4.0 RADIATION PROTECTION

This chapter describes the American Centrifuge Plant (ACP) Radiation Protection (RP) Program for keeping occupational radiation exposures and radioactive contamination below regulatory limits and as low as reasonably achievable (ALARA). The RP Program addresses the occupational radiation protection requirements set forth in 10 *Code of Federal Regulations* (CFR) Parts 19, 20, and 70. The Radiation Protection Manager (RPM) is responsible for the ACP RP Program. The RPM or designee carries out responsibilities of the RPM described in this chapter.

4.1 Radiation Protection Program Implementation

In accordance with 10 CFR 20.1101(c), the RP Program content and implementation is reviewed annually. The RPM is responsible for this annual review and preparation of a report documenting the results of the review. The ALARA Committee then reviews the report. Revisions to the RP Program, if warranted, are initiated and processed by the RPM as part of the annual review process. Any resulting changes to the Radiation Worker Training module are also implemented.

4.2 As Low As Reasonably Achievable Program

In accordance with 10 CFR 20.1101, the ACP RP Program is designed to protect personnel entering the ACP from unnecessary exposure to ionizing radiation and radioactive materials. This program is based upon the following principles and is implemented through written procedures.

- Personnel radiation exposures and the release of radioactive effluents shall be maintained in accordance with the ALARA principle.
- No individual shall receive a radiation dose in excess of any regulatory limit.

Responsibility for establishing and ensuring adherence to these principles rests with the Senior Vice President, Field Operations. The General Manager has the overall responsibility and authority for the ALARA Program. The RPM is responsible for establishing and implementing the ALARA Program in accordance with written policies and procedures.

4.2.1 As Low As Reasonably Achievable Committee

The ALARA Committee is an independent advisory group to the General Manager and the Plant Safety Review Committee on RP issues. It functions to: (1) monitor selected operational RP issues; (2) advise ACP management on RP concerns; and (3) review proposed designs, work practices, selected suggestions, and selected projects with regard to contamination control and/or ALARA.

The ALARA Committee:

- Communicates management's commitment to the ALARA Program;
- Monitors the implementation of the ALARA Program and serves as the advisor to ACP management for maintaining occupational dose and environmental dose in accordance with ALARA principles; and
- Reviews, for the purpose of occupational dose and environmental dose reduction, proposed designs, practices, selected suggestions, and selected project schedules.

The ALARA Committee also:

- Establishes the annual exposure goals;
- Provides recommendations to ACP management and/or the Plant Safety Review Committee as appropriate, regarding procedural, equipment, or design changes that could have a significant impact on personnel radiation exposure; and
- Forms subcommittees or assigns individuals to undertake special studies or conduct ALARA reviews that will be documented and presented to the ALARA Committee with any recommendations.

Membership consists of persons from various functional disciplines who have the necessary competence and experience to perform the functions of the committee. Standing committee members are the RPM who serves as the chairperson, the vice-chairperson who is appointed by the RPM, the Production Support Manager, Operations Manager, Regulatory Manager, and an operations technician and/or a maintenance technician. Participation from other functional disciplines may vary depending on the issue of concern. The committee chairperson, or designee, is responsible for requesting appropriate functional representation. Committee members may designate an alternate to attend committee meetings in their place.

The ALARA Committee meets at least annually and as directed by the chairperson. A quorum consists of five standing committee members or their alternates. Ad hoc subcommittees may be established for special studies or reviews pertinent to committee-related issues.

The chairperson ensures those functions of the committee and tasks are properly executed. Minutes are provided to the General Manager. The committee issues special reports prepared upon request of ACP management, or as determined by the chairperson.

~~The committee reviews matters that have or may have an impact on contamination control and/or ALARA.~~ The ALARA Committee reviews the ALARA Program and the review includes an evaluation of the results of audits performed by Health Physics (HP), reports of radiation levels, contamination levels, employee exposures, and effluent releases. The review determines if there are any upward trends in personnel exposure for identified categories of workers and types of operations. The review also identifies any upward trends in effluent releases and contamination levels and determines if exposures, releases, and contamination levels are in accordance with the ALARA concept. Specific areas reviewed include, but are not limited to the following:

- Technologies for selected job tasks;
- Current work practices and completed tasks which have/had contamination control or ALARA concerns;
- Radiation protection violations;
- Lessons learned;
- Trends and resulting impacts on contamination control and/or ALARA; and
- Environmental monitoring reports.

The committee also establishes annual contamination control and exposure goals. Minutes are issued that identify committee members and/or alternates in attendance, agenda items, a summary of decisions made, and action items. Copies are made available to ACP management and the committee members. Recommendations of the ALARA Committee are documented and tracked to completion in the Corrective Action Program.

4.3 Organization and Personnel Qualifications

The RPM is responsible for providing guidance and direction for establishment and implementation of the RP Program and has direct access to the General Manager and Senior Vice President, Field Operations for radiological control matters. The RPM reports to the Production Support Manager, which provides independence from operations. The RPM and designee are required to have the technical competence and experience to establish RP programs (RPM qualifications are stated in Chapter 2.0 of this license application) and the management capability to direct the implementation and maintenance of RP programs.

The HP Group reports to the RPM and provides radiological protection support to the plant. HP is independent of the organizations responsible for production. The HP Group is staffed with suitably trained individuals who provide oversight and control of the technical aspects of the program elements that affect RP. There are sufficient HP resources available to support ACP activities.

HP Technicians ~~and their managers~~ perform the functions of assisting and guiding workers in the radiological aspects of the job. HP Technicians ~~and their managers~~ have the responsibility and authority to stop radiological work or mitigate the effect of an activity if they suspect that the initiation or continued performance of a job, evolution, or test will result in the violation of approved RP requirements.

4.4 Written Procedures

4.4.1 Procedures

The RP Program is implemented using procedures. The procedures are prepared consistent with the requirements of 10 CFR Part 20 and are approved, maintained, and adhered to for operations involving personnel radiation exposure and toxicological exposure to soluble uranium. The procedures are reviewed and revised as necessary to incorporate any plant or operational changes, including ~~these~~ those initiated by changes to the Integrated Safety Analysis (ISA) for commercial ACP operations and for the HALEU Demonstration. These procedures are prepared, maintained and made available to appropriate personnel at the plant as described in Section 11.4 of this license application.

4.4.2 Radiation Work Permits

Radiation Work Permits (RWPs) are a basic implementing tool by which radiological controls are established. RWPs provide information to the worker concerning protective clothing, job/task identification, and special instructions such as radiological hold points. Radiological surveys that supplement RWPs provide information regarding radiation and contamination levels.

RWPs are required for work activities in Contamination Areas (CAs), High Contamination Areas (HCAs), Airborne Radioactivity Areas (ARAs), Radiation Areas (RAs), High Radiation Areas (HRAs) and other areas as required by HP. Qualified HP personnel are authorized to approve, issue, update, revise, and close RWPs. The RPM may exempt the requirement for an RWP in certain RAs as specified in approved procedures.

The limits established for contamination control (surface and airborne) are based on the toxicity of soluble uranium. The contamination control program, of which RWPs are a part, is designed to ensure that the inhalation or ingestion of soluble uranium is below the limits stated in 10 CFR 20.1201(e).

An RWP may be issued for any period up to one year, based on the stability and predictability of changes in the radiological conditions of the work area. RWPs are normally closed upon job completion. HP may close an RWP at any time.

Radiological surveys are reviewed to evaluate the adequacy of RWP requirements. RWPs are updated or closed and reissued if radiological conditions change to the extent ~~those~~ the protective requirements need to be modified.

HP management reviews the RWP closure package to ensure appropriate actions have been taken.

Continuous HP coverage may be used in lieu of RWPs when approved by the RPM. Qualified HP Technicians are authorized to provide continuous radiological coverage in lieu of an RWP for short duration (less than one shift), non-complex tasks. When continuous HP coverage is used, requirements normally specified on an RWP are communicated to the worker verbally.

4.5 Training

Radiological control is provided by controlling access to areas where radioactive material may be encountered and by requiring that each person who enters those areas or facilities receive the appropriate level of radiological worker training. Personnel are trained commensurate with the hazard per 10 CFR Parts 19 and 20. Details concerning Visitor Site Access Orientation and radiological training are provided in Section 11.3.1 of this license application. The Radiological Worker Training Program addresses the requirements of 10 CFR 19.11 and 19.12 and workers' responsibilities under the Radiation Protection Program. The Radiation Worker Training program is described in Section 11.3.1.3 of this license application.

