DS3-1 SW1-1 LW1-2	Criticality	AC	Administratively restrict proximity of vessels in non-designed locations containing enriched uranic material to ensure subcritical configuration.
IROFS14b	FR1-2 DS1-2 DS2-2 DS3-2 SW1-2 LW1-3	Criticality	AC	Administratively restrict proximity of vessels in non-designed locations containing enriched uranic material to ensure subcritical configuration.
IROFS15	PT3-5	Criticality	AC	Administratively restrict an independent parameter of the criticality sequence to ensure subcriticality configuration by preventing additional transfer of enriched uranic material to another container if that container contains enriched uranic material and is a non-safe-by-design container.
IROFS16a	PB2-2 CP1-2	Criticality	AC	Administratively limit moderator mass (oil and water) in cylinders containing enriched uranic material to ensure subcriticality by allowing no visible oil and limiting cylinder vapor pressure.
IROFS23a	VR1-3	Chemical	AC	Administrative use of personal respiratory protection to ensure that inhalation of uranic material and HF consequences are low.
IROFS23b	VR2-1	Chemical	AC	Administrative use of personal respiratory protection to ensure that inhalation of uranic material and HF consequences are low.
IROFS26	SEISMIC-1 SEISMIC-2 SEISMIC-3	Chemical	AEC	Automatic Building HVAC system trip on detection of seismic event to ensure offsite exposures from building out flow maintain consequences low.

Table 3.8-2 Sole Items Relied On For Safety (IROFS)
Page 2 of 4

IROFS Identifier	Accident Sequence	Type of Accident	Type of IROFS	Title
IROFS27c	SEISMIC-1 SEISMIC-2 SEISMIC-3 TORNADO SNOW LP-BLD (T)	Chemical	PEC	Design feature of buildings containing UF_6 process systems for seismic, tornado, tornado missile, high wind, roof snow load, and for roof ponding and site flooding due to local intense precipitation, to ensure UF_6 process systems integrity.
IROFS27d	LP-PAD	Chemical	PEC	Design feature of the uranium byproduct cylinders (UBC) storage pad for site flooding due to local intense precipitation, to ensure UBC integrity.
IROFS28	SEISMIC-5	Chemical	PEC	Design feature to maintain Product Liquid Sampling Autoclave leak tight integrity.
IROFS35	FF1-1 FF6-1 FF8-1 FF11-1 FF15-1 FF21-1 FF23-1 FF24-1 FF38-1	Chemical	PEC	Automatic closure of fire-rated barrier opening protectives (e.g., doors, dampers, penetration seals) to ensure the integrity of area fire barriers prevents fires from propagating into areas containing uranic material.
IROFS36a	FF1-2 FF6-2 FF8-2 FF11-2 FF16-1 FF16-2 FF38-2	Chemical	AC	Administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low.
IROFS36b	FF5-1	Chemical	AC	Administratively limit storage of UF_6 cylinders in the CRDB to ensure ≥ 1 m (3 ft) setback from the edge of the loading dock.
IROFS36c	FF7-1 FF42-1	Chemical	AC	Administratively limit onsite UF_6 cylinder transporters/movers to ensure only use of electric drive or diesel powered with a fuel capacity of less than 280 L (74 gal).
IROFS36d	FF21-2 FF23-2 FF25-1 FF25-2	Chemical	AC	Administratively limit transient combustible loading in areas containing uranic material to ensure integrity of uranic material components/containers and limit the quantity of uranic material at risk to ensure consequences to the public are low.
IROFS36e	FF43-1	Chemical	AC	Administratively limit transient combustible loading on the UBC Storage Pad to ensure cylinder integrity.

IROFS Identifier	Accident Sequence	Type of Accident	Type of IROFS	Title
IROFS36f	FF43-2	Chemical	AC	Administratively limit designated routes for bulk fueling vehicles onsite to ensure UBC cylinder integrity.
IROFS36g	FF44-1	Chemical	AC	Administratively limit onsite vegetation fire sources to ensure integrity of important targets.
IROFS36h	FF5-2	Chemical	AC	Administratively limit fire exposure to feed cylinders, product cylinders and UBCs containing ≥ 0.1 kg of UF_6 due to a semi-tractor trailer fire during the receipt and shipping process.
IROFS37	FF25-2	Chemical	AEC	Automatic trip of the Ventilated Room HVAC and isolation from TSB GEVS on smoke detection and Ventilated Room design leakage limited to ensure offsite exposure from building out flow maintains consequences to the public low.
IROFS38	TT2-2 UF2-2 PT2-4 PB2-4	Chemical	AC	Administratively limit the cylinder fill mass to ensure cylinder integrity.
IROFS39a	EE-SEISMIC-WORKER EVAC	Chemical	AC	Administratively limit exposure by requiring worker action to evacuate area(s) of concern to ensure worker consequences of inhalation of uranic material and HF are low.
IROFS39b	FF-WORKER EVAC	Chemical	AC	Administratively limit exposure by requiring worker action to evacuate area(s) of concern to ensure worker consequences of inhalation of uranic material and HF are low.
IROFS39c	CHEM RELEASE-WORKER EVAC	Chemical	AC	Administratively limit exposure by requiring worker action to evacuate area(s) of concern to ensure worker consequences of inhalation of uranic material and HF are low.
IROFS41	SEISMIC-1 SEISMIC-2 SEISMIC-3	Chemical	PEC	Design features to ensure building leak integrity.
IROFS45	PB1-3 RD1-1	Criticality	AC	To ensure subcriticality geometry, prior to moving a cylinder containing enriched uranium in the CRDB or the Blending and Liquid Sampling Area, verify that the stored cylinders containing enriched uranium in these areas are in a horizontal, co-planar (i.e., non-stacked), condition and that no other cylinder containing enriched uranium is in movement in the associated area.

IROFS Identifier	Accident Sequence	Type of Accident	Type of IROFS	Title
IROFSC6	EC3-1	Criticality	AC	Administratively calculate and set the cascade enrichment control device in accordance with the calculation to ensure ^{235}U enrichment ≤ 5 $^{w}/_{o}$ to ensure subcriticality within the designed process and analyzed activities.

Emergency Plan

Revision 3, April 2005
Including Page Removal and Insertion Instructions

NATIONAL ENRICHMENT FACILITY
EMERGENCY PLAN, REVISION 3
PAGE REMOVAL AND INSERTION INSTRUCTIONS

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1.2 DESCRIPTION OF FACILITY AND SITE

The NEF site is located in southeast New Mexico, approximately 32 kilometers (20 miles) south of Hobbs, New Mexico (population 28,657) and 8 km (5 mi) east of Eunice, New Mexico (population 2,562). The site is located in Lea County, approximately 0.8 km (0.5 mi) west of the Texas state border, 51 km (32 mi) west-north-west of Andrews, Texas (population 10,182) and 523 km (325 mi) southeast of Albuquerque, New Mexico (population 712,728). The nearest large population center (>100,000 population) and commercial airport is the Midland-Odessa, Texas area which is approximately 103 km (64 mi) to the southeast. The approximate center of the NEF is located at latitude 32°, 26 min, 1.74 s North and longitude 103°, 4 min, 43.47 s West.

Land parcel Section 32, Township 21 south, Range 38 East, New Mexico Principal Meridian, Lea County, New Mexico, location of the NEF site, is currently owned by the State of New Mexico and is in the process of being acquired by LES. Until such time as the land acquisition is completed, a 35-year easement on Section 32 has been granted to LES for site access and control. Section 32 is relatively flat with slight undulations in elevation, with an elevation profile ranging from 1,033 to 1,045 m (3,390 to 3,430 ft) above mean sea level. Overall slope direction of the Section is southwest. Predominant vegetation species identified are mesquite bush, yucca, sand sage and sand drop seed. Domestic livestock actively graze Section 32. Figure 1.2-1, Facility Layout Map, shows the site property boundary and the general layout of the buildings.

The major structures and areas of the NEF are described below.

The main Security Building is located at the entrance to the facility. It functions as a security checkpoint for incoming and outgoing employee and visitor traffic. It also contains the necessary space and provisions for an alternate Emergency Operations Center (EOC) should the primary EOC become unusable. A security guard station is also provided for incoming and outgoing shipping and receiving traffic at an alternate entrance to the site.

The Separations Building houses three, essentially identical, plant process units called "Modules." Each Module has two Cascade Halls, each of which has eight Cascades. A number of centrifuges make up each cascade. Each Module also houses a UF_6 Handling Area, and a Process Services Area. Product is fed into the Cascade Halls and enriched UF_6 and depleted UF_6 (tails materials) are removed. The Cylinder Receipt and Dispatch Building (CRDB) is located between two Separations Building Modules, adjacent to the Blending and Liquid Sampling Area.

The Centrifuge Assembly Building (CAB) is used to assemble centrifuges. The centrifuges are then moved to the Separations Building Modules and installed in the Cascade Halls.

The Technical Services Building (TSB) contains various laboratories and maintenance facilities necessary to safely operate and maintain the facility. The TSB also includes a Medical Room and the Control Room. In an emergency, the Control Room serves as the primary EOC for the facility. The EOC is described in more detail in Section 6, Emergency Response Equipment and Facilities. The emergency assessment areas (i.e., laboratories for sample analysis) are located in the TSB.

The Central Utilities Building (CUB) provides a central location for the utility services for the process buildings. Major electrical distribution panels, facility air compressors, facility cooling water and chillers, and facility boiler units are located in this building. The CUB houses two diesel generators, which provide the site with standby power.

The CRDB is used to receive, inspect, weigh and temporarily store cylinders of feed UF_6 sent to the plant; temporarily store, inspect, weigh, and ship cylinders of enriched UF_6 to facility customers; receive, inspect, weigh, and temporarily store clean empty product and UBCs prior to being filled in the Separations Building; and inspect, weigh, and transfer filled UBCs to the UBC Storage Pad.

The Blending and Liquid Sampling Area provides the means to fill product cylinders with UF_6 to the correct ^{235}U concentration level. The area contains the major components associated with the Product Liquid Sampling System and the Product Blending System.

The UBC Storage Pad is a series of concrete pads designed to temporarily store the expected volume of UBCs (cylinders of depleted UF_6) produced by the facility.

The Administration Building provides general office space and Entry Exit Control Point for the facility. All personnel access to the facility occurs at this location. Personnel requiring access to the facility areas or the Controlled Access Area must pass through the Entry Exit Control Point. Vehicular traffic passes through a security checkpoint before being allowed to park. Parking is located outside of the Controlled Access Area security fence. Personnel enter the Administration Building and general office areas via the main lobby.

A Visitor Center is located outside of the facility's security fenced area.

The Site Stormwater Detention Basin collects stormwater runoff. The UBC Storage Pad Stormwater Retention Basin is a lined basin which exclusively collects the UBC Storage Pad stormwater runoff, cooling tower blowdown water discharge and heating boiler blowdown discharge. The Treated Effluent Evaporative Basin is a double-lined basin that collects potentially contaminated waste water discharge from the Liquid Effluent Collection and Treatment System.

Two assembly areas have been designated for personnel accountability in the event of an emergency. One assembly area is located in the lobby of the Administration Building and space has been allocated for the storage of emergency equipment and supplies and emergency monitoring equipment. The second assembly area is located in the TSB. Emergency communications, assembly, and accountability are discussed further in Section 6, Emergency Response Equipment and Facilities of this plan.

A meteorological measurement program will monitor meteorological phenomena during facility operation. An instrument tower will be located at a site approximately the same elevation as the finished facility grade and in an area where facility structures will have little or no influence on the measurements. Monitoring instrument readouts will be located in the Control Room for use

Table 1.2-1 Filter Types and Efficiency Specifications

System	Filter Efficiency	Estimated Maximum Stack Flow Rate
TSB GEVS	Pre-filter 85%	18,700 m^3/hr (11,000 ft^3/min)
	HEPA Filter 99.97%	18,700 m^3/hr (11,000 ft^3/min)
	Activated Carbon 99%	18,700 m^3/hr (11,000 ft^3/min)
Separations Building GEVS (2 filtration trains)	Electrostatic Filters 97%	4,248 m^3/hr (2,500 ft^3/min)
	Pre-filter 85%	11,000 m^3/hr (6,500 ft^3/min)
	HEPA Filter 99.97%	11,000 m^3/hr (6,500 ft^3/min)
	Activated Carbon 99%	11,000 m^3/hr (6,500 ft^3/min)
Centrifuge Test and Post Mortem Exhaust Filtration System	Pre-filter 85%	9,345 m^3/hr (5,500 ft^3/min)
	Activated Carbon 99%	9,345 m^3/hr (5,500 ft^3/min)
	HEPA Filter 99.97%	9,345 m^3/hr (5,500 ft^3/min)

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2.1.1.9 Pump Exhaust Plugged - Worker

The event is initiated by UF_6 passing through the Vacuum Pump/Chemical Trap Set vacuum pump in error.

For the uncontrolled accident sequence, UF_6 passes through the pump and de-sublimes in the vacuum pump discharge pipe forming a blockage, causing high pressure, which causes a failure of the flange seal and a local area release of UF_6 in the Process Services Areas, UF_6 Handling Area, Technical Services Building (Ventilated Room and Cylinder Preparation Room), Blending and Liquid Sampling Area, or Centrifuge Test Facility exposing workers. The potential exposure consequence to the worker would be high while the potential exposure consequences to the public are low, except for the pump exhaust plugged event associated with the Contingency Dump System for which potential exposure consequences to the public are intermediate.

For the controlled accident sequence, the mitigating/preventive measures are a fail-safe hard-wired carbon trap high weight trip of the vacuum pump, flow restrictions or vacuum pump trips on high pressure, and administrative control through the use of procedures and training to control and verify proper filling of chemical traps.

2.1.1.10 UF_6 Sub-sampling Unit Hot Box Heater Controller Failure

The initiating event is failure of a heater controller that causes the UF_6 sub-sampling unit hot box heater to remain energized.

For the uncontrolled accident sequence, the sample cylinder hydraulically ruptures due to the expansion of the UF_6. Upon cylinder rupture, the cylinder contents of UF_6 are released and locally exposes workers. The potential exposure consequence to the worker would be high while the potential exposure consequences to the public are low.

For the controlled accident sequence, the preventive measures are (1) fail-safe hard-wired high temperature heater trip, and (2) operation of the TSB GEVS attached to the chemical laboratory hood.

2.1.1.11 Empty UF_6 Cold Trap (UF_6 Release) - Worker

The initiating event is an operator error of failing to put liquid nitrogen in the UF_6 cold trap contained as part of the UF_6 Sub-sampling unit. During the process of transferring product samples for assay analysis, liquid UF_6 flashes to gas and is released in the chemical laboratory, exposing the worker. The UF_6 is subsequently released to the site boundary.

The potential exposure consequence to the worker would be high while the potential exposure consequences to the public are low.

For the controlled accident sequence, the mitigating/preventive measures are operation of the TSB GEVS attached to the chemical hood containing the UF_6 Sub-sampling unit and the administrative verification that product samples are in a solid state, prior to transfer of product samples for assay analysis, to ensure work consequences of inhalation of uranic material and HF are low.

2.1.1.12 Cylinder Valve/Connection Failure During Pressure Test

The initiating event is the failure of a cylinder superior valve or the flexible piping of a cylinder containing UF_6 undergoing a cylinder pressure test after repair/replacement of a leaking cylinder component.

For the uncontrolled accident sequence, a slight over pressure release of UF_6 exposes the worker. This event was calculated to result in a high consequence to the work and low consequence to the public.

For the controlled accident sequence, the preventive measure is administrative use of personnel respiratory protection to ensure that inhalation of uranic material and HF consequences are low when performing positive pressure testing of a UF_6 cylinder after repair/replacement of a leaking cylinder component.

2.1.1.13 Chemical Dump Trap Failure

The initiating event is the loss of containment of a chemical dump trap and the emptying of its contents into the Ventilated Room in the TSB. The cause could be operator error in the unloading of a chemical dump trap or significant physical impact to an open chemical dump trap.

For the uncontrolled accident sequence, the worker is exposed to a release of sodium fluoride fines containing uranic material. The potential exposure consequences for the worker could be high while the potential exposure consequences to the public are low.

For the controlled accident sequence, the preventive measures are (1) workers will use personnel protection equipment to prevent exposure to airborne uranic material during the unloading of the chemical dump traps, (2) workers will use the TSB GEVS with flexible connections or an unloading device connected to TSB GEVS to prevent exposure to airborne uranic material during unloading of the chemical dump traps, and (3) purpose-engineered handling and emptying equipment is provided to preclude the possibility of spillage.

2.1.1.14 Worker Evacuation

The initiating event is a release of UF_6, due to a seismic event, fire or other unplanned release, of a magnitude that would require evacuation.

For the uncontrolled accident sequence, the UF_6 release is of a magnitude that results in worker consequences of inhalation of uranic material and HF that are greater than a low consequence category. The subsequent release for this event is assumed to have a high consequence to the worker present in the area.

For the controlled accident sequence, the mitigative measure is to administratively limit exposure by requiring worker action to evacuate area(s) of concern to ensure that consequences of inhalation of uranic material and HF are low. Sufficient time is available for the worker to detect and to evacuate the area(s) of concern.

2.1.2 Postulated Intermediate Consequence Events

In addition to the foregoing postulated high consequence events, several intermediate consequence events, which have a very low probability of occurring, have also been identified for the facility. These are discussed below.

Postulated intermediate consequence events are those events and sequences of events described in the ISA that have, for the uncontrolled case, been categorized as having the potential to result in any consequence specified in 10 CFR 70.61(c). No exposure to offsite individuals is expected from any of the accidents, since multiple barriers are in place to prevent or mitigate such events.

Exposures to local area workers would most likely be higher than exposures to offsite individuals and dependent on the workers actual proximity to the incident location. All workers at the NEF are trained in the physical characteristics and potential hazards associated with facility processes and materials. Therefore, facility workers know and understand how to lessen their exposures to chemical and radiological substances in the event of an incident at the facility.

2.1.2.1 Carbon Trap Failure

The initiating event is the loss of containment of a carbon trap and the emptying of its contents into the Ventilated Room in the TSB. The cause could be operator error in the unloading of a carbon trap or significant physical impact to an open carbon trap.

For the uncontrolled accident sequence, the local worker is exposed to a release of carbon fines containing uranic material. The potential exposure consequences to the worker would be intermediate while the potential exposure consequences to the public are low.

For the controlled accident sequence, the preventive measure are (1) workers will use personnel protection equipment to prevent exposure to airborne uranic material during the unloading of carbon traps, and (2) administrative controls (i.e., procedures and training) are required for personnel to use the purpose-engineered handling and emptying equipment provided to preclude the possibility of spillage.

2.1.2.2 Pump Exhaust Plugged (Contingency Dump System) - Public

The event is initiated by UF_6 passing through the Vacuum Pump/Chemical Trap Set vacuum pump in error.

For the uncontrolled accident sequence, UF_6 passes through the pump and de-sublimes in the vacuum pump discharge pipe forming a blockage, causing high pressure, which causes a failure of the flange seal and a local area release of UF_6 in the Process Service Area exposing workers and resulting in a potential release to the site boundary. The potential exposure consequence to the worker would be high while the potential exposure consequences to the public are intermediate.

For the controlled accident sequence, the preventive measures are a fail-safe hard-wired carbon trap high weight trip of the vacuum pump and administrative control through the use of procedures and training to control and verify proper filling of chemical traps.

2.1.2.3 Spill of Failed Centrifuge Parts (Crashed Centrifuge Debris)

During centrifuge post-mortem the contents of the centrifuge machine casing are emptied into sturdy plastic bags. Should the bag split or otherwise fail, contamination may become airborne within the Centrifuge Post Mortem Facility.

In the uncontrolled accident sequence, it is assumed that the Centrifuge Post Mortem Facility local exhaust ducting and the room exhaust points do not reduce the airborne concentration level and no credit is taken for the use of any personnel breathing apparatus. The potential exposure consequences for the local worker could be high while the potential exposure consequences to the public are low.

For the controlled accident sequence, the preventive measures are the Centrifuge Test and Post Mortem Exhaust Filtration System, plus the breathing equipment that is worn by the operators. Additionally, this sequence, if uncontrolled, would be limited in its severity by the evacuation of the affected area.

2.1.2.4 Dropped Contaminated Centrifuge

The event is initiated if, during the early part of a centrifuge post-mortem, the centrifuge drops from the mechanical handling equipment. This can cause contamination to become airborne within the Centrifuge Post Mortem Facility.

In the uncontrolled accident sequence, it is assumed that the Centrifuge Post Mortem Facility local exhaust ducting and the room exhaust points do not reduce the airborne concentration level and no credit is taken for the use of any personnel breathing apparatus. The potential exposure consequences for the local worker could be high while the potential exposure consequences to the public are low.

For the controlled accident sequence, the preventive measures are the Centrifuge Test and Post Mortem Exhaust Filtration System reducing the quantity of contamination that becomes airborne while minimizing the exposure time to airborne material before it can be removed. The breathing equipment worn by the operators is an additional preventative measure. This sequence, if uncontrolled, would be limited in its severity by the evacuation of the local area. While a centrifuge post mortem is a relatively infrequent activity, the mechanical handling of centrifuges is commonplace and well understood.

2.1.2.5 Fire in Ventilated Room

The initiating event is fire considering expected in-situ and transient combustibles in the Ventilated Room.

For the uncontrolled accident sequence, the exposed uranic material/HF is released within the Ventilated Room and subsequently released outside the TSB to the site boundary.

For the controlled accident sequence, the mitigating measure is a smoke detection trip of the Ventilated Room ventilation.

2.1.3 Non-Integrated Safety Analysis-Site Area Emergency Conditions

The following postulated conditions were not addressed in the ISA, but are derived from guidance in the Regulatory Guide 3.67, dated January 1992. These conditions could require a response by an Offsite Response Agency to protect persons offsite.

2.1.3.1 Imminent or Actual Loss of Physical Control of the Facility

The condition is initiated if a hostile force has taken control of (or loss of control is imminent) facility equipment such that facility personnel are unable to operate equipment required to maintain safety functions. A security compromise that progresses to the point where a hostile force has taken control of (or loss of control is imminent) the facility control systems may create an event with the potential to result in consequences to the public. However, extensive security measures described in the Physical Security Plan and/or Safeguards Contingency Plan are provided to prevent or mitigate the occurrence of security compromises.

2.1.3.2 Elevated Radiation Levels Outside the Facility

There is no specific initiating sequence identified for this condition. This condition occurs if, for any reason, elevated radiation levels or airborne contamination levels outside the facility are detected which indicate a significant release to the environment (factor of 100 over normal levels). These levels indicate that there has been a significant degradation in the level of control of radioactive materials, which indicates an event with the potential to result in consequences to the public. Extensive monitoring of ambient and effluent radiation levels is provided to detect any increases before these levels are reached and strict controls on handling and processing radioactive materials to preclude releases at these levels.

2.1.4 Non-Integrated Safety Analysis-Alert Conditions

The following postulated conditions were not addressed in the ISA, but are derived from guidance in the Regulatory Guide 3.67, dated January 1992. These conditions are not expected to require a response by an Offsite Response Agency to protect persons offsite.

2.1.4.1 Fire Within the Site Boundary

Any fire that lasts more than 15 minutes after application of fire suppression efforts is indicative of a fire with the potential to result in consequences to the workers at the facility or, if allowed to progress, result in consequences to the public. Fire protection program requirements are in place to prevent the occurrence of fire within the facility. Fire detection and suppression equipment and the facility Fire Brigade will limit the extent and duration of any fires that might occur.

2.1.4.2 Ongoing Security Compromise

This condition is any security compromise that lasts more than 15 minutes after discovery. This type of incident may be indicative of an event with the potential to result in consequences to the workers at the facility or, if allowed to progress, may result in consequences to the public. Offsite law enforcement personnel may respond to the facility to support NEF Security Personnel. However, in this condition the public is not endangered and the criteria for a Site Area Emergency have not been met.

2.1.4.3 Elevated Radiation Levels Inside the Facility

There is no specific initiating sequence identified for this condition. This condition occurs if, for any reason, elevated radiation levels or airborne contamination levels within the facility are detected which indicate a severe loss of control of radioactive materials (factor of 100 over normal levels). These levels indicate that there has been a significant degradation in the level of control of radioactive materials, which indicates an event with the potential to result in consequences to the worker. Extensive monitoring of ambient and process radiation levels is provided to detect any increases before these levels are reached and strict controls on handling and processing radioactive materials to preclude releases at these levels.

With a UF_6 release, resultant UO_2F_2 would be visible and the presence of HF would easily be detected due to its strong odor.

2.2.3.8 Open Sample Manifold Purge Valve and Blind Flange

Alarms in the Control Room would alert the operators to the abnormal conditions detected by the HF monitor and the Product Liquid Sampling Autoclave pressure. If the sequence progresses, facility personnel near the area would immediately detect the release. With a UF_6 release, resultant UO_2F_2 would be visible and the presence of HF would easily be detected due to its strong odor.

2.2.3.9 Pump Exhaust Plugged - Worker

Alarms in the Control Room would alert the operators to the carbon trap high weight condition and/or trip of the vacuum pump.

2.2.3.10 UF_6 Sub-sampling Unit Hot Box Heater Controller Failure

Alarms in the Chemical Laboratory would alert the operators to the abnormal high temperature.

If the sequences progress, facility personnel would immediately detect the release. With a UF_6 release, resultant UO_2F_2 would be visible, and the presence of HF would easily be detected by the strong odor.

2.2.3.11 Empty UF_6 Cold Trap (UF_6 Release) - Worker

Facility personnel near the area would immediately detect the release. With a UF_6 release, resultant UO_2F_2 would be visible and the presence of HF would easily be detected due to its strong odor.

2.2.3.12 Cylinder Valve/Connection Failure During Pressure Test

Facility personnel near the area would immediately detect the release. With a UF_6 release, resultant UO_2F_2 would be visible and the presence of HF would easily be detected due to its strong odor.

2.2.3.13 Chemical Dump Trap Failure

Facility personnel involved in the handling of a Chemical Dump Trap would be immediately alerted to the condition. If the sequence progresses, facility personnel near the area would immediately detect the release. With a UF_6 release, resultant UO_2F_2 would be visible and the presence of HF would easily be detected due to its strong odor.

2.2.3.14 Worker Evacuation

Worker detection of ground motion associated with a seismic event would be immediate since the worker would sense the ground motion. Worker detection of a fire in the area would be immediate since visual cues and odor allow prompt detection by workers in the area. Worker detection of other unplanned releases of uranic material and HF would be immediate. With a UF_6 release, resultant UO_2F_2 would be visible and the presence of HF would easily be detected due to its strong odor by workers in the area.

2.2.4 Detection of Postulated Intermediate Consequence Events

2.2.4.1 Carbon Trap Failure

Facility personnel involved in the handling of a carbon trap would be immediately alerted to the condition. If the sequence progresses, facility personnel near the area would immediately detect the release. With a UF_6 release, resultant UO_2F_2 would be visible and the presence of HF would easily be detected due to its strong odor.

2.2.4.2 Pump Exhaust Plugged (Contingency Dump System) - Public

Alarms in the Control Room would alert the operators to the high carbon trap weight and/or the trip of the vacuum pump.

2.2.4.3 Spill of Failed Centrifuge Parts (Crashed Centrifuge Debris)

Facility personnel near the area would immediately detect any spill. With a UF_6 release, resultant UO_2F_2 would be visible and the presence of HF would easily be detected due to its strong odor.

2.2.4.4 Dropped Contaminated Centrifuge

Facility personnel involved in the movement of the centrifuge machine would be immediately alerted to the condition. If the sequence progresses, facility personnel near the area are trained to recognize the potential release.

2.2.4.5 Fire in Ventilated Room

Fire in the Ventilated Room would be detected and alarmed locally and in the Control Room.

2.2.5 Detection of Non-Integrated Safety Analysis-Site Area Emergency Conditions

The following postulated conditions were not addressed in the ISA, but are derived from guidance in the Regulatory Guide 3.67, dated January 1992. These conditions could require a response by an Offsite Response Agency to protect persons offsite.

2.2.5.1 Imminent or Actual Loss of Physical Control of the Facility

The Physical Security Plan describes the methods available to detect an imminent or actual loss of physical control of the facility.

2.2.5.2 Elevated Radiation Levels Outside the Facility

Alarms in the Control Room would alert operators to elevated effluent radiation levels. Routine radiation surveys during operations and during special evolutions that could potentially cause elevated radiation or airborne levels outside the facility would alert personnel in the area to the event.

2.2.6 Detection of Non-Integrated Safety Analysis-Alert Conditions

The following postulated conditions were not addressed in the ISA, but are derived from guidance in the Regulatory Guide 3.67, dated January 1992. These conditions are not expected to require a response by an Offsite Response Agency to protect persons offsite.

2.2.6.1 Fire Within Site Boundary

A facility wide fire detection system is provided including a microprocessor based intelligent control alarm console. Any fire in the facility structures would be immediately detected and alarmed in the Control Room. Facility personnel in the course of their normal duties, vehicle drives, and security patrol and/or security video cameras would detect a fire outside the facility structures visually.

2.2.6.2 Ongoing Security Compromise

The Physical Security Plan describes the methods available to detect a security compromise at the facility. Security personnel will determine the credibility of threats to the facility.

2.2.6.3 Elevated Radiation Levels Inside the Facility

Alarms in the Control Room would alert operators to elevated area radiation levels. Routine radiation surveys during operations and during special evolutions that could potentially cause elevated radiation or airborne levels inside the facility would alert personnel in the area to the event.

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Table 3.1-1 Classification of Postulated Events

Page 1 of 1

Alert	Site Area Emergency
Dropped Contaminated Centrifuge Machine	Natural Phenomena Beyond Design Basis [(a)]
Carbon Trap Failure	Nuclear Criticality
Pump Exhaust Plugged (Contingency Dump System) - Public	Fire Propagation Between Areas
Spill of Failed Centrifuge Parts (Crashed Centrifuge Debris)	Fires Involving Excessive Transient Combustibles
Fire in Ventilated Room	Heater Controller Failure
Fire within the Site Boundary (>15 minutes)	Over-Filled Cylinders Heated to Ambient
Ongoing Security Compromise (>15 minutes)	Product Liquid Sampling Autoclave Heater Failure Followed By Reheat
Elevated radiation levels or airborne contamination levels within the facility that indicates a severe loss of control of radioactive materials (factor of 100 over normal levels).	Open Sample Manifold Purge Valve And Blind Flange
Other conditions that warrant precautionary activation of the EO.	Pump Exhaust Plugged - Worker
	UF_6 Sub-sampling Unit Hot Box Heater Controller Failure
	Empty UF_6 Cold Trap (UF_6 Release) - Worker
	Cylinder Valve/Connection Failure During Pressure Test
	Chemical Dump Trap Failure
	Worker Evacuation
	Imminent or Actual Loss of Physical Control of the Facility
	Elevated radiation levels or airborne contamination levels outside the facility that indicates a significant release to the environment (factor of 100 over normal levels).
	Other conditions that warrant activation of offsite EOs or precautionary notification of the public near the site.

(a) Includes seismic event with a magnitude greater than or equal the automatic seismic ventilation trip setting.

Table 3.3-1 National Enrichment Facility Emergency Notification Form
Page 1 of 1

1. This is: A REAL EVENT / A DRILL (Circle One)

2. This is:____________ Shift Manager at __________ (Telephone Number)

3. There has been: ALERT / SITE AREA EMERGENCY (Circle One) at the National Enrichment Facility.

4. EAL Designator: ____________

5. Brief description of the event: ____

____

____

____

6. Event Declared At:__________ (time) on _____________ (date)

7. Radiological Conditions:

No Abnormal Release Offsite	☐	Abnormal Release Offsite	☐
Liquid Release Offsite	☐	Release Information Not Known	☐

8. Protective Action Recommendation:
   - ☐ None at this time.
   - ☐ ____

   ____

9. Meteorological Data:
   Wind Speed:_____ mph   Wind Direction:_____° (wind from)

10. (NMEMA Operations) Initiate return call to ____________ (Telephone Number) via commercial line to validate information.

11. (County Operations) Initiate return call to _____________ (Telephone Number) via commercial line to validate information.

12. (Texas Operations) Initiate return call to______________ (Telephone Number) via commercial line to validate information.

13. Notify Nuclear Regulatory Commission (NRC) using NRC Form 361A, "Fuel Cycle and Materials Event Notification Worksheet," within one hour of declaring an emergency.

Release of this
Message Approved by: ___________________________ Time/Date: _____________
Emergency Director

6.4 EMERGENCY MONITORING EQUIPMENT

6.4.1 Criticality Accident Alarms

A Criticality Accident Alarm System (CAAS) is provided to detect and alarm if a criticality event occurs in an area where uranium quantities at or above the 10 CFR 70.24 limits are used, stored, or handled. In the unlikely event of a criticality accident, the CAAS system is equipped with its own specific visual and audible alarm system to alert personnel if a specific area is to be evacuated. Additionally, this system interfaces with the Plant Control System (PCS) to provide system and alarm status in the Control Room.

6.4.2 Personnel Monitoring Equipment

Personnel who may be exposed to radiation wear thermoluminescent dosimeters (TLDs), which are processed on a routine basis to determine exposure. As appropriate, other types of dosimeters, including finger rings, direct-reading dosimeters and neutron dosimeters are used and available during an emergency.

Appropriate radiation dose rate and contamination survey instruments are used to measure the types and energies of radiation encountered at the NEF. Instrumentation includes alpha, beta and gamma count and dose rate meters, as well as scalar instrumentation to evaluate personnel exposure. Radiological instruments are calibrated routinely as specified in procedures.

Monitoring stations are strategically located onsite for normal egress from potentially contaminated areas and for evacuation during radiological events.

The facility maintains emergency monitoring instrumentation for chemically toxic material releases. These instruments are maintained in dedicated emergency response kits and in the routine monitoring equipment inventory.

6.4.3 Liquid Effluent Monitors

Chemical and/or radiological monitoring and batch sampling/testing of process effluents will take place in tanks prior to initiating discharge. The Liquid Effluent and Collection Treatment System discharges to the Treated Effluent Evaporative Basin. Runoff from the Uranium Byproduct Cylinders (UBC) Storage Pad, cooling tower blowdown water and heating boiler blowdown water are discharged to the UBC Storage Pad Stormwater Retention Basin, a single-lined basin.

Site surface water runoff, excluding that from the UBC Storage Pad, will be collected in a storm water collection basin.

6.4.4 Air Monitors

Air quality monitoring devices assess concentrations of material (radioactive and chemical) being released to the environment. The details of the program, including locations of sampling points, are described in the Chapter 9, Environmental Protection, of the SAR.

Air particulate samples are collected on filters in continuously operating air samplers. Gross alpha and gross beta analyses are performed on a routine basis. Following an incident in which UF_6 is released to the environment, additional air sampling for both air particulates and chemicals will be performed, as necessary, to aid in recovery from the event.

In addition to the facility's inventory of routinely used radiological monitoring equipment, the facility maintains emergency monitoring instrumentation for chemically toxic material releases. These instruments are maintained in dedicated emergency response kits.

6.4.5 Hydrogen Fluoride (HF) Monitoring

HF monitors are installed in the Separations Building Gaseous Effluent Vent System (GEVS), the Technical Services Building GEVS, the Centrifuge Test and Post Mortem Facilities Exhaust Filtration Stack, and the exhaust stack associated with the confinement function of the TSB Heating, Ventilation, and Air Conditioning System. These monitors are capable of sensing HF and providing alarm and readout in the Control Room.

6.4.6 Meteorological Monitoring

A facility meteorological measurement system comprised of wind speed, direction, and temperature equipment is located on the meteorological tower. The instrument tower will be located at a site approximately the same elevation as the finished facility grade and in an area where facility structures will have little or no influence on the meteorological measurements.

Measurement instrumentation will be located at a height of approximately 10 meters (33 feet) from the finished grade of the nearest building structure and at 40 meters (130 feet) from the finished grade. A distance approximately ten times the obstruction height around the tower towards the prevailing wind direction will be maintained in accordance with established standards for meteorological measurements. The program for instrument maintenance and servicing, combined with redundant data recorders, assures at least 90% data recovery.

The data this equipment provides is recorded in the Control Room and can be used for dispersion calculations.

Equipment will also measure temperature and humidity, which will be recorded in the Control Room.

Environmental Report

Revision 4, April 2005
Including Page Removal and Insertion Instructions

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requirements savings associated with recycling of commercial and military plutonium are in the range of 2% and 3% over the long term.

Table 1.1-3, World Average Annual Uranium Enrichment Requirements Forecast After Adjustment for Plutonium Recycle in MOX Fuel (Million SWU) provides a forecast of average annual enrichment services requirements by world region that must be supplied from world sources of uranium enrichment services. These requirements reflect adjustment for the use of recycled plutonium in mixed oxide (MOX) fuel. It should be recognized that on a year to year basis, there can be both upward and downward annual fluctuations that reflect the various combinations of nominal 12-month, 18-month and 24-month operating/refueling cycles that occur at nuclear power plants throughout the world. Therefore, interval averages are provided in this table.

As shown in Table 1.1-3, World Average Annual Uranium Enrichment Requirements Forecast After Adjustment for Plutonium Recycle in MOX Fuel (Million SWU), during the 2003 to 2005 period, world annual enrichment services requirements are forecast to be 40.2 million separative work units (SWU), which is a 3.3% increase over the estimated 2002 value of 38.9 million SWU. LES forecasts that annual enrichment services requirements will rise very gradually with the average annual requirements during the 2006 to 2010 period reaching 41.6 million SWU, an increase of 3.5% over the prior five year period. Annual requirements for enrichment services are forecast to be virtually flat thereafter, averaging 41.5 million SWU per year throughout the period 2011 through 2020.

These LES forecasts of uranium enrichment requirements in the U.S. and world are generally consistent with the most recently published forecasts by both the EIA and WNA (WNA, 2003; DOE, 2001g; DOE, 2003c). Figure 1.1-4, Comparison of Forecast of World Average Annual Uranium Enrichment Requirements Forecasts, Unadjusted for Plutonium Recycle in MOX Fuel and Figure 1.1-5, Comparison of Forecast of U.S. Average Annual Uranium Enrichment Requirements Forecast, Unadjusted for Plutonium Recycle in MOX Fuel, provide comparisons of the LES forecasts with those published by these two organizations for world and U.S. requirements. Since both EIA and WNA present their uranium enrichment requirements forecasts prior to adjustment for the use of recycled plutonium in MOX fuel, LES has presented its forecasts in the same manner.

Since the EIA does not publish a forecast of plutonium recycle in MOX fuel, LES has compared its forecast of plutonium recycle in MOX fuel, which is developed based in part on published information (NEA 2003), against that of WNA (WNA, 2003) and finds the forecasts to be in general agreement. LES's assumptions, as reflected in Table 1.1-3, for the adjustment to uranium enrichment requirements associated with the utilization of commercial and military plutonium recycle in MOX fuel are summarized in Table 1.1-4.

In the context of the analysis that is presented in subsequent sections of this report, it may be useful to note that LES's uranium enrichment requirements forecasts, which are presented in Table 1.1-3, suggest U.S. requirements for uranium enrichment services (Figure 1.1-5) that are 14.6% lower than the average of the EIA and WNA forecasts during the period 2011 through 2020 and 8.5% lower worldwide than the average of the EIA and WNA forecasts (Figure 1.1-4) during this same period. If the higher EIA or WNA forecasts for uranium enrichment requirements were used by LES in the analysis that is presented in this report, then an even greater need would be forecast for newly constructed uranium enrichment capability.

1.1.2.3 Current and Potential Future Sources of Uranium Enrichment Services

Table 1.1-5, Current and Potential Future Sources of Uranium Enrichment Services, summarizes current and potential future sources and quantities of uranium enrichment services. These sources include existing inventories of low enriched uranium (LEU), production from existing uranium enrichment plants, enrichment services obtained by blending down Russian weapons grade highly enriched uranium (HEU), as well as new enrichment plants and expansions in existing facilities, together with enrichment services that might be obtained by blending down U.S. HEU. The distinction is made in this table between current annual "physical capability," and current annual "economically competitive and physically usable capability," both of which may be less that the facility's "nameplate rating." In the case of facilities that are in the process of expanding their capability, the annual production that is available to fill customer requirements during the year is listed, not the end of year capability.

The nameplate rating is characterized as the annual enrichment capability of the enrichment cascades if all auxiliary systems were physically capable of supporting that level of facility operation, which is not always the situation in an older facility. The physical capability is characterized as the annual enrichment capability of the entire facility, taking into account whatever limits may be imposed by auxiliary systems, but independent of the economics associated with operation at that level of production. The economically competitive and physically usable capability refers to that portion, which may be all or part, of the physical capability that is capable of producing enrichment services that can be competitively priced. For instance, the cost of firm power during the summer months which can be several times higher than the cost of non-firm power that may be purchased under contract during the remainder of the year. In practice this limits the annual enrichment capability of electricity intensive gaseous diffusion enrichment plants. In addition, physically usable requires that the enriched uranium product that can be obtained from the enrichment plant that is not subject to international trade restrictions and will meet appropriate material specifications for its use in commercial nuclear power plants that operate in countries outside the CIS and Eastern Europe.

Current total world annual supply capability from all available sources, independent of physical suitability of material or economics is presently estimated by LES to be approximately 49.6 million SWU, as shown in Table 1.1-5. However, the total world annual supply capability of enrichment services that are used to meet CIS and Eastern European requirements, plus those which are economically competitive and meet material specifications for use by Western customers, and are not constrained by international trade restrictions amounts to only 40.7 million SWU, as also shown in Table 1.1-5. This is only 1.8 million SWU greater than the estimated 2002 requirements of 38.9 million SWU and nearly identical to the 2003 to 2005 average requirements of 40.2 million SWU, which were presented in Table 1.1-3, World Average Annual Uranium Enrichment Requirements Forecast After Adjustment for Plutonium Recycle in MOX Fuel (Million SWU). These conclusions are consistent with other recently published analyses of the market for uranium enrichment services (NEIN, 2003; NMR, 2002b; Van Namen, 2000; Grigoriev, 2002).

The Inventories (Table 1.1-5, Ref. 1) refer to existing inventories of LEU that are held primarily by owners and operators of nuclear power plants in Europe and East Asia, those that are present in Kazakhstan, and to a limited extent elsewhere. LES expects that most such inventories will be used internally in the near term and will decline from just under one million SWU in 2003 to 0.5 million SWU by 2007.

The Central Utilities Building (CUB) provides a central location for the utility services for the process buildings. The CUB also contains the two standby diesel powered electric generators that provide power to protect selected equipment in the unlikely event of loss of offsite supplied power. The building also contains electrical rooms, an air compression room, a boiler room, and cooling water facility.

The Cylinder Receipt and Dispatch Building (CRDB) is used to receive, inspect, weigh and temporarily store cylinders of natural UF_6 sent to the plant and ship cylinders of enriched UF_6 to customers. Additionally, clean, empty product and UBC are received, inspected, weighed, and temporarily stored prior to their being filled in the Separations Building.

The UBC Storage Pad is a series of concrete pads designed to store up to 15,727 UBCs. A single-lined UBC Storage Pad Stormwater Retention Basin will be used specifically to retain runoff from the UBC Storage Pad during heavy rainfalls. This basin will also receive cooling tower blowdown and heating boiler blowdown. The unlined Site Stormwater Detention basin will receive rainfall runoff from the balance of the developed plant site. Liquid effluent from plant process systems will be discharged to the double-lined Treated Effluent Evaporative Basin provided with a leak detection system.

1.2.4 Schedule of Major Steps Associated with the Proposed Action

The NEF will be constructed in six phases corresponding to the successive completion of six centrifuge Cascade Halls. All construction will be completed in 2013. Each phase will result in an additional nominal 0.5 million SWU, with the first unit beginning operation prior to the completion of the remaining phases. Like the Claiborne Enrichment Center (LES, 1991a), the NEF is designed for at least 30 years of operation. A review of the centrifuge replacement options will be conducted late in the second decade of 2000. Decommissioning is expected to take approximately nine (9) years.

The anticipated schedule for licensing, construction, operation and decommissioning is as follows:

Milestone	Estimated Date
• Submit Facility License Application	December 2003
• Initiate Facility Construction	August 2006
• Start First Cascade	October 2008
• Achieve Full Nominal Production Output	October 2013
• Submit License Termination Plan to NRC	April 2025
• Complete Construction of D&D Facility	April 2027
• D&D Completed	April 2036

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offsite disposal. Any person owning or operating a new or existing facility that treats, stores, or disposes of a hazardous waste must obtain a hazardous waste permit from the New Mexico Hazardous Waste Bureau. It is anticipated that small to medium volumes of hazardous waste will be stored at the facility for eventual offsite disposal. The NEF will generate small quantities of hazardous waste that are expected to be greater than 100 kg (220 lbs) per month and is not planning to store these wastes in excess of 90 days (see ER Section 3.12, Waste Management). Thus, the NEF will qualify as a small quantity hazardous waste generator in accordance with 20.4.1 NMAC (NMAC, 2000). As a result, NEF will not require a hazardous waste permit, but instead must file a US EPA Form 8700-12, Notification of Regulated Waste Activity.

The NEF is committed to pollution prevention and waste minimization practices and will incorporate RCRA pollution prevention goals, as identified in 40 CFR 261 (CFR, 2003p). A Pollution Prevention Waste Minimization Plan will be developed to meet the waste minimization criteria of NRC, EPA and state regulations. The Pollution Prevention Waste Minimization Plan will describe how the NEF design procedures for operation will minimize (to the extent practicable) the generation of radioactive, mixed, hazardous, and nonhazardous solid waste.

New Mexico State Land Office (NMSLO):

Right–of-Entry Permit: Surface Resources section of the NMSLO administers renewable resources and sustainable activities on state trust land and works to enhance environmental quality of the lands. Also, it manages the biological, archeological, and paleontological resources. Surface Resources administers agriculture leases, rights of way, and special access permits. It is responsible for mapping, surveying, geographic information systems, and records management. LES applied for and received a Right-of-Entry Permit early in the license application preparation phase so that they could conduct environmental surveys on Section 32 prior to the land being transferred, or an easement granted, to LES.

New Mexico Department of Game and Fish (NMDGF):

Rare, Threatened and Endangered Species Survey: The NMDGF mission is to assist all New Mexico wildlife in need. The program funds four general categories: research, public education, habitat protection, and wildlife rehabilitation, including rare threatened and endangered species. LES conducted a rare, threatened and endangered (RTE) survey for both plants and animals. RTE species were not identified on the NEF site.

New Mexico Radiological Control Bureau (NMED/RCB):

(X-Ray) Radiation Machine Registration: Radiation machine is defined by the New Mexico Radiation Protection Regulations (NMRPR) as any device capable of producing radiation except those which produce radiation only from radioactive material. Examples include medical x-ray machines, particle accelerators, and x-ray radiography machines used for non-destructive testing of materials. The bureau regulates the machines and their usage in accordance with the requirements of the NMRPR (20.3 NMAC) (NMAC, 2001a). Registrants are required to maintain hardcopies of pertinent parts of the regulations. Mandatory parts include 20.3.2, 20.3.4 (except appendices), and 20.3.10. Other parts apply as applicable for the type of use. LES plans to use non-destructive (x-ray) inspection systems for package security requirement. If the output at 0.3 m (1 ft) from the unit exceeds 1.29E-07 C/kg/hr (0.5 mR/hr), than the x-ray unit must be registered with the State Radiological Control Bureau under section 20.3.11 of

NMAC. LES has notified the NMED/RCB (LES, 2004) that they will register NEF X-Ray equipment prior to use when the equipment specifications become available.

New Mexico State Historic Preservation Office (NMSHPO) (NMAC, 2001b):

Class III Cultural Survey: Cultural properties, including prehistoric and historic archaeological sites, historic buildings and other structures, and traditional cultural properties located on state land in New Mexico are protected by the Cultural Properties Act. It is unlawful for any person to excavate, injure, destroy, or remove any cultural property or artifact on state land without a permit. It is also unlawful for any person to intentionally excavate any unmarked human burial, and any material object or artifact interred with the remains, located on any non-federal or non-Indian land in New Mexico without a permit. LES retained a subcontractor that obtained a permit to conduct an archaeological survey. The survey was conducted during September and October of 2003.

A Class III Cultural Resource Inventory and Palentological Survey was conducted on the site. The survey for the cultural resources (archaeological, historical and palentological) consisted of the following: 1) File search and records check; 2) Class III field inventory; and 3) Class III inventory report for the project. The tasks described in this scope are those necessary to complete a Class III survey and National Register of Historic Places evaluations of all cultural resources within the project area and approval by the New Mexico State Historic Preservation Office. Results of the survey are provided in ER Section 3.8, Historic and Cultural Resources, and Section 4.8, Historic and Cultural Resource Impacts.

1.3.3 Local Agencies

Plans for construction and operation of the proposed NEF are being communicated to and coordinated with local organizations. Officials in Lea and Andrews Counties have been contacted regarding the locations of roads and water lines which traverse the site. The Eunice and Hobbs municipal water system operators have been contacted to obtain compliance information for the potable water supplies received from these cities.

Emergency support services have been coordinated with the state and local agencies. When contacted, the Central Dispatch in the Eunice Police Department will dispatch fire, Emergency Medical Services (EMS) and local law enforcement personnel. Mutual Aid agreements exist between the Eunice Police Department, Lea County Sheriff's Department, and New Mexico State Police, which are activated if additional police support is needed. Mutual aid agreements also exist between Eunice, New Mexico, the City of Hobbs Fire Department, and Andrews County, Texas for additional Fire and medical services. If emergency fire and medical services personnel in Lea County are not available, the mutual aid.agreements are activated and the Eunice Central Dispatch will contact the appropriate agencies for the services requested at the facility.

Memoranda of Understanding (MOU) have been signed between LES and Eunice Fire and Rescue and the City of Hobbs Fire Department for fire and medical emergency services. MOUs have also been signed with the Eunice Police Department, the Lea County Sheriff's Office and the New Mexico Department of Public Safety, which includes both the New Mexico State Police and the New Mexico Office of Emergency Management. Copies of the Memoranda of Understanding with the agencies that have agreed to support the LES project for construction impregnated carbon filter (potassium carbonate), centrifugal fan, automatically operated inlet-outlet isolation dampers, monitorings, and differential pressure transducers.

2.1.2.4.6 Laundry System

The Laundry System cleans contaminated and solid clothing and other articles within the plant. The laundry is divided into two main streams: articles with high or low possibility of contamination. Articles likely to be contaminated are collected in special water soluble bags. Articles unlikely to be contaminated are collected in bin bags and sorted into lightly and heavily soiled articles. Lightly soiled articles are laundered; heavy soiled articles are inspected first and if to difficult to clean are sent to the Solid Waste Collection System, otherwise they are laundered as well. Laundry water is discharged to the Liquid Effluent Collection and Treatment System.

2.1.2.4.7 Centrifuge Test and Post Mortem Facilities Exhaust Filtration System

The Centrifuge Test and Post Mortem Facilities Exhaust Filtration System provides exhaust of potentially hazardous contaminants from the Centrifuge Test and Post Mortem Facilities. The system also ensures the Centrifuge Post Mortem Facility is maintained at a negative pressure with respect to adjacent areas. The Centrifuge Test and Post Mortem Facilities Exhaust Filtration System is located in the Centrifuge Assembly Building and is monitored from the Control Room.

The ductwork is connected to one filter station and vents through either of two 100% fans. Both the filter station and either of the fans can handle 100% of the effluent. One of the fans will normally be in standby. Operations that require the Centrifuge Test and Post Mortem Facilities Exhaust Filtration System to be operational are manually shut down if the system shuts down. After filtration, the clean gases pass through a fan, which maintains the negative pressure upstream of the filter station. The clean gases are then discharged through the monitored (alpha and HF) stack on the Centrifuge Assembly Building.

2.1.2.5 Site and Nearby Utilities

The cities of Eunice and Hobbs, New Mexico will provide water to the site. Water consumption for the NEF is calculated to be 240 m^3/day (63,423 gal/d) to meet potable and process consumption needs. Peak water usage for fire protection is 33 L/s (521 gal/min). The natural gas requirements of the plant are 354 m^3/hr (12,500 ft^3/hr). Electrical service to the site will be provided by Xcel Energy. The projected demand is approximately 30 MW. Six septic tanks, each with one or more leach fields, will be installed onsite for the collection of sanitary and non-contaminated liquid waste.

Identified, onsite pipelines include a 25.4-cm (10-in) diameter, underground carbon dioxide pipeline that runs southeast-northwest. This pipeline is owned by Trinity Pipeline LLC. A 40.6-cm (16-in) diameter, underground natural gas pipeline, owned by the Sid Richardson Energy Services Company, is located along the south property line, paralleling New Mexico Highway 234. A parallel 35.6-cm (14-in) diameter gas pipeline is not in use. There are no known onsite underground storage tanks, wells, or sewer systems.

Detailed information concerning water resources and the use of potable water supplies is discussed in ER Section 3.4, Water Resources, and the impacts from these water resources are discussed in ER Section 4.4, Water Resources Impacts. A discussion of impacts related to utilities that will be provided is included in ER Section 4.1, Land Use Impacts.

2.1.2.6 Chemicals Used at NEF

The NEF uses various types and quantities of non-hazardous and hazardous chemical materials. Table 2.1-1, Chemicals and Their Properties, lists the chemicals associated with the NEF operation and their associated hazards. Tables 2.1-2 through 2.1-5 summarize the chemicals in use and storage, categorized by building. These tables also include the physical state and the expected quantity of chemical materials.

2.1.2.7 Monitoring Stations

The NEF will monitor both non-radiological and radiological parameters. Descriptions of the monitoring stations and the parameters measured are described in other sections of this ER as follows:

- Meteorology (ER Chapter 3, Section 3.6)
- Water Resources (ER Chapter 3, Section 3.4)
- Radiological Effluents (ER Chapter 6, Section 6.1)
- Physiochemical (ER Chapter 6, Section 6.2)
- Ecological (ER Chapter 6, Section 6.3)

2.1.2.8 Summary of Potential Environmental Impacts

Following is a summary of impacts from undertaking the proposed action and measures used to mitigate impacts. Table 2.1-6, Summary of Environmental Impacts for the Proposed Action, summarizes the impact by environment resource and provides a pointer to the corresponding section in ER Chapter 4, Environmental Impacts, that includes a detailed description of the impact. Detailed discussions of proposed mitigation measures and environmental monitoring programs are provided in ER Chapter 5, Mitigation Measures and Chapter 6, Environmental Measurements And Monitoring Programs, respectively.

Operation of the NEF would result in the production of gaseous, liquid, and solid waste streams. Each stream could contain small amounts of hazardous and radioactive compounds either alone or in a mixed form.

Gaseous effluents for both non-radiological and radiological sources will be below regulatory limits as specified in permits issued by the New Mexico Air Quality Bureau (NMAQB) and release limits by NRC (CFR, 2003q; NMAC, 2002a). This will result in minimal potential impacts to members of the public and workers.

Liquid effluents include stormwater runoff, sanitary waste water, cooling tower blowdown water, heating boiler blowdown and treated liquid effluents. All proposed liquid effluents, except sanitary waste water, will be discharged onsite to evaporative detention or retention basins.

General site stormwater runoff is collected and released untreated to a site stormwater detention basin. A single-lined retention basin will collect stormwater runoff from the Uranium Byproduct Cylinder (UBC) Storage Pad, cooling tower blowdown water and heating boiler blowdown water. All stormwater discharges will be regulated, as required, by a National Pollutant Discharge Elimination System (NPDES) Stormwater Permit. LES will also need to obtain a New Mexico Groundwater Quality Bureau (WQB) Groundwater Discharge Permit/Plan prior to operation for its onsite discharges of stormwater, treated effluent water, cooling tower blowdown water, heating boiler blowdown water and sanitary water. Approximately 174,100 m^3 (46 million gal) of stormwater from the site is expected to be released annually to the onsite retention/detention basins.

NEF liquid effluent discharge rates are relatively low, for example, NEF process waste water flow rate from all sources is expected to be about 28,900 m^3/yr (7.64 million gal/yr). This includes waste water from the liquid effluent treatment system, domestic sewerage, cooling tower blowdown water and heating boiler blowdown water . Only the former source can be expected to contain minute amounts of uranic material. The liquid effluent treatment system and shower/hand wash/laundry effluents will be discharged onsite to a double-lined evaporative basin; whereas the cooling tower blowdown water, heating boiler blowdown water and UBC pad stormwater run-off will be discharged onsite to a single-lined retention basin. Domestic sewerage will be discharged to onsite septic tanks and leach fields.

The NEF water supply will be obtained from the city of Eunice, Mew Mexico and the city of Hobbs, New Mexico. Current capacities for the Eunice and Hobbs, New Mexico municipal water supply systems are 16,350 m^3/day (4.32 million gpd) and 75,700 m^3/day (20 million gpd), respectively and current usages are 5,600 m^3/day (1.48 million gpd) and 23,450 m^3/day (6.2 million gpd), respectively. Average and peak potable water requirements for operation of the NEF are expected to be approximately 240 m^3/day (63,423 gpd) and 85 m^3/hr (378 gpm), respectively. These usage rates are well within the capacities of both water systems.

Solid waste that will be generated at the NEF, which falls into the non-hazardous, radioactive, hazardous, and mixed waste categories, will be collected and transferred to authorized treatment or disposal facilities offsite as follows. All solid radioactive waste generated will be Class A low-level waste as defined in 10 CFR 61 (CFR, 2003r). Approximately 86,950 kg (191,800 lbs) of low-level waste will be generated annually. In addition, annual hazardous and mixed wastes generated are expected to be about 1,770 kg (3,930 lbs) and 50 kg (110 lbs), respectively. As a result, the NEF will be a small quantity generator (SQG) of hazardous waste and dispose of the waste by licensed contractors. LES does not plan to treat hazardous waste or store quantities longer than 90 days. Non-hazardous waste, expected to be approximately 172,500 kg (380,400 lbs) annually, will be collected and disposed of by a County licensed solid waste disposal contractor. The non-hazardous wastes will be disposed of in the new Lea Country landfill which has more than adequate capacity to accept NEF non-hazardous wastes for the life of the facility.

No communities or habitats defined as rare or unique, or that support threatened and endangered species, have been identified as occurring on the NEF site. Thus, no proposed activities are expected to impact communities or habitats defined as rare or unique, or that support threatened and endangered species, within the 220-ha (543-acre) site.

Noise generated by the operation of the NEF will be primarily limited to truck movements on the road. The noise at the nearest residence will probably increase; however, it may not be noticeable. While the incremental increases in noise level are small, some residents may experience some disturbance for a short period of time as they adjust to these slight increases.

The results of the economic analysis show that the greatest fiscal impact (i.e., 66% of total value impacts) will derive from the 8-year construction period associated with the proposed facility. The largest impact on local business revenues stems from local construction expenditures, while the most significant impact in household earnings and jobs is associated with construction payroll and employment projected during the 8-year construction period.

Annual facility operations will involve about 210 employees receiving pay of $10.5 million and $3.1 million in benefits. LES expects that most of these jobs will be filled by Lea County and other nearby county residents, providing numerous opportunities in construction of new housing, in provision of services, and in education. NEF operations could have minor impacts on local public services including education, health services, housing, and recreational facilities, but are anticipated to be minimal.

Radiological release rates to the atmosphere and retention basins during normal operations are estimated to be less than 8.9 MBq/yr (240 μCi/yr) and 14 Bq/yr (390 μCi/yr), respectively. Estimated annual effective dose equivalents and critical organ (lung) dose equivalents from discharged gaseous effluent to a maximally exposed adult individual located at the plant site boundary are 1.7×10^{-4} mSv (1.7×10^{-2} mrem) and 1.4×10^{-3} mSv (1.4×10^{-1} mrem), respectively. The annual effective dose equivalent and critical organ (teen-lung) dose equivalents from discharged gaseous effluent to the nearest resident located beyond 4.3 km (2.63 mi) in the west sector are expected to be less than 1.7×10^{-5} mSv (1.7×10^{-3} mrem) and 1.2×10^{-4} mSv (1.2×10^{-2} mrem), respectively. Estimated annual effective dose equivalent and critical organ lungdose equivalents from liquid effluent to a maximally exposed individual at the south site boundary are 1.7×10^{-5} mSv (1.7×10^{-3} mrem) and 1.5×10^{-4} mSv (1.5×10^{-2} mrem), respectively. The nearest resident (teenager) location had a maximum annual effective dose equivalent of 1.7×10^{-6} mSv (1.7×10^{-4} mrem). The maximum annual organ (lung) at the nearest resident (teenager) from liquid effluents was estimated to be 1.3×10^{-5} mSv (1.3×10^{-3} mrem).

These dose equivalents due to normal operations are small fractions of the normal background radiation range of 2.0 to 3.0 mSv (200 to 300 mrem) dose equivalent that an average individual receives in the US (NCRP, 1987a), and within regulatory limits (CFR, 2003q). Given the conservative assumptions used in estimating these values, these concentrations and resulting dose equivalents are insignificant and their potential impacts on the environment and health are inconsequential.

Operation of the NEF would also result in the annual nominal production of approximately 7,800 metric tons (8,600 tons) at full capacity of depleted UF_6. The depleted UF_6 would be stored onsite in Uranium Byproduct Cylinders (UBCs) and would have minor impact while in storage. The maximum annual dose equivalent due to external radiation from the UBC Storage Pad (skyshine and direct) is estimated to be less than 2.0×10^{-1} mSv (20 mrem) to the maximally exposed person at the nearest point on the site boundary (2,000 hrs/yr) and 8×10^{-12} mSv/yr (8×10^{-10} mrem/yr) to the maximally exposed resident (8,760 hrs/yr) located approximately 4.3 km (2.63 mi) from the UBC Storage Pad.

Based on 2000 US Census Bureau data, construction and/or operation of the NEF will not pose a disproportionate impact to the Lea County, New Mexico or Andrews County, Texas minority or low-income population.

- Nine site groundwater exploration borings (B-1 through B-9)
- Five geotechnical borings (B-1 through B-5).

Other borings depicted on Figure 3.3-5, not on the NEF site, were performed by others.

The Southeast New Mexico-West Texas area presently is structurally stable. The Permian Basin has subsided slightly since the Laramide Orogeny. This is believed to be a result of dissolution of the Permian evaporite layers by groundwater infiltration and possibly from oil and gas extraction (WBG, 1998).

The NEF site lies within the Landreth-Monument Draw Watershed. Site drainage is to the southwest with runoff not able to reach any water body before it evaporates. The only major regional drainage feature is Monument Draw, which is located just over 4 km (2.5 mi) west of the site, between the proposed NEF site and the city of Eunice, New Mexico (USDA, 1974). The draw begins with a southeasterly course to a point north of Eunice where it turns south and becomes a well defined cut approximately 9 m (30 ft) in depth and 550 to 610 m (1,800 to 2,000 ft) in width. The draw does not have through-going drainage and is partially filled with dune sand and alluvium.

Along Red Bed Ridge (TTU, 2000), approximately 1.6 km (1 mi) northeast of the NEF site is Baker Spring (Figure 3.3-5, Site Boring Plan and Profile). The depression contains water only intermittently (see ER Section 3.4.1.1, Major Surface and Subsurface Hydrological Systems). No defined drainage features are present at the site. Rainfall on the site will be collected in detention/retention basins. Rainfall that is not collected is expected to infiltrate, or evaporate without creating any runoff that flows beyond site boundaries.

Within Lea County, New Mexico and Andrews County, Texas there are water-bearing strata used for water production. North and east of the NEF site, beneath the High Plains, the Ogallala Aquifer is the most productive of these regional aquifers. West of the site, in the alluvial deposits of Monument Draw, subsurface flow is also locally used as a minor aquifer. Lastly, the Santa Rosa Formation of the Lower Dockum Group and sandy lenses in the Upper Dockum Chinle formation are occasionally used as aquifers on a regional basis.

The most shallow strata to produce measurable quantities of water is an undifferentiated siltstone seam of the Chinle encountered at approximately 65 to 68 m (214 to 222 ft) below ground surface (WBG, 1998). There is also a 30.5-meter (100-foot) thick water-bearing sandstone layer at about 183 m (600 ft) below ground surface. However, the uppermost aquifer capable of producing significant volumes of water is the Santa Rosa Formation located approximately 340 m (1,115 ft) below ground surface (CJI, 2004).

With respect to the environment, geologic conditions at the NEF site will not be significantly affected by construction or operation of the NEF. (See ER Section 4.3, Geology and Soils Impact.)

3.3.1 Stratigraphy and Structures

The Permian Basin, a massive subsurface bedrock structure, is a downward flexure of a large thickness of originally flat-lying, bedded, sedimentary rock. It dominates the geologic structure of the region. It extends to 4,880 meters (16,000 feet) below msl. The NEF site is located above the Central Basin Platform that divides the Permian Basin into the Midland and Delaware sub-basins, as shown in Figure 3.3-2, Regional Geology of the Permian Basin. The base of the Permian basin sediments extends about 1,525 m (5,000 ft) deep beneath the NEF site.

The top of the Permian deposits are approximately 434 m (1,425 ft) below ground surface. Overlying the Permian are the sedimentary rocks of the Triassic Age Dockum Group. The upper formation of the Dockum Group is the Chinle. Locally, the Chinle Formation consists of red, purple and greenish micaceous claystone and siltstone with interbedded fine-grained sandstone. The Chinle is regionally extensive with outcrops as far away as the Grand Canyon region in Arizona (WBG, 1998). Locally overlying the Chinle Formation in the Permian Basin is either the Tertiary Ogallala, Gatuña or Antlers Formations, or Quaternary alluvium. The Tertiary Ogallala Formation underlies all of the High Plains (to the east) and mantles several ridges in Lea County. Unconsolidated sediments northeast of the NEF site are recognized as the Ogallala and deposits west of the NEF site are mapped as the Gatuña or Antlers Formations. This sediment is described as alluvium (WBG, 1998) and is mined as sand and gravel in the NEF site area.

As shown in Table 3.3-1, Geological Units Exposed At, Near, or Underlying the Site, the uppermost 340 m (1,115 ft) of the subsurface in the NEF site vicinity can include up to 0.6 m (2 ft) of silty fine sand, about 3 m (10 ft) of dune sand, 6 m (20 ft) of caliche, and 16 m (54 ft) of alluvium overlying the Chinle Formation of the Triassic Age Dockum Group. The Chinle Formation is predominately red to purple moderately indurated claystone, which is highly impermeable (WBG, 1998). Red Bed Ridge is a significant topographic feature in this regional plain that is just north and northeast of the NEF site, and is capped by relatively resistant caliche. Ground surface elevation increases about 15 m (50 ft) from +1,045 m (+3,430 ft) to +1,059 m (+3,475 ft) across the ridge.

Recent deposits at the site and in the site area are primarily dune sands derived from Permian and Triassic rocks of the Permian Basin. These so-called Mescalero Sands cover approximately 80% of Lea County, locally as active sand dunes.

Information from recent borings done on the NEF site is consistent with the data shown on the profile in Figure 3.3-5, Site Boring Plan and Profile. This includes a thin layer of loose sand at the surface; about 12 m (40 ft) of high blow count alluvial silty sand and sand and gravel locally cemented with caliche; and the Chinle clay at a depth of about 12 m (40 ft) below the ground surface. No sandy clay layers were reported in the clay.

The boring logs for the NEF site geotechnical borings (Borings B-1 through B-5) are provided in the Integrated Safety Analysis Summary Figures 3.2-10 through 3.2-15.

Two types of faulting were associated with early Permian deformation. Most of the faults were long, high-angle reverse faults with well over a hundred meters (several hundred feet) of vertical displacement that often involved the Precambrian basement rocks. The second type of faulting is found along the western margin of the platform where long strike-slip faults, with displacements of tens of kilometers (miles), are found. The closest fault to the site as defined by the New Mexico Bureau of Geology and Mineral Resources (NMIMT, 2003) is over 161 km (100 mi) to the west and is associated with the deeper portions of the Permian Basin (Machette, 1998).

The large structural features of the Permian Basin are reflected only indirectly in the Mesozoic and Cenozoic rocks, as there has been virtually no tectonic movement within the basin since the Permian period. Figure 3.3-2, Regional Geology of the Permian Basin, shows the structure that

Table 3.3-1 Geological Units Exposed At, Near, or Underlying the Site

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Formation	Geologic Age	Descriptions	Estimates for the NEF Site Area[1], [6]	
			Depths: m (ft)	Thickness: m (ft)
Topsoils	Recent	Silty fine sand with some fine roots - eolian	Range: 0 to 0.6 (0 to 2) Average: 0 to 0.4 (0 to 1.4)	Range: 0.3 to 0.6 (1 to 2) Average: 0.4 (1.4)
Mescalero Sands/ Blackwater Draw Formation	Quaternary	Dune or dune-related sands	Range (sporadic across site): 0 to 3 (0 to 10) Average: NA[4]	Range (sporadic across site): 0 to 3 (0 to 10) Average: NA[5]
Gatuña/ Antlers Formation	Pleistocene/ mid-Pliocene	Pecos Valley alluvium: Sand and silty sand with interbedded caliche near the surface and a sand and gravel base layer	Range: 0.3 to 17 (1 to 55) Average: 0.4 to 12 (1.4 to 39)	Range: 6.7 to 16 (22 to 54) Average: 12 (38)
Mescalero Caliche	Quaternary	Soft to hard calcium carbonate deposits	Range: 1.8 to 12 (6 to 38) Average: 3.7 to 8 (12 to 26)	Range: 0 to 6 (0 to 20) Average (all 14 borings)[2]: 1.4 (5) Average (five borings that encountered caliche): 4.3 (14)
Chinle Formation	Triassic	Claystone and silty clay: red beds	Range: 7 to 340 (23 to 1,115) Average: 12 to 340 (39 to 1,115)	Range: 323 to 333 (1,060 to 1,092) Average: 328 (1,076)
Santa Rosa Formation	Triassic	Sandy red beds, conglomerates and shales	Range: 340 to 434 (1,115 to 1,425) Average: NA[4]	Range: NA[3] Average: 94 (310)
Dewey Lake	Permian	Muddy sandstone and shale red beds	Range: 434 to 480 (1,425 to 1,575) Average: NA[4]	Range: NA[3] Average: 46 (150)

Notes:

1. Range of depths is below ground level to shallowest top and deepest bottom of geological unit determined from site boring logs, unless noted.
   Average depths are below ground level to average top and average bottom of geological unit determined from site boring logs, unless noted.
   Range of thickness is from the smallest thickness to the largest thickness of geological unit determined from site boring logs, unless noted.
   Average thickness is the average as determined from site boring logs, unless noted.
   Bottom of Chinle Formation, top and bottom of Santa Rosa Formation and top and bottom of Dewey Lake Formation are single values from a deep boring just south of the NEF.
2. Caliche is not present at some locations of the site. Where not present in a particular boring, a thickness of '0' m (ft) was used in calculating the average.
3. Range of thickness is not available.
4. Average depths are not available.
5. Average thickness is not available.
6. Near surface depth and thickness information is primarily from sources (CJI, 2003) and (MACTEC, 2003). Deeper depth and thickness information is from source (CJI, 2004).