4.5.1 Visitor Site Access Orientation

Visitors review basic information related to the site and hazards present at the ACP. Trained radiological workers escort visitors who are granted access to the Restricted Areas.

4.5.2 General Employee Radiological Training

General Employee Radiological Training covers the employee's responsibilities for maintaining exposures to radiation and radioactive materials in accordance with the ALARA philosophy.

4.5.3 Radiation Worker Training

If a person requires unescorted access to the Restricted Area, radiological worker qualification is required. Radiation Worker Training is a biennial training requirement. Qualified Radiation Workers may be task qualified to perform selected HP Technician duties as authorized by the RPM.

4.5.4 Health Physics Technician

HP Technicians are trained and qualified in accordance with an approved qualification standard and training is delivered consistent with applicable training procedures (see Section 11.3). The qualification standard is based on the requirements of American National Standards Institute (ANSI)/American Nuclear Society 3.1, *Selection, Qualification, and Training of Personnel for Nuclear Power Plants*, 1987 Edition. HP Technician training develops the skills necessary to perform assigned work in a competent manner. The training consists of initial, on-the-job, and continuing training.

HP Technician qualification consists of the standardized core course training material, ACP-specific information, and on-the-job training. Passing a final comprehensive written examination is required. The training program ensures personnel are proficient in radiation measurements, characterization of radiological conditions, release monitoring, and personnel monitoring. Formal remediation protocols are utilized.

Entry-level prerequisites are established to ensure that HP Technicians meet minimum standards for education. Task qualification for entry-level positions may be used until formal training is completed.

Following initial qualification, HP Technicians are requalified every two years. The requalification process requires successful completion of a comprehensive written examination. The written examination may be waived for personnel with National Registry of Radiation Protection Technologist certification. Personnel who maintain qualifications as HP Technicians satisfy the requirements of Radiation Worker Training.

HP Technician managers complete and maintain qualifications as HP Technicians.

4.6 Ventilation and Respiratory Protection Programs

ACP building ventilation systems are described in Chapter 1.0 of this license application and in the ISA Summary. These systems are primarily designed to maintain the building environment required for proper operation of process and associated equipment.

There are no items relied on for safety (IROFS) identified with ventilation systems in the commercial ACP ISA Summary or its Addendum for the HALEU Demonstration. However, building ventilation systems are credited as defense in depth design features that help reduce the consequences of a UF_6 release in multiple analyzed events.

The ISA accident scenarios also identify use of portable ventilation units (commonly referred to as "gulpers") during applications ranging from pigtail operations to small-scale maintenance tasks to reduce worker exposure. In addition, administrative guidance requires the shutdown of building ventilation systems following detection of a UF_6 release to minimize the consequences to personnel (on and off site) during loss of confinement events.

4.6.1 Ventilation

In addition to general ventilation systems, and gulpers, portable ventilation units may be employed in the commercial ACP operation for short duration jobs when the unprotected worker could potentially exceed 0.8 Derived Air Concentration (DAC)-hours of exposure. These portable ventilation units are equipped with high efficiency particulate air (HEPA) filters and are designed to discharge room air at low velocities.

The differential pressure of portable HEPA filtered ventilation units is checked per operating procedure for radiological purposes. The operating differential pressure range is based on manufacturer's recommendations or as specified in the technical design basis. HEPA filter systems, both fixed and portable, are efficiency tested in accordance with American Society of Mechanical Engineers (ASME) N510-1989, *Testing of Nuclear Air- Treatment Systems,* as it applies to radiological contaminants likely to be found at the ACP. Portable HEPA filter unit use is normally specified on the RWP.

HEPA filter systems used to implement ALARA principles and to control worker exposures are tested in accordance with ASME N510-1989. For those systems not designed in accordance with ASME N509-1989, *Nuclear Power Plant Air-Cleaning Units and Components*, ASME N510-1989 is used as testing guidance.

The average air velocity through openings in uranium sampling and handling hoods containing readily dispersible uranium is a minimum of 100 linear feet per minute (lfpm). This velocity is checked at least annually.

If radiological containments are used, when they are in use and have the potential to generate airborne radioactivity, they will be maintained at a negative differential pressure.

4.6.2 Respiratory Protection

The Respiratory Protection Program follows the requirements of 29 CFR 1910.134 and 10 CFR Part 20 for use, issuance, training, and qualifications for respirator users. Procedures for respirator usage follow the requirements of 10 CFR 20.1703(c)(4). Records of respirator user training and fit testing are maintained as required by Section 11.7 of this license application. RWPs specify respiratory protection required for radiological protection purposes. Respirator use is considered for activities where an individual may be exposed to soluble uranium that may exceed 0.8 DAC-hours or an intake of 1 milligram (mg) of soluble uranium during a work shift.

Engineering and administrative controls, including access restrictions and the use of specific work practices designed to minimize airborne contamination or loss of contamination control are used to minimize worker internal exposure. When engineering and administrative controls have been applied and the potential for airborne radioactivity still exists, respiratory protection is used to limit internal exposures. Use of respiratory protection is considered under any of the following conditions:

- During entry into posted ARAs;
- During breach of contaminated systems or components;
- During work in areas or on equipment with removable contamination levels greater than 100 times the levels in Table 4.6-1; and
- During work on contaminated surfaces with the potential to generate airborne radioactivity.

In specific situations approved by the RPM, respiratory protection may not be used due to physical limitations, such as heat stress, or the potential for significantly increased external exposure. In such situations, stay time controls to limit intakes are established and continuous workplace airborne monitoring is provided along with expedited analysis of results.

Table 4.6-1 Contamination Levels

Nuclide[a]	Removable (dpm/100 cm^2)[b]	Total (Fixed + Removable) (dpm/100 cm^2)
U-natural, ^{235}U, ^{238}U, and associated decay products, Transuranics ≤ 2 percent by alpha activity, ^{99}Tc, and beta-gamma emitters	1,000	5,000
Transuranic modified materials containing > 2 percent and < 8 percent transuranics by alpha activity, Th-natural, ^{232}Th, ^{223}Ra, ^{224}Ra, and ^{232}U	200	1,000
^{226}Ra, ^{228}Ra, ^{230}Th, ^{228}Th, ^{231}Pa, ^{227}Ac, ^{125}I, ^{129}I, and Transuranics ≥ 8 percent by alpha activity	20	200

[a] The values in this table apply to radioactive contamination deposited on, but not incorporated into the interior of, the contaminated item. Where contamination by both alpha and beta-gamma-emitting nuclides exists, the levels established for the alpha- and beta-gamma-emitting nuclides apply independently.

[b] The amount of removable radioactive material per 100 square centimeters (cm^2) of surface area is determined by swiping the area with a dry filter or soft absorbent paper while applying moderate pressure and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency. For objects with a surface area less than 100 cm^2, the entire surface is swiped; and the activity per unit area is based on the actual surface area. Except for transuranics ≥ 8 percent by alpha activity, ^{228}Ra, ^{227}Ac, ^{228}Th, ^{230}Th, ^{231}Pa, and alpha emitters, it is not necessary to use swiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual contamination is within the levels for removable contamination.

The levels may be averaged over one square meter provided the maximum surface activity in any area of 100 cm^2 is less than three times the level specified. For purposes of averaging, any square meter of surface is considered to be above the level G if: (1) from measurements of a representative number of n of sections it is determined that $1/n \Sigma_n S_i \geq G$, where S_i is the disintegration per minute (dpm)/100 cm^2 determined from measurements of section i; or (2) it is determined that the sum of the activity of all isolated spots or particles in any 100 cm^2 area exceeds 3G. (G is defined as the levels listed above.)

4.7 Radiation Surveys and Monitoring Program

The Radiation Surveys and Monitoring Programs are based on the requirements of 10 CFR Part 20, Subpart F and ALARA principles. Written procedures are prepared for the elements of the Radiation Survey and Monitoring Programs discussed in this section. Deficiencies associated with surveys and the monitoring program or results that exceed the administrative control levels are dispositioned in accordance with the Corrective Action Program, described in Section 11.6 of this license application.

4.7.1 Surveys

The radiological survey program consists of routine, work support, and material release surveys (refer to Section 4.8.2.4 below). Surveys are conducted to support plant activities in a manner that ensures radiological hazards associated with each activity are properly identified, and relative radiation levels and concentrations of radioactive material are determined. Radiological surveys for the purposes of establishing personnel protection equipment or for posting requirements are performed by qualified ~~HP Technicians~~personnel. Decontamination is performed as appropriate considering the gained benefit from waste minimization, ALARA principles and worker access.