Sources: (CJI, 2003; CJI, 2004; DOE, 1997b; MACTEC, 2003; TTU, 2000)

Table 3.3-2 Measured Permeabilities Near the NEF Site

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Permeability Direction	Sediment Type	Permeability, cm/s (ft/s)
Vertical	Clays	$1.00x10^{-9}$ to $1.76x10^{-8}$ ($3.28x10^{-11}$ to $5.77x10^{-10}$)
Horizontal	Clays	$1.63x10^{-9}$ to $1.10x10^{-8}$ ($5.35x10^{-11}$ to $3.61x10^{-10}$)
Vertical	Siltstones and sandstones within 18 to 27 m (56 to 90 ft) depth	$2.58x10^{-8}$ to $1.93x10^{-6}$ ($8.46x10^{-10}$ to $6.33x10^{-8}$)
Horizontal	Siltstones and sandstones within 18 to 27 m (56 to 90 ft) depth	Average: $6.53x10^{-7}$ ($2.14x10^{-8}$)
Vertical	Siltstone at 63 m (208 ft) depth	$2.06x10^{-8}$ ($6.76x10^{-10}$)

Nine boreholes oriented on a three-by-three grid were drilled to the top of the Chinle red beds (Figure 3.4-6). Only one of the borings produced cuttings that were slightly moist at 1.8 to 4.2 m (6 to 14 ft) below ground surface; other cuttings were very dry. Left open for at least a day, no groundwater was observed to enter any of these holes. No samples could be collected for water quality analysis at the time of well construction. One groundwater sample has since been collected due to limited water occurrence, as discussed in ER Section 3.4.15.6, Interactions Among Different Aquifers.

The land surface elevation was surveyed at each of the nine borehole locations and the elevation of the top of the red beds was computed. This information was combined with similar information from the WCS facility to produce an elevation map of the top of the red beds (see Figure 3.4-6). The dry nature of the soils from each of these borings supports a conclusion that there is no recharge from the ground surface at the site (Walvoord, 2002).

The three monitoring wells were installed at the end of September 2003 (Figures 3.3-5 and 3.4-6). Through the first month of monitoring only one well, MW-2, located at the northeast corner of the site, produced water. Several water samples have been taken from that well. It is anticipated that the other two wells may provide water over lengthy time periods, based on information from the WCS site. Groundwater quality is discussed in ER Section 3.4.2, Water Quality Characteristics.

Another factor to consider relative to hydrologic conditions at the NEF site is the presence of the Triassic Chinle Formation red bed clay. This clay unit is approximately 323 to 333 m (1,060 to 1,092 ft) thick beneath the site. With an estimated hydraulic conductivity on the order of $2x10^{-8}$ cm/s ($7.9x10^{-9}$ in/s), the unit is very tight (Table 3.3-2, Measured Permeabilities on the NEF Site). This permeability is of the same order prescribed for engineered landfill liner materials. One would expect vertical travel times through this clay unit to be on the order of thousands of years, based on this permeability and the thickness of the unit.

The first presence of saturated porous media beneath the site appears to be within the Chinle red bed clay where there exists a low-permeability silty sandstone or siltstone. Borings and monitor wells at the WCS facility directly to the east of the NEF site have encountered this zone approximately 61 to 91 m (200 to 300 ft) below land surface. Wells completed in this unit are very slow to produce water. This makes sampling quite difficult. It is arguable whether this zone constitutes an aquifer, given the low permeability of the unit. Similarly, there is a 30.5-meter (100-foot) thick water-bearing layer at about 183 m (600 ft) below ground surface (CJI, 2004). As discussed above, three monitoring wells were installed on the NEF site in September 2003 with screened intervals within this siltstone unit. These wells are approximately 73 m (240 ft) deep.

The first occurrence of a well-defined aquifer is approximately 340 m (1,115 ft) below land surface, within the Santa Rosa formation (CJI, 2004). Because of the depth below land surface to this unit, and the fact that the thick Chinle clay unit would limit any potential migration to depth, this aquifer has not been investigated. No impacts are expected to the Santa Rosa aquifer.

Figure 3.4-7, Water and Oil Wells in the Vicinity of the NEF Site, is a map of wells and surface water features in the vicinity of the NEF plant site. The figure also includes oil wells. No water wells are located within 1.6 km (1 mi) of the site boundary.

3.4.1.2 Facility Withdrawals and/or Discharges to Hydrologic Systems

The NEF plant will receive its water supply from one or more municipal water systems and thus no water will be drawn from either surface water or groundwater sources at the NEF site. Supply of nearby groundwater users will thus not be affected by operation of the NEF. NEF water supply requirements are discussed in ER Section 4.4, Water Resources Impact.

The NEF design precludes operational process discharges from the plant to surface or groundwater at the site other than into engineered basins. Discharge of routine plant liquid effluents will be to the Treated Effluent Evaporative Basin on the site. The Treated Effluent Evaporative Basin is utilized for the collection and containment of waste water discharge from the Liquid Effluent Collection and Treatment System. The ultimate disposal of waste water will be through evaporation of water and impoundment of the residual dry solids byproduct of evaporation. Total annual discharge to that basin will be approximately 2,535 m^3 per year (669,844 gal/yr). The location of the basin is shown in Figure 4.12-2, Site Layout for NEF. Evaporation will provide the only means of liquid disposal from this basin. The Treated Effluent Evaporative Basin will include a double membrane liner and a leak detection system. A summary of liquid wastes volumes accumulated at the NEF is provided in Table 3.4-1, Summary of Potentially Contaminated Liquid Wastes for the NEF. Of the wastes listed in Table 3.4-1, only uncontaminated liquid wastes are released to the Treated Effluent Evaporative Basin for evaporation without treatment. Contaminated liquid waste is neutralized and treated for removal of uranium, as required. Effluents unsuitable for the evaporative disposal will be removed off-site by a licensed contractor in accordance with US EPA and State of New Mexico regulatory requirements. The State of New Mexico has adopted the US EPA hazardous waste regulations (40 CFR Parts 260 through 266, 268 and 270) (CFR, 2003cc; CFR, 2003p; CFR, 2003dd; CFR, 2003ee; CFR, 2003v; CFR, 2003ff; CFR, 2003gg; CFR, 2003hh; CFR, 2003ii) governing the generation, handling, storage, transportation, and disposal of hazardous materials. These regulations are found in 20.4.1 NMAC, "Hazardous Waste Management" (NMAC, 2000).

Stormwater from parts of the site will be collected in a retention or detention basin. The design for this system includes two basins as shown in Figure 4.12-2, Site Layout for NEF. The Site Stormwater Detention Basin at the south side of the site will collect runoff from various developed parts of the site including roads, parking areas and building roofs. It is unlined and will have an outlet structure to control discharges above the design level. The normal discharge will be through evaporation/infiltration into the ground. The basin is designed to contain runoff for a volume equal to that for the 24-hour, 100-year return frequency storm, a 15.2 cm (6.0 in) rainfall. The basin will have approximately 123,350 m^3 (100 acre-ft) of storage capacity. Area served includes about 39 ha (96 acres) with the majority of that area being the developed portion of the 220 ha (543 acres) NEF site. In addition, the basin has 0.6 m (2 ft) of freeboard beyond the design capacity. It will also be designed to discharge post-construction peak flow runoff rates from the outfall that are equal to or less than the pre-construction runoff rates from the site area.

The Uranium Byproduct Cylinder (UBC) Storage Pad Stormwater Retention Basin is utilized for the collection and containment of water discharges from three sources: (1) cooling tower blowdown discharges, (2) heating boiler blowdown discharges and (3) stormwater runoff from the UBC Storage Pad. The ultimate disposal of basin water will be through evaporation of water and impoundment of the residual dry solids after evaporation. It is designed to contain runoff for a volume equal to twice that for the 24-hour, 100-year return frequency storm, a 15.2-cm (6.0-in) rainfall plus an allowance for cooling tower blowdown water and heating boiler blowdown water. The UBC Storage Pad Stormwater Retention Basin is designed to contain a volume of approximately 77,700 m^3 (63 acre-ft). Area served by the basin includes 9.2 ha (22.8 acres), the total area of the UBC Storage Pad. This basin is designed with a membrane lining to minimize any infiltration into the ground.

A standard septic system is planned to dispose of sanitary wastes at the site, as described in ER Section 4.1.2, Utilities Impacts.

3.4.2 Water Quality Characteristics

As discussed in ER Section 3.4.1.1, Major Surface and Subsurface Hydrological Systems, water resources in the area of the NEF site are minimal. Runoff from precipitation at the site is effectively collected and contained by detention/retention basins and through evapotranspiration. It is highly unlikely that any groundwater recharge occurs at the site.

The first occurrence of groundwater beneath the NEF site is in a silty sandstone or siltstone horizon in the Chinle Formation, approximately 67 m (220 ft) below the surface. This unit is low in permeability and does not yield water readily. Groundwater quality in monitoring wells in the Chinle Formation, the most shallow saturated zone, is poor due to natural conditions. Samples from monitoring wells within this horizon on the WCS facility have routinely been analyzed with Total Dissolved Solids (TDS) concentrations between about 2,880 and 6,650 mg/L. Table 3.4-2, Groundwater Chemistry, contains a summary of metal analyses from four background monitoring wells at the WCS site for 1997-2000. Essentially all results are below maximum contaminant limits (MCL) for EPA drinking water standards. The tightness of the formation, the limited thickness of saturation, and the poor water quality, support the argument that this zone does not constitute an aquifer.

Three monitoring wells have been drilled and installed on the NEF site, i.e., MW-1, MW-2, and MW-3 shown on Figure 3.3-5, Site Boring Plan and Profile and Figure 3.4-6, Dockum Group (Chinle Formation) Surface Contour, and yield several water quality samples. The results of the water quality analyses are summarized in Table 3.4-3, Chemical Analyses of NEF Site Groundwater. Water quality characteristics are similar to those for WCS site samples. No local groundwater well sites and, as a result, groundwater data are available with the exception of groundwater well sites on the WCS site and those that have been installed on the NEF site. Additional groundwater sampling and analysis of the onsite monitoring wells will be conducted on a frequency needed to establish a baseline.

Table 3.4-3 presents a summary of results from analyses of a groundwater sample from NEF monitoring well MW-2 which is adjacent to the location of NEF groundwater exploration of boring B-9 on the NEF site (Figure 3.4-6). Standard protocols (ASTM, 1992) were used for sampling.

The data listed for ^{238}U and below in Table 3.4-3 is from the analysis of site ground water for radionuclides. Some of the radionuclide results given in Table 3.4-3 are negative. It is possible to calculate radioanalytical results that are less than zero, although negative radioactivity is physically impossible. This result typically occurs when activity is not present in a sample or is present near background levels. Laboratories sometimes choose not to report negative results or results that are near zero. The EPA does not recommend such censoring of results (EPA, 1980).

The laboratory performing the radioanalytical services for the NEF site follows the recommendations given by the EPA in the report "Upgrading Environmental Radiation Data;

Health Physics Society Committee Report HPSR-1" (EPA, 1980). This report recommends that all results, whether positive, negative, or zero, should be reported as obtained.

Groundwater analyses included routine groundwater including: standard inorganic components, Volatile Organic Compounds (VOCs), Semi-Volatile Organic Compounds (SOCs), pesticides, PCB and radiological constituents. The table includes the parameter, NEF sample result, and two regulatory limits. The first limit is the New Mexico Water Quality Control Commission (NMWQCC) standard for discharges to surface and groundwater (NMWQCC, 2002). The second limit is the EPA Safe Drinking Water Act (SDWA) maximum contaminate levels (MCLs) for potable water supplies. These MCLs include both the Primary and Secondary Drinking Water Standards (CFR, 2003h). In general, the water is of low quality compared to drinking water standards. Total dissolved solids are 2,500 mg/L, higher than the New Mexico and EPA limits of 1,000 and 500 mg/L, respectively. Also high are chlorides at 1,600 mg/L compared to regulatory limits of 250 mg/L, and sulfate at 2,200 mg/L compared to regulatory limits of 250 to 600 mg/L. A very minor level of a pesticide was detected in the sample, likely due to field or laboratory contamination. Gross alpha activity was detected at a level just slightly above the screening level of 0.6 Bq/L (15 pCi/L).

3.4.3 Pre-Existing Environmental Conditions

There is no documented history of manufacturing, storage or significant use of hazardous chemicals on the NEF property. Historically the site has been used to graze cattle.

The WCS facility is a nearly 541-ha (1,338-acre) property located in Texas. WCS possesses a radioactive materials license from Texas, an NRC agreement state. The facility is licensed to treat and temporarily store low-level and mixed low-level radioactive waste. WCS is also permitted to treat and dispose of hazardous, toxic waste in landfills. While a potential source for release, this disposal site is also a well-monitored facility.

The DD Landfarm, a petroleum contaminated soil treatment facility is adjacent to the west. To the south, across New Mexico Highway 234, is the Lea County Landfill.

To the north of the NEF site about 0.5 km (0.3 mi) a series of man-made ponds contain water and sludge used by petroleum industry contractors to assist with oil and gas drilling and extraction. Unlined, these ponds have some potential for input of hydrocarbon chemicals to the subsurface, but due to the considerable depth to groundwater and the great thickness of the underlying and highly impermeable red bed clay of the Chinle Formation, this arrangement is not likely to impact any natural water systems. Analytes expected from such activities have not been detected during the analysis of groundwater samples taken from monitoring wells at the WCS facility or at the NEF.

3.4.4 Historical and Current Hydrological Data

The NEF is located in an area with little to no surface water or runoff. There are no rivers or streams in the area that would be impacted by the facility. The occurrence of groundwater is also limited at the site. Flow data for Monument Draw, an intermittent stream and the closest surface water conveyance feature are presented in ER Section 3.4.12.9.

3.4.5 Statistical Inferences

No statistical parameters are used to provide or interpret hydrologic data for the NEF.

3.4.6 Water Rights and Resources

The NEF site will obtain water for operational purposes from one or more municipal water systems. Memoranda of Understanding (HNM, 2003; LG, 2004) have been signed with the City of Eunice, New Mexico, and the City of Hobbs, New Mexico, for the supply of water to NEF. Any water rights potentially required for this arrangement will be negotiated with the municipalities. A description of the available municipal water supply systems, the source of plant water, is provided in ER Section 4.1.2.

3.4.7 Quantitative Description of Water Use

No subsurface or surface water use, such as withdrawals and consumption are made at the site by the NEF. All water used at the facility will be provided through the Eunice and Hobbs Municipal Water Supply Systems, as described in ER Section 4.1.2. Those systems obtain water from groundwater sources in or near the city of Hobbs, approximately 32 km (20 mi) north of the site. Water use by the facility is shown in Table 3.4-4, Anticipated Normal Plant Water Consumption and Table 3.4-5, Anticipated Peak Plant Water Consumption. Water supply is sufficient for operation and maintenance of the NEF. See ER Section 4.4.5, Ground and Surface Water Use, for detailed information concerning the capacities of the Hobbs and Eunice, New Mexico water supply systems and the expected NEF average and peak usage.

3.4.8 Non-Consumptive Water Use

The NEF makes no non-consumptive use of water. Non-consumptive water use is water that is used and returned to its source and made available for other uses. An example is a once-through cooling system.

3.4.9 Contaminant Sources

There will be no discharges to natural surface waters or groundwaters from the NEF. The EPA reports (EPA, 2003a) that no Superfund (CERCLA) sites exist in the area near the NEF site in either Lea County, New Mexico or Andrews County, Texas.

Water intake for the NEF plant will be made from one or more municipal supply systems. There is sufficient capacity available to provide water supply for the NEF, as discussed in ER Section 4.4.

Stormwater runoff from the NEF site will be controlled during construction and operation. Appropriate stormwater construction runoff permits for construction activities will be obtained before construction begins. Design of stormwater run-off controls for the operating plant are described in Section 4.4. Appropriate routine erosion control measures best management practices (BMPs), will be implemented, as is normally required by such permits.

During operation stormwater will be collected from appropriate site areas and routed to detention/retention basins. These basins and the site stormwater system are described in ER Section 3.4.1.2.

3.4.10 Description of Wetlands

An evaluation of the site and of available wetlands information has been used to determine that the site does not contain jurisdictional wetlands.

3.4.11 Federal and State Regulations

ER Section 1.3 describes all applicable regulatory requirements and permits. ER Section 4.4 describes potential site impacts as they relate to environmental permits regarding water use by the facility.

Applicable regulations for water resources include:

- NPDES: The NEF is eligible to claim the "No Exposure" exclusion for industrial activity of the NPDES storm water Phase II regulations. As such, the LES would submit a No Exposure Certification immediately prior to initiating operational activities at the NEF site. LES also has the option of filing for coverage under the Multi-Section General Permit (MSGP) because the NEF is one of the 11 eligible industry categories. If this option is chosen, LES will file a Notice of Intent (NOI) with the EPA, Washington, D.C., at least two days prior to the initiation of NEF operations. A decision regarding which option is appropriate for the NEF will be made in the future.
- NPDES: Construction General Permit for stormwater discharge is required because construction of the NEF will involve the grubbing, clearing, grading or excavation of one or more acres of land. This permit is administered by the EPA Region 6 with oversight review by the New Mexico Water Quality Bureau. Various land clearing activities such as offsite borrow pits for fill material have also been covered under this general permit. LES construction contractors will be clearing approximately 81 ha (200 acres) during the construction phase of the project. LES will develop a Storm Water Pollution Prevention Plan (SWPPP) and file a Notice of Intent (NOI) with the EPA, Washington, D.C., at least two days prior to the commencement of construction activities.
- Groundwater Discharge Permit/Plan is required by the New Mexico Water Quality Bureau for facilities that discharge an aggregate waste water volume of more than 7.6 m^3 (2,000 gal) per day to surface impoundments or septic systems. This requirement is based on the assumption that these discharges have the potential of affecting groundwater. NEF will discharge treated process water, stormwater, cooling tower blowdown water and heating boiler blowdown water to surface impoundments, as well as domestic septic wastes.

3.4.12 Surface Water Characteristics for Relevant Water Bodies

No offsite surface water runoff will occur from the NEF site. There are no drainage features that would transport surface water offsite. Precipitation onsite is either subject to infiltration, natural evapotranspiration, or facility system collection and evaporation.

3.4.12.1 Freshwater Streams, Lakes, Impoundments

The NEF site includes no freshwater streams or lakes. Impoundments to contain stormwater runoff and process water will be constructed as part of the facility. These components are described in ER Section 3.4.1.2 Facility Withdrawals and/or Discharges to Hydrologic Systems.

3.4.12.2 Flood Frequency Distributions, Including Levee Failures

Site grade will be above the elevation of the 100-year and the 500-year flood elevations (WBG, 1998; FEMA, 1978).

Table 3.4-3 Chemical Analyses of NEF Site Groundwater

Page 1 of 3

		Existing Regulatory Standards	
PARAMETER	NEF Sample (mg/L, or as noted)	NEW MEXICO (mg/L, or as noted)	EPA MCL (mg/L, or as noted)
General Properties			
Total Dissolved Solids (TDS)	2500 (k)	1000	500 (a)
Total Suspended Solids	6.2	NS	NS
Specific Conductivity	6800 (µmhos/L)	NS	NS
Inorganic Constituents			
Aluminum	0.480 (c)	5.0 (i)	0.05 – 0.2 (a)
Antimony	<0.0036	NS	0.006
Arsenic	<0.0049	0.1	0.05
Barium	0.021	1	2
Beryllium	<0.00041	NS	0.004
Boron	1.6	0.75 (i)	NS
Cadmium	<0.00027	0.01	0.005
Chloride	1600	250	250 (a)
Chromium	0.043	0.05	0.1
Cobalt	<0.00067	0.05 (i)	NS
Copper	0.0086	NS	1.3 (al)
Cyanide	<0.0039	0.2	0.2
Fluoride	<0.5	1.6	4
Iron	0.51	1	0.3 (a)
Lead	<0.0021	0.05	0.015 (al)
Manganese	1.0	0.2	0.05 (a)
Mercury	<0.000054	0.002	0.002
Molybdenum	0.04	1.0 (i)	NS
Nickel	0.034	0.2 (i)	0.1
Nitrate	<0.25	10	10
Nitrite	<1	NS	1
Selenium	<0.0046	0.05	0.05
Silver	<0.0007	0.05	0.05
Sulfate	2200	600 (a)	250 (a)
Thallium	<0.0081	NS	0.002
Zinc	0.016	10	5 (a)

Table 3.4-3 Chemical Analyses of NEF Site Groundwater

PARAMETER	NEF Sample (mg/L, or as noted)	Existing Regulatory Standards NEW MEXICO (mg/L, or as noted)	EPA MCL (mg/L, or as noted)
Radioactive Constituents			
Gross Alpha (pCi/L)*	**0.6 Bq/L (15.1 pCi/L)**	NS	0.6 Bq/L (15 pCi/L)
Gross beta	1.2 Bq/L (31.4 pCi/L)	NS	4 (mrem/yr)
Radium 224	<4.88 Bq/L (<130 pCi/L)	NS	NS
Radium 226**	0.24 Bq/L (6.5 pCi/L)	NS	0.2 Bq/L (5 pCi/L)
Uranium		0.005	0.030
U-234	(0.00695 mg/L) (4.75 pCi/L)	0.005	0.030
U-235	(0.000231 mg/L) (0.158 pCi/L)	0.005	0.030
U-238	(0.001551 mg/L) (1.06 pCi/L)	0.005	0.030
	Bq/L (pCi/L (j)		
Ag-108m	-0.044 (-1.20)	NS	***
Ag-110m	-0.03 (-0.8)	NS	***
Ba-140	0.093 (2.5)	NS	***
Be-7	0.2 (6)	NS	***
Ce-141	0.12 (3.3)	NS	***
Ce-144	-0.12 (-3.3)	NS	***
Co-57	0.04 (1)	NS	***
Co-58	-0.004 (-0.1)	NS	***
Co-60	-0.004 (-0.1)	NS	***
Cr-51	-1.3 (-34)	NS	***
Cs-134	0.02 (0.6)	NS	***
Cs-137	0.03 (0.8)	NS	***
Fe-59	0.041 (1.1)	NS	***
I-131	0.063 (1.7)	NS	***
K-40	1.6 (44)	NS	***
La-140	0.11 (2.9)	NS	***
Mn-54	0.004 (0.1)	NS	***
Nb-95	-0.03 (-0.7)	NS	***
Ra-228	0.22 (5.9)	NS	***
Ru-103	-0.044 (-1.2)	NS	***
Ru-106	0.3 (9)	NS	***
Sb-124	-0.21 (-5.6)	NS	***
Sb-125	-0.10 (-2.7)	NS	***
Se-75	-0.0037 (-0.1)	NS	***
Zn-65	-0.052 (-1.4)	NS	***
Zr-95	-0.056 (-1.5)	NS	***

Table 3.4-3 Chemical Analyses of NEF Site Groundwater

		Existing Regulatory Standards	
PARAMETER	NEF Sample (mg/L, or as noted)	NEW MEXICO (mg/L, or as noted)	EPA MCL (mg/L, or as noted)
Miscellaneous Constituents			
Other VOCs and Pesticides	<MDLs	Various	Various
Semi-Volatile Organic Compounds (SOCs)	<MDLs	Various	Various
Polychlorinated biphenyls, PCBs	<MDLs	0.001	0.0005

Notes:

Highlighted values exceed a regulatory standard

(a): EPA Secondary Drinking Water Standard

(al): Action Level requiring treatment

(c): Results of lab or field-contaminated sample

(i): Crop irrigation standard

(j) See ER Section 3.4.2, Water Quality Characteristics, for explanation of negative values

(k) Reported TDS sample value of 2,500 mg/L is likely inaccurate since three subsequent samples produced TDS values from 6,000 mg/L to 6,400 mg/L

* The proposed standard excludes ^{222}Rn, ^{226}Ra and uranium activity

** This standard excludes ^{228}Ra activity. Units for the existing standard are mrem/yr. U.S.

*** EPA MCL Goal (mg/L, or as noted) 0.04 mSv/yr (4 mrem/yr). EPA has proposed to change the units to mrem Effective Dose Equivalent per year

**** Minimum Detection Level

NS: No standard or goal has been defined

MCL: Maximum Contaminant Level

MDL: Minimum Detection Limit

Table 3.4-4 Anticipated Normal Plant Water Consumption
Page 1 of 1

Potable Water/Sewer Average Consumption	**L/Day**	**Gal/Day**
All Shifts – 210 People	19,873	5,250
Cooling Tower Water		
Process Cooler Drift	5,924	1,565
Process Cooler Evaporation	59,677	15,765
Process Cooler Blowdown	22,379	5,912
HVAC Cooler Drift	6,768	1,788
HVAC Cooler Evaporation	80,035	21,143
HVAC Cooler Blowdown	30,015	7,929
Humidification	8,464	2,236
Total Cooling Water	213,263	56,338
Summation of Liquid Effluents (excluding utilities)		
Floor Washings, Misc. Condensates and Lab Effluent	64	17
Degreaser Washer	11	3
Citric Acid	8	2
Laundry	1,113	294
Hand Wash and Shower Water	5,754	1,520
Total Liquid Effluents	6,950	1,836
Total City Water Consumption	240,086	63,423

3.6 METEOROLOGY, CLIMATOLOGY AND AIR QUALITY

In this section, data characterizing the meteorology (e.g., winds, precipitation, and temperature) for the proposed National Enrichment Facility (NEF) site are presented along with discussions on severe storms, ambient air quality, and the impact of local terrain features on site meteorology.

3.6.1 Onsite Meteorological Conditions

The meteorological conditions at the NEF have been evaluated and summarized in order to characterize the site climatology and to provide a basis for predicting the dispersion of gaseous effluents. No onsite meteorological data were available, however, Waste Control Specialists (WCS) have a meteorological monitoring station within approximately 1.6 km (1 mi) from the proposed NEF site.

Climate information from Hobbs, New Mexico, 32 km (20 mi) north of the site, obtained from the Western Regional Climate Center, was used. In addition, National Oceanic and Atmospheric Administration (NOAA) Local Climatological Data (LCD) recorded at Midland-Odessa Regional Airport, Texas, 103 km (64 mi) southeast of the site and at Roswell, New Mexico, 161 km (100 mi) northwest of the site were used. In the following summaries of meteorological data, the averages are based on:

- Hobbs station (WRCC, 2003) averages are based on a 30-year record (1971 to 2000) unless otherwise stated,
- Midland-Odessa station (NOAA, 2002a) averages are based on a 30-year record (1961 to 1990) unless otherwise stated,
- Roswell station (NOAA, 2002b) averages are based on a 30-year record (1961 to 1990) unless otherwise stated.

The meteorological tower in use at WCS is 10 m (32.8 ft) tall with ambient temperature measurements at 10 m and 2 m (32.8 ft and 6.6 ft) above ground level. Although there are wind speed and direction measurements, there are no data to determine atmospheric stability. WCS provided unvalidated hourly meteorological data from January 2000 through December 2001. These were the only full years of data available from WCS at the time of the analysis.

The WCS meteorological data were reviewed and analyzed for the specific purpose of determining the prevailing wind direction in the vicinity of the proposed NEF site. Use of the WCS data for this purpose is acceptable because it was consistent with the Midland-Odessa and Roswell data, although the WCS data was not from a first-order source. This analysis indicates that the prevailing wind direction in the vicinity of the NEF site is consistent with the prevailing wind directions at Midland-Odessa and Roswell. The WCS data, however, were not used for the purpose of characterizing atmospheric transport and diffusion processes at the NEF site because these data have not been fully verified by WCS. Instead, the Midland-Odessa data were used for this purpose. Use of the Hobbs, Midland-Odessa, and Roswell observations for a general description of the meteorological conditions at the NEF was deemed appropriate as they are all located within the same region and have similar climates. Use of the Midland-Odessa data for predicting the dispersion of gaseous effluents was deemed appropriate. It is the closest first-order National Weather Service (NWS) station to the NEF site and both Midland-Odessa and the NEF site have similar climates. In addition, wind direction frequency comparisons between Midland-Odessa and the closest source of meteorological measurements (WCS) to the NEF site show good agreement as reflected in Table 3.6-22, Wind Frequency Distribution, and Figure 3.6-12, Comparison of WCS and Midland-Odessa Wind Direction Data. There are five years of data from Midland-Odessa (five years of data is considered to be a minimum when using EPA air dispersion codes to perform air quality analyses), and the EPA had filled in all missing data values in the Midland-Odessa data set, as required for use with EPA air dispersion models. Midland-Odessa and Roswell data were compiled and certified by the National Climatic Data Center. Hobbs data were compiled and certified by the Western Regional Climate Center.

The information for Midland-Odessa and Roswell did not contain monthly and annual dewpoint temperature summaries, number of hours with precipitation, hourly rainfall rate distribution, description of local airflow patterns and characteristics, hourly averages of wind speed and direction, and estimated monthly mixing height data.

3.6.1.1 Regional Climate

The NEF site is located in the Southeast Plains of New Mexico close to the border with Texas. The climate is typical of a semi-arid region, with generally mild temperatures, low precipitation and humidity, and a high evaporation rate. Vegetation consists mainly of native grasses and some mesquite trees. During the winter, the weather is often dominated by a high pressure system located in the central part of the western United States and a low pressure system located in north-central Mexico. During the summer, the region is affected by a low pressure system normally located over Arizona.

3.6.1.2 Temperature

A summary of 30 years of temperature data (Table 3.6-1A, Hobbs, New Mexico, Temperature Data (1971-2000)) collected at the Hobbs, New Mexico, Cooperative Observer's Station shows a mean annual temperature of 16.8°C (62.2°F) with the mean monthly temperature ranging from 6.1°C (42.9°F) in January to 26.7°C (80.1°F) in July. The highest mean maximum temperature on record is 38.9°C (102.1°F) and the lowest mean minimum temperature is -5.1°C (22.8°F).

Mean monthly temperatures in Midland-Odessa (NOAA, 2002a) range from 5.8°C (42.5°F) in January to 27.8°C (82.0°F) in July. The lowest daily minimum temperature was -23.9°C (–11.0°F) in February 1985 and the highest daily maximum temperature was 46.7°C (116.0°F) in June 1994. The average relative humidity ranges approximately from 45% to 61%. Highest humidities occur mainly during the early morning hours (NOAA, 2002a). For the Midland-Odessa data, the daily and monthly mean values and extremes of temperature, and the monthly averages of mean relative humidity, are listed in Table 3.6-2, Midland-Odessa, Texas Temperature Data and Table 3.6-3, Midland-Odessa, Texas Relative Humidity Data, respectively. The temperature summaries are based on 30-year records.

Mean monthly temperatures in Roswell (NOAA, 2002b) range from 4.2°C (39.5°F) in January to 27.1°C (80.7°F) in July. The lowest daily minimum temperature was -22.8°C (–9.0°F) in January 1979 and the highest daily maximum temperature was 45.6°C (114.0°F) in June 1994. The average relative humidity of observations taken every 6 hours ranges approximately from 22% to 76%. Highest humidities occur mainly during the early morning hours (NOAA, 2002b). For the Roswell data, the daily and monthly mean values and extremes of temperature, and the monthly averages of mean relative humidity, are listed in Table 3.6-4, Roswell, New Mexico Temperature Data and Table 3.6-5, Roswell, New Mexico Relative Humidity Data, respectively. These temperature summaries are based on 30-year records.

Tornadoes occur infrequently in the vicinity of the NEF. Only two significant tornadoes (i.e., F2 or greater) were reported in Lea County, New Mexico, (Grazulis, 1993) from 1880-1989. Across the state line, only one significant tornado was reported in Andrews County, Texas, (Grazulis, 1993) from 1880-1989.

Tornadoes are commonly classified by their intensities. The F-Scale classification of tornados is based on the appearance of the damage that the tornado causes. There are six classifications, F0 to F5, with an F0 tornado having winds of 64 to 116 km/hr (40 to 72 mi/hr) and an F5 tornado having winds of 420 to 512 km/hr (261-318 mi/hr) (AMS, 1996). The two tornadoes reported in Lea County were estimated to be F2 tornadoes (Grazulis, 1993).

Hurricanes, or tropical cyclones, are low-pressure weather systems that develop over the tropical oceans. These storms are classified during their life cycle according to their intensity:

- Tropical depression – wind speeds less than 63 km/hr (39 mi/hr)
- Tropical storm – wind speed between 63 and 118 km/hr (39 and 73 mi/hr)
- Hurricane – wind speeds greater than 118 km/hr (73 mi/hr)

Hurricanes are fueled by the relatively warm tropical ocean water and lose their intensity quickly once they make landfall. Since the NEF is sited about 805 km (500 mi) from the coast, it is most likely that any hurricane that tracked towards it would have dissipated to the tropical depression stage, that is, wind speeds less than 63 km/hr (39 mi/hr), before it reached the NEF.

3.6.1.7 Mixing Heights

Mixing height is defined as the height above the earth's surface through which relatively strong vertical mixing of the atmosphere occurs. Holzworth developed mean annual morning and afternoon mixing heights for the contiguous United States (EPA, 1972). This information is presented in Figure 3.6-8, Annual Average Morning Mixing Heights and Figure 3.6-9, Annual Average Afternoon Mixing Heights. From these figures, the mean annual morning and afternoon mixing heights for the NEF are approximately 450 m (1,476 ft) and 2,300 m (7,544 ft), respectively.

3.6.1.8 Sandstorms

Blowing sand or dust may occur occasionally in the area due to the combination of strong winds, sparse vegetation, and the semi-arid climate. High winds associated with thunderstorms are frequently a source of localized blowing dust. Dust storms that cover an extensive region are rare, and those that reduce visibility to less than 1.6 km (1 mi) occur only with the strongest pressure gradients such as those associated with intense extratropical cyclones which occasionally form in the area during winter and early spring (DOE, 2003d).

3.6.2 Existing Levels Of Air Pollution And Their Effects On Plant Operations

The United States Environmental Protection Agency (EPA) uses six criteria pollutants as indicators of air quality. Maximum concentrations, above which adverse effects on human health may occur, have been set. These concentrations are referred to as the National Ambient Air Quality Standards (NAAQS). Areas either meet the national primary or secondary air quality standards for the criteria pollutants (attainment) or do not meet the national primary or secondary air quality standards for the criteria pollutants (nonattainment). The criteria pollutants are ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, and lead.