The routine survey program involves surveys to determine workplace radiological conditions, effectiveness of contamination control measures, and proper identification and posting of radiological hazards. Routine survey frequencies are established based on the stability of operations as demonstrated by the consistency of survey results. Areas within the plant are categorized and scheduled for survey commensurate with their relative radiological hazard and contamination potential. Survey frequencies are based on area occupancy, potential for spread of contamination, and process knowledge. The routine survey program is reviewed annually by the RPM, documented, maintained, and modified to reflect changes in radiological conditions. Table 4.7-1 provides the contamination survey program frequencies for ACP areas.

In the event that large areas of removable contamination are identified on accessible surfaces exceeding the levels specified in Table 4.6-1, the area will be re-posted as a Contamination Area (CA) or High Contamination Area (HCA) and actions will be taken to locate the source of contamination. If access is required to the area, decontamination of the area is initiated as soon as practical with consideration of ALARA principles.

Work support surveys are a fundamental element of the RWP process. In-process surveys are conducted as necessary to verify radiological conditions at various points in the work activity and to ensure exposure potentials are maintained in accordance with the ALARA principle. When required by work activities, surveys are conducted by qualified personnel to support decontamination efforts and the release of tools, equipment, and waste material from the work area.

4.7.2 Personnel Monitoring

~~Both the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Energy (DOE) regulated sources of radiation and radioactive materials are interspersed on the reservation. This situation makes separation of personnel exposure between NRC and DOE regulated sources impractical.~~

If required, ~~T~~to comply with the personnel monitoring requirements of 10 CFR 20.1502(a) and (b), 10 CFR 20.1202, and the reporting requirements of 10 CFR 19.13, 20.2106, and 20.2206, the ACP tracks exposures for personnel issued National Voluntary Laboratory Accreditation Program (NVLAP)-accredited dosimeters regardless of whether the exposure is from an NRC or DOE regulated source. Whenever worker notification is required by 10 CFR 19.13, the individual's "total exposure" while on the site is reported without differentiating between exposure from NRC-regulated sources and DOE-regulated sources.

~~The established~~ A personnel monitoring program ~~consists~~ can include~~of~~ the following as determined by the RPM:

- An Administrative Control Level (ACL) of 500 millirem (mrem) per year Total Effective Dose Equivalent per person;
- The intake limit for soluble uranium is set at 10 mg per week;
- Personnel dosimeters to measure the external exposure of personnel;
- Analysis of personnel occupational exposure and maintenance of exposure records; and
- A network of Fixed Nuclear Accident Dosimeters (FNADs) situated in the ACP areas requiring a Criticality Accident Alarm System. A NVLAP accredited dosimeter reader processes dosimeters in the FNADs. The ACP maintains onsite capability to determine neutron flux and energy. The FNADs also serve as area monitors.

Personal dosimeters are also evaluated for neutron dose. In addition, permanent site personnel are provided an indium foil that can be evaluated for neutron activation. If the indium foil indicates exposure to a neutron flux exceeding 10 rads, the dosimeter is read and/or biological materials of personnel may be evaluated.

4.7.3 External

Persons requiring radiation exposure monitoring per 10 CFR 20.1502(a) wear beta-gamma-sensitive dosimeters which are processed and evaluated by a processor holding current NVLAP accreditation from the National Institute of Standards and Technology (NIST). Dosimeters are exchanged at least quarterly (plus or minus two weeks) unless authorized in writing by the RPM. The dosimeters may be supplemented, as appropriate, ~~by other types of dosimeters (e.g., finger rings, direct-reading dosimeters, and neutron dosimeters) and~~ by radiation measurements made with radiation survey instruments. ~~Self-reading or alarming dosimeters are used for entry into HRAs or Very High Radiation Areas.~~

If an individual exceeds 50 percent of the ACL during a calendar quarter or the ACL in the calendar year, an evaluation is performed by the RPM for approval by the General Manager. The evaluation is performed to determine the types of activities that may have contributed to the worker's exposure. This may include, but is not limited to, procedural reviews, and review of work practices, work locations, and job assignments. Depending upon the conclusions of the evaluation, the individual may be allowed to continue radiological work; however, work restrictions may be imposed on individuals whose exposure exceeds the ACL.

Approval for continued work is documented in the evaluation, as described in the preceding paragraph, which requires approval by the General Manager. Investigations to determine cause, assess the exposure, and document the results are conducted in accordance with written procedures.

HP determines any unusual trends or exposures during reviews of external dosimetry results. If the external exposure status of an individual is uncertain, the individual is removed from further exposure until HP determines the exposure status and advises management of any special controls or restrictions to be applied.

To comply with the reporting requirements of 10 CFR 20.2206, the site submits personnel monitoring information for the Radiation Exposure Information Reporting System (REIRS) report based on the personnel exposure database. This includes summation of internal and external doses as outlined in Section 7 of Regulatory Guide 8.34, *Monitoring Criteria and Methods to Calculate Occupational Radiation Doses*.

The occupational exposure received by ACP employees, subcontractors, and visitors must not exceed the 10 CFR Part 20, Subpart C limits. The ACP requires current year exposure history of an occupational worker as required by 10 CFR 20.2104.

Personnel declaring pregnancy are advised to control radiation exposure to an embryo or fetus in accordance with the ALARA principle during the entire gestation period. The ACP complies with the guidelines of Regulatory Guide 8.13, Revision 2, *Instructions Concerning Prenatal Radiation Exposure.*

4.7.4 Internal

The chemical characteristics and retention times of soluble uranium processed at the ACP are such that renal toxicity limitations are the limiting conditions for health effects. A bioassay program is employed to confirm the results of radioactive material contamination control and respiratory protection programs. Bioassay results are the primary means of calculating internal doses. Personnel who have the potential to receive intakes resulting in a Committed Effective Dose Equivalent (CEDE) greater than or equal to 0.1 ~~roentgen~~ Roentgen ~~equivalent~~ Equivalent ~~man~~ Man (~~rem~~REM) CEDE in a year or intakes of 1 mg of soluble uranium per week participate in the routine bioassay program.

Personnel submit bioassay urine samples~~, such as urine or fecal samples, and participate in *Invivo* monitoring~~ as required by the bioassay program. Table 4.7-2 provides a summary of the bioassay program description and the analytical methods employed. The routine sample submission frequencies and administrative control levels are listed in Table 4.7-3.

Because chemical toxicity is limiting when personnel are exposed to soluble uranium, the uranium action levels have been selected to limit an individual's chronic intake to 10 mg of soluble uranium per week. Personnel participate in follow-up bioassay monitoring when their bioassay results exceed administrative control levels or as determined by HP. Special bioassay studies are performed as necessary and investigations performed when intakes are confirmed or suspected to exceed 1 mg of soluble uranium per week.

The ~~ACP~~ Licensee collects "random single void" urine samples from personnel. Isotopic analysis ~~of fecal samples and~~ of 24-hour urine sampling are not routinely performed, however, ~~these~~ 24-hour samples~~analyses~~ will be considered when dose assessments exceed 0.5 rem CEDE. Bioassay results are used to assign internal dose. ~~The sensitivities of lung counting systems are~~

~~not as effective as urinalysis for Class D uranium; lung counting is considered when intake estimates exceed 0.5 rem CEDE.~~

The CEDE per unit of intake by inhalation from Federal Guidance Report No. 11, *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion,* is used to calculate internal dose.

HP determines unusual trends during reviews of urinalysis results. If bioassay sample results indicate an internal exposure that exceeds action levels or appears uncertain, additional analyses and removal of the individual from further exposure are considered.

4.7.5 Airborne Radioactivity

The ACP air sampling program is consistent with the basic requirements of Regulatory Guide 8.25, *Air Sampling in the* Workplace, Sections 1, 2, 5, and 6. Routine general area air sampling is established in areas where airborne radioactivity concentrations may exceed 10 percent of the DAC listed in Table 4.7-4, averaged over 8 hours. Table 4.7-4 also summarizes the airborne radioactivity posting levels. Investigations are performed when airborne radioactivity data indicates personnel exposures exceed 0.8 DAC-hours. Special bioassay sampling is required when air samples exceed 0.8 DAC-hours. Adjustment for respirator use is considered in determining bioassay monitoring.

A combination of low-volume, high-volume, and lapel air samplers are used for job coverage and general area air sampling. Low-volume air samplers are used for routine air sampling and are exchanged at least weekly. Due to radon and radon daughter products, routine air samples are allowed to decay for a minimum of three days.

Air sample data is not used as the primary method to determine internal dose~~,~~. ~~however~~However, the data is used to prompt bioassay monitoring. Only air samples collected in the workers' breathing zone (approximately 30 cm) are considered representative.

Air sample flow measurement devices are calibrated under standard laboratory conditions at least annually. The NIST traceable standards used have accuracy and precision of 20 percent or better. Lapel samplers are calibrated in accordance with a procedure.

Table 4.7-1 Routine Contamination Survey Frequencies

Area Surveyed	Survey Frequency
Uranium Centrifuge Area	Yearly[a]
Contaminated Maintenance Areas	Quarterly
Contamination Control Zones (CCZ)	Quarterly
Lunchrooms/Breakrooms	Note c
Permanent Boundary Control Stations (BCS)[b]	Weekly
Change Rooms	Monthly
UF_6 Sample Handling Areas and Feed and Withdrawal Areas	Monthly[a]

[a] Localized area surveys are taken following an indication of release and during maintenance activities.

[b] When personnel contamination is detected at the BCS, the ensuing follow-up activities include a physical survey of the BCS.

[c] Surveys are performed daily during normal working days (i.e., Monday through Friday). Weekends and plant holidays are excluded.

Table 4.7-2 Bioassay Program

Urine Bioassay Capabilities	Comment
Workers Participation	Selected based on work locations
Frequency of Urine Monitoring	Monthly[a]
Routine Urine Sample Volume	Single void sample, between 60 and 100 mL
Primary Uranium Analysis Methods	Fluorimetry or Inductively Coupled Plasma (ICP) Mass Spectroscopy
ICP Mass Spectroscopy Minimum Detectable Concentration	<0.006 µg/L ^{235}U <0.015 µg/L ^{238}U
Fluorimetry Minimum Detectable Concentration	5 µg/L Total Uranium

Additional Analytical Capabilities	
Alpha Spectroscopy	0.1 pCi/sample[b]
Uranium Alpha with Proportional Counter	40 dpm/L Total Uranium in urine
~~Invivo Lung Counting~~	~~0.2 nCi ^{235}U~~ ~~4 nCi ^{238}U~~
Dose Assessment Software	INDOS (Routine Analysis) ~~CINDY (Developmental and Special)~~

a Samples scheduled for submission every four weeks.

b Equipment also used for loose contamination and airborne radioactivity samples for characterization efforts.

Table 4.7-3 Internal Dosimetry Program Action Levels

Bioassay Technique	Frequency	Action Level	Actions to be Taken
Urinalysis Routine	Monthly[a]	5 µg U/L	Resample to confirm result and determine intake[b]
	Monthly	20 µg U/L	Restrict individual and resample to determine intake[b]
Urinalysis Special	2-6 hours after intake	5 µg U/L 300 µg U/L	Resample to confirm result and determine intake[b] Restrict individual and resample to determine intake[b]
	16-30 hours after intake	5 µg U/L 50 µg U/L	Resample to confirm result and determine intake[b] Restrict individual and resample to determine intake[b]
~~**Lung Counting**~~	~~As Required~~	~~>100 :g ^{235}U or 7 nCi Total U~~	~~Recount to confirm result and perform urinalysis~~

a In addition, personnel may be assigned a special frequency if deemed necessary by HP.

b When intake is confirmed to be > 1 mg uranium, an investigation is performed to identify the source of the exposure, assess the impact, and if practical, a means to prevent reoccurrence.

Table 4.7-4 DAC and Airborne Radioactivity Posting Levels

NUCLIDE[a]	DAC[c, d]	POSTING LEVEL[b]
Gross Alpha based on Class D ^{234}U and 2 percent Class W ^{230}Th	1.0×10^{-10}	1.0×10^{-11}
Gross Alpha based on Class D ^{234}U and 8 percent Class W ^{230}Th	3.0×10^{-11}	3.0×10^{-12}
Gross Alpha based on Class W ^{230}Th	3.0×10^{-12}	3.0×10^{-13}
Gross Beta-Gamma based on Class Y ^{234}Th	6.0×10^{-8}	6.0×10^{-9}

a All values are listed with units of µCi/mL.

b Posting Levels are 10 percent of DAC.

c The values above are assumed as worst case, i.e., ^{230}Th is present in each mixture at the highest concentration per category as described.

d Area may be posted based on calculated DACs from actual airborne radioactivity concentration data.

4.8 Additional Program Elements

4.8.1 Posting and Labeling

Caution signs for Radioactive Material Areas (RMAs), ARAs, RAs, and HRAs are maintained as required by 10 CFR 20.1901, 20.1902, 20.1903, 20.1904, and 20.1905. RMAs located within a posted CCZ, CA, HCA, ARA, RA, HRA or other posted radiological area are not required to be posted as an RMA since a higher level of control is already required. In addition, as noted in Section 1.2.5 of this license application, the following exceptions to the applicable 10 CFR Part 20 requirements have been taken and require an exemption:

- UF_6 feed, product, and depleted uranium cylinders, which are routinely transported inside the reservation boundary between plant locations and/or storage areas at the plant, are readily identifiable due to their size and unique construction, and are not routinely labeled as radioactive material. Qualified radiological workers attend UF_6 cylinders during movement.

- Containers located in Restricted Areas within the ACP are exempt from container labeling requirements of 10 CFR 20.1904, as it is deemed impractical to label each and every container. In such areas, one sign stating that every container may contain radioactive material will be posted. By procedure, when containers are to be removed from contaminated or potentially contaminated areas, a survey is performed to ensure that contamination is not spread around the reservation.

- In lieu of the requirements of 10 CFR 20.1601(a), each High Radiation Area with radiation reading greater than 0.1 ~~rem~~REM/hour at 30 cm but less than 1 ~~rem~~REM/hour at 30 cm is conspicuously posted "Caution, High Radiation Area" and entrance into the area is controlled by an RWP. Physical and administrative controls to prevent inadvertent or unauthorized access to High and Very High Radiation Area is maintained.

4.8.2 Contamination Control

4.8.2.1 Access to Restricted Areas

Restricted Areas are areas to which access is limited to protect individuals against undue risks from exposure to radiation and radioactive materials. Unescorted access to Restricted Areas requires the successful completion of the appropriate level of radiological worker training and, if required, a personnel dosimeter. Depending upon the type and extent (or amount) of radioactive material present, Restricted Areas are further identified as RMAs, CCZs, CAs, HCAs, ARAs, RAs, or HRAs.

Radiological control is provided by controlling access to areas where radioactive material may be encountered and by requiring that each person who enters those areas receive the appropriate level of radiological worker training. Access and departure requirements are specified by procedure and/or reiterated in RWPs. Radiological posting is used to alert personnel to the presence of radiation and radioactive materials, aid in minimizing exposures, and prevent the spread of contamination. Where contamination is present, contamination controls are implemented.

Table 4.8-1 provides definitions and criteria used for posting ACP Restricted Areas.

4.8.2.2 Equipment and Personnel Monitoring

Personnel exiting areas controlled for removable contamination (CCZs and CAs) are required to monitor themselves for contamination after removing their protective clothing and prior to leaving the step-off pad area. Personnel monitoring requirements are specified on RWPs. Equipment and materials are monitored and decontaminated if required prior to removal from CCZs and CAs, or are contained and controlled as radioactive material.

4.8.2.3 Personal Protective Equipment

Personal Protective Equipment (PPE) is provided for personnel entering contaminated areas. The type(s) of PPE required is consistent with the individual's work assignment and is dependent upon the type and level of contamination anticipated. With the eException for of emergency evacuations, protective clothing is removed prior to exiting the Boundary Control Station as specified in Radiation Worker Training, RWP, area posting, or procedures. During emergency evacuations, personnel report to designated assembly points and/or monitoring stations where protective clothing is removed and contamination monitoring is performed.

Industrial safety equipment, such as face shields, goggles, and acid suits are available. In addition, full-face negative pressure respirators and full-face positive pressure respirators and other National Institute for Occupational Safety and Health and Mine Safety and Health Administration approved devices may also be utilized for respiratory protection in accordance with Section 4.6.2 of this chapter.