Ozone is a photochemical (formed in chemical reactions between volatile organic compounds and nitrogen oxides in the presence of sunlight) oxidant and the major component of smog. Exposure to ozone for several hours at low concentrations has been shown to significantly reduce lung function and induce respiratory inflammation in normal, healthy people during exercise. Other symptoms include chest pain, coughing, sneezing, and pulmonary congestion.

Carbon monoxide is an odorless, colorless, poisonous gas produced by incomplete burning of carbon in fuels. Exposure to carbon monoxide reduces the delivery of oxygen to the body's organs and tissues. Elevated levels can cause impairment of visual perception, manual dexterity, learning ability, and performance of complex tasks.

Nitrogen dioxide is a brownish, highly reactive gas that is present in all urban environments. It is an important precursor to both ozone and acid rain. Exposure to nitrogen dioxide can irritate the lungs, cause bronchitis and pneumonia, and lower resistance to respiratory infections.

Sulfur dioxide results largely from stationary sources such as coal and oil combustion, steel and paper mills, and refineries. It is a primary contributor to acid rain and contributes to visibility impairments in large parts of the country. Exposure to sulfur dioxide can affect breathing and may aggravate existing respiratory and cardiovascular disease.

Particulate matter, such as dust, dirt, soot, smoke, and liquid droplets, are emitted into the air by sources such as factories, power plants, cars, construction activity, fires, and natural windblown dust. Exposure to high concentrations of particulate matter can effect breathing, cause respiratory symptoms, aggravate existing respiratory and cardiovascular disease, alter the body's defense systems against foreign materials, damage lung tissue, and cause premature death.

Lead can be inhaled, ingested in food, water, soil, or dust. High exposure to lead can cause seizures, mental retardation, and/or behavioral disorders. Low exposure to lead can lead to central nervous system damage.

According to information from the EPA (EPA, 2003a), both Lea County, New Mexico, and Andrews County, Texas, are in attainment for all of the criteria pollutants (see Figure 3.6-10, EPA Criteria Pollutant Nonattainment Map). Air quality in the region is very good and should have no impact on plant operations. Normal operations at the NEF will result in emissions of the criteria pollutants from the boilers that power the heating system; these emissions are addressed in ER Section 4.6, Air Quality Impacts. Air emissions during site preparation and plant construction could include particulate matter and other pollutants; these potential emissions are also addressed in ER Section 4.6. Table 3.6-19, National Ambient Air Quality Standards lists the National Ambient Air Quality Standards (EPA, 2003b).

The closest monitoring station operated to the site by the Monitoring Section of the New Mexico Air Quality Bureau is about 32 km (20 mi) north of the site in Hobbs, New Mexico. This station monitors particulate matter, particles 2.5 µm or less in diameter. Summary readings from this monitor are presented in Table 3.6-20, Hobbs, New Mexico Particulate Matter Monitor Summary. No instances of the particulate matter National Ambient Air Quality Standards being exceeded have been measured by this monitoring station.

There are 54 sources of criteria pollutants in Lea County, New Mexico, and six sources in Andrews County, Texas, listed in the EPA AirData data base for emissions year 1999

Table 3.6-22 Wind Frequency Distribution

	WCS Data		Midland-Odessa Data	
Compass Sector	**Hours**	**Percent Frequency**	**Hours**	**Percent Frequency**
North (N)	549	3.2	2,388	5.6
North-Northeast (NNE)	788	4.5	1,692	4.0
Northeast (NE)	1,005	5.8	2,103	4.9
East-Northeast (ENE)	1,031	5.9	2,094	4.9
East (E)	1,158	6.7	2,691	6.3
East-Southeast (ESE)	1,071	6.2	2,366	5.5
Southeast (SE)	1,902	11.0	3,237	7.6
South-Southeast (SSE)	2,327	13.4	4,648	10.9
South (S)	2,038	11.8	8,784	20.6
South-Southwest (SSW)	1,280	7.4	3,136	7.3
Southwest (SW)	990	5.7	2,345	5.5
West-Southwest (WSW)	779	4.5	1,997	4.7
West (W)	768	4.4	1,887	4.4
West-Northwest (WNW)	624	3.6	997	2.3
Northwest (NW)	609	3.5	1,104	2.6
North-Northwest (NNW)	417	2.4	1,272	3.0
Total	17,336	100	42,741	100.1[(1)]

(1) The percent frequency total is greater than 100% due to round off.

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3.12 WASTE MANAGEMENT

Waste Management for the National Enrichment Facility (NEF) is divided into gaseous and liquid effluents, and solid wastes. Descriptions of the sources, systems, and generation rates for each waste stream are discussed in this section. Disposal plans, waste minimization, and environmental impacts are discussed in ER Section 4.13, Waste Management Impacts.

3.12.1 Effluent Systems

The following paragraphs provide a comprehensive description of the NEF systems that handle gaseous and liquid effluent. The effectiveness of each system for effluent control is discussed for all systems that handle and release effluent.

3.12.1.1 Gaseous Effluent Vent System

The function of the Gaseous Effluent Vent System (GEVS) is to remove particulates containing uranium and hydrogen fluoride (HF) from potentially contaminated process gas streams. Prefilters and high efficiency particulate air (HEPA) filters remove particulates and potassium carbonate impregnated activated carbon filters are used for the removal of any HF. Electrostatic filters remove oil vapor from the gaseous effluent associated with exhaust from vacuum pump/chemical trap set outlets wherever necessary.

The systems produce solid wastes from the periodic replacement of prefilters, HEPA filters, and chemical filters. The systems produce no gaseous effluents of their own, but discharge effluents from other systems after treatment to remove hazardous materials. There are two GEVS for the plant: (1) the Separations Building Gaseous Effluent Vent System and (2) the Technical Services Building (TSB) Gaseous Effluent Vent System.

3.12.1.1.1 Sources and Flow Rates

Potentially contaminated exhaust air comes from the rooms and services within the TSB. Air from the Fomblin Oil Recovery System is part of the Decontamination Workshop discharge. The total airflow to be handled by the GEVS for the TSB and Separations Building are 18,700 m^3/hr (11,000 cfm) and 11,000 m^3/hr (6,474 cfm), respectively.

The design requirements for the facility provide a large safety margin between normal and accident conditions so that no single failure could result in the release of significant hazardous material. The amounts of UF_6 in the system also preclude the release of significant quantities of hazardous material from a single failure or multiple failures. Instrumentation is provided to detect abnormal process conditions so that the process can be returned to normal by operator actions.

These requirements and operating conditions also provide assurance that personnel exposure to hazardous materials are maintained "as low as reasonably achievable" and that effluent discharges comply with environmental and safety criteria.

3.12.1.1.2 System Description

The GEVS for the Separations Building and the TSB consists of the following major components:

- Duct system

- Prefilter
- High Efficiency Particulate Air (HEPA) Filter
- Activated carbon filter (impregnated with potassium carbonate)
- Centrifugal Fan
- Monitoring and controls
- Automatically controlled inlet and outlet isolation dampers
- Discharge stack

The GEVS serving the TSB consists of a duct network that serves all of the UF_6 processing systems and operates at negative pressure. The ductwork is connected to one filter station and vents through one fan. Both the filter station and the fan can handle 100% of the effluent. There is no standby filter station or fan. Operations that require the GEVS to be operational will be shut down if the system shuts down. The system capacity is estimated to be 18,700 m^3/hr (11,000 cfm). A differential pressure controller controls the fan speed and maintains negative pressure in front of the filter station.

Gases from the UF_6 processing systems pass through an 85% efficient prefilter. The prefilter removes dust particles and thereby prolongs the useful life of the HEPA filter. Gases then flow through a 99.97% efficient HEPA filter. The HEPA filter removes uranium aerosols which consist of UO_2F_2 particles. Finally, the gases pass through a 99% efficient activated charcoal for removal of HF. The cleaned gases pass through the fan, which maintains the negative pressure upstream of the filter stations. The cleaned gases are then discharged through the vent stack.

One Separation Building GEVS serves the entire Separations Building. It consists of a duct network that serves all of the uranium processing systems and operates at negative pressure. It is sized to handle the flow from all permanently ducted process locations, as well as up to 13 noncorrugated flexible duct exhaust points at one time. The flexible duct is used for cylinder connection/disconnection or maintenance procedures.

The ductwork is connected to two parallel filter stations. Each is capable of handling 100% of the effluent. One is online and the other is a standby. Each station consists of an 85% efficient prefilter, a 99.97% efficient HEPA filter and a 99% efficient activated charcoal filter for removal of HF. The leg of the distribution system securing the exhaust of the vacuum pump/trap set outlets is routed through an electrostatic filter. Electrostatic filters have an efficiency of 97%. The filter stations vent through one of two fans. Each fan is capable of handling 100% of the effluent. One fan is online, and the other is a standby. A switch between the operational and standby systems can be made using automatically controlled dampers. The system total airflow capacity is estimated to be 11,000 m^3/hr (6,474 cfm). A differential pressure controller controls the fan speed and maintains negative pressure upstream of the filter station.

Gases from the UF_6 processing systems pass through the prefilter which removes dust and protects the HEPA filter, then through the HEPA filter which removes uranium aerosols (mainly UO_2F_2 particles), then through the potassium carbonate impregnated activated carbon filters which captures HF. The remaining clean gases pass through the fan, which maintains the negative pressure upstream of the filter stations. Finally, the clean gases are discharged through a roof top vent on the TSB. One vent is common to the operational system and the standby system.

3.12.1.1.3 System Operation

For the TSB GEVS, and Separations Building GEVS, HF monitors and alarms are installed downstream of the filtration systems and immediately upstream of the vent stack to detect the release of hazardous materials to the environment. The alarms are monitored in the Control Room.

The units will be located in a dedicated room in the TSB. The filters will be bag-in bag-out. It is estimated that the filters will be changed on a yearly basis or multi-yearly basis.

If the GEVS stops operating, material within the duct will not be released into the building because each of the GEVS connections has a P-trap to catch entrained material that could otherwise fall back into the building from the ductwork during system failure.

3.12.1.1.4 Effluent Releases

Under normal operating conditions, the system will not be contaminated. In the event that an abnormal situation occurs, the GEVS is designed to protect plant personnel against UF_6 and HF exposure. The GEVS is designed to meet all applicable NRC requirements for public and plant personnel safety and effluent control and monitoring. The system design also complies with all standards of OSHA, EPA, and state and local agencies.

The annual discharge of uranium in routine gaseous effluent discharged from the NEF is expected to be less than 10 grams (0.35 ounces). The environmental impacts of gaseous releases and associated doses to the public are described in detail in ER Section 4.12.1.1, Routine Gaseous Effluent.

3.12.1.2 Centrifuge Test and Post Mortem Facilities Exhaust Filtration System

The Centrifuge Test and Post Mortem Facilities Exhaust Filtration System provides exhaust of potentially hazardous contaminants from the Centrifuge Test and Post Mortem Facilities. The system also ensures the Centrifuge Post Mortem Facility is maintained at a negative pressure with respect to adjacent areas. The Centrifuge Test and Post Mortem Facilities Exhaust Filtration System is located in the Centrifuge Assembly Building and is monitored from the Control Room.

Potentially contaminated exhaust air comes from the Centrifuge Test and Post Mortem Facilities. The total airflow to be handled by the Centrifuge Test and Post Mortem Facilities Exhaust Filtration System is 9,345 m^3/hr (5,500 cfm). All flow rates and capacities are subject to change during final design.

The Centrifuge Test and Post Mortem Facilities Exhaust Filtration System consists of a duct network that serves the Centrifuge Test and Post Mortem Facilities and operates at negative pressure. The ductwork is connected to one filter station and vents through either of two 100% fans. Both the filter station and either of the fans can handle 100% of the effluent. One of the fans will normally be in standby. Operations that require the Centrifuge Test and Post Mortem Facilities Exhaust Filtration System to be operational are manually shut down if the system shuts down.

Gases from the associated areas pass through the 85% efficient prefilter which removes dust and protects downstream filters, then through the 99% efficient activated charcoal filter that captures HF. Remaining uranic particles, (mainly UO_2F_2) are treated by a 99.7% efficient HEPA filter. After filtration, the clean gases pass through a fan, which maintains the negative pressure upstream of the filter station. The clean gases are then discharged through the monitored (alpha and HF) stack on the Centrifuge Assembly Building.

3.12.1.3 Liquid Effluent System

Quantities of radiologically contaminated, potentially radiologically contaminated, and nonradiologically contaminated aqueous liquid effluents are generated in a variety of operations and processes in the TSB and in the Separations Building. The majority of all potentially radiologically contaminated aqueous liquid effluents are generated in the TSB. All aqueous liquid effluents are collected in tanks that are located in the Liquid Effluent Collection and Treatment System in the TSB. The collected effluent is sampled and analyzed.

3.12.1.3.1 Effluent Sources and Generation Rates

Numerous types of aqueous and non-aqueous liquid wastes are generated in the plant. These effluents may be significantly radiologically contaminated, potentially contaminated with low amounts of contamination, or non-contaminated. Effluents include:

- Hydrolyzed uranium hexafluoride and aqueous laboratory effluent

  These hydrolyzed uranium hexafluoride solutions and the aqueous effluents are generated during laboratory analysis operations and require further processing for uranium recovery.

- Degreaser Water

  This is water, which has been used for degreasing contaminated pump and plant components coated in Fomblin oil. The oil, which is heavier than water will be separated from the water via gravity separation, and the suspended solids filtered, prior to routing for uranium recovery. Most of the soluble uranium components dissolve in the degreaser water.

- Citric Acid

  The decontamination process removes a variety of uranic material from the surfaces of components using citric acid. The citric acid tank contents comprise a suspension, a solution and solids, which are strongly uranic and need processing. The solids fall to the bottom of the citric acid tank and are separated, in the form of sludge, from the citric acid using gravity separation. The other sources of citric acid is from the UF_6 Sample Bottles cleaning rig and flexible hose decontamination cabinet. Part of the cleaning process involves rinsing them in 5-10% by volume citric acid.

- Laundry Effluent

  This is water that has arisen from the washing of the plant personnel laundry including clothes and towels. The main constituents of this wastewater are detergents, bleach and very low levels of dissolved uranium based contaminants. This water is routed into a collection tank, monitored and neutralized as required. The effluent is contained and treated on the NEF site.

- Floor Washings

  This is water, which has arisen from all the active areas of the plant namely the UF_6 Handling Area, Chemical Laboratories, Decontamination Workshop and Rebuild Workshop. The main constituents of this wastewater are detergents, and very low levels of dissolved uranium based contaminants. This water is routed into a collection tank and monitored prior to routing for uranium recovery.

- Miscellaneous Condensates

  This is water which has arisen from the production plant during the defrost cycle of the low temperature take off stations. This water is collected in a common holding tank with floor washings, monitored and pumped into the Miscellaneous Effluent Collection Tank prior to routing.

- Radiation Areas Hand Washing and Shower Water

  Plant personnel generate this uncontaminated water from hand washing and showering. This water is collected and monitored and then released to the Treated Effluent Evaporative Basin.

3.12.1.3.2 System Description

Aqueous laboratory effluents with uranic concentrations are sampled to determine their uranic content and then pumped from the labs to the agitated Miscellaneous Effluent Collection Tank in the Liquid Effluent Collection and Treatment Room. Floor washings are sampled to determine their uranic content and then manually emptied into the tank. Condensate may be either manually transported or piped to the tank after sampling.

All water from the personnel hand washes and showers in the TSB, Separations Building, Blending and Liquid Sampling Area, the Centrifuge Test Facility and the Centrifuge Post Mortem Facility goes to the Hand Wash/Shower Monitor Tanks in the Liquid Effluent Collection and Treatment Room. Since these effluents are expected to be non-contaminated, no agitation is provided in these tanks. Samples of the effluents are regularly taken to the laboratory for analysis. Lab testing determines pH, soluble uranic content, and insoluble uranic content.

All washing machine water is discharged from the clothes washers to the Laundry Effluent Monitor Tanks in the Liquid Effluent Collection and Treatment Room. Due to the very low uranium concentration of this effluent and the constant flow into these tanks, they are not agitated. Samples of the effluents are regularly taken to the laboratory for determination of pH, soluble uranic content, and insoluble uranic content. Based on operating plant experience, the clothes washed contain very small amounts of uranyl fluoride (UO_2F_2) and trace amounts of uranium tetrafluoride (UF_4). Following sampling, the laundry effluent is sent to the Treated Effluent Evaporative Basin.

Effluents containing uranium are treated in the Precipitation Treatment Tank to remove the majority of the uranium that is in solution. After the effluent is transferred to the Precipitation Treatment Tank, a precipitating agent, such as potassium hydroxide (KOH) or sodium hydroxide (NaOH), is added. The addition of the precipitating agent raises the pH of the effluent to the range of 9 to 12. This treatment renders the soluble uranium compounds insoluble and they precipitate from the solution. The tank contents are constantly agitated to provide a homogeneous solution. The precipitated compounds are then removed from the effluent by circulation through a small filter press. The material removed by the filter press is deposited in a container and sent for off-site low-level radioactive waste disposal.

The clean effluent is re-circulated back to the Precipitation Treatment Tank. Depending on the characteristics of the effluent, the effluent may have to be circulated through the filter press numerous times to obtain the percent of solids removal required. A sample of the effluent is taken to determine when the correct percent solids have been removed. When it is determined that the correct amount of solids have been removed, the effluent is transferred to the Contaminated Effluent Hold Tank.

The effluent in the Contaminated Effluent Hold Tank is then transferred to the agitated Evaporator/Dryer Feed Tank. Acid is added via a small chemical addition unit to reduce the pH back down to 7 or 8. This is necessary to help minimize corrosion in the Evaporator/Dryer.

From the Evaporator/Dryer Feed Tank, the effluent is pumped to the Evaporator/Dryer. The Evaporator/Dryer is an agitated thin film type that separates out the solids in the effluent. The Evaporator/Dryer is heated by steam in a jacket or from an electric coil. As the effluent enters the Evaporator/Dryer, the effluent is heated and vaporized. The Evaporator/Dryer discharges a "dry" concentrate into a container located at the bottom of the Evaporator/Dryer. Container contents are monitored for criticality, labeled, and stored in the radioactive waste storage area. When full, the container is sent for shipment offsite to a low-level radioactive waste disposal facility. Liquid vapor exits the evaporator and is condensed in the Evaporator/Dryer Condenser, which is cooled with chilled water.

The condensate from the Evaporator/Dryer Condenser is collected in the Distillate Tank before being transferred to one of the Treated Effluent Monitor Tanks. The effluent in these tanks is sampled and tested for pH and uranic content to ensure compliance with administrative guidelines prior to release to the double-lined Treated Effluent Evaporative Basin with leak detection. If the lab tests show the effluent does not meet administrative guidelines, the effluent can be further treated. Depending on what conditions the lab testing show, the effluent is either directed back to the Evaporator/Dryer Feed Tank for another pass through the Evaporator/Dryer, or it can be directed through the Mixed Bed Demineralizers. After either option, the effluent is transferred back to a Treated Effluent Monitor Tank where it is again tested. When the lab tests are acceptable, the effluent is released to the Treated Effluent Evaporative Basin.

The Citric Acid Tank in the Decontamination Workshop is drained, all the effluent is transferred to the Spent Citric Acid Collection Tank in the Liquid Effluent Collection and Treatment Room. A "sludge" remains in the bottom of the Citric Acid Tank. This "sludge" consists primarily of uranium and metal particles. This sludge is flushed out with deionized water (DI). The combination of the sludge and the DI water also goes to the Spent Citric Acid Collection Tank. The spent citric acid effluent/sludge contains the wastes from the Sample Bottle and Flexible Hose Decontamination Cabinets, which are manually transferred to the Citric Acid Tank in the Main Decontamination System. The contents of the Spent Citric Acid Collection Tank are constantly agitated to keep all solids in suspension and to provide a homogeneous solution. This is necessary to prevent build-up of uranic material in the bottom of the tank.

The Degreaser Tank in the Decontamination Workshop is drained, and the effluent is transferred to the Degreaser Water Collection Tank in the Liquid Effluent Collection and Treatment Room. A "sludge" remains in the bottom of the Degreaser Tank after the degreasing water is drained. This "sludge" consists primarily of Fomblin oil and uranium. This sludge is flushed out with DI water. The combination of the sludge and the DI water also goes to the Degreaser Water Collection Tank. The contents of the Degreaser Water Collection Tank remain agitated to keep all solids in suspension and to provide a homogeneous solution. This is necessary to prevent build-up of uranic material in the bottom of the tank. Since this effluent contains Fomblin oil, it is not possible to send the degreaser water to the Precipitation Treatment Tank for treatment. Therefore, the Fomblin oil must be removed first.

For Fomblin oil removal, the contents of the Degreaser Water Collection Tank circulate through a small centrifuge. The oil and sludge are centrifuged off, collected in a container, and sent for offsite low-level radioactive waste disposal.

3.12.1.3.3 System Operation

Handling and eventual disposition of the aqueous liquid effluents is accomplished in two stages, collection and treatment. All aqueous liquid effluents are collected in tanks that are located in the Liquid Effluent Collection and Treatment Room in the TSB.

There are other tanks in the Liquid Effluent Collection and Treatment Room used for monitoring and treatment prior to release to the Treated Effluent Evaporative Basin.

The Spent Citric Acid Collection Tank, Degreaser Water Tank, Miscellaneous Effluent Collection Tank, and Precipitation Treatment Tank are all located in a contained area. The containment consists of a curb around all the above-mentioned tanks. The confined area is capable of containing at least one catastrophic failure of one given tank 1,325 L (350 gal), minimum. In the event of a tank failure, the effluent in the confined area is pumped out with a portable pump set.

Reduced volume, radiologically contaminated wastes that are a by-product of the treatment system, as well as contaminated non-aqueous wastes, are packaged and shipped to a licensed low-level radioactive waste disposal facility.

3.12.1.3.4 Effluent Discharge

Total liquid effluent from the NEF is estimated at 2,535 m^3/yr (669,844 gal/yr). The uranium source term used in this report for routine liquid effluent releases from the NEF is 2.1×10^6 Bq (56 μCi) per year and is comprised of airborne uranium particulates created due to resuspension at times when the Treated Effluent Evaporative Basin is dry. There is no plant tie-in to a Publicly Owned Treatment Works (POTW). Instead, all effluents are contained on the NEF site.. Accordingly, all contaminated liquid effluents are treated and sent to the double-lined Treated Effluent Evaporative Basin with leak detection on the NEF site.

Decontamination, Laboratory and Miscellaneous Liquid Effluents are treated to meet the requirements of 10 CFR 20.2003, 10 CFR 20, Appendix B, Table 3 (CFR, 2003q) and the administrative levels recommended by Regulatory Guide 8.37 (NRC, 1993). The treated effluent is discharged to the double-lined Treated Effluent Evaporative Basin, which has leak detection.

The Treated Effluent Evaporative Basin consists of two synthetic liners with soil over the top liner. The Treated Effluent Evaporative Basin will have leak detection capabilities. At the end of plant life, the sludge and soil over the top of the uppermost liner and the liner itself will be disposed of, as required, at a low-level radioactive waste repository.

Hand Wash and Shower Effluents are not treated. These effluents are discharged to the same Treated Effluent Evaporative Basin as for the Decontamination, Laboratory and Miscellaneous Effluents. Laundry Effluent is treated if necessary and discharged to this basin as well.

Cooling Tower Blowdown Effluent is discharged to a separate on-site basin, the UBC Storage Pad Stormwater Retention Basin. The single-lined retention basin is used for the collection and monitoring of rainwater runoff from the UBC Storage Pad and to collect cooling tower blowdown and heating boiler blowdown water. A third unlined basin is used for the collection and monitoring of general site stormwater runoff.

Six septic systems are planned for the NEF site. Each septic system will consist of a septic tank with one or more leachfields. Figure 3.12-1, Planned Septic Tank System Locations, shows the planned location of the six septic tank systems.

The six septic systems are capable of handling approximately 40,125 liters per day (10,600 gallons per day) based on a design number of employees of approximately 420. Based on the actual number of employees, 210, the overall system will receive approximately 20,063 liters per day (5,300 gallons per day). Total annual design discharge will be approximately 14.6 million liters per year (3.87 million gallons per year). Actual flows will be approximately 50 percent of the design values.

The septic tanks will meet manufacturer specifications. Utilizing the percolation rate of approximately 3 minutes per centimeter (8 minutes per inch) established by actual test on the site, and allowing for 76 to 114 liters (20 to 30 gallons) per person per day, each person will require 2.7 linear meters (9 linear feet) of trench utilizing a 91.4-centimeter (36-inch) wide trench filled with 61 centimeters (24 inches) of open graded crushed stone. As indicated above, although the site population during operation is expected to be 210 persons, the building facilities are designed by architectural code analysis to accommodate up to 420 persons. Therefore, a total of approximately 975 linear meters (3,200 linear feet) of percolation drain field will be required. The combined area of the leachfields will be approximately 892 square meters (9,600 square feet).

3.12.2 Solid Waste Management

Solid waste generated at the NEF will be grouped into industrial (nonhazardous), radioactive and mixed, and hazardous waste categories. In addition, solid radioactive and mixed waste will be further segregated according to the quantity of liquid that is not readily separable from the solid material. The solid waste management systems will be a set of facilities, administrative procedures, and practices that provide for the collection, temporary storage, (no solid waste processing is planned), and disposal of categorized solid waste in accordance with regulatory requirements. All solid radioactive wastes generated will be Class A low-level wastes (LLW) as defined in 10 CFR 61 (CFR, 2003r).

Industrial waste, including miscellaneous trash, vehicle air filters, empty cutting oil cans, miscellaneous scrap metal, and paper will be shipped offsite for minimization and then sent to a licensed waste landfill. The NEF is expected to produce approximately 172,500 kg (380,400 lbs) of this normal trash annually. Table 3.12-2, Estimated Annual Non-Radiological Wastes, describes normal waste streams and quantities.

Radioactive waste will be collected in labeled containers in each Restricted Area and transferred to the Radioactive Waste Storage Area for inspection. Suitable waste will be volume-reduced and all radioactive waste disposed of at a licensed low-level waste (LLW) disposal facility.

The waste and effluent estimates were developed specifically for the NEF. Each system was analyzed to determine the wastes and effluents generated during operation. These values were analyzed and a waste disposal path was developed for each. LES considered the facility site, facility operation, applicable URENCO experience, applicable regulations, and the existing U.S. waste processing/disposal infrastructure in developing the paths. The Liquid Waste and the Solid Waste Collection Systems were designed in accordance with these considerations.

Applicable experience was derived from each of the existing three URENCO enrichment facilities. The majority of the wastes and effluents from the facility are from auxiliary systems and activities and not from the enrichment process itself. Waste and effluent quantities of specific individual activities instead of scaled site values were used in the development of NEF estimates. An example is the NEF laboratory waste and effluent estimate which was developed by determining which analyses would be performed at the NEF, and using URENCO experience to perform that analysis, determine the resulting expected wastes and effluents. The cumulative waste and effluent values were then compiled.

The customs of URENCO as compared to LES also affect the resultant wastes and effluents. For example, in Europe, employers typically provide work clothes such as coveralls and lab coats for their employees. These are typically washed onsite with the resulting effluent sent to the municipal sewage treatment system. LES provides only protective clothing for employees, and the small volume of effluent that results has a higher quantity of contaminants which must be treated onsite.

Each of the URENCO facilities produces different wastes and effluents depending on the specific site activities, the type of auxiliary equipment installed, and the country-specific regulations. Each of the URENCO facilities is located either in an industrial or municipal area so that the facility water supply and sewage treatment are obtained and performed by municipal systems. The proposed NEF site will use municipal water supplies. However, all liquid effluents will be contained on the NEF site. Unlike other URENCO facilities, LES does not perform any interior cylinder washing activities. Thus, the generation of significant quantities of uranic wastewater is precluded.

3.12.4 Resources and Materials Used, Consumed or Stored During Construction and Operation

Typical construction commodities are used, consumed, or stored at the site during the construction phase. Construction commodities are typically used immediately after being brought to the site. Some materials are stored for a short duration until they are used or installed. Table 3.12-5, Commodities Used, Consumed or Stored at the NEF During Construction, summarizes the resources and materials used during the 3-year period of site preparation and major building construction.

Tables 3.12-1, Estimated Annual Radiological and Mixed Wastes, 3.12-2, Estimated Annual Non-Radiological Wastes, and 3.12-3, Estimated Annual Gaseous Effluent, provide listings of materials and resources that are expected to be used, consumed, or stored on site during plant operation. The resources and materials provided in Table 3.12-6, Commodities Used, Consumed, Or Stored at the NEF During Operation, are also expected to be used, consumed, or stored on an annual basis at the NEF during operation.

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Table 3.12-3 Estimated Annual Gaseous Effluent

Area	Quantity (yr^{-1})	Discharge Rate m^3/yr (SCF/yr (STP)
Gaseous Effluent Vent Systems	NA	2.6×10^8 (9.18×10^9)
HVAC Systems	NA	
Radiological Areas	NA	1.5×10^9 (max) (5.17 $x10^{10}$)
Non-Radiological Areas	NA	1.0×10^9 (max) ($3.54x10^{10}$)
Total Gaseous HVAC Discharge	NA	2.5×10^9 (max) ($8.71x10^{10}$)
Constituents:		
Helium	440 m^3 (STP) (15,540 ft^3)	NA
Nitrogen	52 m^3 (STP) (1,836 ft^3)	NA
Ethanol	40 L (10.6 gal)	NA
Laboratory Compounds	Traces (HF)	NA
Argon	190 m^3 (STP) (6,709 ft^3)	NA
Hydrogen Fluoride	<1.0 kg (<2.2 lb)	NA
Uranium	<10 g (<0.0221 lb)	NA
Methylene Chloride	610 L (161 gal)	NA
Thermal Waste:		
Summer Peak	3.2×10^6 J/hr ($3.1x10^6$ BTU/hr)	NA
Winter Peak	1.0×10^7 J/hr ($9.5x10^6$ BTU/hr)	NA

NA – Not Applicable

Table 3.12-4 Estimated Annual Liquid Effluent

Effluent	Typical Annual Quantities	Typical Uranic Content
Contaminated Liquid Process Effluents:	**m^3 (gal)**	**kg (lb)**
Laboratory Effluent/Floor Washings/Miscellaneous Condensates	23.14 (6,112)	16 (35)[1]
Degreaser Water	3.71 (980)	18.5 (41)[1]
Spent Citric Acid	2.72 (719)	22 (49)[1]
Laundry Effluent	405.8 (107,213)	0.2 (0.44)[2]
Hand Wash and Showers	2,100 (554,820)	None
Total Contaminated Effluent :	2,535 (669,884)	56.7 (125)[3]
Cooling Tower Blowdown:	19,123 (5,051,845)	None
Heating Boiler Blowdown:	138 (36,500)	None
Sanitary:	7,253 (1,916,250)	None
Stormwater Discharge:		
Gross Discharge[4]	174,100 (46 E+06)	None

[1] Uranic quantities are before treatment, volumes for degreaser water and spent citric acid include process tank sludge.

[2] Laundry uranic content is a conservative estimate.

[3] Uranic quantity is before treatment. After treatment approximately 1% or 0.57 kg (1.26 lb) of uranic material is expected to be discharged into the Treated Effluent Evaporative Basin.

[4] Maximum gross discharge is based on total annual rainfall on the site runoff areas, contributing runoff to the Site Stormwater Detention Basin and the UBC Storage Pad Stormwater Retention Basin, neglecting evaporation and infiltration.

providing electrical service, Xcel Energy, will install two onsite transformers to ensure redundant service. Six underground septic tanks will be installed onsite. The leach fields will require about 975 linear meters (3,200 linear feet) of percolation drain field. The drain fields will either be placed below grade or buried in a mound consisting of sand, aggregate and soil.

Overall land use impacts to the site and vicinity will be minimal considering that the majority of the site will remain undeveloped, the current industrial activity on neighboring properties, the nearby expansive oil and gas well fields, and the placement of most utility installations along highway easements. LES is not aware of any Federal action that would have cumulatively significant land use impacts.

4.1.3 Comparative Land Use Impacts of No Action Alternative Scenarios

ER Chapter 2 provides a discussion of possible alternatives to the construction and operation of the NEF, including an alternative of "no action," i.e., not building the NEF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three "no action" alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B – No NEF; USEC deploys a centrifuge plant and continues to operate the Paducah gaseous diffusion plant (GDP): The impact would be less since less land is disturbed by building only one centrifuge plant instead of two.

Alternative Scenario C – No NEF; USEC deploys a centrifuge plant and increases the centrifuge plant capability: The land use would be the same if undisturbed land is used for the original or increased capacity site(s). If the site(s) were previously disturbed, the impact would be less.

Alternative Scenario D – No NEF; USEC does not deploy a centrifuge plant and operates the Paducah GDP at an increased capacity: The impact of this would be less because no new land would be disturbed.

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4.4 WATER RESOURCES IMPACTS

Water resources at the site are virtually nonexistent. There are no surface waters on the site and appreciable groundwater resources are only at depths greater than approximately 340 m (1,115 ft). The site region has semi-arid climate, with low precipitation rates and minimal surface water occurrence. Thus, the potential for negative impacts on those water resources are very low due to lack of water presence and formidable natural barriers to any surface or subsurface water occurrences. Groundwater at the site would not likely be impacted by any potential releases. The pathways for planned and potential releases are discussed below.

Permits related to water must be obtained for site construction and NEF operation are described in ER Section 1.3, Applicable Regulatory Requirements, Permits and Required Consultation. The purpose of these permits is to address the various potential impacts on water and provide mitigation as needed to maintain state water quality standards and avoid any degradation to water resources at or near the site. These include:

- *A National Pollutant Discharge Elimination System (NPDES) General Permit for Industrial Stormwater:* This permit is required for point source discharge of stormwater runoff from industrial or commercial facilities to the waters of the state. All new and existing point source industrial stormwater discharges associated with industrial activity require a NPDES Stormwater Permit from the EPA Region 6 and an oversight review by the New Mexico Water Quality Bureau (NMWQB). The NEF is eligible to claim the "No Exposure" exclusion for industrial activity of the NPDES storm water Phase II regulations. As such, the LES would submit a No Exposure Certification immediately prior to initiating operational activities at the NEF site. LES also has the option of filing for coverage under the Multi-Section General Permit (MSGP) because the NEF is one of the 11 eligible industry categories. If this option is chosen, LES will file a Notice of Intent (NOI) with the EPA, Washington, D.C., at least two days prior to the initiation of NEF operations. A decision regarding which option is appropriate for the NEF will be made in the future.
- *NPDES General Permit for Construction Stormwater:* Because construction of the NEF will involve the disturbance of more than 0.4 ha (1 acre) of land (disturbance of about 81 ha (200 acres) will be required for the construction phase of the project), an NPDES Construction General Permit from the EPA Region 6 and an oversight review by the New Mexico Water Quality Bureau (NMWQB) are required. LES will develop a Storm Water Pollution Prevention Plan (SWPPP) and file a NOI with the EPA, Washington, D.C., at least two days prior to the commencement o construction activities.
- *Groundwater Discharge Permit/Plan:* The NMWQB requires that facilities that discharge an aggregate waste water of more than 7.6 m^3 (2,000 gal) per day to surface impoundments or septic systems apply for and submit a groundwater discharge permit and plan. This requirement is based on the assumption that these discharges have the potential of affecting groundwater. NEF will discharge treated process water, stormwater, cooling tower blowdown water and heating boiler blowdown water to surface impoundments, as well as domestic septic wastes. A groundwater discharge permit/plan will be required under 20.6.2.3104 NMAC (NMAC, 2002a). Section 20.6.2.3.3104 NMAC (NMAC, 2002a) of the New Mexico Water Quality Control Commission (NMWQCC) Regulations (20.6.2 NMAC) requires that any person proposing to discharge effluent or leachate so that it may move

directly or indirectly into groundwater must have an approved discharge permit, unless a specific exemption is provided for in the Regulations.