4.8.2.4 Release of Materials and Equipment

Materials and equipment are not released for unrestricted use unless the surface contamination levels are less than the levels specified in Table 4.6-1. Contamination surveys are performed on materials, equipment, and facilities to be released from radiological controls.

Use histories are used to supplement surveys of materials or equipment that have inaccessible surfaces. Use histories are summaries of the operational history of the item. Use history information includes the function, location(s) where the item was used, and other relevant evidence to assess the item's potential for internal contamination.

Total contamination in bulk, aggregate materials, or waste to be released for unrestricted use or disposal is specified in plant procedures.

4.8.3 Radioactive Source Control

The Radioactive Source Control Program maintains administrative and physical control of sealed radioactive sources. The Source Control Program establishes source custodians and requires leak testing, accountability, and control of sealed radioactive sources.

Each sealed source containing more than 100 microcuries (µCi) of beta and/or gamma emitting material or more than 10 µCi of alpha emitting material, other than ^3H, with a half-life greater than 30 days and in any form other than gas, is tested for leakage and/or contamination at intervals not to exceed six months. In the absence of a certificate from a transferor indicating that a test has been made within six months prior to the transfer, the sealed source is not put into use until tested.

Sealed plutonium alpha sources containing 0.1 µCi or more of plutonium, when not in use, are stored in a closed container designed and constructed to contain plutonium that might otherwise be released during storage. When in use, the ACP will test the sources at least every three months using radiation detection instruments capable of detecting 0.005 µCi of alpha contamination.

Leak tests are taken from the source or from appropriate accessible surfaces of the container or from the device where the sealed source is mounted or stored where one might expect contamination to accumulate. Leak testing is conducted by HP. The test is capable of detecting the presence of 0.005 µCi or more of removable contamination, or if a plutonium source has been damaged or broken, the source will be deemed to be loosing plutonium.

The ACP will immediately withdraw the sealed source from use and repair or dispose of the source, if determined to be leaking. Within five days after determining that any source has leaked, the ACP will file a report with the NRC Director, Nuclear Material Safety and Safeguards, describing the source, test results, extent of contamination, apparent or suspected cause of source failure, and corrective action taken. A copy of the report will be sent to the NRC Regional Administrator, Region II.

The periodic leak test does not apply to sealed sources that are stored and not being used. The sources excepted from this test will be tested for leakage prior to any use or transfer to another person unless they have been leak tested within six months, or three months for a sealed plutonium source, prior to the date of use or transfer.

4.8.4 Radiation Protection Instrumentation

Radiation dose rate and contamination survey instruments are selected to measure the types and energies of radiation encountered with gas centrifuge enrichment operations. The primary complement of instrumentation includes alpha/beta count rate and scaler instrumentation plus ion chambers used to evaluate shallow dose and deep dose equivalent readings. Table 4.8-2 describes typical instrumentation available to support the operation of the ACP.

The RPM is responsible for maintaining adequate quantities of calibrated radiation detection and measurement instruments.

Radiological portable instruments are calibrated based on specifications derived from applicable vendors manuals and other nationally recognized guidance as appropriate (e.g., National Council on Radiation Protection 112). The standards found in the ANSI N323 (1978) are followed except for Sections 4.6 and 5.1(3). The following requirements apply to all such equipment and instruments:

- Portable radiation detection and measurement instruments are inspected, maintained, and calibrated at least annually or removed from service.
- Instruments are calibrated following any maintenance, modification, or repair deemed likely to affect operation before being returned to service.
- Calibration sources and equipment used for dose rate instruments are within 5 percent (at 2 sigma) of the stated value and have documented traceability links to the NIST. Large area uranium slab sources are certified to 10 percent by NIST. Calibration sources used to calibrate contamination-monitoring equipment are within 20 percent (at 2 sigma) for activity and 10 percent (at 2 sigma) for surface emission rate.
- Portable HP instruments that are in use but do not have a built in automatic functional test feature are source checked daily, or prior to using the instrument if not used on a daily basis. Instruments with the automatic functional test feature that are in use are checked once a week.

4.8.5 Records and Reports

Radiological protection records demonstrate the effectiveness of the overall program and document personnel exposure. Records are maintained in the form required by 10 CFR 20.2110 and are retained as required by 10 CFR 20.2101 through 20.2106 according to the Records Management Program as outlined in Section 11.7 of this license application. The Licensee follows the guidance contained in ANSI N13.6, *Practice for Occupational Radiation Exposure Records Systems*, 1999 Edition, for radiological protection records.

Reports and notifications of RP issues are made pursuant to 10 CFR Part 20, Subpart M; 10 CFR 30.50; 10 CFR 40.60; 10 CFR 70.50; and/or 10 CFR 70.74. Events requiring reporting to the NRC are investigated, tracked in a database, and monitored through completion in accordance with the Corrective Action Program. Details of reporting and notification for ACP incidents are described in Section 11.6 of this license application.

Table 4.8-1 Posting Criteria

AREA	CRITERIA	POSTING
~~[a]~~Radiation Area measured at 30 cm	>0.005 rem/hr but ≤ 0.1 rem/hr	"CAUTION, RADIATION AREA" "TLD and RWP Required for Entry"
~~[a]~~High Radiation Area measured at 30 cm	>0.1 ~~rem~~REM/hour but ≤ 1.0 rem/hr	"CAUTION, HIGH RADIATION AREA" "TLD, Supplemental Dosimeter and RWP Required for Entry"
~~[a]~~High Radiation Area measured at 30 cm	>1.0 rem/hr	"DANGER, HIGH RADIATION AREA" "TLD, Supplemental Dosimeter and RWP Required for Entry"
~~[a]~~Very High Radiation Area measured at 1 m	> 500 rads/hr	"GRAVE DANGER, VERY HIGH RADIATION AREA" "Special Controls Required for Entry" "Contact PSS Before Entry"
Contamination (Removable)	Levels > 1 time but ≤ 100 times Table 4.6-1 values	"CAUTION, CONTAMINATION AREA" "RWP Required for Entry"
High Contamination (Removable)	Levels >100 Times Table 4.6-1 values	"CAUTION, HIGH CONTAMINATION AREA" "RWP Required for Entry"
Fixed Contamination[a]	Removable Contamination < Table 4.6-1 levels and total contamination levels > Table 4.6-1 column 3 values	"CAUTION, FIXED CONTAMINATION AREA"
Airborne Radioactivity Area	Levels 0.1 Times Table 4.7-4 DAC values	"CAUTION, AIRBORNE RADIOACTIVITY AREA" or "CAUTION AIRBORNE RADIOACTIVITY AREA" "Respiratory Protection Required"
Contamination Control Zone	Levels normally less than Table 4.6-1 removable column values with potential to exceed Table 4.6-1 removable column values	"CAUTION, CONTAMINATION CONTROL ZONE"
Radioactive Material Area or Radioactive Material Storage Area[b]	An amount of radioactive material used or stored exceeding 10 times the quantity of such material specified in 10 CFR Part 20, Appendix C	"CAUTION" "Radioactive Material Area" or "Radioactive Material Storage Area"

[a] If the area has been sealed with contrasting fixatives or alternative methods and labeled in accordance with methods approved by the RPM, the area is exempt from posting as a Fixed Contamination Area.

[b] Areas posted as a Contamination Control Zone, Contamination Area, High Contamination Area, Airborne Radioactivity Area, Radiation Area, High Radiation Area, or Very High Radiation Area need not be posted as Radioactive Materials Area.

Table 4.8-1 Posting Criteria (continued)

Definitions

Airborne Radioactivity Area (ARA) — Any area where the measured concentration of airborne radioactivity, above natural background, may be reasonably expected to exceed either: (1) 10 percent of the DAC sampled over 8 hours, (2) a peak concentration of 1 DAC sampled over no more than 1 hour, or (3) soluble uranium concentration exceeds 50 $\mu g/m^3$ averaged over 8 hours.

Contamination Area (CA) — An area where transferable contamination levels are greater than the release limits stated in Table 4.6-1, but less than or equal to 100 times those limits.

Contamination Control Zone (CCZ) — An area where transferable contamination levels are less than the release limits stated in Table 4.6-1. CCZs are essentially buffer zones established where discrete areas of contamination may be occasionally encountered as a result of plant size.

Fixed Contamination Area (FCA) — An area containing radioactive material that cannot be readily removed from surfaces by nondestructive means, such as casual contact, wiping, brushing, or washing.

High Contamination Area (HCA) — An area where transferable contamination levels are greater than 100 times the limits stated in Table 4.6-1.

High Radiation Area (HRA) — An area, accessible to personnel, in which radiation levels could result in a person receiving a dose equivalent in excess of 0.1 rem Deep Dose Equivalent (DDE) in 1 hour at 30 cm from the radiation source or 30 cm from any surface that the radiation penetrates.

Radiation Area (RA) — An area, accessible to personnel, in which radiation levels could result in a person receiving a dose equivalent in excess of 0.005 rem DDE in 1 hour at 30 cm from the source or from any surface that the radiation penetrates.

Radioactive Material Area (RMA) — An area or structure where radioactive material is used, handled or stored.

Restricted Area — An area, to which access is limited for the purpose of protecting individuals against undue risk from exposure to radiation and radioactive materials.

Very High Radiation Area (VHRA) — An area, accessible to personnel, in which radiation levels could result in a person receiving an absorbed dose in excess of 500 rads in one hour at 1 meter from a radiation source or 1 meter from any surface that the radiation penetrates.

Table 4.8-2 Radiological Protection Instrumentation and Capabilities

Instrument	Manufacturer	Use	Detection Limit
LB5100	Tennelec	Air sample counting and Removable contamination sample counting	alpha - 4 pCi beta-gamma - 8 pCi alpha- 20 dpm/100 cm^2 beta-gamma - 40 dpm/100 cm^2
~~LB1043AS~~	~~Berthold~~	~~Personnel contamination monitoring~~	~~5,000 dpm/100 cm^2 total contamination[a]~~
PCM2	Eberline	Personnel contamination monitoring	5,000 dpm/100 cm^2 total contamination
Ludlum 12 with GM probe	Ludlum	Alpha personnel contamination monitoring and removable contamination surveys	100 cpm above background[ba]
Ludlum 12 with alpha scintillator	Ludlum	Beta-gamma personnel contamination monitoring and removable contamination surveys	100 cpm above background[ba]
~~REM 500~~	~~Health Physics Instruments~~	~~Neutron Dose/Dose Rate~~	~~0.001 rem (rad)/hr - 999 rem (rad)/hr~~
~~Teletector~~	~~Eberline~~	~~Beta-gamma Dose/Dose rate~~	~~0 mR/hr - 1,000 R/hr~~
RO20	Ludlum	Beta-gamma Dose/Dose rate	0 mR/hr - 5 R/hr

[a] ~~The Berthold Monitors are set to alarm with 95 percent confidence upon detection of less than or equal to 5,000 dpm total contamination per detector. The actual detection limits are approximately 3-sigma above background, and depends on detector size, efficiency, background, and count time.~~

[ab] Personnel are trained in Radiation Worker Training to notify HP when contamination is detected greater than 100 counts per minute (cpm) above background. The maximum acceptable background count rate is 300 cpm.

[bc] Minimum calibration frequency is annual or manufacturer recommendations.

The instruments listed above are used for routine operations. Additional instruments are available to support emergency response.

4.9 References

1. ASME N509-1989, *Nuclear Power Plant Air-Cleaning Units and Components*

2. ASME N510-1989, *Testing of Nuclear Air-Treatment Systems*

3. ANSI/American Nuclear Society 3.1, *Selection, Qualification, and Training of Personnel for Nuclear Power Plants*, 1987 Edition

4. ANSI N13.6, *Practice for Occupational Radiation Exposure Records Systems*, 1999 Edition

5. ANSI N323-1978, *Radiation Protection Instrumentation Test and Calibration*

6. Federal Guidance Report No. 11, *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion*

7. NUREG-1520, *Standard Review Plan for ~~the Review of a License Application for a~~ Fuel Cycle Facilit~~y~~ies License Applications*, Revision 2

8. Regulatory Guide 8.13, Revision 2, *Instructions Concerning Prenatal Radiation Exposure*

9. Regulatory Guide 8.25, Revision 1, *Air Sampling in the Workplace*, Sections 1, 2, 5, and 6

10. Regulatory Guide 8.34, *Monitoring Criteria and Methods to Calculate Occupational Radiation Doses*, Section 7

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5.0 NUCLEAR CRITICALITY SAFETY

The American Centrifuge Plant (ACP) possesses large quantities of enriches uranium hexafluoride (UF_6) at enrichments of up to 10 weight (wt.) percent uranium-235 (^{235}U). The commercial ACP operation is designed to enrich and safely handle up to 10 weight (wt.) % uranium-235 (^{235}U). The HALEU Demonstration Program is designed to enrich and safely handle uranium with an operational limit less than 20.0 wt. percent ^{235}U; however, enrichment levels up to 25 wt. % ^{235}U are authorized to permit for process fluctuations which can result in higher weight percent material. The maximum acceptable enrichment is identified for each operation evaluated for nuclear criticality safety (NCS). The specific authorized uses for each class of U. S. Nuclear Regulatory Commission (NRC)-regulated material are shown in Table 1.2-2 3 (commercial ACP operation) and Table 1.2-4 (HALEU Demonstration Program) of this license application. The Licensee is required to comply with the performance requirements of 10 *Code of Federal Regulations* (CFR) 70.61. 10 CFR 70.61(d) requires that the risk of nuclear criticality accidents be limited by assuring that under normal and credible abnormal conditions, nuclear processes are subcritical, including use of an approved margin of subcriticality for safety. It also requires that preventive controls and measures must be the primary means of protection against nuclear criticality accidents. Accordingly, these requirements are implemented through this chapter summarizes the ACP Nuclear Criticality Safety (NCS) Program.

In accordance with the requirements contained in 10 CFR 70.62, the likelihood and risks of an inadvertent nuclear criticality weare evaluated in the Integrated Safety Analysis (ISA). The evaluation considersed moderation events, maintenance evolutions, machine upset conditions, and cylinder operations accident sequences caused by process deviations or other events internal to the facility and credible external events, including natural phenomena. Criticality Events are derived and evaluated through the process of generating Nuclear Criticality Safety Evaluations (NCSEs). In the case of the commercial ACP operation, Nuclear Criticality Safety Reports (NCSRs) were generated that will be transitioned to NCSEs prior to commencement of commercial plant operations. NCSEs will be developed based on the detailed design of the commercial ACP operationThe ISA effort documented these evaluations in NCS Reports that will in turn form the bases to develop Nuclear Criticality Safety Evaluations (NCSEs) addressing the detailed design. If changes to the ISANCSEs or NCSRs are identified during the development of the NCSEs, the Licensee will revise the ISA, as necessary, to include any new or updated event sequence information, identify additional double contingency controls, or credit additional items relied on for safety (IROFS). The ISA concluded that includes credible nuclear criticality accident scenarios that could be identified for the ACP were controlled through a combination of administrative and engineered controls to assure that all nuclear processes are subcritical under normal and credible abnormal conditions. Additionally, preventative controls and measures are the primary means of protection against criticality in compliance with the performance requirements of 10 CFR 70.61(d).

The plant has established a threshold of 1 wt. percent or higher enriched ^{235}U and 100 grams (g) or more of ^{235}U for determining when an evaluation for NCS considerations of planned operations must be performed. This 100 g ^{235}U mass is a minimum of a factor of 107 below the minimum critical mass, at 10 percent ^{235}U enrichment, regardless of whether the material is optimally moderated and fully reflectednon-oily, oily, or heterogeneous for a fully reflected system. Based on this, the value is sufficiently low to use as a threshold limit. In view of this threshold, many of the ACP NCS Program features described in this chapter may not be required to be implemented for operations below the threshold. ~~In this regard~~As described herein, the NCS Program provides the framework for a defense-in-depth philosophy to help ensure the risk of inadvertent criticality is maintained acceptably low. The NCS Program also provides the framework and resources for evaluating plant performance in establishing NCS analyses and controls for the design and operation of a uranium enrichment plant.

5.1 Management of the Nuclear Criticality Safety Program

5.1.1 Program Elements

The NCS Program described in this chapter is implemented by plant procedures. The NCS procedures address plant personnel NCS responsibilities, adherence to NCSE requirements, review and approval of fissile material operations, posting and labeling requirements, response to NCSE violations, and NCS training requirements. Controls and/or barriers that are relied on to prevent inadvertent criticalities are designated as IROFS in the ISA. The NCS Program meets the Baseline Design Criteria (BDC) requirements in 10 CFR 70.64(a)(9) concerning application of the double contingency principle in determining NCS controls and IROFS in the design of new facilities and new processes.