- *Section 401 Certification*: Under Section 401 of the federal Clean Water Act, states can review and approve, condition, or deny all federal permits or licenses that might result in a discharge to State waters, including wetlands. A 401 certification confirms compliance with the State water quality standards. Activities that require a 401 certification include Section 404 permits issued by the USACE. The State of New Mexico has a cooperative agreement and joint application process with the USACE relating to 404 permits and 401 certifications. By letter dated March 17, 2004, the USACE notified LES of its determination that there are no USAEC jurisdictional waters at the NEF site and for this reason the project does not require a 404 permit (USACE, 2004). As a result, a Section 401 certification is not required.

NEF site design addresses:

- Discharge of stormwater and waste water to site retention/detention basins
- Septic system design and construction
- General construction activities
- Potential for filling or alteration of an arroyo, should one be identified on the site

Discharge of operations waste water will be made exclusively to the Treated Effluent Evaporative Basin for only those liquids that meet physical and chemical criteria per prescribed standards. That basin, described in ER Section 3.4.1.2, is double-lined to prevent infiltration, provided with leak detection, and open to allow evaporation. An annual volume of about 2,535 m^3/yr (669,844 gal/yr) will be discharged to the Treated Effluent Evaporative Basin for evaporation.

Collection and discharge of stormwater runoff will be made to two basins, the Site Stormwater Detention Basin and the Uranium Byproduct Cylinder (UBC) Storage Pad Stormwater Retention Basin. These basins are described in ER Section 3.4.1.2. The Site Stormwater Detention Basin will allow infiltration into the ground as well as evaporation and it has an outlet structure to allow its drainage. The UBC Storage Pad Stormwater Retention Basin is single-lined and will not have an outfall. For an average annual rainfall at the site of 35.94 cm/yr (14.15 in/yr) the potential runoff volumes (before evapotranspiration) are about 33,160 m^3/yr (8,760,000 gal/yr), 139,600 m^3/yr (36,880,000 gal/yr) and 617,000 m^3/yr (163,000,000 gal/yr) for the UBC Storage Pad Stormwater Retention Basin area, the Site Stormwater Detention Basin area, and the balance (i.e., undeveloped) of the site area, respectively.

Industrial construction for the NEF site will provide a short-term risk with regard to a variety of operations and constituents used in construction activities. These will be controlled by employing BMPs including control of hazardous materials and fuels. BMPs will assure stormwater runoff related to construction activities will be detained prior to release to the surrounding land surface. BMPs will also be used for dust control associated with excavation and fill operations during construction. See ER Section 4.1, Land Use Impacts, for more information on construction BMPs. Impact from stormwater runoff generated during plant operations is not expected to differ significantly from impacts currently experienced at the site.

The water quality of the discharge from the site stormwater detention basin will be typical of runoff from building roofs and paved areas from any industrial facility. Except for small amounts of oil and grease typically found in runoff from paved roadways and parking areas, the discharge is not expected to contain contaminants. Other potential sources for runoff contamination during plant operation include an outdoor storage pad containing UBCs of depleted uranium. Although a highly unlikely occurrence, this pad is a potential source of low-level radioactivity that could enter runoff. The engineering of cylinder storage systems (high-grade sealed cylinders as described in ER Section 2.1.2, Proposed Action) and environmental monitoring of the UBC Storage Pad Stormwater Retention Basin, combine to make the potential for contamination release through this system extremely low. An initial analysis of maximum potential levels of radioactivity in rainwater runoff due to surface contamination of UBCs shows that any potential levels of radioactivity in discharges will be well below (two orders of magnitude or more) the effluent discharge limits of 10 CFR 20, Appendix B (CFR, 2003q). The UBC Storage Pad Stormwater Retention Basin is also the discharge location for cooling tower blowdown water and heating boiler blowdown water.

4.4.1 Receiving Waters

The NEF will not obtain any water or discharge any process effluents onto the site or into surface waters other than into engineered basins. Sanitary waste water discharges will be made through site septic systems. Rain runoff from developed portions of the site will be collected in retention/detention basins, described previously and in ER Section 3.4, Water Resources. These include the Site Stormwater Detention Basin and the UBC Storage Pad Stormwater Retention Basin.

Discharge from the Site Stormwater Detention Basin will be by evaporation and by infiltration into the ground. Discharge from the UBC Storage Pad Stormwater Retention Basin will be by evaporation only.

Discharge from the double-lined Treated Effluent Evaporative Basin, with leak detection, will be by evaporation only. NEF effluent flow rates providing input to this basin are relatively low, as described in ER Section 3.4.1.2.

The NEF site includes no surface hydrologic features. Groundwater was encountered at depths of 65 to 68 m (214 to 222 ft). Significant quantities of groundwater are only found at a depth over 340 m (1,115 ft) where cover for that aquifer is provided by 323 to 333 m (1,060 to 1,092 ft) of clay, as described in ER Section 3.4.1.1.1, Site Groundwater Investigations.

Due to high evapotranspiration rates for the area, it is not anticipated that there will be any receiving waters for runoff derived from the NEF facility other than residual amounts from that collected in the Site Stormwater Detention Basin. At shallower depths vegetation at the site provides highly efficient evapotranspiration processes, as described in ER Section 3.4.1.1, Major Surface and Subsurface Hydrological Systems. That natural process will remove the major part of stormwater runoff at the site.

Stormwater runoff detention/retention basins for the site, shown in Figure 4.4-1, Site Plan with Stormwater Detention/Retention Basins are designed to provide a means of controlling discharges of rainwater and runoff chemistry for about 39 ha (96 acres) of the NEF site plus an additional 9.2 ha (22.8 acres) of the UBC Storage Pad. These areas represent a combined 48.2 ha (118.8 acres) of the 220 ha (543 acre) total NEF site area.

The UBC Storage Pad Stormwater Retention Basin, which will exclusively serve that paved, outdoor storage area, will be lined to prevent any infiltration, and designed to retain a volume (77,700 m^3 (63 acre-ft)) slightly more than twice that for the 24-hour duration, 100-year frequency storm plus an allowance for cooling tower blowdown and heating boiler blowdown.

The basin configuration will allow for radiological testing of water and sediment (see ER Section 4.4.2, Impacts on Surface Water and Groundwater Quality), but the basin will contain no flow outlet. All discharge for the UBC Storage Pad Retention Basin will be through evaporation. The UBC Storage Pad will be constructed of reinforced concrete with a minimal number of construction joints, and pad joints will be provided with joint sealer and water stops as a leak-prevention measure. The ground surface around the UBC Storage Pad will be contoured to prevent rainfall in the area surrounding the pad from entering the pad drainage system.

The Site Stormwater Detention Basin will be designed with an outlet structure for drainage, as needed. Local terrain serves as the receiving area for this basin. The basin will be included in the site environmental monitoring program as described in ER Section 6.1, Radiological Monitoring and ER Section 6.2, Physiochemical Monitoring.

4.4.2 Impacts on Surface Water and Groundwater Quality

Although quantities are severely limited, local shallow groundwater is of a minimally suitable quality to provide sources of potable water. Water for most domestic and industrial uses should contain less than 1,000 mg/L Total Dissolved Solids (TDS) (Davis, 1966), and this compares with a EPA secondary standard of 500 mg/L TDS (CFR, 2003h). The nearby Waste Control Specialists (WCS) facility wells have routinely been analyzed with TDS concentrations between about 2,880 and 6,650 mg/L.

The NEF will not obtain any water from the site or discharge process effluents to groundwater and surface waters other than to the double-lined Treated Effluent Evaporative Basin with leak detection. Therefore, no impacts on natural water systems quality due to facility water use are expected.

Control of surface water runoff will be required for NEF construction activities, covered by the NPDES Construction General Permit. As a result, no significant impacts are expected for either surface water bodies or groundwater.

During NEF operation, stormwater from the site will be collected in a collection system that includes runoff detention/retention basins, as described in ER Section 4.4.1, Receiving Waters and shown in ER Figure 4.4-1, Site Plan with Stormwater Detention/Retention Basins.

No wastes from facility operational systems will be discharged to stormwater. In addition, stormwater discharges during plant operation will be controlled by a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP will meet the requirements of U.S. EPA Construction General Permit (CGP) Section 3. The SWPPP will identify all potential sources of pollution that may reasonably be exspected to affect the quality of stormwater discharge from the site, describe the practices used to reduce pollutants in stormwater, and assure compliance with the terms and conditions of the CGP.

The UBC Storage Pad Stormwater Retention Basin will collect the runoff water from the UBC Storage Pad. This water runoff has the extremely remote potential to contain low-level radioactivity from cylinder surfaces or leaks. Runoff from the pad will be channeled to a dedicated retention basin that is single-lined with a synthetic fabric with ample soil cover over the liner to prevent surface damage and ultraviolet degradation. This basin is described in ER Section 3.4.1.2, Facility Withdrawal and/or Discharges to Hydrologic Systems. It is suitable to contain at least the volume of water from slightly more than twice the 100-year, 24-hour-frequency rainfall of 15.2 cm (6.0 in) plus an allowance for cooling tower blowdown and heating boiler blowdown. The drainage system will include precast catch basins and concrete trench drains; piping will be reinforced concrete with rubber gasketed joints to preclude leakage. An assessment was made by LES that assumed a conservative level of radioactive contamination level on cylinder surfaces and 100% washoff to the UBC Storage Pad Stormwater Retention Basin from a single rainfall event. Results show the level of radioactivity in such a discharge to the basin will be well below the regulatory unrestricted release criteria (CFR, 2003q).

The UBC Storage Pad Stormwater Retention Basin will be provided with a means to sample sediment. Refer to ER Section 6.1, Radiological Monitoring, for more information regarding environmental monitoring of stormwater site detention/retention basins.

4.4.3 Hydrological System Alterations

Excavation and placement of fill will provide the site with a finished level grade of about +1,041 m (+3,415 ft), msl. This work will not require alteration or filling of any surface water features on the site.

No alterations to groundwater systems will occur due to facility construction. Referring to ER Section 3.4.12, since there is no consistent groundwater in the sand and travel layer above the Chinle Formation, it does not provide a likely contaminant pathway in a lateral or vertical direction. Although engineered fill will be used during site preparation and will likely be placed against the existing dense sand and gravel layer in some locations, the potential for water or other liquids from spills or pipeline leaks to introduce sufficient amounts of liquid to saturate the sand and gravel layer to a point where significant contaminant migration reaches and flows along the top of the Chinle Formation, is considered unlikely. The addition of on-site fill is not expected to alter this situation. Furthermore, the travel time to downstream users through a lateral contaminant pathway would be significant since potential contamination would travel laterally at very small rates, if at all. Groundwater travel through the Chinle clay would be on the order of thousands of years.

4.4.4 Hydrological System Impacts

Due to absence of water extraction, limited effluent discharge from the facility operations, the lack of groundwater in the sand and gravel layer above the Chinle Formation and the considerable depth to groundwater at the NEF site, no significant impacts are expected for the site's hydrologic systems.

Control of surface water runoff will be required for NEF construction activities, covered by the NPDES Construction General Permit. As a result, no significant impacts are expected to either surface or groundwater bodies. Control of impacts from construction runoff is discussed in ER Section 4.4.7, Control of Impacts to Water Quality.

The volume of water discharged into the ground from the Site Stormwater Detention Basin is expected to be minimal, as evapotranspiration is expected to be the dominant natural influence on standing water.

4.4.5 Ground and Surface Water Use

The NEF will not obtain any water from the site or have any planned surface discharges at the site other than to the retention and detention basins. All potable, process and fire water supply used at the NEF will be obtained from the Eunice and/or Hobbs, New Mexico, municipal water systems. Wells serving these systems are about 32 km (20 mi) from the site. Anticipated normal plant water consumption and peak plant water requirements are provided in Table 3.4-4, Anticipated Normal Plant Water Consumption, and Table 3.4-5, Anticipated Peak Plant Water Consumption, respectively.

Site groundwater will not be utilized for any reason, and therefore, should not be impacted by routine NEF operations. The NEF water supply will be obtained from the city of Eunice, New Mexico and the city of Hobbs, New Mexico. Current capacities for the Eunice and Hobbs, New Mexico municipal water supply system are 16,350 m^3/day (4.32 million gpd) and 75,700 m^3/day (20 million gpd), respectively and current usages are 5,600 m^3/day (1.48 million gpd) and 23,450 m^3/day (6.2 million gpd), respectively. Average and peak potable water requirements for operation of the NEF are expected to be approximately 240 m^3/day (63,423 gpd) and 85 m^3/hr (378 gpm), respectively. These usage rates are well within the capacities of both water systems.

For both peak and the normal usage rates, the needs of the NEF facility should readily met by the municipal water systems. Impacts to water resources onsite and in the vicinity of the NEF are expected to be negligible.

4.4.6 Identification of Impacted Ground and Surface Water Users

Location of an intermittent surface water feature and groundwater users in the site vicinity including an area just beyond a 1.6-km (1-mi) radius of the site boundary are shown on Figure 3.4-7, Water and Oil Wells in the Vicinity of the NEF Site. These locations were provided by the Office of New Mexico State Engineer (NMSE) (NMSE, 2003), the Texas Water Development Board (TWDB) (TWDB, 2003) and the United States Geological Survey (USGS) (USGS, 2003b). No producing supply water wells are within 1.6 km (1 mi) of the boundaries of the NEF site as shown on Figure 3.4-7. However, nearby facilities do have groundwater monitoring wells within this region.

The absence of near-surface groundwater users within 1.6 km (1 mi) from the site and the absence of surface water on the NEF site will prevent any impact to local surface or groundwater users. Due to the lack of process water discharge from the facility to the environment, no impact is expected for these water users.

Effluent discharges will be controlled in a way that will also prevent any impacts. The locations of the closest municipal water systems for both Eunice and Hobbs are in Hobbs, New Mexico, 32 km (20 mi) north northwest of the site. There is no potential to impact these sources.

4.4.7 Control of Impacts to Water Quality

Site runoff water quality impacts will be controlled during construction by compliance with NPDES Construction General Permit requirements and BMPs will be described in a site Stormwater Pollution Prevention (SWPP) plan.

Wastes generated during site construction will be varied, depending on activities in progress. Any hazardous wastes from construction activities will be handled and disposed of in accordance with applicable state regulations. This includes proper labeling, recycling, controlling and protected storage and shipping offsite to approved disposal sites. Sanitary wastes generated at the site will be handled by portable systems until such time that the site septic systems are available for use.

The need to level the site for construction will require some soil excavation as well as soil fill. Fill placed on the site will provide the same characteristics as the existing natural soils thus providing the same runoff characteristics as currently exist due to the presence of natural soils on the site.

During operation, the NEF's stormwater runoff detention/retention system will provide a means to allow controlled release of site runoff from the Site Stormwater Detention Basin only. Stormwater discharge will be periodically monitored in accordance with state and/or federal permits. This system will also be used for routine sampling of runoff as described in ER Section 6.1.1.2, Liquid Effluent Monitoring. A Spill Prevention Control and Countermeasure (SPCC) plan will be implemented for the facility to identify potential spill substances, sources and responsibilities. A SWPP will also be implemented for the NEF to assure that runoff released to the environment will be of suitable quality. These plans are described in ER Section 4.1, Land Use Impacts.

Water discharged to the NEF site septic systems will meet required levels for all contaminants stipulated in any permit or license required for that activity, including the 10 CFR 20 (CFR, 2003q) and a Groundwater Discharge Permit/Plan. The facility's Liquid Effluent Collection and Treatment System provides a means to control liquid waste within the plant. The system provides for collection, treatment, analysis, and processing of liquid wastes for disposal. Effluents unsuitable for release to the Treated Effluent Evaporative Basin are processed onsite or disposed of offsite in a suitable manner in conformance with U.S. EPA and State of New Mexico regulatory requirements. The State of New Mexico has adopted the U.S. EPA hazardous water regulations (40 CFR Parts 260 through 266, 268 and 270) (CFR, 2003cc; CFR, 2003p; CFR, 2003dd; CFR, 2003ee; CFR, 2003v; CFR, 2003ff; CFR, 2003gg; CFR, 2003hh; CFR, 2003ii) governing the generation, handling, storage, transportation, and disposal of hazardous materials. These regulations are found in 20.4.I NMAC, "Hazardous Waste Management" (NMAC, 2000).

The UBC Storage Pad Stormwater Retention Basin, which exclusively serves the UBC Storage Pad, cooling tower blowdown water and heating boiler blowdown water discharges, is lined to prevent infiltration. It is designed to retain a volume slightly more than twice that for the 24-hour, 100-year frequency storm plus an allowance for cooling tower blowdown and heating boiler blowdown. Designed for sampling and radiological testing of the contained water and sediment, this basin has no flow outlet. All discharge is through evaporation.

The Site Stormwater Detention Basin is designed with an outlet structure for drainage. Local terrain serves as the receiving area for this basin. During a rainfall event larger than the design basis, the potential exists to overflow the basin if the outfall capacity is insufficient to pass beyond design basis inflows to the basin. Overflow of the basin is an unlikely event. The additional impact to the surrounding land over that which would occur during such a flood alone, is assumed to be small. Therefore, potential overflow of the Site Stormwater Detention Basin during an event beyond its design basis is expected to have a minimal impact to surrounding land. The Site Stormwater Detention Basin will also receive runoff from a portion of the site stormwater diversion ditch. The purpose of the diversion ditch is to safely divert surface runoff from the area upstream of the NEF around the east and west sides of the NEF structures during extreme precipitation events. There is no retention or attenuation of flow associated with this feature. The east side will divert surface runoff into the Site Stormwater Detention Basin. The basin is designed to provide no flow attenuation for this component of flow The west side will divert surface runoff around the site where it will continue on as overland flow. Since there are no modifications or attenuation of flows, there are no adverse impacts and no mitigative measures are required.

Discharge of operations-generated potentially contaminated waste water is made exclusively to the Treated Effluent Evaporative Basin. Only liquids meeting site administrative limits (based on prescribed standards) are discharged to this basin. The basin is double-lined with leak detection and open to allow evaporation.

Mitigation measures will be in place to minimize potential impact on water resources. These include employing BMPs and the control of hazardous materials and fuels. In addition, the following controls will also be implemented:

- Construction equipment will be in good repair without visible leaks of oil, greases, or hydraulic fluids.
- The control of spills during construction will be in conformance with Spill Prevention Control and Countermeasures (SPCC) plan.
- Use of the BMPs will assure stormwater runoff related to these activities will not release runoff into nearby sensitive areas (EPA, 2003g). See ER Sections 4.1.1 and 4.2.5 for construction BMPs.
- BMPs will also be used for dust control associated with excavation and fill operations during construction. Water conservation will be considered when deciding how often dust suppression sprays will be applied (EPA, 2003g).
- Silt fencing and/or sediment traps will be used.
- External vehicle washing (no detergents, water only).
- Stone construction pads will be placed at entrance/exits if unpaved construction access adjoins a state road.
- All temporary construction and permanent basins are arranged to provide for the prompt, systematic sampling of runoff in the event of any special needs.
- Water quality impacts will be controlled during construction by compliance with the National Pollution Discharge Elimination System – General Permit requirements and by applying BMPs as detailed in the site Stormwater Pollution Prevention (SWPP) plan.
- A Spill Prevention Control and Countermeasure Plan (SPCC), will be implemented for the facility to identify potential spill substances, sources and responsibilities.
- All above-ground diesel storage tanks will be bermed.
- Any hazardous materials will be handled by approved methods and shipped offsite to approved disposal sites. Sanitary wastes generated during site construction will be handled by portable systems, until such time that plant sanitary facilities are available for site use. An adequate number of these portables systems will be provided.
- The NEF Liquid Effluent Collection and Treatment System provides a means to control liquid waste within the plant including the collection, analysis, and processing of liquid wastes for disposal.
- Control of surface water runoff will be required for activities covered by the EPA Region 6 NPDES Construction General Permit.

4.5 ECOLOGICAL RESOURCES IMPACTS

4.5.1 Maps

See Figure 4.5-1, Ecological Resource Impacts.

4.5.2 Proposed Schedule of Activities

The following is a tentative, abbreviated schedule of proposed activities. Refer to ER Section 1.2.4, Schedule on Major Steps Associated With the Proposed Action, for a complete schedule of all major steps in the proposed action:

- December 2003 — Submit Facility License Application
- August 2006 — Initiate Facility Construction
- October 2008 — Start First Cascade
- October 2013 — Achieve Full Nominal Production Output
- April 2025 — Submit License Termination Plan to NRC
- April 2027 — Complete Construction of Decommissioning and Decontamination (D&D) Facilities
- April 2036 — D&D Completed

4.5.3 Area of Disturbance

The area of land to be disturbed is approximately 81 ha (200 acres). This area includes 8 ha (20 acres) that will be used for contractor parking and lay-down areas. The contractor lay-down and parking area will be restored after completion of plant construction. (See ER Figure 3.4-1, Local Hydrological Features, for a map indicating proposed buildings, land to be cleared and surrounding areas.)

4.5.4 Area Of Disturbance By Habitat Type

The proposed NEF site consists of one vegetation community type. The Plains Sand Scrub vegetation community is identified by the dominant presence of deep sand tolerant and deep sand adapted plants. The Plains Sand Scrub vegetation community is common in parts of southeastern New Mexico. Density of specific plant species, quantified by individuals per acre, varies slightly across the proposed site. Differences in the composition of the vegetation community within the proposed site are accounted for by slight variations in soil texture and structure and small changes in aspect.

The Plains Sand Scrub vegetation community is interrupted by a single access road through the NEF site. The road is void of vegetation. This area represents a small fraction of the total area and is not considered a habitat type.

The majority of the proposed site is suitable for use by wildlife resources. The Plains Sand Scrub provides potential habitat for an assortment of birds, mammals, and reptiles (Reference ER Section 3.5.2, General Ecological Conditions of the Site).

The total area of disturbance proposed for the NEF site is approximately 81 ha (200 acres) of the 220-ha (543-acre) site. The disturbance would affect the Plains Sand Scrub vegetation community.

4.5.5 Maintenance Practices

Maintenance practices such as the use of chemical herbicides, roadway maintenance, and clearing practices will be employed both during construction and/or plant operation. However, none of the practices are anticipated to permanently affect biota (see ER Sections 4.1.1 and 4.2.5 for construction and maintenance BMPs) (EPA, 2003g).

No herbicides will be used during construction, but may be used in limited amounts according to government regulations and manufacturer's instructions to control unwanted noxious vegetation during operation of the facility. Additionally, natural, low-water consumption landscaping will be used and maintained. Any eroded areas that may develop will be repaired and stabilized.

Roadway maintenance practices will be employed both during construction and operational phases of the NEF. However, these practices are currently being employed by the Wallach Quarry along the existing access road, and do not represent a new or significant impact to biota.

Clearing practices will be employed during the construction phase of the NEF project. The additional noise, dust and other factors associated with the clearing practices will be short-lived in duration and will represent only a temporary impact to the biota of the NEF site.

Additionally, only 81 ha (200 acres) of the 220 ha (543 acres) total site area will be disturbed affording the biota of the site an opportunity to move to undisturbed areas within the NEF site as well as additional areas of suitable habitat bordering the NEF site. Refer to ER Section 4.1, Land Use Impacts, for construction and clearing BMPs.

4.5.6 Short Term Use Areas And Plans For Restoration

The area to be used on a short-term basis during construction, including contractor parking and lay-down areas, will be limited to approximately 8.1 ha (20 acres). These areas will be revegetated with native plant species and other natural, low-water consumption landscaping to control erosion upon completion of site construction and returned as close as possible to original conditions. Lay-down (short term use areas) will be selected as to minimize the impacts to local vegetation.

During the ISA process, evaluation of most accident sequences resulted in identification of design bases and design features that prevent a criticality event or chemical release to the environment. Table 4.12-15, Accident Criteria Chemical Exposure Limits by Category lists the accident criteria chemical exposure limits by category for an immediate consequence and high consequence categories. Examples of preventative controls for criticality events include limits on UF_6 quantities or equipment geometry for UF_6 vessels that eliminate the potential for a criticality event. Examples of preventative controls for UF_6 releases include highly reliable protection features to prevent overheating of UF_6 cylinders and explicit design basis such as that for tornadoes.

These preventive controls reduce the likelihood of the accident (criticality events and HF release scenarios) such that the risk is reduced to acceptable levels as defined in 10 CFR 70.61 (CFR, 2003b). All HF release scenarios with the exception of those caused by seismic and for some fire cases are controlled through design features or by administrative procedural control measures.

Several accident sequences involving HF releases to the environment due to seismic or fire events were mitigated using design features to delay and reduce the UF_6 releases inside the buildings from reaching the outside environment. The seismic accident scenario considers an earthquake event of sufficient magnitude to fail the UF_6 process piping and some UF_6 components resulting in a large gaseous UF_6 release inside the buildings housing UF_6 process systems. The fire accident scenario considers a fire within the TSB that causes the release of uranic material from open waste containers and chemical traps during waste drum filling operations. These mitigation features include automatic shutoff of building HVAC systems following a seismic event or during a fire event along with building features to limit building air leakage to the outside environment. With mitigation, the dose equivalent consequences to the public for these accident sequences have been reduced to below an intermediate consequence as defined in 10 CFR 70.61 (CFR, 2003b).

Without mitigation, the bounding seismic scenario results in a 30-minute radiological dose equivalent of 0.18 mSv (18 mrem) TEDE, a 30-minute uranium inhalation intake of 2.9 mg, a 30-minute uranium chemical exposure to 4.7 mg U/m^3, a 24-hour airborne uranium concentration of 0.10 mg U/m^3, and a 30-minute HF chemical exposure to 32 mg HF/m^3. The controlling dose is for the HF chemical exposure, which is a high consequence as defined in 10 CFR 70.61 (CFR, 2003b).

With mitigation, the bounding seismic scenario results in a 30-minute radiological dose equivalent of 8μSv (0.8 mrem) TEDE, a 30-minute uranium inhalation intake of 0.13 mg, a 30-minute uranium chemical exposure to 0.213 mg U/m^3, a 24-hour airborne uranium concentration of 0.004 mg U/m^3, and a 30-minute HF chemical exposure to 1.4 mg HF/m^3. The controlling dose is for the HF chemical exposure, which is a below an intermediate consequence as defined in 10 CFR 70.61 (CFR, 2003b).

Without mitigation, the bounding fire scenario results in a 30-minute radiological dose equivalent of 0.055 mSv (5.5 mrem) TEDE, a 30-minute uranium inhalation intake of 0.92 mg, a 30-minute uranium chemical exposure to 1.5 mg U/m^3, a 24-hour airborne uranium concentration of 0.03 mg U/m^3, and a 30-minute HF chemical exposure to 5 mg HF/m^3. The controlling dose is for the HF chemical exposure, which is an intermediate consequence as defined in 10 CFR 70.61 (CFR, 2003b).

With mitigation, the bounding fire scenario results in a 30-minute radiological dose equivalent of 16 μSv (1.6 mrem) TEDE, a 30-minute uranium inhalation intake of 0.265 mg, a 30-minute uranium chemical exposure to 0.425 mg U/m^3, a 24-hour airborne uranium concentration of 0.0089 mg U/m^3, and a 30-minute HF chemical exposure to 1.44 mg HF/m^3. The controlling dose is for the HF chemical exposure, which is a below an intermediate consequence as defined in 10 CFR 70.61 (CFR, 2002b).

4.12.3.2 Accident Mitigation Measures

Potential adverse impacts for accident conditions are described in ER Section 4.12.3.1 above. Several accident sequences involving HF releases to the environment due to seismic or fire events were mitigated using design features to delay and reduce the UF_6 releases inside the buildings from reaching the outside environment. These mitigative features include automatic shutoff of building HVAC systems following a seismic event or during a fire event along with building features to limit building air leakage to the outside environment. With mitigation, the dose equivalent consequences to the public for these accident sequences have been reduced to below an intermediate consequence as defined in 10 CFR 70.61 (CFR, 2003b).

4.12.3.3 Non-Radiological Accidents

A review of non-radiological accident injury reports for the Capenhurst facility was conducted for the period 1999-2003. No injuries involving the public were reported. Injuries to workers occurred due to accidents in parking lots and offices as well as in the plant. The typical causes of injuries sustained at the Capenhurst facility are summarized in Table 4.12-16, Causes of Injuries at Capenhurst (1999-2003). Non-radiological accidents to equipment that did not result in injury to workers are not reported by Capenhurst.

4.12.4 Comparative Public and Occupational Exposure Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the NEF, including an alternative of "no action" i.e., not building the NEF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three "no action" alternative scenarios addressed in ER Section 2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B – No NEF; USEC deploys a centrifuge plant and continues to operate the Paducah gaseous diffusion plant (GDP): The public and occupational exposure impact would be greater because of greater effluents and operational exposure associated with GDP operation.

Alternative Scenario C – No NEF; USEC deploys a centrifuge plant and increases the centrifuge plant capability: The public and occupational exposure impact would be greater in the short term due to more effluents and operational exposure associated with GDP operation. In the long term, the public and occupational exposure would be the same or greater.

Alternative Scenario D – No NEF; USEC does not deploy a centrifuge plant and operates the Paducah GDP at an increased capacity: The public and occupational exposure impact would be significantly greater since a significant amount of additional effluent and exposure results from operation of the GDP at the increased capacity.

Table 4.12-14 Estimated NEF Occupational (Individual) Exposures

Position	Annual Dose Equivalent*
General Office Staff	< 0.05 mSv (< 5.0 mrem)
Typical Operations & Maintenance Technician	1 mSv (100 mrem)
Typical Cylinder Handler	3 mSv (300 mrem)

*The average worker exposure at the Urenco Capenhurst facility during the years 1998 through 2002 was approximately 0.2 mSv (20 mrem) (URENCO, 2000; URENCO, 2001; URENCO, 2002a).

Table 4.12-15 Accident Criteria Chemical Exposure Limits by Category

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	High Consequence (Category 3)	Intermediate Consequence (Category 2)
Worker (local)	> 40 mg U intake > 139 mg HF/m^3	> 10 mg U intake > 78 mg HF/m^3
Worker (elsewhere in room)	> 146 mg U/m^3 > 139 mg HF/m^3	> 19 mg U/m^3 > 78 mg HF/m^3
Outside Controlled Area (30-min exposure)	> 13 mg U/m^3 > 28 mg HF/m^3	> 2.4 mg U/m^3 > 0.8 mg HF/m^3

resource. LES will make a determination as to whether the depleted uranium is a resource or a waste and notify the NRC.

The NRC also noted in its letter to LES (NRC, 2003b), that the NEF license application should demonstrate that, given the expected constituents of the LES depleted uranium, the material meets the definition of low-level radioactive waste given in 10 CFR Part 61 (CFR, 2003r). The definition of low-level waste in 10 CFR 61 (CFR, 2003r) is radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or byproduct material as defined in section 11e.(2) of the Atomic Energy Act (uranium or thorium tailings and waste), 10 CFR 30 (CFR, 2003c), and 10 CFR 40 (CFR, 2003d). High-level radioactive waste (HLW) is primarily in the form of spent fuel discharged from commercial nuclear power reactors. The LES depleted uranium is produced as a result of enriching natural uranium feed material in the form of uranium hexafluoride. No spent fuel is used in the NEF. Therefore, the LES depleted uranium is not high-level waste nor does it contain any high-level waste.

A transuranic element is an artificially made, radioactive element that has an atomic number higher than uranium in the Periodic Table of Elements such as neptunium, plutonium, americium, and others. Transuranic waste is material contaminated with transuranic elements. It is produced primarily from reprocessing spent fuel and from the use of plutonium in the fabrication of nuclear weapons. Since the LES depleted uranium is produced as a result of enriching natural uranium feed material in the form of uranium hexafluoride, it contains no transuranic waste.

Spent nuclear fuel is fuel that has been removed from a nuclear reactor because it can no longer sustain power production for economic or other reasons. The LES depleted uranium is produced as a result of enriching natural uranium feed material in the form of uranium hexafluoride. Therefore, the LES depleted uranium is not nuclear fuel.

Section 11e.(2) of the Atomic Energy Act classifies tailings produced from uranium ore as byproduct material. Tailings are the waste left after ore has been extracted from rock. The LES depleted uranium is produced as a result of enriching natural uranium feed material in the form of uranium hexafluoride, not from uranium ore or rock tailings. Therefore, the NEF depleted uranium is not byproduct material per section 11e.(2) of the Atomic Energy Act.

10 CFR 30 (CFR, 2003c) states that byproduct material is any radioactive material, except special nuclear material, yielded in or made radioactive by exposure to the process of producing or utilizing special nuclear material. The LES depleted uranium is produced as a result of enriching natural uranium feed material in the form of uranium hexafluoride and is not made radioactive by exposure to radiation incident to the process of producing or utilizing special nuclear material.

10 CFR 40 (CFR, 2003c) states that byproduct material is the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes. Underground ore bodies depleted by such solution extraction operations do not constitute "byproduct material" within this definition. The LES depleted uranium is produced as a result of enriching natural uranium feed material in the form of uranium hexafluoride and is not produced by extraction or concentration of uranium or thorium from ore.

The NEF depleted uranium is not high-level radioactive waste, contains no transuranic waste, spent nuclear fuel, or byproduct material as defined in Section 11e.(2) of the Atomic Energy Act, 10 CFR 30 (CFR, 2003c) and 10 CFR 40 (CFR, 2003d); therefore, once NEF depleted uranium is determined by LES to be a waste and not a resource, it meets the 10 CFR 61 definition of low-level radioactive waste.

Disposition of the UBCs has several potential impacts that depend on the particular approach taken. Currently, the preferred options are short-term onsite storage followed by conversion and underground burial (Option 1 below) or transportation of the UBCs to a DOE conversion facility (Option 2 below). LES considered several other options in addition to the preferred options that could have implications on the number of UBCs stored at the NEF and the length of storage for the cylinders. All of these options are discussed below along with some of their impacts. However, at this time, LES considers only Options 1 and 2 below to represent plausible strategies for the disposition of its UBCs.

Option 1 –U.S. Private Sector Conversion and Disposal (Preferred Plausible Strategy)

Transporting depleted UF_6 from the NEF to a private sector conversion facility and depleted U_3O_8 permanent disposal in a western U.S. exhausted underground uranium mine is the preferred "plausible strategy" disposition option. The NRC repeatedly affirmed its acceptance of this option during its licensing review of the previous LES license application. In Section 4.2.2.8 of its final environmental impact statement (FEIS) for that application, the NRC staff noted that "it is plausible to assume that depleted UF_6 converted into U_3O_8 may be disposed by emplacement in near surface or deep geological disposal units" (NRC, 1994a). And during the subsequent adjudicatory hearing on that application, an NRC Atomic Safety and Licensing Board held that "[LES] has presented a plausible disposal strategy. [Its] plan to convert depleted UF_6 to U_3O_8 at an offsite facility in the United States and then ship that material as waste to a final site for deeper than surface burial is a reasonable and credible plan for depleted UF_6 disposal (NRC, 1997).

LES has committed to the Governor of New Mexico (LES, 2003b) that: (1) there will be no long-term disposal or long-term storage (beyond the life of the plant) of UBCs in the State of New Mexico; (2) a disposal path outside the State of New Mexico is utilized as soon as possible; (3) LES will aggressively pursue economically viable paths for UBCs as soon as they become available; (4) LES will work with qualified vendors pursuing construction of private deconversion facilities by entering in good faith discussions to provide such vendor long-term UBC contracts to assist them in their financing efforts; and (5) LES will put in place as part of the NRC license a financial surety bonding mechanism that assures funding will be available in the event of any default by LES.

ConverDyn, a company that is engaged in converting U_3O_8 material to UF_6 for enrichment, has the technical capability to construct and operate a depleted UF_6 to depleted U_3O_8 facility at its facility in Metropolis, Illinois in the future if there is an assured market. One of the two ConverDyn partners, General Atomics, may have access to an exhausted uranium mine (the Cotter Mines in Colorado) where depleted U_3O_8 could be disposed. Furthermore, discussions have recently been held with Cogema concerning a private conversion facility. Cogema has experience with such a facility currently processing depleted UF_6 in France. These factors support LES's position that this option is the preferred "plausible strategy" option.

Any deconversion facility used by NEF will not be located in the State of New Mexico.

Option 2 – DOE Conversion and Disposal (Plausible Strategy)

Transporting depleted UF_6 from the NEF to DOE conversion facilities for ultimate disposition is a plausible disposition option. Pursuant to Section 3113 of the USEC Privatization Act, DOE is instructed to "accept for disposal" depleted UF_6, such as those that will be generated by the NRC-licensed NEF. To that end, DOE has recently contracted for the construction and

The LLNL cost analyses assumed that the depleted UF_6 would be converted to depleted U_3O_8, the DOE's preferred disposal form, using one of two dry process conversion alternatives. The first alternative, the AHF option, upgrades the hydrogen fluoride (HF) product to anhydrous HF (<1.0% water). In the second option, the HF neutralization alternative, the HF would be neutralized with lime to produce calcium fluoride (CaF_2). The LLNL cost analyses assumed that the AHF and CaF_2 conversion products' would have negligible uranium contamination and could be sold for unrestricted use. LES will not use a deconversion facility that employs a process that results in the production of anhydrous HF.

Table 4.13-2, LLNL Estimated Life-Cycle Costs for DOE Depleted UF_6 to Depleted U_3O_8 Conversion, presents the LLNL-estimated life-cycle capital, operating, and regulatory discounted costs in 1996 dollars, for conversion of 378,600 MTU (417,335 tons uranium) over 20 years, of depleted UF_6 to depleted U_3O_8 by anhydrous hydrogen fluoride (AHF) and HF neutralization processing. The costs were extracted from Table 4.8 in the LLNL report. The discounted LLNL life-cycle costs in 1996 dollars were undiscounted and converted to per kg unit costs and adjusted to 2002 dollars using the Gross Domestic Product (GDP) Implicit Price Deflator (IPD), as shown in the table. The escalation adjustment resulted in the 1996 costs being increased by 11%.

The anhydrous hydrogen fluoride (AHF) conversion option for which LLNL provides a cost estimate assumes that the AHF by-product is saleable, and that total sales revenues over the 20 years of operation would amount to $77.32 million, in discounted dollars. LLNL also assumed that the life-cycle sale of CaF_2 obtained from neutralizing HF with lime would result in discounted revenues of $11.02 million.

The cost estimates for the conversion facility assumed that all major buildings are to be structural steel frame construction, except for the process building which is a two story reinforced concrete structure. Most of this building is assumed to be "special construction" with 0.3-m (1-ft) thick concrete perimeter walls and ceilings, 8-in concrete interior walls, and 0.6-m (2-ft) thick concrete floor mat. The "standard construction" area walls were taken to be 8-in thick concrete with 15-cm (6-in) elevated floors and 20 cm (8-in) concrete floors slabs on grade.

Table 4.13-3, Summary of LLNL Estimated Capital, Operating and Regulatory Unit Costs for DOE depleted UF_6 to Depleted U_3O_8 Conversion, presents a summary of estimated capital, operating and regulatory costs for depleted UF_6 to depleted U_3O_8 conversion on a dollars per kgU basis, in both 1996 and 2002 dollars, undiscounted. It can be seen that in either case the conversion process is operations and maintenance intensive.

Table 4.13-4, LLNL Estimated Life Cycle Costs for DOE Depleted UF_6 Disposal Alternatives, presents LLNL-estimated life-cycle costs for the waste form preparation and disposal of DOE depleted U_3O_8 produced by conversion of depleted UF_6. The table presents estimated costs for two depleted U_3O_8 disposal alternatives: shallow earthen structures (engineered "trenches") and concrete vaults. The waste form preparation for each alternative consists primarily of loading, compacting, and sealing the depleted U_3O_8 into 208-L (55-gal) steel drums.

The LLNL-estimated life-cycle costs for depleted U_3O_8 disposal range from $86 million, in discounted 1996 dollars, for the engineered trench alternative to $180 million for depleted U_3O_8 disposal in a concrete vault. The disposal unit costs range from $1.46 per kgU to $2.17 per kgU, in 2002 dollars. As discussed later in this section, the LLNL-estimated concrete vault costs are higher than those that would be required to either sink a new underground mine or to refurbish and operate an existing exhausted mine, an alternative that the NRC has indicated to be acceptable (ORNL, 1995). For example, the capital cost for the concrete vault alternative of

$130.75 million in discounted 1996 dollars or $349.7 million in undiscounted 2002 dollars is far greater than the $12.4 million cost of a new 200 MT (220 tons) per day underground mine, as shown later in this section.

Table 4.13-5, Summary of Total Estimated Conversion and Disposal Costs presents the depleted UF_6 conversion and depleted U_3O_8 disposal costs already discussed on a dollar per kgU basis, in undiscounted 2002 dollars. In addition it also includes the LLNL-estimated cost to DOE of rail transportation (including loading and unloading) of conforming depleted UF_6 cylinders to the conversion facility site and drummed depleted U_3O_8 to the disposal sites. It does not include interim storage costs since it may reasonably be assumed that LES UBCs may be shipped directly to the deconversion facility. The table indicates that the total costs for depleted UF_6 disposal in, in 2002 dollars, based on the LLNL study estimates, is likely to range from about $5.06 to $5.81 per kgU.

On August 29, 2002, the DOE announced the competitive selection of UDS to design and construct conversion facilities near the DOE enrichment plants at Paducah, Kentucky and Portsmouth, Ohio, and to operate these facilities from 2006 to 2010. UDS will also be responsible for maintaining the depleted uranium and conversion product inventories and transporting depleted uranium from Oak Ridge East Tennessee Technology Park (ETTP) to the Portsmouth site for conversion. The contract scope includes packaging, transporting and disposing of the conversion product depleted U_3O_8. Table 4.13-6, DOE UDS August 29, 2002 Contract Quantities and Costs presents a summary of the UDS contract quantities and costs.

The DOE-estimated value of the cost reimbursement incentive fee contract, which runs from August 29, 2002 to August 3, 2010, is $558 million (DOE, 2002c). Design, construction and operation of the facilities will be subject to appropriations of funds from Congress. On December 19, 2002, the White House confirmed that funding for both conversion facilities will be included in President Bush's 2004 budget. However, the Office of Management and Budget has not yet indicated how much funding will be allocated. Framatome is a subsidiary of Areva, the French company whose subsidiary Cogema has operated the world's only existing commercial depleted UF_6 conversion plant since 1984.

The table shows the target deconversion quantities and the estimated fee. The contract calls for the construction of a 12,200 MTU (13,448 tons uranium) per year conversion plant at Paducah and a 9,100 MTU (10,031 tons uranium) per year conversion plant at Portsmouth, for an annual nominal total capacity of 21.3 million kgU (23,479 tons uranium), which is also the target conversion rate per year. Based on the target conversion rate the UDS contract total unit capital cost is estimated to be $0.77 per kgU ($0.35 per lb U). This unit cost is based on plant operation over 25 years and 6% government cost of money. The conversion, disposal and material management total operating cost during the first five years of operation corresponds to $3.15 per kgU. The total unit capital and operating cost is $3.92 per kgU. As noted earlier in this section, the DOE has indicated that the disposal of the depleted U_3O_8 may take place at the Nevada Test Site. The cost to DOE of depleted U_3O_8 disposal at NTS is currently estimated at $7.50 per ft^3 or about $0.11 per kgU ($.0.05 per lb U). In 1994 it was reported that the NTS charge to the DOE of $10 per ft^3 ($0.15 per kgU) was not a full cost recovery rate (EGG, 1994).

It is of interest to note that USEC entered into an agreement with the DOE on June 30, 1998, wherein it agreed to pay the DOE $50,021,940 immediately prior to privatization for a commitment by the DOE "for storage, management and disposition of the transferred depleted uranium..." generated by USEC during the FY 1999 to FY 2004 time period (DOE, 1998).

Under the terms of the agreement, the DOE also committed to perform "...research and development into the beneficial use of depleted uranium, and related activities and support services for depleted uranium-related activities". The agreement specifies that USEC will transfer to the DOE title to and possession of 2,026 48G cylinders containing approximately 16,673,980 kgU (18,380 tons of uranium). Under this agreement, DOE effectively committed to dispose of the USEC DUF_6 at an average rate of approximately 3.0 million kgU per year between the middle of calendar 1998 and the end of 2003 at a cost of exactly $3.00 per kgU ($1.36 per lb U), in 1998 dollars.

According to Urenco its depleted UF_6 disposal will be similar to those that will be generated by LES at the NEF. Urenco contracts with a supplier for depleted UF_6 to depleted U_3O_8 conversion. The supplier has been converting depleted UF_6 to depleted U_3O_8 on an industrial scale since 1984.

The Claiborne Energy Center costs given in Table 4.13-7, Summary of Depleted UF_6 Disposal Costs from Four Sources are based upon those presented to John Hickey of the NRC in the LES letter of June 30, 1993 (LES, 1993) as adjusted for changes in units and escalated to 2002. A conversion cost of $4.00 per kgU was provided to LES by Cogema at that time. A value of $1.00 per kgU U_3O_8 ($0.45 lb U_3O_8) depleted U_3O_8 disposal cost was based on information provided by Urenco at the time.

As indicated earlier in this section, the NRC has noted that an existing exhausted underground uranium mine would be a suitable repository for depleted U_3O_8 (NRC, 1995). For purposes of comparing alternatives, the conservative assumption of constructing a new mine was assessed. A mine disposal facility would consist of surface facilities for waste receiving and inspection (the waste-form facility), and shafts and ramps for access to and ventilation of the underground portion of the repository, and appropriate underground transport and handling equipment. The mine underground would consist of tunnels (called "drifts") and cross-cuts for the transport and storage of stacked 208-L (55-gal) steel drums which are then back-filled. A great many features of a typical underground mine would be applicable to this disposal alternative.

The NEF, when operating at its nominal full capacity of 3.0 million Separative Work Units (SWUs) per year will produce 7,800 MT (8.598 tons) of depleted UF_6. A typical U.S. underground mine, operating for five days per week over fifty weeks of the year, excepting ten holiday days per year, would operate for 240 days per year. Thus, if LES UBCs were disposed uniformly over the year, the average disposal rate would be 32.5 MT (35.8 tons) of depleted UF_6 per day. This is much less than the rate of ore production in even a typical small under ground mine. However, it may reasonably assumed that the rate of emplacement of the drummed depleted U_3O_8 would be less than the rate of ore removal from a typical underground mine.

The estimated capital and operating costs for a 200 MT per day underground metal mine in a U.S. setting was provided by a U.S. mining engineering company, Western Mine Engineering, Inc. The costs are for a vein type mine accessed by a 160-m (524-ft) deep vertical shaft with rail type underground haulage transport. The operating costs for the 200 MT per day mine is estimated to be $0.07 per kg ($0.03 per lb) of ore and the capital cost is estimated to be approximately $0.04 per kg ($0.02 per lb) of ore, for a total cost of $0.11 per kg ($0.05 per lb) of ore. The capital cost of the mine is $12.4 million 2002 dollars. In the case of an existing exhausted mine the capital costs could be much less.

The mine cost estimates presented indicate that the assumption of the much higher costs presented in Table 4.13-4, LLNL Estimated Life Cycle Costs for DOE Depleted UF_6 Disposal

Alternatives for the concrete vault alternative, represents an upper bound cost estimate for depleted U_3O_8 disposal. For example, the capital cost of the concrete vault alternative, which may be obtained by undiscounting the LLNL estimate costs presented in Table 4.13-4, is $350 million in 2002 dollars, or 28 times the capital cost of the 200 MT (220 tons) mine discussed above.

The four sets of cost estimates obtained are presented in Table 4.13-7 in 2002 dollars per kgU. Note that the Claiborne Enrichment Center cost had a greater uncertainty associated with it. The UDS contract does not allow the component costs for conversion, disposal and transportation to be estimated. The costs in the table indicate that $5.50 per kgU ($2.50 per lb U) is a conservative and, therefore, prudent estimate of total depleted UF_6 disposition cost for the LES NEF. That is, the historical estimates from LLNL and CEC and the more recent actual costs from the UDS contract were used to inform the LES cost estimate. Urenco has reviewed this estimate and, based on its current cost for UBC disposal, finds this figure to be prudent.

Based on information from corresponding vendors, the value of $5.50 per kgU (2002 dollars), which is equal to $5.70 per kgU when escalated to 2004 dollars, was revised in January 2005 to $4.68 per kgU (2004 dollars) (with no contingency applied). The value of $4.68 per kgU was derived from the estimates of costs from the three components that make up the total disposition cost of DUF_6 (i.e., deconversion, disposal, and transportation).

4.13.3.2 Water Quality Limits

All plant effluents are contained on the NEF site. A series of evaporation retention/detention basins, and septic systems are used to contain the plant effluents. There will be no discharges to a Publicly Owned Treatment Works (POTW). Contaminated water is treated to the limits in 10 CFR 20.2003, 10 CFR 20, Appendix B, Table 3 and to administrative levels recommended by Regulatory Guide 8.37 (CFR, 2003q; NRC, 1993). Refer to ER Section 4.4, Water Resource Impacts, for additional water quality standards and permits for the NEF. ER Section 3.12, Waste Management, also contains information on the NEF systems and procedures to ensure water quality.

4.13.4 Waste Minimization

The highest priority has been assigned to minimizing the generation of waste through reduction, reuse or recycling. The NEF incorporates several waste minimization systems in its operational procedures that aim at conserving materials and recycling important compounds. For example, all Fomblin Oil will be recovered where practical. Fomblin Oil is an expensive, highly fluorinated, inert oil selected specifically for use in UF_6 systems to avoid reactions with UF_6. The NEF will also have in place a Decontamination Workshop designed to remove radioactive contamination from equipment and allow some equipment to be reused rather than treated as waste.

In addition, the NEF process systems that handle UF_6, other than the Product Liquid Sampling System, will operate entirely at subatmospheric pressure to prevent outward leakage of UF_6. Cylinders, initially containing liquid UF_6, will be transported only after being cooled, so that the UF_6 is in solid form, to minimize the potential risk of accidental releases due to mishandling.

The NEF is designed to minimize the usage of natural and depletable resources. Closed-loop cooling systems have been incorporated in the designs to reduce water usage. Power usage will be minimized by efficient design of lighting systems, selection of high-efficiency motors, and use of proper insulation materials.

ALARA controls will be maintained during facility operation to account for standard waste minimization practices as directed in 10 CFR 20 (CFR, 2003q). The outer packaging associated with consumables will be removed prior to use in a contaminated area. The use of glove boxes will minimize the spread of contamination and waste generation.

Collected waste such as trash, compressible dry waste, scrap metals, and other candidate wastes will be volume reduced at a centralized waste processing facility. This facility could be operated by a commercial vendor such as GTS Duratek. This facility would further reduce generated waste to a minimum quantity prior to final disposal at a land disposal facility or potential reuse.

4.13.4.1 Control and Conservation

The features and systems described below serve to limit, collect, confine, and treat wastes and effluents that result from the UF_6 enrichment process. A number of chemicals and processes are used in fulfilling these functions. As with any chemical/industrial facility, a wide variety of waste types will be produced. Waste and effluent control is addressed below as well as the features and systems used to conserve resources.

4.13.4.1.1 Mitigating Effluent Releases

The equipment and design features incorporated in the NEF are selected to keep the release of gaseous and liquid effluent contaminants as low as practicable, and within regulatory limits. They are also selected to minimize the use of depletable resources. Equipment and design features for limiting effluent releases during normal operation are described below:

The process systems that handle UF_6 operate almost entirely at sub-atmospheric pressures. Such operation results in no outward leakage of UF_6 to any effluent stream.

- The one location where UF_6 pressure is raised above atmospheric pressure is in the piping and cylinders inside the sampling autoclave. The piping and cylinders inside the autoclave confine the UF_6. In the event of leakage, the sampling autoclave provides secondary containment of UF_6.
- Cylinders of UF_6 are transported only when cool and when the UF_6 is in solid form. This minimizes risk of inadvertent releases due to mishandling.
- Process off-gas, from UF_6 purification and other operations, is discharged through desublimers to solidify and reclaim as much UF_6 as possible. Remaining gases are discharged through high-efficiency filters and chemical adsorbent beds. The filters and adsorbents remove HF and uranium compounds left in the gaseous effluent stream.
- Liquids and solids in the process systems collect uranium compounds. When these liquids and solids (e.g., oils, damaged piping, or equipment) are removed for cleaning or maintenance, portions end up in wastes and effluent. Different processes are employed to separate uranium compounds and other materials (such as various heavy metals) from the resulting wastes and effluent. These processes are described in ER Section 4.13.4.2 below.

- Processes used to clean up wastes and effluent create their own wastes and effluent as well. Control of these is also accomplished by liquid and solid waste handling systems and techniques, which are described in detail in the Sections below. In general, careful applications of basic principles for waste handling are followed in all of the systems and processes. Different waste types are collected in separate containers to minimize contamination of one waste type with another. Materials that can cause airborne contamination are carefully packaged; ventilation and filtration of the air in the area is provided as necessary. Liquid wastes are confined to piping, tanks, and other containers; curbing, pits, and sumps are used to collect and contain leaks and spills. Hazardous wastes are stored in designated areas in carefully labeled containers; mixed wastes are also contained and stored separately. Strong acids and caustics are neutralized before entering an effluent stream. Radioactively contaminated wastes are decontaminated insofar as possible to reduce waste volume.
- Following handling and treatment processes to limit wastes and effluent, sampling and monitoring is performed to assure regulatory and administrative limits are met. Gaseous effluent is monitored for HF and is sampled for radioactive contamination before release; liquid effluent is sampled and/or monitored in liquid waste systems; solid wastes are sampled and/or monitored prior to offsite treatment and disposal. Samples are returned to their source where feasible to minimize input to waste streams.

4.13.4.1.2 Conserving Depletable Resources

The NEF design serves to minimize the use of depletable resources. Water is the primary depletable resource used at the facility. Electric power usage also depletes fuel sources used in the production of the power. Other depletable resources are used only in small quantities. Chemical usage is minimized not only to conserve resources, but also to preclude excessive waste production. Recyclable materials are used and recycled wherever practicable.

The main feature incorporated in the NEF to limit water consumption is the use of closed-loop cooling systems.

The NEF is designed to minimize the usage of natural and depletable resources as shown by the following measures:

- The use of low-water consumption landscaping versus conventional landscaping reduces water usage.
- The installation of low flow toilets, sinks and showers reduces water usage when compared to standard flow fixtures.
- Localized floor washing using mops and self-contained cleaning machines reduces water usage compared to conventional washing with a hose twice per week.
- The use of high efficiency washing machines compared to standard machines reduces water usage.
- The use of high efficiency closed cell cooling towers (water/air cooling) versus open cell design reduces water usage.
- Closed-loop cooling systems have been incorporated to reduce water usage.

Power usage is minimized by efficient design of lighting systems, selection of high-efficiency motors, use of appropriate building insulation materials, and other good engineering practices.

The demand for power in the process systems is a major portion of plant operating cost; efficient design of components is incorporated throughout process systems.

4.13.4.1.3 Prevention and Control of Oil Spills

The NEF will implement a spill control program for accidental oil spills. The purpose of the spill control program will be to reduce the potential for the occurrence of spills, reduce the risk of injury in case of a spill occurs, minimize the impact of a spill, and provide a procedure for the cleanup and reporting of spills. The oil spill control program will be established to comply with the requirements of 40 CFR 112 (CFR, 2003aa), Oil Pollution Prevention. As required by Part 112 , a Spill Prevention, Control, and Countermeasure (SPCC) plan will be prepared prior to either the start of facility operation of the facility or prior to the storage of oil onsite in excess of the de minimis quantities established in 40 CFR 112.1(d) (CFR, 2003aa). The SPCC Plan will be reviewed and certified by a Professional Engineer and will be maintained onsite.

As a minimum the SPCC Plan will contain the following information:

- Identification of potential significant sources of spills and a prediction of the direction and quantity of flow that would result from a spill from each such source;
- Identification the use of containment or diversionary structures such as dikes, berms, culverts, booms, sumps, and diversion ponds to be used at the facility where appropriate to prevent discharged oil from reaching navigable waters;
- Procedures for inspection of potential sources of spills and spill containment/diversion structures; and
- Assigned responsibilities for implementing the plan, inspections, and reporting.

In addition to preparation and implementation of the SPCC Plan, the facility will comply with the specific spill prevention and control guidelines contained in 40 CFR 112.7(e) (CFR, 2003aa), such as drainage of rain water from diked areas, containment of oil in bulk storage tanks, above ground tank integrity testing, and oil transfer operational safeguards.

4.13.4.2 Reprocessing and Recovery Systems

Systems used to allow recovery or reuse of materials are described below.

4.13.4.2.1 Fomblin Oil Recovery System

Fomblin oil is an expensive, highly fluorinated, inert oil selected specifically for use in UF_6 systems to avoid reaction with UF_6. The Fomblin Oil Recovery System recovers used Fomblin oil from pumps used in UF_6 systems. All Fomblin oil is recovered; none is normally released as waste or effluent.

Used Fomblin oil is recovered by removing impurities that inhibit the oil's lubrication properties. The impurities collected are primarily uranyl fluoride (UO_2F_2) and uranium tetrafluoride (UF_4) particles. The recovery process also removes trace amounts of hydrocarbons, which if left in the oil would react with UF_6. The Fomblin Oil Recovery System components are located in the Decontaminated Workshop in the Technical Services Building (TSB). The total annual volume of oil to be processed in this system is approximately 535 L (141 gal).

The Fomblin oil recovery process consists of oil collection, uranium precipitation, trace hydrocarbon removal, oil sampling, and storage of cleaned oil for reuse. Each step is performed manually.

Fomblin oil is collected in the Vacuum Pump Rebuild Workshop as part of the pump disassembly process. The oil is the transferred for processing to the Decontamination Workshop in plastic containers. The containers are labeled so each can be tracked through the process. Used oil awaiting processing is stored in the used oil storage receipt array to eliminate the possibility of accidental criticality.

Uranium compounds are removed from the Fomblin oil in the Fomblin oil fume hood to minimize personnel exposure to airborne contamination. Dissolved uranium compounds are removed by the addition of anhydrous sodium carbonate (Na_2CO_3) to the oil container which causes the uranium compounds to precipitate into sodium uranyl carbonate $Na_4UO_2(CO_3)_3$. The mixture is agitated and then filtered through a coarse screen to remove metal particles and small parts such as screws and nuts. These are transferred to the Solid Waste Collection System. The oil is then heated to 90°C (194°F) and stirred for 90 minutes to speed the reaction. The oil is then centrifuged to remove UF_4, sodium uranyl carbonate, and various metallic fluorides. The particulate removed from the oil is collected and transferred to the Solid Waste Collection Room for disposal.

Trace amounts of hydrocarbons are next removed in the Fomblin oil fume hood next by adding activated carbon to the Fomblin oil and heating the mixture at 100°C (212°F) for two hours. The activated carbon absorbs the hydrocarbons, and the carbon in turn is removed by filtration through a bed celite. The resulting sludge is transferred to the Solid Waste Disposal Collection Room for disposal.

Recovered Fomblin oil is sampled. Oil that meets the criteria can be reused in the system while oil that does not meet the criteria will be reprocessed. The following limits have been set for evaluating recovered Fomblin oil purity for reuse in the plant:

- Uranium - 50 ppm by volume
- Hydrocarbons - 3 ppm by volume

Recovered Fomblin oil is stored in plastic containers in the Chemical Storage Area.

Failure of this system will not endanger the health and safety of the public. Nevertheless, design and operating features are included that contribute to the safety of plant workers. Containment of waste is provided by components, designated containers, and air filtration systems. Criticality is precluded through the control of geometry, mass, and the selection of appropriate storage containers. To minimize worker exposure, airborne radiological contamination resulting from dismantling is extracted. Where necessary, air suits and portable ventilation units are available for further worker protection.

4.13.4.2.2 Decontamination System

The Contaminated Workshop and Decontamination System are located in the same room in the TSB. This room is called the Decontamination Workshop. The Decontamination Workshop in the TSB will contain the area to break down and strip contaminated equipment and to decontaminate that equipment and its components. The decontamination systems in the workshop are designed to remove radioactive contamination from contaminated materials and equipment. The only significant forms of radioactive contamination found in the plant are uranium hexafluoride (UF_6), uranium tetrafluoride (UF_4) and uranyl fluoride (UO_2F_2).

One of the functions of the Decontamination Workshop is to provide a maintenance facility for both UF_6 pumps and vacuum pumps. The workshop will be used for the temporary storage and subsequent dismantling of failed pumps. The dismantling area will be in physical proximity to the decontamination train, in which the dismantled pump components will be processed. Full maintenance records for each pump will be kept.

The process carried out within the Decontamination Workshop begins with receipt and storage of contaminated pumps, out-gassing, Fomblin oil removal and storage, and pump stripping. Activities for the dismantling and maintenance of other plant components are also carried out. Other components commonly decontaminated besides pumps include valves, piping, instruments, sample bottles, tools, and scrap metal. Personnel entry into the facility will be via a sub-change facility. This area has the required contamination controls, washing and monitoring facilities.

The decontamination part of the process consists of a series of steps following equipment disassembly including degreasing, decontamination, drying, and inspection. Items from uranium hexafluoride systems, waste handling systems, and miscellaneous other items are decontaminated in this system. The decontamination process for most plant components is described below, with a typical cycle time of one hour. For smaller components the decontamination process time is slightly less, about 50 minutes. Sample bottles and flexible hoses are handled under special procedures due to the difficulty of handling the specific shapes. Sample bottle decontamination and decontamination of flexible hoses are addressed separately below.

Criticality is precluded through the control of geometry, mass, and the selection of appropriate storage containers. Administrative measures are applied to uranium concentrations in the Citric Acid Tank and Degreaser Tank to maintain these controls. To minimize worker exposure, airborne radiological contamination resulting from dismantling is extracted. Air suits and portable ventilation units are available for further worker protection.

Containment of chemicals and wastes is provided by components, designated containers, and air filtration systems. All pipe work and vessels in the Decontamination Workshop are provided with design measures to protect against spillage or leakage. Hazardous wastes and materials are contained in tanks and other appropriate containers, and are strictly controlled by administrative procedures. Chemical reaction accidents are prevented by strict control on chemical handling.

4.13.4.2.3 General Decontamination

Prior to removal from the plant, the pump goes through an isolation and de-gas process. This removes the majority of UF_6 from the pump. The pump flanges are then sealed prior to movement to the Decontamination Workshop. The pumps are labeled so each can be tracked through the process. Pumps enter the Decontamination Workshop through airlock doors. The internal and external doors are electrically interlocked such that only one door can be opened at a given time. Pumps may enter the workshop individually or in pairs. Valves, pipework, flexible hoses, and general plant components are accepted into the room either within plastic bags or with the ends blinded.

Pumps waiting to be processed are stored in the pump storage array to eliminate the possibility of accidental criticality. The array maintains a minimum edge spacing of 600 mm (2 ft). Pumps are not accepted if there are no vacancies in the array.

Before being broken down and stripped, all pumps are placed in the Outgas Area and the local ventilation hose is positioned close to the pump flange. The flange cover is then removed. HF and UF_6 fumes from the pump are extracted via the exhaust hose, typically over a period of several hours. While in the Outgas Area, the oil will be drained from the pumps and the first stage roots pumps will be separated from the second stage roots pumps. The oil is drained into 5-L (1.3 gal) plastic containers that are labeled so each can be tracked through the process.

Prior to transfer from the Outgas Area, the outside of the bins, the pump frames, and the oil bottles are all monitored for radiological contamination. The various items will then be taken to the decontamination system or Fomblin oil storage array as appropriate.

Oil waiting to be processed is stored in the Fomblin oil storage array to eliminate the possibility of accidental criticality. The array maintains a minimum edge spacing of about 600 mm (2 ft) between containers. When ready for processing, the oil is transferred to the Fomblin Oil Recovery System where the uranics and hydrocarbon contaminants can be separated prior to reuse of the oil.

After out-gassing, individual pumps are removed from the Outgas Area and placed on either of the two hydraulic stripping tables. An overhead crane is utilized to aid the movement of pumps and tools over the stripping table. The tables can be height-adjusted and the pump can be moved and positioned on the table. Hydraulic stripping tools are then placed on the stripping tables using the overhead crane or mobile jig truck. The pump and motor are stripped to component level using various hydraulic and hand tools. Using the overhead crane or mobile jig truck, the components are placed in bins ready for transportation to the General Decontamination Cabinet.

Degreasing is performed following disassembly of equipment. Degreasing takes place in the hot water Degreaser Tank of the decontamination facility system. The degreased components are inspected and then transferred to the next decontamination tank..

Following disassembly and degreasing, decontamination is accomplished by immersing the contaminated component in a citric acid bath with ultrasonic agitation. After 15 minutes, the component is removed, and is rinsed with water to remove the citric acid.

The tanks are sampled periodically to determine the condition of the solution and any sludge present. The Citric Acid Tank contents are analyzed for uranium concentration and citric acid concentration. A limit on ^{235}U of 0.2 g/L (0.02 ounces/gal) of bath has been established to prevent criticality. Additional citric acid is added as necessary to keep the citric acid concentration between 5% and 7%. Spent solutions, consisting of citric acid and various uranyl and metallic citrates, are transferred to a citric acid collection tank. The Rinse Water Tanks are checked for satisfactory pH levels; unusable water is transferred to an effluent collection tank.

All components are dried after decontamination. This is performed manually using compressed air.

The decontaminated components are inspected prior to release. The quantity of contamination remaining shall be "as-low-as-reasonably practicable." Components released for unrestricted use do not have contamination exceeding 83.3 Bq/100 cm^2 (5,000 dpm/100 cm^2) for average fixed alpha or beta/gamma contamination and 16 Bq/100 cm^2 (1,000 dpm/100 cm^2) removable alpha or beta/gamma contamination. However, if all the component surfaces cannot be monitored then the consignment will be disposed of as a low-level waste.

4.13.4.2.4 Sample Bottle Decontamination

Sample bottle decontamination is handled somewhat differently than the general decontamination process. The Decontamination Workshop has a separate area dedicated to sample bottle storage, disassembly, and decontamination. Used sample bottles are weighed to confirm the bottles are empty. The valves are loosened, and the remainder of the decontamination process is performed in the sample bottle decontamination hood. The valves are removed inside the fume hood. Any loose material inside the bottle or valve is dissolved in a citric acid solution. Spent citric acid is transferred to the Spent Citric Acid Collection Tank in the Liquid Effluent Collection and Treatment System.

Initially, sample bottles and valves are flushed with a 10% citric acid solution and then rinsed with deionized water. In the case of sample bottles, these are filled with deionized water and left to stand for an hour, while the valves are grouped together and citric acid is recirculated in a closed loop for an hour. These used solutions are collected and taken to the Citric Acid Collection Tank in the General Decontamination Cabinet. Any liquid spillages / drips are soaked away with paper tissues that are disposed of in the Solid Waste Collection Room. Bottles and valves are then rinsed again with deionized water. This used solution is collected in a small plastic beaker, and then poured into the Citric Acid Tank in the decontamination train. Both the bottles and valves are dried manually, using compressed air, and inspected for contamination and rust. The extracted air exhausts to the Gaseous Effluent Vent System (GEVS) to ensure airborne contamination is controlled. The bottles are then put into an electric oven to ensure total dryness, and on removal are ready for reuse. The cleaned components are transferred to the clean workshop for reassembly and pressure and vacuum testing.

4.13.4.2.5 Flexible Hose Decontamination

The decontamination of flexible hoses is handled somewhat differently than the general process and has a separate area. The decontamination process is performed in a Flexible Hose Decontamination Cabinet. This decontamination cabinet is designed to process only one flexible hose at a time and is comprised of a supply of citric acid, deionized water and compressed air.

Initially, the flexible hose is flushed with a 10% citric acid solution at 60°C (140°F) and then rinsed with deionized water (also at 60°C) (140°F) in a closed loop recirculation system. The used solutions (citric acid and deionized water) are transferred into the contaminated Citric Acid Tank for disposal. Interlocks are provided in the recirculation loop to prevent such that the recirculation pumps from starting if the flexible hose has not been connected correctly at both ends. Both the citric acid and deionized water recirculation pumps are equipped with a 15-minute timer device. The extracted air exhausts to the Gaseous Effluent Vent System (GEVS) to ensure airborne contamination is controlled. Spill from the drip tray are routed to either the Citric Acid Tank or the hot water recirculation tank, depending upon the decontamination cycle. Each flexible hose is then dried in the decontamination cupboard using hot compressed air at 60°C (140°F). to ensure complete dryness. The cleaned dry flexible hose is then transferred to the Vacuum Pump Rebuild Workshop for reassembly and pressure testing prior to reuse in the plant.