5.1.2 Program Objectives

The NCS Program meets the requirements of 10 CFR Part 70. The objectives of the program include:

- Preventing an inadvertent nuclear criticality;
- Protecting against the occurrence of an identified accident sequence in the ISA Summary that could lead to an inadvertent nuclear criticality;
- Complying with the NCS performance requirements of 10 CFR 70.61;
- Establishing and maintaining NCS safety parameters and procedures;
- Establishing and maintaining NCS safety limits and NCS operating limits for IROFS;
- Conducting NCS evaluations to assure that under normal and credible abnormal conditions nuclear processes remain subcritical, and maintain an approved margin of subcriticality for safety;
- Establishing and maintaining NCS IROFS, based on current NCS evaluations;
- Providing training in emergency procedures in response to an inadvertent nuclear criticality;
- Complying with NCS BDC requirements in 10 CFR 70.64(a)(9);

- Complying with the NCS ISA Summary requirements in 10 CFR 70.65(b); and
- Complying with the NCS ISA Summary change process requirements in 10 CFR 70.72; and
- Complying with the reporting requirements of 10 CFR 70.52 and 10 CFR 70 Appendix A.

5.2 Organization and Administration

5.2.1 Nuclear Criticality Safety Responsibilities

The ACP organization and administration are described in Chapter 2.0 of this license application. The General Manager assigns responsibilities and delegates commensurate authority to ACP managers/supervisors for the implementation and oversight of the NCS requirements. The managers/supervisors ensure that sufficient resources are available for implementation of NCS requirements. The Director, Nuclear Safety is responsible for implementing the ACP NCS Program. The Director, Nuclear Safety reports to the Senior Vice President, Field Operations and is responsible for the direct management of the NCS functions and administration of the NCS Program on a day-to-day basis. The management reporting structure for the ACP is depicted in Chapter 2.0 of this license application. The Director, Nuclear Safety has direct access to the General Manager for nuclear safety matters and reports directly to the Senior Vice President, Field Operations.

The ACP organization managers are responsible for ensuring that operations involving uranium enriched to 1 wt. percent or higher ^{235}U and 100 g or more of ^{235}U (hereafter referred to as fissile material operations) are identified and evaluated for NCS considerations prior to initiation of the operation. The organization managers or their designees are also responsible for ensuring NCS evaluations are requested, and for ensuring implementation of the requirements contained in the evaluations for these same operations. For those fissile material operations performed by personnel from multiple organizations, the General Manager assigns responsibility for that operation to a single organization manager or designee.

Management is responsible, in their respective operations, for ensuring that personnel are made aware of the requirements and limitations established by approved NCSEs either through pre-job briefings, required reading, training, and/or procedures (based on the complexity of the change). These managers/supervisors are responsible for ensuring fissile material operations that do not have approved NCSEs will not be performed until the necessary approvals have been obtained. Management is responsible for ensuring that only personnel who have received and passed NCS training as specified in ACP NCS procedures will handle fissile material.

Managers/supervisors who are responsible for one or more fissile material operations are trained in NCS and ensure appropriate personnel receive NCS training as specified in ACP NCS procedures. This training provides personnel with the knowledge necessary to fulfill their NCS responsibilities. Section 11.3.1.4 of this license application discusses the NCS training program for those who manage, work in, or work near facilities where the potential exists for a criticality accident to occur (i.e. where fissile material handling/operations are performed).

The fissile material operators are responsible for conducting operations in a safe manner in compliance with procedures ~~or work instructions~~ and are required to stop operations if unsafe conditions exist.

The Director, Nuclear Safety has, as a minimum, a bachelor's degree in engineering, mathematics or related science or equivalent technical experience, and six years nuclear experience, including six months at a uranium processing plant where nuclear criticality safety was practiced. The Director, Nuclear Safety or designee is responsible for the administration of the NCS Program. This includes reviewing the overall effectiveness of the NCS Program, ensuring that NCS staff members are placed, trained, and qualified in accordance with written procedures, and that NCSEs are prepared and technically reviewed by qualified NCS engineers. The NCS organization is independent of organizations that require NCSEs.

Qualified NCS Engineers and Senior NCS Engineers are responsible for performing the following functions:

- Providing NCSEs for fissile material operations;
- Performing walk-throughs of facilities which handle fissile material and advising appropriate management of any NCS concerns;
- Participating in investigation of incidents involving NCS and in the determination of recommendations for eliminating such incidents;
- Assisting in emergency preparedness planning;
- Providing support to the Plant Safety Review Committee (PSRC);
- Participating in the review of procedures that involve fissile material operations to ensure NCSE commitments have been effectively incorporated into operating procedures; and
- Participating in the review of work packages that involve fissile material operations ~~to ensure NCSE commitments have been effectively incorporated into work package instructions. For work packages that are used repeatedly for the same kind of job, the review is only necessary once. For work packages that have the NCSE commitments incorporated into an approved procedure, additional NCS review is not necessary~~, as requested.
- NCS group personnel have the authority to halt any unsafe activity.

The responsibilities of Senior NCS Engineers performing technical reviews of NCSEs are specified in the NCS evaluation and approval procedure. These responsibilities include:

- Verifying that sufficient information is documented to allow independent analysis by a reviewer with knowledge of the process and the NCS Program;
- Verifying that credible process upsets related to criticality safety are properly identified

and evaluated;

- Verifying compliance with the double contingency principle;
- Checking for accuracy; and
- Verifying applicability of the calculational methods.

5.2.2 Nuclear Criticality Safety Staff Qualifications

The minimum requirements for a qualified NCS Engineer are:

- Bachelor's degree in engineering, mathematics, or related science;
- Familiarization with NCS by having a minimum of one year experience at an enriched uranium processing facilityfacility that process fissionable material where nuclear criticality safety was practiced;
- Completion of NCS-related training course and KENO V.a training course or equivalent;
- Performance of at least four evaluations under the direction of a Senior NCS Engineer; and
- Performance of walk-through inspections under the guidance of a qualified NCS Engineer.

The Director, Nuclear Safety can modify the minimum qualified NCS Engineer qualification requirements for personnel who have worked for a minimum of three years at other facilities as an NCS Engineer.

The minimum requirements for a qualified Senior NCS Engineer are:

- Completion of the minimum requirements for a qualified NCS Engineer;
- Performance of the functions of a qualified NCS Engineer;
- Completion of one year as a qualified NCS Engineer; and
- Approval by the Director, Nuclear Safety.

The Director, Nuclear Safety may modify the minimum Senior NCS Engineer qualification requirements for personnel who have worked for a minimum of five years at other facilities as a nuclear criticality safety engineer.

5.3 Management Measures

5.3.1 Procedure Requirements

Operations to which NCS pertains are governed by written procedures or work packages. These procedures or work packages contain the appropriate NCS controls for processing, storing, and handling fissile material. The NCSE requirements that specify employee actions are incorporated into procedures, or work packages as work instructions and are identified. Identifying these requirements ensures changes to these requirements are not made without review and approval by NCS. The NCSE requirements are incorporated into the appropriate procedures or work packages as required by the NCS Program procedure.

New and modified procedures or work packages are reviewed by the appropriate safety organizations, including NCS, as specified in the procedure for procedure control and/or work control process. NCS reviews the procedures and/or work instructions to verify that the appropriate NCSE requirements have been incorporated and to verify that the proposed operation complies with NCS Program requirements. Section 11.4 of this license application provides more details related to the procedure development and change process.

5.3.2 Posting and Labeling Requirements

Administrative NCS limits and controls for areas, equipment, and containers are presented through the use of postings and labels as specified in approved NCSEs and procedures. Postings and labels are proposed, reviewed, and approved during the NCSE implementation process. review and approval process. Postings and/or labels are not required for engineered controls and may not be required for administrative controls when those limits and controls are included in "in-hand" operating procedures. These limits and controls are posted on the NCS requirements signs that are controlled and maintained according to as required by the plant NCS procedures. Approved NCSEs specify the wording for the postings. Labels are also prepared in accordance with the plant NCS procedures and used as required bydetermined during NCSEs implementation. Limits and controls are printed or written in an appropriate size, and the postings and labels are placed in conspicuous locations such that they are legible to the operator at the work location, on the specific component, item, or piece of equipment, or posted at the entrance to an operating area or storage area. The specific locations may be specified in the applicable NCSE or determined by the supervision responsible for the material.