4.13.4.2.6 Decontamination Equipment

The following major components are included in the Decontamination System:

- Citric Acid Baths: An open top Citric Acid Tank with a sloping bottom in hastelloy is provided for the primary means of removing radioactive contamination. The sloping-bottom construction is provided for ease of emptying and draining the tank completely. The tank has a liquid capacity of 800 L (211 gal). The tank is located in a cabinet and is furnished with ultrasonic agitation, a thermostatically controlled electric heater to maintain the content's temperature at 60°C (140°F), and a recirculation pump. Mixing is provided to accommodate sampling for criticality prevention. Level control with a local alarm is provided to maintain the acid level. The tank has a ring header and a manual hose to rinse out residual solids/sludge with deionized water after the batch has been pumped to the Liquid Effluent Collection and Treatment System. In order to minimize uranium concentration, the rinse water from the Rinse Water Tank that receives deionized water directly is pumped into the other Rinse Water Tank, which in turn is pumped into the Citric Acid Tank. The counter-current system eliminates a waste product stream by concentrating the uranics only in the Citric Acid Tank. The rinse water transfer pump is linked with the level controller of the Citric Acid Tank, which prevents overfilling of this tank during transfer of the rinse water. During transfer, the rinse water transfer pump trips at a high tank level resulting in a local alarm. The extracted air exhausts to the Gaseous Effluent Vent System (GEVS) to assure airborne contamination is controlled. The Citric Acid Tank contents are monitored and then emptied by an air-driven double diaphragm pump into the Spent Citric Acid Collection Tank in the Liquid Effluent Collection and Treatment System.
- Rinse Water Baths: Two open top Rinse Water Tanks with stainless steel sloping bottoms are provided to rinse excess citric acid from decontaminated components. Each of the tanks has a liquid capacity of 800 L (211 gal). Both tanks are located in an enclosure, and each tank is furnished with ultrasonic agitation, a thermostatically controlled electric heater to maintain the contents temperature at 60°C (140°F), and a recirculation pump to accommodate sampling for criticality prevention. The sloping-bottom is provided of emptying and draining the tank completely. Fresh deionized water is added to the tank. In order to minimize uranium concentration, the rinse water from the tank that receives deionized water directly is pumped into the other Rinse Water Tank, which in turn is pumped into the Citric Acid Tank. Level control is provided to maintain the deionized (rinse) water level. During transfer, the rinse water transfer pump trips at tank high level resulting in a local alarm. The Rinse Water Tank that directly receives deionized water is topped up manually with the water as necessary. The extracted air exhausts to the GEVS to assure airborne contamination is controlled. A manual spray hose is available for rinsing the tank after it has been emptied.
- Decontamination Degreasing Unit: An open top Degreaser Tank with a sloping bottom in hastelloy is provided for the primary means of removing the Fomblin oil and greases that may inhibit the decontamination process. Components requiring degreasing are cleaned manually and then immersed into the Degreaser Tank. The sloping-bottom construction is provided for ease of emptying and draining the tank completely. During the decontamination process, the tank contents are continuously recirculated using a pump. Recirculation is provided to accommodate sampling for criticality prevention. The tank has a capacity of 800 L (211 gal) and is located in a cabinet. It is furnished with an ultrasonic

agitation facility, and a thermostatically-controlled electric heater to maintain the temperature at 60°C (140°F). The tank has a ring header and a manual hose to rinse out residual solids/sludge with deionized water after the batch has been pumped to the Liquid Effluent Collection and Treatment System. The extracted air exhausts to the Gaseous Effluent Vent System (GEVS) to ensure airborne contamination is controlled. Level control with a local alarm is provided to maintain the liquid level. The Degreaser Tank contents are monitored and then emptied by an air-driven double diaphragm pump into the Degreaser Water Collection Tank in the Liquid Effluent Collection and Treatment System.

- The activities carried out in the Decontamination Workshop may create potentially contaminated gaseous streams, which would require treatment before discharging to the atmosphere. These streams consist of air with traces of UF_6, HF, and uranium particulates (mainly UO_2F_2). The Gaseous Effluent Vent System is designed to route these streams to a filter system and to monitor, on a continuous basis, the resultant exhaust stream discharged to the atmosphere. Air exhausted from the General Decontamination Cabinet, the Sample Bottle Decontamination Cabinet, and the Flexible Hose Decontamination Cabinet is vented to the GEVS. There will be local ventilation ports in the stripping area and Outgas Area that operate under vacuum with all air discharging through the GEVS. The room itself will have other HVAC ventilation.
- Vapor Recovery Unit and distillation still.
- Drying Cabinet: One drying cabinet is provided to dry components after decontamination.
- Decontamination System for Sample Bottles (in a cabinet) - a small, fresh citric acid tank; a small, deionized water tank; and 5 L (1.3 gal) containers for citric acid/uranic waste
- Decontamination System for Flexible Hoses (in a cabinet) - a small citric acid tank for fresh and waste citric acid, an air diaphragm pump and associated equipment
- Various tools for moving equipment (e.g., cranes)
- Various tools for stripping equipment
- An integral monorail hoist with a lifting capacity of one ton, located within the decontamination enclosure, is provided to lift the basket and its components into and out of the Degreaser Tank, Citric Acid Tank, and the two Rinse Water Tanks as part of the decontamination activity sequence.
- Citric Acid Tank and Degreaser Tank clean-up ancillary items, comprised for each tank, a portable air driven transfer pump and associated equipment
- Radiation monitors.

4.13.4.2.7 Laundry System

The Laundry System cleans contaminated and soiled clothing and other articles which have been used throughout the plant. It contains the resulting solid and liquid wastes for transfer to appropriate treatment and disposal facilities. The Laundry System receives the clothing and articles from the plant in plastic bin bags, taken from containers strategically positioned within the plant. Clean clothing and articles are delivered to storage areas located within the plant. The Contaminated Laundry System components are located in the Laundry room of the TSB.

The Laundry System collects, sorts, cleans, dries, and inspects clothing and articles used throughout the plant in the various Restricted Areas. The laundry system does not handle any articles from outside the radiological zones. Laundry collection is divided into two main groups: articles with a low probability of contamination and articles with a high probability of contamination. Those articles unlikely to have been contaminated are further sorted into lightly soiled and heavily soiled groups. The sorting is done on a table underneath a vent hood that is connected to the TSB Gaseous Effluent Vent System (GEVS). All lightly soiled articles are cleaned in the laundry. Heavily soiled articles are inspected and any considered to be difficult to clean (i.e., those with significant amounts of grease or oil on them) are transferred to the Solid Waste Collection Room without cleaning. Special containers and procedures are used for collection, storage, and transfer of these items as described in the Solid Waste Disposal System section. Articles from one plant department are not cleaned with articles from another plant department.

Special water-absorbent bags are used to collect the articles that are more likely to be contaminated. These articles may include pressure suits and items worn when, for example, it is required to disconnect or "open up" an existing plant system. These articles that are more likely to be contaminated are cleaned separately. Expected contaminants on the laundry include slight amounts of uranyl fluoride (UO_2F_2) and uranium tetrafluoride (UF_4).

Clothing processed by this system normally includes overalls, laboratory coats, shirts, towels and miscellaneous items. Approximately 113 kg (248 lbs) of clothing is washed each day. Upon completion of a cycle, the washer discharges to one of three Laundry Effluent Monitor Tanks in the Liquid Effluent Collection and Treatment System.

The washed laundry is dried in the hot air dryers. The exhaust air passes through a lint drawer to the atmosphere. Upon completion of a drying cycle, the dried laundry is inspected for excessive wear. Usable laundry is folded and returned to storage for reuse. Unusable laundry is handled as solid waste as described in the Solid Waste Disposal System section.

When sorting is completed, the articles are placed into the front-loading washing machine in batches. The cleaning process uses 80°C (176°F) minimum water, detergents, and non-chlorine bleach for dirt and odor removal, and disinfection of the laundry. Detergents and non-chlorine bleach are added by vendor-supplied automatic dispensing systems. No "dry cleaning" solvents are used. Wastewater from the washing machine is discharged to one of three Laundry Effluent Monitor Tanks in the Liquid Effluent Collection and Treatment System. The laundry effluent is then sampled, analyzed, and transferred to the double-lined Treated Effluent Evaporative Basin with leak detection for disposal (if uncontaminated) or to the Precipitation Treatment Tank for treatment as necessary.

When the washing cycle is complete, the wet laundry is placed in a front-loading, electrically heated dryer. The dryer has variable temperature settings, and the hot wet air is exhausted to the atmosphere through a lint drawer that is built into the dryer. The lint from the drawer is then sent to the Solid Waste Disposal System as combustible waste.

Dry laundry is removed from the dryer and placed on the laundry inspection table for inspection and folding. Folded laundry is returned to storage areas in the plant.

The following major components are included in this system:

- Washers: Two industrial quality washing machines are provided to clean contaminated and soiled laundry. One machine is operating and one is a spare for standby. Each machine has an equal capacity that is capable of washing the daily batches.

- Dryers: Two industrial quality dryers are provided to dry the laundry cleaned in the washing machine. One dryer is operating and one is a spare for standby. Each machine has an equal capacity that is capable of drying the daily batches. The dryer has a lint drawer that filters out the majority of the lint.
- Air Hood: One exhaust hood mounted over the sorting table and connected to the TSB GEVS. The hood is to draw potentially contaminated air away as laundry is sorted prior to washing.
- Sorting Table: One table to sort laundry prior to washing.
- Laundry Inspection Table: One table to inspect laundry for excessive wear after washing and drying.

The Laundry System interfaces with the following other plant systems:

- Liquid Effluent Collection and Treatment System: The wastewater generated during the laundry process is pumped to one of three Laundry Effluent Monitor Tanks.
- Solid Waste Disposal System: The Solid Waste Disposal System receives clothing that has been laundered but is not acceptable for further use. It also receives clothing rejected from the laundry system due to excess quantities of oil or hazardous liquids.
- TSB GEVS: Air from the sorting hood is sent to the TSB GEVS.
- Process Water System: The Process Water System supplies hot and cold water to the washer.
- Compressed Air System: Compressed air will be supplied as required to support options selected for the Laundry washers and dryers.
- Electrical System: The washing machines and dryers consume power.

Piping, piping components, and a laundry room sump provide containment of any liquid radiological waste. Small leaks and spills from the washer are mopped up and sent to the Liquid Effluent Collection and Treatment System. A rarely occurring large leak is captured in the laundry room sump. Any effluent captured in the sump is transferred to the Liquid Effluent Collection and Treatment System by a portable pump.

Liquid effluents from the washers are collected in the Liquid Effluent Collection and Treatment System and monitored prior to discharge to the Treated Effluent Evaporative Basin. Clothing containing hazardous wastes is segregated prior to washing to avoid introduction into this system. The exhaust air blows to atmosphere because there is little chance of any contaminant being in it.

The washer and dryer are equipped with electronic controls to monitor the operation. The dryer has a fire protection system that initiates an isolated sprinkler inside the dryer basket if a fire is detected in the dryer.

4.13.5 Comparative Waste Management Impacts of No Action Alternative Scenarios

ER Chapter 2, Alternatives, provides a discussion of possible alternatives to the construction and operation of the NEF, including an alternative of "no action" i.e., not building the NEF. The following information provides comparative conclusions specific to the concerns addressed in this subsection for each of the three "no action," alternative scenarios addressed in ER Section

2.4, Table 2.4-2, Comparison of Environmental Impacts for the Proposed Action and the No-Action Alternative Scenarios.

Alternative Scenario B – No NEF; USEC deploys a centrifuge plant and continues to operate the Paducah gaseous diffusion plant (GDP): The waste management impact would be greater since a greater amount of waste results from GDP operation.

Alternative Scenario C – No NEF; USEC deploys a centrifuge plant and increases the centrifuge plant capability: The waste management impact would be greater in the short term because the GDP produces a larger waste stream. In the long term, the waste management impact would be the same once the GDP production is terminated.

Alternative Scenario D – No NEF; USEC does not deploy a centrifuge plant and operates the Paducah GDP at an increased capacity: The waste management impact would be significantly greater because a significant amount of additional waste results from GDP operation at the increased capacity.

- Silt fencing and/or sediment traps.
- External vehicle washing (water only and controlled to minimize use).
- Stone construction pads will be placed at entrance/exits if unpaved construction access adjoins a state road.
- All basins are arranged to provide for the prompt, systematic sampling of runoff in the event of any special needs.
- Water quality impacts will be controlled during construction by compliance with the National Pollution Discharge Elimination System – Construction General Permit requirements and by applying BMPs as detailed in the site Stormwater Pollution Prevention Plan (SWPPP).
- A Spill Prevention Control and Countermeasure (SPCC) plan, will be implemented for the facility to identify potential spill substances, sources and responsibilities.
- All above ground diesel storage tanks will be bermed.
- Any hazardous materials will be handled by approved methods and shipped offsite to approved disposal sites. Sanitary wastes generated during site construction will be handled by portable systems, until such time that plant sanitary facilities are available for site use. An adequate number of these portables systems will be provided.
- The facility's Liquid Effluent Collection and Treatment System provides a means to control liquid waste within the plant including the collection, analysis, and processing of liquid wastes for disposal.
- Liquid effluent concentration releases to the Treated Effluent Evaporative Basin and the UBC Storage Pad Stormwater Retention Basin will both be below the 10 CFR 20 (CFR, 2003q) uncontrolled release limits. Both basins are included in the site environmental monitoring plan.
- Periodic visual inspections of the NEF basins for high level will be performed to verify proper functioning. The visual inspections will be performed on a frequency that is sufficient to allow for identification of basin high water level conditions and implementation of corrective actions to restore water level of the associated basin(s) prior to overflowing.
- Control of surface water runoff will be required for activities as covered by the National Pollutant Discharge Elimination System (NPDES) Construction General Permit. As a result, no impacts are expected to surface or groundwater bodies.

The NEF is designed to minimize the usage of natural and depletable resources as shown by the following measures:

- The use of low-water consumption landscaping versus conventional landscaping reduces water usage.
- The installation of low flow toilets, sinks and showers reduces water usage when compared to standard flow fixtures.
- Localized floor washing using mops and self-contained cleaning machines reduces water usage compared to conventional washing with a hose twice per week.
- The use of high efficiency washing machines compared to standard machines reduces water usage.
- The use of high efficiency closed cell cooling towers (water/air cooling) versus open cell design reduces water usage.
- Closed-loop cooling systems have been incorporated to reduce water usage.

The UBC Storage Pad Stormwater Retention Basin, which exclusively serves the UBC Storage Pad and cooling tower blowdown water and heating boiler blowdown water discharges, is lined to prevent infiltration. It is designed to retain a volume slightly more than twice that for the 24-hour, 100-year frequency storm and an allowance for the cooling tower blowdown water and heating boiler blowdown water. Designed for sampling and radiological testing of the contained water and sediment, this basin has no flow outlet. All discharge is through evaporation.

The Site Stormwater Detention Basin is designed with an outlet structure for drainage. Local terrain serves as the receiving area for this basin.

Discharge of operations-generated potentially contaminated waste water is made exclusively to the Treated Effluent Evaporative Basin. Only liquids meeting site administrative limits (based on prescribed standards) and discharged to this basin. The basin is double-lined, open to allow evaporation, has no flow outlet and has leak detection.

5.2.5 Ecological Resources

Mitigation measures will be in place to minimize potential impact on ecological resources. These include the following items:

- Use of BMPs recommended by the State of New Mexico to minimize the construction footprint to the extent possible
- The use of detention and retention ponds
- Site stabilization practices to reduce the potential for erosion and sedimentation.
- Proposed wildlife management practices include:
- The placement of a raptor perch in an unused open area.
- The use of bird feeders at the visitor's center.
- The placement of quail feeders in the unused open areas away from the NEF buildings.
- The management of unused open areas (i.e. leave undisturbed), including areas of native grasses and shrubs for the benefit of wildlife.
- The use of native plant species (i.e., low-water consuming plants) to revegetate disturbed areas to enhance wildlife habitat.
- The use of netting, or other suitable material, to ensure migratory birds are excluded from evaporative ponds that do not meet New Mexico Water Quality Control Commission (NMWQCC, 2002) surface water standards for wildlife usage.
- The use of animal-friendly fencing around the site so that wildlife cannot be injured or entangled in the site security fence.
- Minimize the amount of open trenches at any given time and keep trenching and backfilling crews close together.
- Trench during the cooler months (when possible).
- Avoid leaving trenches open overnight. Escape ramps will be constructed at least every 90 m (295 ft). The slope of the ramps will be less than 45 degrees. Trenches that are left open overnight will be inspected and animals removed prior to backfilling.

In addition to proposed wildlife management practices above, LES will consider all recommendations of appropriate state and federal agencies, including the United States Fish and Wildlife Service and the New Mexico Department of Game and Fish.

6.0 ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

6.1 RADIOLOGICAL MONITORING

6.1.1 Effluent Monitoring Program

The Nuclear Regulatory Commission (NRC) requires, pursuant to 10 CFR 20 (CFR, 2003q) that licensees conduct surveys necessary to demonstrate compliance with these regulations and to demonstrate that the amount of radioactive material present in effluent from the facility has been kept as low as reasonably achievable (ALARA). In addition, the NRC requires pursuant to 10 CFR 70 (CFR, 2003b), that licensees submit semiannual reports, specifying the quantities of the principal radionuclides released to unrestricted areas and other information needed to estimate the annual radiation dose to the public from effluent discharges. The NRC has also issued Regulatory Guide 4.15 – Quality Assurance for Radiological Monitoring Programs (Normal Operations) – Effluent Streams and the Environment (NRC, 1979) and Regulatory Guide 4.16 – Monitoring and Reporting Radioactivity in Releases of Radioactive Materials in Liquid and Gaseous Effluent from Nuclear Fuel Processing and Fabrication Plants and Uranium Hexafluoride Production Plants (NRC, 1985) that reiterate that concentrations of hazardous materials in effluent must be controlled and that licensees must adhere to the ALARA principal such that there is no undue risk to the public health and safety at or beyond the site boundary.

Refer to Figure 6.1-1, Effluent Release Points and Meteorological Tower, and Figure 6.1-2, Modified Site Features With Proposed Sampling Stations and Monitoring Locations. Effluents are sampled as shown in Table 6.1-1, Effluent Sampling Program. For gaseous effluents, continuous air sampler filters are analyzed for gross alpha and beta each week. The filters are composited quarterly and an isotopic analysis is performed. For liquids, a grab sample is taken for isotopic analysis post-treatment prior to discharge to the Treated Effluent Evaporative Basin.

Public exposure to radiation from routine operations at the National Enrichment Facility (NEF) may occur as the result of discharge of liquid and gaseous effluents, including controlled releases from the uranium enrichment process lines during decontamination and maintenance of equipment. In addition, radiation exposure to the public may result from the transportation and storage of uranium hexafluoride (UF_6) feed cylinders, product cylinders, and Uranium Byproduct Cylinders (UBCs). Of these potential pathways, discharge of gaseous effluent has the highest possibility of introducing facility-related uranium into the environment. The plant's procedures and facilities for solid waste and liquid effluent handling, storage and monitoring result in safe storage and timely disposition of the material. ER Section 1.3, Applicable Regulatory Requirements and Required Consultations, accurately describes all applicable Federal and New Mexico State standards for discharges, as well as required permits issued by local, New Mexico and Federal governments.

Compliance with 10 CFR 20.1301 (CFR, 2003q) is demonstrated using a calculation of the total effective dose equivalent (TEDE) to the individual who is likely to receive the highest dose in accordance with 10 CFR 20.1302(b)(1) (CFR, 2003q). The determination of the TEDE by pathway analysis is supported by appropriate models, codes, and assumptions that accurately represent the facility, site, and the surrounding area. The assumptions are reasonably conservative, input data is accurate, and all applicable pathways are considered. ER Section 4.12, Public and Occupational Health Impacts, presents the details of these determinations.

The computer codes used to calculate dose associated with potential gaseous and liquid effluent from the plant follow the methodology, for pathway modeling, described in Regulatory Guide 1.109 (NRC, 1977c), and have undergone validation and verification. The dose conversion factors used are those presented in Federal Guidance Reports Numbers 11 (EPA, 1988) and 12 (EPA, 1993a).

Administrative action levels are established for effluent samples and monitoring instrumentation as an additional step in the effluent control process. All action levels are sufficiently low so as to permit implementation of corrective actions before regulatory limits are exceeded. Effluent samples that exceed the action level are cause for an investigation into the source of elevated radioactivity. Radiological analyses will be performed more frequently on ventilation air filters if there is a significant increase in gross radioactivity or when a process change or other circumstances cause significant changes in radioactivity concentrations. Additional corrective actions will be implemented based on the level, automatic shutdown programming, and operating procedures to be developed in the detailed alarm design. Under routine operating conditions, radioactive material in effluent discharged from the facility complies with regulatory release criteria.

Compliance is demonstrated through effluent and environmental sampling data. If an accidental release of uranium should occur, then routine operational effluent data and environmental data will be used to assess the extent of the release. Processes are designed to include, when practical, provision for automatic shutdown in the event action levels are exceeded. Appropriate action levels and actions to be taken are specified for liquid effluents and gaseous releases. Data analysis methods and criteria used in evaluating and reporting environmental sample results are appropriate and will indicate when an action level is being approached in time to take corrective actions.

The effluent monitoring program falls under the oversight of the NEF Quality Assurance (QA) program. Therefore, it is subject to periodic audits conducted by the facility QA personnel. Written procedures will be in place to ensure the collection of representative samples, use of appropriate sampling methods and equipment, proper locations for sampling points, and proper handling, storage, transport, and analyses of effluent samples. In addition, the plant's written procedures also ensure that sampling and measuring equipment, including ancillary equipment such as airflow meters, are properly maintained and calibrated at regular intervals. Moreover, the effluent monitoring program procedures include functional testing and routine checks to demonstrate that monitoring and measuring instruments are in working condition. Employees involved in implementation of this program are trained in the program procedures.

The NEF will ensure, when sampling particulate matter within ducts with moving air streams, that sampling conditions within the sample probe are maintained to simulate as closely as possible the conditions in the duct. This will be accomplished by implementing the following criteria: 1) calibrating air sampling equipment so that the sample is representative of the effluent being sampled in the duct; 2) maintaining the axis of the sampling probe head parallel to the air stream flow lines in the ductwork; 3) sampling (if possible) at least ten duct diameters downstream from a bend or obstruction in the duct; and 4) using shrouded-head air sampling probes when they are available in the size appropriate to the air sampling situation. Particle size distributions will be determined from process knowledge or measured to estimate and compensate for sample line losses and momentary conditions not reflective of airflow conditions in the duct.

The NEF will ensure that sampling equipment (pumps, pressure gages and air flow calibrators) are calibrated by qualified individuals. All air flow and pressure drop calibration devices (e.g., rotometers) will be calibrated periodically using primary or secondary air flow calibrators (wet test meters, dry gas meters or displacement bellows). Secondary air flow calibrators will be calibrated annually by the manufacturer(s). Air sampling train flow rates will be verified and/or calibrated each time a filter is replaced or a sampling train component is replaced or modified. Sampling equipment and lines will be inspected for defects, obstructions and cleanliness. Calibration intervals will be developed based on applicable industry standards.

6.1.1.1 Gaseous Effluent Monitoring

As a matter of compliance with regulatory requirements, all potentially radioactive effluent from the facility is discharged only through monitored pathways. See ER Section 4.12.2.1, Routine Gaseous Effluent, for a discussion of pathway assessment. The effluent sampling program for the NEF is designed to determine the quantities and concentrations of radionuclides discharged to the environment. The uranium isotopes ^{238}U, ^{236}U, ^{235}U and ^{234}U are expected to be the prominent radionuclides in the gaseous effluent. The annual uranium source term for routine gaseous effluent releases from the plant has been conservatively assumed to be 8.9 MBq (240 µCi) per year, which is equal to twice the source term applied to the 1.5 million SWU plant described in NUREG-1484 (NRC, 1994a). This is a very conservative annual release estimate used for bounding analyses. Additional details regarding source term are provided in ER Section 4.12, Public and Occupational Health Impacts. Representative samples are collected from each release point of the facility. Because uranium in gaseous effluent may exist in a variety of compounds (e.g., depleted hexavalent uranium, triuranium octoxide, and uranyl fluoride), effluent data will be maintained, reviewed, and assessed by the facility's Radiation Protection Manager, to assure that gaseous effluent discharges comply with regulatory release criteria for uranium. Table 6.1-1, Effluent Sampling Program, presents an overview of the effluent sampling program.

The gaseous effluent monitoring program for the NEF is designed to determine the quantities and concentrations of gaseous discharges to the environment.

Gaseous effluent from the NEF, which has the potential for airborne radioactivity (albeit in very low concentrations) will be discharged through the Separations Building Gaseous Effluent Vent System (GEVS), the Technical Services Building (TSB) GEVS, the Centrifuge Test and Post Mortem Facilities Exhaust Filtration System, and portions of the TSB Heating Ventilating and Air Conditioning (HVAC) System that provide the confinement ventilation function for areas of the TSB with the potential for contamination (Decontamination Workshop, Cylinder Preparation Room and the Ventilated Room). Monitoring for each of these systems is as follows:

- Separations Building GEVS: This system discharges to a stack on the TSB roof. The Separations Building GEVS provides for continuous monitoring and periodic sampling of the gaseous effluent in the exhaust stack in accordance with the guidance in NRC Regulatory Guide 4.16 (NRC, 1985). The GEVS stack sampling system provides the required samples. The exhaust stack is equipped with monitors for alpha radiation and HF.

- TSB GEVS: This system discharges to an exhaust stack on the TSB roof. The TSB GEVS provides for continuous monitoring and periodic sampling of the gaseous effluent in the exhaust stack in accordance with the guidance in NRC Regulatory Guide 4.16 (NRC, 1985). The TSB GEVS stack sampling system provides the required samples. The exhaust stack contains monitors for alpha radiation and HF.
- The Centrifuge Test and Post Mortem Facilities Exhaust Filtration System: This system discharges through a stack on the Centrifuge Assembly Building (CAB). The Centrifuge Test and Post Mortem Facilities Exhaust Filtration stack sampling system provides for continuous monitoring and periodic sampling of the gaseous effluent in the exhaust stack in accordance with the guidance in NRC Regulatory Guide 4.16 (NRC, 1985). The exhaust stack is provided with an alpha radiation monitor and an HF monitor.
- TSB HVAC System (confinement ventilation function portions): This system maintains the room temperature in various areas of the TSB, including some potentially contaminated areas. For the potentially contaminated areas (Ventilated Room, Decontamination Workshop and Cylinder Preparation Room), the confinement ventilation function of the TSB HVAC system maintains a negative pressure in these rooms and discharges the gaseous effluent to an exhaust stack on the TSB roof. The stack sampling system provides for continuous monitoring and periodic sampling of the gaseous effluent from the rooms served by the TSB HVAC confinement ventilation function in accordance with the guidance in NRC Regulatory Guide 4.16 (NRC, 1985).

The gaseous effluent sampling program supports the determination of quantity and concentration of radionuclides discharged from the facility and supports the collection of other information required in reports to be submitted to the NRC. A minimum detectable concentration (MDC) of at least 3.7×10^{-11} Bq/ml (1.0×10^{-15} µCi/ml) is a program requirement (NRC, 2002b) for all gross alpha analyses performed on gaseous effluent samples. That MDC value represents <2% of the limit for any uranium isotope. Table 6.1-2, Required Lower Level of Detection for Effluent Sample Analyses, summarizes detection requirements for effluent sample analyses.

6.1.1.2 Liquid Effluent Monitoring

Liquid effluents containing low concentrations of radioactive material, consisting mainly of spent decontamination solutions, floor washings, liquid from the laundry, and evaporator flushes, is expected to be generated by the NEF. Table 6.1-3, Estimated Uranium in Pre-Treated Liquid Waste from Various Sources, provides estimates of the annual volume and radioactive material content in liquid effluent by source prior to processing. Uranium is the only radioactive material expected in these wastes. Potentially contaminated liquid effluent is routed to the Liquid Effluent Collection and Treatment System for treatment. Most of the radioactive material is removed from waste water in the Liquid Effluent Collection and Treatment System through a combination of clean-up processes that includes precipitation, evaporation, and ion exchange. Post-treatment liquid waste water is sampled and undergoes isotopic analysis prior to discharge to assure that the released concentrations are well below the concentration limits established in Table 3 of Appendix B to 10 CFR 20 (CFR, 2003q).

After treatment, the effluent is released to the double-lined Treated Effluent Evaporative Basin, which includes leak detection monitoring. Concentrated radioactive solids generated by the liquid treatment processes at the facility are handled and disposed of as low-level radioactive waste.

The design basis uranium source term for routine liquid effluent discharge to the Treated Effluent Evaporative Basin has been conservatively estimated to be 14.4 MBq (390 µCi) per year. There is no offsite release of liquid effluents to unrestricted areas. ER Section 4.12, Public and Occupational Health Impacts, provides additional details regarding effluent source terms.

Representative sampling is required for all batch liquid effluent releases. Liquid samples are collected from each liquid batch and analyzed prior to any transfer. Isotopic analysis is performed prior to discharge. The MDC for analysis of liquid effluent are presented in Table 6.1-2, Required Lower Level of Detection for Effluent Sample Analyses. The liquid effluent sampling program supports the determination of quantities and concentrations of radionuclides discharged to the Treated Effluent Evaporative Basin and supports the collection of other information required in reports submitted to the NRC.

Periodic sampling of liquid effluent is required since these effluents are treated in batches. Representative sampling is assured through the use of tank agitators and recirculation lines. All collection tanks are sampled before the contents are sent through any treatment process. Treated water is collected in Monitor Tanks, which are sampled before discharge to the Treated Effluent Evaporative Basin.

NRC Information Notice 94-07 (NRC, 1994b) describes the method for determining solubility of discharged radioactive materials. Note that liquid effluents at the NEF are treated such that insoluble uranium is removed as part of the treatment process. Releases are in accordance with the ALARA principle.

General site stormwater runoff is routed to the Site Stormwater Detention Basin. The UBC Storage Pad Stormwater Retention Basin collects rainwater from the UBC Storage Pad as well as cooling tower blowdown water and heating boiler blowdown water. Approximately 174,100 m^3 (46 million gal) of stormwater are expected to be collected each year by the two basins. Both of these basins will be included in the site Radiological Environmental Monitoring Program. See ER Section 6.1.2.

6.1.2 Radiological Environmental Monitoring Program

The Radiological Environmental Monitoring Program (REMP) at the NEF is a major part of the effluent compliance program. It provides a supplementary check of containment and effluent controls, establishes a process for collecting data for assessing radiological impacts on the environs and estimating the potential impacts on the public, and supports the demonstration of compliance with applicable radiation protection standards and guidelines.

The primary objective of the REMP is to provide verification that the operations at the facility do not result in detrimental radiological impacts on the environment. Through its implementation, the REMP provides data to confirm the effectiveness of effluent controls and the effluent monitoring program. In order to meet program objectives, representative samples from various environmental media are collected and analyzed for the presence of plant-related radioactivity. The types and frequency of sampling and analyses are summarized in Table 6.1-4, Radiological Environmental Monitoring Program. Environmental media identified for sampling consist of ambient air, groundwater, soil/sediment, and vegetation. All environmental samples will be analyzed onsite. However, samples may also be shipped to a qualified independent laboratory for analyses. The MDCs for gross alpha (assumed to be uranium) in various environmental media are shown in Table 6.1-5, Required MDC for Environmental Sample Analyses. Monitoring and sampling activities, laboratory analyses, and reporting of facility-related radioactivity in the environment will be conducted in accordance with industry-accepted and regulatory-approved methodologies.

The Quality Control (QC) procedures used by the laboratories performing the plant's REMP will be adequate to validate the analytical results and will conform with the guidance in Regulatory Guide 4.15 (NRC, 1979). These QC procedures include the use of established standards such as those provided by the National Institute of Standards and Technology (NIST), as well as standard analytical procedures such as those established by the National Environmental Laboratory Accreditation Conference (NELAC).

Monitoring procedures will employ well-known acceptable analytical methods and instrumentation. The instrument maintenance and calibration program will be appropriate to the given instrumentation, in accordance with manufacturers' recommendations.

The NEF will ensure that the onsite laboratory and any contractor laboratory used to analyze NEF samples participates in third-party laboratory intercomparison programs appropriate to the media and analytes being measured. Examples of these third-party programs are: 1) Mixed Analyte Performance Evaluation Program (MAPEP) and the DOE Quality Assurance Program (DOEQAP) that are administered by the Department of Energy; and 2) Analytics Inc, Environmental Radiochemistry Cross-Check Program. The NEF will require that all radiological and non-radiological laboratory vendors are certified by the National Environmental Laboratory Accreditation Program (NELAP) or an equivalent state laboratory accreditation agency for the analytes being tested.

Reporting procedures will comply with the requirements of 10 CFR 70.59 (CFR, 2003b) and the guidance specified in Regulatory Guide 4.16 (NRC, 1985). Reports of the concentrations of principal radionuclides released to unrestricted areas in effluents will be provided and will include the Minimum Detectable Concentration (MDC) for the analysis and the error for each data point.

The REMP includes the collection of data during pre-operational years in order to establish baseline radiological information that will be used in determining and evaluating impacts from operations at the plant on the local environment. The REMP will be initiated at least 2 years prior to plant operations in order to develop a sufficient database. The early initiation of the REMP provides assurance that a sufficient environmental baseline has been established for the plant before the arrival of the first uranium hexafluoride shipment. Radionuclides in environmental media will be identified using technically appropriate, accurate, and sensitive analytical instruments. Data collected during the operational years will be compared to the baseline generated by the pre-operational data. Such comparisons provide a means of assessing the magnitude of potential radiological impacts on members of the public and in demonstrating compliance with applicable radiation protection standards.

Table 6.1-1 Effluent Sampling Program

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Effluent	Sample Location	Sample Type	Analysis-Frequency
Gaseous	Separative Building GEVS Stack TSB GEVS Stack TSB HVAC Stack Centrifuge Test and Post Mortem Facilities Exhaust Filtration System Stack	Continuous Air Particulate Filter	Gross Alpha/Beta-Weekly Isotopic Analysis[a] - Quarterly
	Process Areas	Continuous Air Particulate Filter*	Gross Alpha/Beta - Weekly Isotopic Analysis[a] - Quarterly
	Non-Process Areas	Continuous Air Particulate Filter*	Gross Alpha/Beta-Quarterly
Liquid	Monitor Tank	Representative Grab Sample	Isotopic Analysis[a] Post-Treatment - Prior to Discharge.

[a] Isotopic analysis for ^{234}U ,^{235}U, ^{236}U, and ^{238}U.

*As required to complement bioassay program.

Table 6.1-2 Required Lower Level Of Detection For Effluent Sample Analyses

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Effluent Type	Nuclide	MDC[a] in Bq/ml (µCi/ml)
Gaseous	^{234}U	$3.7x10^{-13}$ ($1.0x10^{-17}$)
	^{235}U	$3.7x10^{-13}$ ($1.0x10^{-17}$)
	^{236}U	$3.7x10^{-13}$ ($1.0x10^{-17}$)
	^{238}U	$3.7x10^{-11}$ ($1.0x10^{-15}$)
	Gross Alpha	$3.7x10^{-11}$ ($1.0x10^{-15}$)
Liquid	^{234}U	$1.4x10^{-4}$ ($3.0x10^{-9}$)
	^{235}U	$1.4x10^{-4}$ ($3.0x10^{-9}$)
	^{236}U	$1.4x10^{-4}$ ($3.0x10^{-9}$)
	^{238}U	$1.4x10^{-4}$ ($3.0x10^{-9}$)

[a] These MDCs are less than 2% of the limits in 10 CFR 20 Appendix B, Table 2 Effluent Concentrations

Table 6.1-3 Estimated Uranium In Pre-Treated Liquid Waste From Various Sources

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Source	Typical Annual Quantities, m³ (gals)	Typical Annual Uranic Content, kg (lbs)*
Laboratory/floor washings/miscellaneous condensates	23.14 (6112)	16 (35)
Degreaser water	3.71 (980)	18.5 (41)
Citric acid	2.72 (719)	22 (49)
Laundry effluent water	405.80 (107,213)	0.2 (0.44)
Hand wash & shower water	2100 (554,820)	None
TOTAL	2,355 (669,844)	56.7 (125)

*Uranic quantity is before treatment. After treatment, approximately 1% of 0.57 kg (1.26 lb) of uranic material is expected to be discharged into the Treated Effluent Evaporative Basin.

Table 6.1-4 Radiological Environmental Monitoring Program
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Sample Type	Minimum Number of Sample Locations	Sampling and Collection Frequency	Type of Analysis
Continuous Airborne Particulate	7	Continuous operation of air sampler with sample collection as required by dust loading but at least biweekly. Quarterly composite samples by location.	Gross beta/gross alpha analysis each filter change. Quarterly isotopic analysis on composite sample.
Vegetation	8	1 to 2-kg (2.2 to 4.4-lb) samples collected semiannually	Isotopic analysis[a]
Groundwater	5	4-L (1.06-gal) samples collected semiannually	Isotopic analysis[a]
Basins	1 from each of 3 basins[b]	4-L (1.06-gal) water sample/1 to 2-kg (2.2 to 4.4-lb) sediment sample collected quarterly	Isotopic analysis[a]
Soil	8	1 to 2-kg (2.2 to 4.4-lb) samples collected semiannually	Isotopic analysis[a]
Septic Tank(s)	1 from each affected tank	1 to 2-kg (2.2 to 4.4-lb) sludge sample from the affected tank(s) prior to pumping	Isotopic analysis[a]
TLD	16	Quarterly	Gamma and neutron dose equivalent

[a] Isotopic analysis for ^{234}U, ^{235}U, ^{236}U, and ^{238}U.

[b] Site Stormwater Detention Basin, UBC Storage Pad Stormwater Retention Basin and Treated Effluent Evaporative Basin.

Note:
Physiochemical monitoring parameters are addressed separately in ER Section 6.2, Physiochemical Monitoring.

6.3 ECOLOGICAL MONITORING

6.3.1 Maps

See Figure 6.1-2, Modified Site Features with Sampling Stations and Monitoring Locations.

6.3.2 Affected Important Ecological Resources

The existing natural habitats on the NEF site and the region surrounding the site have been impacted by domestic livestock grazing, oil/gas pipeline right-of-ways and access roads. These current and historic land uses have resulted in a dominant habitat type, the Plains Sand Scrub. Hundreds of square kilometers (miles) of this habitat type occur in the area of the NEF. The habitat type at the NEF site does not support any rare, threatened, or endangered animal or plant species. The Plains Sand Scrub vegetation type is characterized by shinnery oak shrub, mesquite shrub, and short to mid-grass prairie with little or no overhead cover.

Based on ecological surveys that have been performed onsite, LES has concluded that there are no important ecological systems onsite that are especially vulnerable to change or that contain important species habitats, such as breeding areas, nursery, feeding, resting, and wintering areas, or other areas of seasonally high concentrations of individuals of important species. The species selected as important (the mule deer and scaled quail) are both highly mobile, generalist species and can be found throughout the site area. Wildlife species on the site typically occur at average population concentrations for the Plains Sand Scrub habitat type.

The nearest suitable habitat for species of concern are several kilometers (miles) from the NEF site. The closest known populations of the Sand Dune Lizard occur approximately 4.8 km (3 mi) north of the site. A population of Lesser Prairie Chickens has been observed approximately 6.4 km (4 mi) north of the NEF site. No Black-Tailed Prairie Dogs are present at the NEF site.

6.3.3 Monitoring Program Elements

Several elements have been chosen for the ecological monitoring program. These elements include vegetation, birds, mammals, and reptiles/amphibians. Currently there is no action or reporting level for each specific element. However, additional consultation with all appropriate agencies (New Mexico Department of Game & Fish, US Fish & Wildlife Service USFWS) will continue. Agency recommendations, based on future consultation and monitoring program data, will be considered when developing action and/or reporting levels for each element. In addition, LES will periodically monitor the NEF site property and basin waters during construction and plant operations to ensure the risk to birds and wildlife is minimized. If needed measures will be taken to release entrapped wildlife. The monitoring program will assess the effectiveness of the entry barriers and release features to ensure risk to wildlife is minimized.

6.3.4 Observations and Sampling Design

The NEF site observations will include preconstruction, construction, and operations monitoring programs. The preconstruction monitoring program will establish the site baseline data. The procedures used to characterize the plant, bird, mammalian, and reptilian/amphibian communities at the NEF site during pre-construction monitoring are considered appropriate and will be used for both the construction and operations monitoring programs. Operational monitoring surveys will also be conducted annually (except semiannually for birds and reptiles/amphibians) using the same sampling sites established during the preconstruction monitoring program.

These surveys are intended to be sufficient to characterize gross changes in the composition of the vegetative, avian, mammalian, and reptilian/amphibian communities of the site associated with operation of the plant. Interpretation of operational monitoring results, however, must consider those changes that would be expected at the NEF site as a result of natural succession processes. Plant communities at the site will continue to change as the site begins to regenerate and mature. Changes in the bird, small mammal, and reptile/amphibian communities are likely to occur concomitantly in response to the changing habitat.

Vegetation

Collection of ground cover, frequency, woody plant density, and production data will be sampled from sixteen permanent sampling locations within the NEF Site. Sampling will occur annually in September or October. Annual sampling is scheduled to coincide with the mature flowering stage of the dominant perennial species.

The sampling locations are selected in areas outside of the proposed footprint of the NEF facility. The selected sampling locations will be marked physically onsite and the Global Positioning System (GPS) coordinates will be recorded. The expected positions of the sampling locations are plotted on a site schematic (See Figure 6.1-2, Modified Site Features With Proposed Sampling Stations and Monitoring Locations). The establishment of permanent sampling locations will facilitate a long-term monitoring system to evaluate vegetation trends and characteristics.

Transects used for data collection will originate at the sampling location and radiate out 30 m (100 ft) in a specified compass direction. Ground cover and frequency will be determined utilizing the line intercept method. Each 0.3 m (1 ft) segment is considered a discrete sampling unit. Cover measurements will be read to the nearest 0.03 m (0.1 ft). Woody plant densities will be determined using the belt transect method. All shrub and tree species rooted within 2 m (6 ft) of the 30 m (100 ft) transect will be counted. Productivity will be determined using a double sampling technique. The double sampling technique consists of estimating the production within three 0.25 m^2 (2.7 ft^2) plots and harvesting one equal sized plot for each transect. Harvesting consists of clipping each species in a plot separately, oven drying, and weighing to the nearest 0.01 g. The weights will be converted to kg (lbs) of oven dry forage per ha (acre).

Birds

Site-specific avian surveys will be conducted in both the wintering and breeding seasons to verify the presence of particular bird species at the NEF site. The winter and spring surveys will be designed to identify the members of the avian community.

For the winter survey, the distinct habitats at the site will be identified and the bird species composition within each of the habitats described. Transects 100 m (328 ft) in length will be established within each distinct homogenous habitat and data will be collected along the transect. Species composition and relative abundance will be determined based on visual observations and call counts.

In addition to verifying species presence, the spring survey will be designed to determine the nesting and migratory status of the species observed and (as a measure of the nesting potential of the site) the occurrence and number of territories of singing males and/or exposed, visible posturing males. The area will be censused using the standard point count method (DOA, 1993; DOA, 1995). Standard point counts require a qualified observer to stand in a fixed position and record all the birds seen and heard over a time period of five minutes. Distances and time are each subdivided. Distances are divided into less than 50 m (164 ft) and greater than 50 m (164 ft) categories (estimated by the observer), and the time is divided into two categories, 0-3 minute and 3-5 minute segments. All birds seen and heard at each station/point visited will be recorded on standard point count forms. All surveys will be conducted from 0615 to 1030 hours to coincide with the territorial males' peak singing times. The stations/points will be recorded using the GPS enabling the observer to make return visits. Surveys will only be conducted at time when fog, wind, or rain does not interfere with the observer's ability to accurately record data.

The avian communities are described in ER Section 3.5.2. All data collected will be recorded and compared to information listed in Table 3.5-2, Birds Potentially Using the NEF Site. The field data collections will be done semiannually. The initial monitoring will be effective for at least the first 3 years of commercial operation. Following this period, program changes may be initiated based on operational experience.

Mammals

The existing mammalian communities are described in ER Section 3.5.2. General observations will be compiled concurrently with other wildlife monitoring data and compared to information listed in Table 3.5-1, Mammals Potentially Using the NEF Site. The initial monitoring will be effective for at least the first 3 years of commercial operation. Following this period, program changes may be initiated based on operational experience.

Reptiles and Amphibians

There are several groups of reptile and amphibian species (lizards, snakes, amphibians) that provide the biological characteristics (demographics, life history characteristics, site specificity, environmental sensitivity) for an informative environmental monitoring program. Approximately 13 species of lizards, 13 species of snakes and 11 species of amphibians may occur on the site and in the area.

A combination of pitfall drift-fence trapping and walking transects (at trap sites) can provide data in sufficient quantity to allow statistical measurements of population trends, community composition, body size distributions and sex ratios that will reflect environmental conditions and changes at the site over time.

As practical, the monitoring program will include at least two other replicated sample sites beyond the primary location on the NEF property. Offsite, locations on Bureau of Land Management (BLM) or New Mexico state land to the south, west or north of NEF will be given preference for additional sampling sites. Each of these catch sites will have the same pitfall drift-fence arrays and standardized walking transects and will be operated simultaneously. Each sample site will be designed to maximize the total catch of reptiles and amphibians, rather than data on each individual caught. Each animal caught will be identified, sexed, snout-vent length measured, inspected for morphological anomalies and released (sample with replacement design). There will be two sample periods, at the same time each year, in May and late June/early July. These coincide with breeding activity for lizards, most snakes and depending on rainfall, amphibians.

Because reptiles and amphibians are sensitive to climatic conditions, and to account for the spotty effects of rainfall, each sampling event will also record rainfall, relative humidity and temperatures. The rainfall and temperature data will act as a covariate in the analysis.

Additionally, the offsite sample locations act to balance out climatic effects on populations of small animals. The comparison of NEF site data and offsite location data allows for monitoring to be a much more informative environmental indicator of conditions at the NEF site.

The reptile and amphibian communities are described in ER Section 3.5.2, General Ecological Conditions of the Site. In addition to the monitoring plan described above, general observations will be gathered and recorded concurrently with other wildlife monitoring. The data will be compared to information listed in Table 3.5-3, Amphibians/Reptiles Potentially Using the NEF Site. As with the programs for birds and mammals, the initial reptile and amphibian monitoring program will be effective for at least the first three years of commercial operation. Following this period, program changes may be initiated based on operational experience.

6.3.5 Statistical Validity of Sampling Program

The proposed sampling program will include descriptive statistics. These descriptive statistics will include the mean, standard deviation, standard error, and confidence interval for the mean. In each case the sampling size will be clearly indicated. The use of these standard descriptive statistics will be used to show the validity of the sampling program. A significance level of 5% will be used for the studies, which results in a 95% confidence level.

6.3.6 Sampling Equipment

Due to the type of ecological monitoring proposed for the NEF no specific sampling equipment is necessary.

6.3.7 Method of Chemical Analysis

Due to the type of monitoring proposed for the NEF, no chemical analysis is proposed for ecological monitoring.

6.3.8 Data Analysis And Reporting Procedures

LES or its contractor will analyze the ecological data collected on the NEF site. The Health, Safety & Environmental (HS&E) Manager or a staff member reporting to the HS&E manager will be responsible for the data analysis.

A summary report will be prepared which will include the types, numbers and frequencies of samples collected.

6.3.9 Agency Consultation

Consultation was initiated with all appropriate federal and state agencies and affected Native American Tribes. Refer to Appendix A, Consultation Documents, for a complete list of consultation documents and comments.

6.3.10 Organizational Unit Responsible for Reviewing the Monitoring Program on an Ongoing Basis

As policy directives are developed, documentation of the environmental monitoring programs will occur. The person or organizational unit responsible for reviewing the program on an ongoing basis will be the HS&E Manager.

centrifuge equipment, production will commence prior to completion of the initial three-year construction period. The manpower and materials used during this phase of the project will vary depending on the construction plan. Table 7.2-2, Estimated Construction Material Yearly Purchases, provides the estimated total quantities of purchased construction materials and Table 7.2-3, Estimated Yearly Labor Costs for Construction, provides the estimated labor that will be required to install these materials. The scheduling of materials and labor expenditures is subject to the provisions of the project construction execution plan, which has not yet been developed.

Approximately 60 to 80% of the construction materials will be purchased from the local NEF site area. According to the labor survey conducted as part of the conceptual estimate, the major portion of the required craft labor forces will come from the five or six counties around the project area, including the nearby Texas counties.

7.2.2 Plant Operation

7.2.2.1 Surface and Groundwater Quality

Liquid effluents at the NEF will include stormwater runoff, sanitary and industrial wastewater, and treated radiologically contaminated wastewater. Radiologically contaminated process water will be treated to 10 CFR 20, Appendix B limits (CFR, 2003q) and discharged to the Treated Effluent Evaporative Basin, which is a double-lined treated effluent evaporative basin with leak detection. Site stormwater runoff from the Uranium Byproduct Cylinder (UBC) Storage Pad is routed to the UBC Storage Pad Stormwater Retention Basin. The general site runoff is routed to the Site Stormwater Detention Basin. Stormwater discharges will be regulated by the National Pollutant Discharge Elimination System (NPDES) during operation. Approximately 174,100 m^3 (46 million gal) of stormwater from the plant site is expected to be released annually to the two stormwater basins.

7.2.2.2 Terrestrial and Aquatic Environments

No communities or habitats defined as rare or unique or that support threatened and endangered species, have been identified anywhere on the NEF site. Thus, no operation activities are expected to impact such communities or habitats.

7.2.2.3 Air Quality

No adverse air quality impacts to the environment, either on or offsite, are anticipated to occur. Air emissions from the facility during normal facility operations will be limited to the plant ventilation air and gaseous effluent systems. All plant process/gaseous air effluents are to be filtered and monitored on a continuous basis for chemical and radiological contaminants, which could be derived from the UF_6 process system. If any UF_6 contaminants are detected in ambient in-plant air systems, the air is treated by appropriate filtration methods prior to its venting to the environment. Two emergency diesel generators that supply standby electrical power operate only in the event of power interruptions. They will have negligible health and environmental impacts.

7.2.2.4 Visual/Scenic

No impairments to local visual or scenic values will result due to the operation of the NEF. The facility and associated structures will be relatively compact, located in a rural location. No offensive noises or odors will be produced as a result of plant operations.

7.2.2.5 Socioeconomic

The Regional Input-Output Modeling System (RIMS) II allows estimation of various indirect impacts associated with each of the expenditures associated with the NEF. Over the anticipated thirty-year license period of the NEF, residents can anticipate an annual total of $15 million in increased economic activity, $23 million in increased earnings by households and an annual average of 782 jobs directly or indirectly relating to the NEF.

In general, no significant impacts are expected to occur for any local area infrastructure (e.g., schools, housing, water, and sewer). Costs of operation should be diffused sufficiently throughout the Hobbs-Eunice, New Mexico area to be indistinguishable from normal economic growth.

7.2.2.6 Radiological Impacts

Potential radiological impacts from operation of the NEF would result from controlled releases of small quantities of UF_6 during normal operations and releases of UF_6 under hypothetical accident conditions. Normal operational release rates to the atmosphere and to the onsite Treated Effluent Evaporative Basin are expected to be less than 8.9 MBq/yr (240 μCi/yr) and 2.1 MBq/yr (56μCi/yr), respectively.

The estimated maximum annual effective dose equivalent and maximum annual organ (lung) committed dose equivalents from gaseous effluent to an adult located at the plant site south boundary are 1.7×10^{-4} mSv (1.7×10^{-2} mrem) and 1.4×10^{-3} mSv (1.4×10^{-1} mrem), respectively. The maximum effective dose equivalent and maximum annual organ (lung) dose equivalent from discharged gaseous effluent to the nearest resident (teenager) located 4.3 km (2.63 mi) in the west sector are expected to be less than 1.7×10^{-5} mSv (1.7×10^{-3} mrem) and 1.2×10^{-4} mSv (1.2×10^{-2} mrem), respectively.

The estimated maximum annual effective dose equivalent and maximum annual organ (lung) committed dose equivalents from liquid effluent to an adult at the south site boundary are 1.7×10^{-5} mSv (1.7×10^{-3} mrem) and 1.5×10^{-4} mSv (1.5×10^{-2} mrem), respectively. The estimated maximum annual effective dose equivalent and maximum annual organ (lung) committed dose equivalents from liquid effluent to an individual (teenager) at the nearest residence are 1.7×10^{-6} mSv (1.7×10^{-4} mrem) and 1.3×10^{-5} mSv (1.3×10^{-3} mrem), respectively.

The maximum annual dose equivalent due to external radiation from the UBC Storage Pad and all other feed, product and byproduct cylinders on the NEF property (skyshine and direct) is estimated to be less than 2.0×10^{-1} mSv (20 mrem) to the maximally exposed person at the nearest point on the site boundary (2,000 hrs/yr) and 8×10^{-12} mSv/yr (8×10^{-10} mrem/yr) to the maximally exposed resident (8,760 hrs/yr) located at 4.3 km (2.63 mi) west of the NEF. Given the conservative assumptions used in estimating these values, these concentrations and resulting dose equivalents are insignificant and their potential impacts on the environment and health are inconsequential.

These dose equivalents due to normal operations are small fractions of the normal background radiation range of 2.0 to 3.0 mSv (200 to 300 mrem) dose equivalent that an average individual receives in the US, and within regulatory limits. .

7.2.2.7 Other Impacts of Plant Operation

NEF water will be obtained from the Hobbs and Eunice, New Mexico municipal water systems, and routine liquid effluent will be treated and discharged to evaporative pond(s), whereas sanitary wastes will be discharged to onsite septic systems. Facility water requirements are relatively low and well within the capacities of the Hobbs and Eunice water utilities. The current capacity for the Eunice Potable water supply system is 16,350 m^3/day (4.3 million gpd), and current usage is 5,600 m^3/day (1.48 million gal/d). The Hobbs water system capacity is 75,700 m^3/day (20 million gal/d) whereas its usage is 23,450 m^3/day (6.2 million gal/d). Requirements for operation of the NEF are expected to be 240 m^3/day (63,423 gal/d), a volume well within the capacity of the supply systems. Non-hazardous and non-radioactive solid waste is expected to be approximately 172,500 kg (380,400 lbs) annually. It will be shipped offsite to a licensed landfill. The local Lea County landfill capacity is more than adequate to accept the non-hazardous waste.

7.2.2.8 Decommissioning

The plan for decommissioning is to decontaminate or remove all materials promptly from the site that prevent release of the facility for unrestricted use. This approach avoids the need for long-term storage and monitoring of wastes on site. Only building shells and the site infrastructure will remain. All remaining facilities, including site basins, will be decontaminated where needed to acceptable levels for unrestricted use. Excavations and berms will be leveled to restore the land to a natural contour.

Depleted UF_6 , if not already sold or otherwise disposed of prior to decommissioning, will be disposed of in accordance with regulatory requirements. Radioactive wastes will be disposed of in licensed low-level radioactive waste disposal sites. Hazardous wastes will be treated or disposed of in licensed hazardous waste facilities. Neither conversion (if done), nor disposal of radioactive or hazardous material will occur at the plant site, but at licensed facilities located elsewhere.

Following decommissioning, all parts of the plant and site will be unrestricted to any specific type of use.

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8.6 ENVIRONMENTAL IMPACTS OF OPERATION

Operation of the National Enrichment Facility (NEF) would result in the production of gaseous effluent, liquid effluent, and solid waste streams. Each stream could contain small amounts of hazardous and radioactive compounds, either alone or in a mixed form. Based on the experience gained from operation of the Urenco European plants, the aggregate routine airborne uranium gaseous releases to the atmosphere are estimated to be less than 10 g (0.35 ounces) annually. However, based on recent environmental monitoring at the Urenco plants, the annual release is closer to 0.1 MBq (2.8 μCi) which is equivalent to 3.9 g of natural uranium. Extremely minute amounts of uranium and hydrogen fluoride (all well below regulatory limits) could potentially be released at the roof-top through the gaseous effluent stacks. The discharge stacks for the Gaseous Effluent Vent System (GEVS) (Separations Building GEVS and Technical Services Building (TSB) GEVS) are co-located atop of the TSB. A third roof-top stack on the TSB discharges effluents from the confinement ventilation function of the TSB heating, ventilation and air conditioning (HVAC). A fourth roof-top stack is located atop the Centrifuge Assembly Building (CAB) that discharges any gaseous effluent from the Centrifuge Test and Post Mortem Facilities Exhaust Filtration System. Gaseous effluent discharges from each of the four stacks are filtered for particulates and hydrogen fluoride (HF), and are continuously monitored prior to release.

Liquid effluents include stormwater runoff, sanitary waste water, cooling tower blowdown water, heating boiler blowdown water and treated contaminated process water. All liquid effluents, with the exception of sanitary waste water, are discharged to one of three onsite basins.

The Site Stormwater Detention Basin is designed with an outlet structure for drainage. Local terrain serves as the receiving area for this basin. During a rainfall event larger than the design basis, the potential exists to overflow the basin if the outfall capacity is insufficient to pass beyond design basis inflows to the basin. Overflow of the basin is an unlikely event. The additional impact to the surrounding land over that which would occur during such a flood alone, is assumed to be small. Therefore, potential overflow of the Site Stormwater Detention Basin during an event beyond its design basis is expected to have a minimal impact to surrounding land.

The UBC Storage Pad Stormwater Retention Basin, which exclusively serves the UBC Storage Pad, cooling tower blowdown water and heating boiler blowdown water discharges, is lined to prevent infiltration. It is designed to retain a volume slightly more than twice that for the 24-hour, 100-year frequency storm and an allowance for cooling tower blowdown and heating boiler blowdown. This lined basin has no flow outlet and all effluents are dispositioned through evaporation.

Discharge of operations-generated potentially contaminated liquid effluent is made exclusively to the Treated Effluent Evaporative Basin. Only liquids meeting site administrative limits (based on NRC standards in 10 CFR 20 (CFR, 2003q) are discharged to this basin. The basin is double-lined with leak detection and open to allow evaporation.

Sanitary waste water will be discharged onsite to the NEF septic tanks and leach fields. No contaminated liquid discharges will be allowed through the onsite septic systems.

Since the NEF will not obtain any water from or discharge process effluents from the site, there are no anticipated impacts on natural water systems quality due to facility water use. Control of surface water runoff will be required for NEF activities, covered by the NPDES General Permit and a New Mexico Water Quality Bureau Groundwater Discharge Plan/Permit. As a result, no significant impacts are expected for either surface water bodies or groundwater.

Solid waste that would be generated at NEF is grouped into nonhazardous, radioactive, hazardous, and mixed waste categories. All these wastes will be collected and transferred to authorized offsite treatment or disposal facilities. All solid radioactive waste generated will be Class A low-level waste as defined in 10 CFR 61 (CFR, 2003r). This waste consists of industrial waste, filters and filter material, resins, gloves, shoe covers, and laboratory waste. Approximately 86,950 kg (191,800 lbs) of low-level waste would be generated annually. In addition, annual hazardous and mixed wastes generated at NEF are expected to be about 1,770 kg (3,930 lbs) and 50 kg (110 lbs), respectively. These wastes will be collected, inspected, volume-reduced, and transferred to treatment facilities or disposed of at authorized waste disposal facilities. Nonhazardous waste, including miscellaneous trash, filters, resins, and paper will be shipped offsite for compaction and then sent to a licensed landfill. The NEF is expected to produce approximately 172,500 kg (380,400 lbs) of this waste annually. Local landfill capacity is more than adequate to accept this mass of nonhazardous waste.

Operation of the NEF would also result in the annual nominal production of approximately 7,800 metric tons (8,600 tons) of depleted UF_6. The depleted UF_6 would be stored onsite in cylinders (UBCs) that will have little or no impact while in storage. The removal and disposition of the depleted UF_6 will most likely involve its conversion offsite to triuranium octoxide (U_3O_8).

8.8 NONRADIOLOGICAL IMPACTS

Numerous design features and administrative procedures are employed to minimize gaseous and liquid effluent releases and keep them within regulatory limits. Potential nonradiological impacts of operation of the NEF include releases of inorganic and organic chemicals to the atmosphere and surface water impoundments during normal operations Other potential impacts involve land use, transportation, soils, water resources, ecological resources, air quality, historic and cultural resources, socioeconomic and public health. Impacts from hazardous, radiological and mixed wastes and radiological effluents have been discussed earlier.

The other potential nonradiological impacts from the construction and operation of NEF are discussed below:

Land-Use Impacts:

The anticipated effects on the soil during construction activities are limited to a potential short-term increase in soil erosion. However, this will be mitigated by proper construction best management practices (BMPs). These practices include minimizing the construction footprint to the extent possible, limiting site slopes, using a sedimentation detention basin, protecting undisturbed areas with silt fencing and straw bales as appropriate, and employing site stabilization practices such as placing crushed stone on top of disturbed soil in areas of concentrated runoff. In addition onsite construction roads will be periodically watered when required, to control fugitive dust emissions. Water conservation will be considered when deciding how often dust suppression sprays will be applied. After construction is complete, the site will be stabilized with natural, low-water maintenance landscaping and pavement.

A Spill Prevention, Control and Countermeasures (SPCC) plan will also be implemented during construction to minimize environmental impacts from potential spills and ensure prompt and appropriate remediation. Spills during construction are likely to occur around vehicle maintenance and fueling locations, storage tanks, and painting operations. The SPCC plan will identify sources, locations and quantities of potential spills and response measures. The plan will also identify individuals and their responsibilities for implementation of the plan and provide for prompt notification of state and local authorities, as required.

Waste management BMPs will be used to minimize solid waste and hazardous materials. These practices include the placement of waste receptacles and trash dumpsters at convenient locations and the designation of vehicle and equipment maintenance areas for the collection of oil, grease and hydraulic fluids. Where practicable, materials suitable for recycling will be collected. If external washing of construction vehicles is necessary, no detergents will be used, and the runoff will be diverted to onsite retention basins. Water conservation measures will be considered to minimize water use. Adequately maintained sanitary facilities will be provided for construction crews.

The NEF facility will require the installation of water, natural gas and electrical utility lines. In lieu of connecting to the local sewer system, six onsite underground septic tanks each with one or more leach fields will be installed for the treatment of sanitary wastes.

A new potable water supply line will be extended from the city of Eunice to the NEF site and another potable water supply line will be extended from the city of Hobbs. The line from Eunice will be about 8 km (5 mi) in length. The line from Hobbs will be about 32 km (20 mi) in length. Placement of the new water supply lines along New Mexico Highways 18 and 234 would minimize impacts to vegetation and wildlife. Since there are no bodies of water between the site and the city of Eunice, no waterways will be disturbed. Likewise, based on site visits, there are no bodies of water between the site vicinity and the city of Hobbs. The natural gas line feeding the site will connect to an existing, nearby line. This will minimize impacts of short-term disturbances related to the placement of the tie-in line.

Two new electrical transmission lines on a large loop system are proposed for providing electrical service to the NEF. These lines would tie into a trunk line about 13 km (8 mi) to the west. Similar to the new water supply lines, land use impacts would be minimized by placing associated support structures along New Mexico Highway 234. An application for highway easement modification will be submitted to the state. There are currently several power poles along the highway in front of the adjacent, vacant parcel east of the site. In conjunction with the new electrical lines serving the site, the local company providing electrical service, Xcel Energy, will install two onsite transformers for redundant service assurance.

Six underground septic tanks will be installed onsite. The combined leach fields will require about 975 m (3,200 ft) of percolation drain field. The drain field will either be placed below grade or buried in a mound consisting of sand, aggregate and soil.

Overall land use impacts to the site and vicinity will be minimal considering that the majority of the site will remain undeveloped, the current industrial activity on neighboring properties, the nearby, expansive oil and gas well fields, and the placement of most utility installations along highway easements.

<u>Transportation Impacts:</u>

Impacts from construction and operation on transportation will include the generation of fugitive dust, changes in scenic quality, added environmental noise and small radiation dose to the public from the transport of UF_6 feed and product cylinders, as well as low-level radioactive waste.

Dust will be generated to some degree during the various stages of construction activity. The amount of dust emissions will vary according to the types of activity. LES estimated that fugitive dust are expected to be well below the National Ambient Air Quality Standards (CFR, 2003w).

Although site construction will significantly alter its natural state, and considering that there are no high quality viewing areas and the industrial development of surrounding properties, impacts to the scenic quality of the site are not considered to be significant. Also, construction vehicles will be comparable to trucks servicing neighboring facilities. Construction worker and worker during operation transportation impacts are not considered to be significant.

The temporary increase in noise levels along New Mexico Highways 18 and 234 and Texas Highway 176 due to construction vehicles are not expected to impact nearby receptors significantly, due to substantial truck traffic currently using these roadways, and the large distance between the nearest receptors and the site, i.e., 4.3 km (2.63 mi). See the environmental noise discussion below concerning noise levels due to traffic during operations.

<u>Water Resources:</u>

Site groundwater will not be utilized for any reason, and therefore, should not be impacted by routine NEF operations. The NEF water supply will be obtained from the cities of Eunice, New Mexico, and Hobbs, New Mexico. Current capacities for the Eunice and Hobbs, New Mexico municipal water supply system are 16,350 m^3/day (4.32 million gpd) and 75,700 m^3/day

(20 million gpd), respectively and current usages are 5,600 m^3/day (1.48 million gpd) and 23,450 m^3/day (6.2 million gpd), respectively. Average and peak potable water requirements for operation of the NEF are expected to be approximately 240 m^3/day (63,423 gpd) and 85 m^3/hr (378 gpm), respectively. These usage rates are well within the capacities of both water systems.

Liquid effluents include stormwater runoff, sanitary waste water, cooling tower blowdown water, heating boiler blowdown water and treated contaminated process water. All liquid effluents, with the exception of sanitary waste water, are discharged to one of three onsite basins.

Stormwater from the site will be diverted and collected in the Site Stormwater Detention Basin. This basin collects runoff from various developed parts of the site. It is unlined and will have an outlet structure to control discharges above the design level. The normal discharge will be through evaporation and infiltration into the ground. The basin is designed to contain runoff for a volume equal to that for the 24-hour, 100-year return frequency storm, a 15.2-cm (6.0-in) rainfall. It will have approximately 123,350 m^3 (100-acre-ft) of storage capacity. In addition, the basin has 0.6 m (2 ft) of free-board beyond the design capacity. It will also be designed to discharge post-construction peak flow runoff rates from the outfall that are equal to or less than the pre-construction runoff rates from the area.

Cooling tower blowdown water, heating boiler blowdown water and stormwater runoff from the UBC Storage Pad are discharged to the UBC Storage Pad Stormwater Retention Basin. The ultimate disposition of this water will be through evaporation along with permanent impoundment of the residual dry solids byproduct of evaporation. It is designed to contain runoff for a volume equal to twice that for the 24-hour, 100-year return frequency storm, a 15.2-cm (6.0-in) rainfall and an allowance for cooling tower blowdown water and heating boiler blowdown water. The UBC Storage Pad Stormwater Retention Basin is designed to contain a volume of approximately 77,700 m^3 (63 acre-ft). This basin is designed with a synthetic membrane lining to minimize any infiltration into the ground.

Discharge of treated contaminated plant process water will be to the onsite Treated Effluent Evaporative Basin. The Treated Effluent Evaporative Basin is utilized for the collection and containment of liquid effluent from the Liquid Effluent Collection and Treatment System. The ultimate disposal the liquid effluent will be through evaporation of water and permanent impoundment of the residual dry solids. Total annual discharge to that basin will be approximately 2,535 m^3/yr (669,844 gal/yr). The basin will be designed for double that volume. Evaporation will provide the only means of liquid disposal from this basin. The basin will include a double-layer membrane liner with a leak detection system to prevent infiltration of basin water into the ground.

Ecological Resources:

No communities or habitats that have been defined as rare or unique or that support threatened and endangered species have been identified as occurring on the 220-ha (543-acre) NEF site. Thus, no proposed activities are expected to impact communities or habitats defined as rare or unique or that support threatened and endangered species within the site area. Field surveys that were performed in September and October 2003, and April 2004, for the lesser prairie chicken, the sand dune lizard, and the black-tailed prairie dog determined that these species were not present at the NEF site. Another survey for the sand dune lizard was conducted in June 2004 and confirmed there were no sand dune lizards at the NEF site.

Several practices and procedures have been designed to minimize adverse impacts to the ecological resources of the NEF site. These practices and procedures include the use of BMPs, i.e., minimizing the construction footprint to the extent possible, channeling site stormwater to temporary detention basins during construction, the protection of all unused naturalized areas, and site stabilization practices to reduce the potential for erosion and sedimentation.

Historic and Cultural Resources:

A pedestrian cultural resource survey of the 220-ha (543-acre) NEF site identified seven prehistoric archaeological sites; three of these sites are located in the Area of Potential Effect (APE). Based on its survey findings and consultations with the New Mexico State Historic Preservation Officer (SHPO), LES is developing a treatment/mitigation plan to recover any significant information from the identified archaeological sites.

Given the small number of potential archaeological sites and isolated occurrences located on the site, and LES's ability to avoid or mitigate impacts to those sites, the NEF project will not have a significant impact on historic and cultural resources. (See ER Section 4.8.6, Minimizing Adverse Impacts.)

Environmental Noise:

Noise generated by the operation of NEF will be primarily limited to truck movements on the road. Potential impacts to local schools, churches, hospitals, and residences are expected to be insignificant because of the large distance to the nearest sensitive receptors. The nearest home is located west of the site at a distance of approximately 4.3 km (2.63 mi) and is not expected to perceive operational noise levels from the plant. The nearest school, hospital, church and other sensitive noise receptors are beyond this distance, thus the noise will be dissipated and attenuated, helping decrease the sound levels even further. Homes located near the construction traffic at the intersection of New Mexico Highway 234 and New Mexico Highway 18 will be affected by the vehicle noise, but due to existing heavy tractor trailer vehicle traffic, the change should be minimal. No schools, hospitals, or any other sensitive receptors are located at this intersection. Expected noise levels will mostly affect a 1.6-km (1-mi) radius and due to the large size of the site, sound levels resulting from the cumulative noise of all site activities will not have a significant impact on even those receptors closest to the site boundary.

Socioeconomics:

LES has estimated the economic impacts to the local economy during the 8-year construction period and 30-year license period of the NEF. This includes a five and one-half year period when both construction and operation are ongoing simultaneously. The analysis traces the economic impact of the proposed NEF, identifying the direct impacts of the plant on revenues of local businesses on incomes accruing to households, on employment, and on the revenues of the state and local government. The analysis also explores the indirect impacts of the NEF within a 80-km (50-mi) radius of the NEF. Details of the analysis are provided in ER Section 7.1, Economic Cost-Benefits, Plant Construction and Operation, and are summarized below.

LES estimates that construction payroll will total $122.2 million with an additional $21 million expended for employment benefits over the eight-year construction period. Construction services purchased from third party firms within the region will add $265 million in direct benefits to the local economy during NEF's construction. See ER Section 7.1, Economic Cost-Benefits, Plant Construction and Operation.

Fundamental Nuclear Material Control Plan
(Proprietary Information Has Been Withheld)

Revision 4, April 2005
Including Page Removal and Insertion Instructions