5.3.3 Change Control

A configuration management (CM) program ensures that any change from an approved baseline configuration is managed so as to preclude inadvertent degradation of safety or safeguards. The CM Program, described in Section 11.1 of this license application, includes organization and administrative processes to ensure accurate, current design documentation that matches the plant's physical configuration. NCS controls that are IROFS are controlled as QL-2 items and NCS controls that are not IROFS are controlled as QL-3 items. The methodology for designating NCS engineered and administrative controls as IROFS is described in Section 3.1.2.3.2.7 for commercial ACP operations and Section 3.1.2.3.2.8 for HALEU Demonstration. The CM program applies to NCS and a change control process is utilized that helps ensure that the requirements of 10 CFR 70.72 are met, including the ISA Summary update requirements contained in 10 CFR 70.72(d)(3).

Functional and physical characteristics of operationsNCS engineered controls controlled for

NCS are described in NCSEs and the ISA. When an NCS engineered control isthose characteristics are required to maintain classified as an IROFS, the management measures described in the CM program associated with the QL-2 classification are applied. Some NCS controls associated with the commercial ACP operations are not IROFS and are classified as QL-3 items. When those functional and physical characteristics are required to maintain double contingency, but are not IROFS, the management measures in the CM program associated with the QL-3 classification are applied. Non-IROFS double contingency controls will be handled as QL-3 items.

QL-3 is a quality grouping for structures, systems, and components required to fulfill the functions and meet the requirements established by the license application. For NCS controls that rely on certain structures, systems, or components, the portions of the CM program within the QL-3 classification as described in this section, as well as the following minimum features, are applied to those structures, systems, and components:

- Components are identified and controlled;
- Modifications are documented and reviewed;
- Change control process is applicable;
- Setpoints and tolerances are established for applicable components;
- Engineering drawings or specifications are provided;
- Procurement controls are provided; and
- Receipt inspection is used when specified.

Components and features that are identified in the NCSEs or the ISA are analyzed to determine the "boundary" of the system, encompassing those interconnecting and/or supporting items that are essential to ensure availability and reliability. The boundaries are identified on system drawings and/or other design outputs, and the configuration is verified to be as-built. These components and features are maintained in a design control document for the building or process. Each time a change is planned, the document is reviewed by the individual (e.g., design authority, system engineer, operations manager, maintenance, etc.) planning the change to determine if the change affects an IROFS/NCS or double contingency control. Changes that could establish new fissile material operations or affect established fissile material operations are reviewed by NCS. The NCS Program establishes and maintains NCS safety limits and NCS operating limits for IROFS/NCS and double contingency controls in nuclear processes and maintains adequate management measures to ensure the availability and reliability of the IROFS/NCS and the double contingency controls. Operating limits may be established during flow down of NCS safety limits to ensure their continued reliability and availability.

The change control process specifies the organizations required to perform reviews of changes. Changes that affect existing fissile material operations are evaluated by NCS If an item is relied on for the criticality safety of an operation (i.e., is an IROFS or a double contingency control),

~~it will be identified and NCS reviews the NCSE for the specific operation and~~ to determines if the change affects the analysis performed and the conclusions made in the NCSE. The change request will be approved by NCS only if the change does not adversely impact NCS, or once a revised NCSE has determined that the change is acceptable and meets NCS Program requirements. If a change affects the ISA Summary, it is updated appropriately. In this way, modifications to controlled operations are evaluated and approved prior to implementation and placing the affected structures, systems, or components in service.

Records management and document control (RMDC) is another element of CM and is described in Section 11.7 of this license application. Procedures, documents, and records control programs provide for centralized control and issuance of documents essential to the maintenance of the design history, and a repository for records to verify this maintenance. NCSEs are specifically included in the index of documents that are required to be controlled.

5.3.4 Operation Surveillance and Assessment

To ensure that the NCS Program is properly established and implemented, walk-throughs, assessments, and audits are utilized. These activities are specified in ACP procedures.

Operating ~~SNM~~fissile material process areas are reviewed on a regular basis through a combination of walk-throughs and reviews by work crew supervision. NCS walk-throughs of facilities that may contain fissile material operations are performed by NCS personnel to determine the adequacy of implementation of NCS requirements and to verify that conditions have not been altered to adversely affect NCS. These walk-throughs are performed as specified by the ACP NCS procedures ~~on walk-throughs~~. For example, a walk-through inspection can be performed in response to trend data, at the request of the operations personnel, or due to concerns raised by employees or NCS personnel. As a minimum, ~~specific~~ fissile material operating areas are assessed by NCS personnel via walk-through at least annually, sometimes in conjunction with the assessments discussed below. ~~By distributing the various areas' walk-throughs over a year's time, NCS personnel are performing a field walk-through on approximately a monthly basis.~~

Work crew supervision provides real-time assessments of fissile material operations within their operating area to ensure NCS requirements are being adequately implemented and operating conditions have not been altered to adversely affect NCS. Fissile material operations management also performs an annual self-assessment to ensure NCS program requirements are being met in the field.

In addition to the annual self-assessments, independent internal audits of the NCS Program are conducted or coordinated by the Piketon Quality Assurance Manager as described in Section 11.5 of this license application. The purpose of these audits is to determine the adequacy of the overall NCS Program. This includes the adequacy of the NCSEs, internal assessment programs, and implementation of the NCS requirements.

The results of these walk-throughs, assessments, and audits are documented and reported to appropriate management. If a condition is identified that is non-compliant with NCS program requirements, field personnel are to report the condition as directed by plant procedures. If the condition is not covered by an existing procedure, consultation with a qualified NCS engineer is required before taking any corrective action. Immediate corrective actions may be provided by the responding NCS engineer verbally or in writing. NCS emergency response is discussed in Section 5.4.2 below and is described in more detail in Chapter 8.0 of this license application.

Managers in charge of fissile material operations are provided additional training on NCS and response to NCS deficiencies as described in Section 11.3.1.4 of this license application and the ACP NCS procedures. Each NCS non-compliance is evaluated by an NCS engineer to determine the impact on double contingency and 10 CFR 70.61 performance requirements. The "as found" field conditions are reviewed against the applicable NCSE and supporting calculational documents to support the shift supervisor in determining reporting requirements.

NCS deficiencies are reported in accordance with the requirements contained in 10 CFR Part 70, Appendix A or other appropriate reporting requirements. Incident reporting and investigation is described in Section 11.6 of this license application. The deficiency data is trended to monitor and prevent future violations. Corrective actions are taken for identified deficiencies in accordance with the Quality Assurance Program Description for the American Centrifuge Plant and the Corrective Action Program as described in Section 11.6 of this license application. , and rRecords of actions taken are retained in accordance with RMDC requirements described in Section 11.7 of this license application.

5.4 Methodologies and Technical Practices

5.4.1 Adherence to American National Standards Institute/American Nuclear Society Standards

The NCS Program has been developed to comply with the requirements of American National Standards Institute (ANSI)/American Nuclear Society (ANS) ANSI/ANS-8.1-1998,2014, ANSI/ANS-8.3-1997, ANSI/ANS-8.19-20141996, and ANSI/ANS-8.20-1991, ANSI/ANS-8.21-1995, ANSI/ANS-8.23-2007, and ANSI/ANS-8.24-2017 standards as discussed in this section with the exceptions noted in Section 1.4.

5.4.2 Process Evaluation and ApprovalNuclear Criticality Safety Evaluation

Each operation involving uranium enriched to 1 wt. percent or higher ^{235}U and 100 g or more of ^{235}U is evaluated for NCS prior to initiation. The evaluation describes the scope of the operation, evaluates credible criticality accident contingencies, and establishes NCS requirements to maintain the operation subcritical. The evaluation process is governed by written procedures.

When an NCSE (or a change to an existing NCSE) is needed for a particular fissile material operation, a request is submitted to the NCS group to evaluate the proposed operation. Other methods for initiating an NCS change include, but are not limited to;: 1) the engineering change process, and 2) the corrective actions process, self-assessments, and external audits and inspections.

In response to the request, an NCS evaluation may be performed or the request may be returned due to inadequate detail, the change is bounded by a current analysis, or the operation does not involve uranium enriched to 1 wt. percent or higher ^{235}U and with mass of 100 g or more ^{235}U (see Section 5.4.2.1). If necessary, a NCSE is prepared (or an existing NCSE is revised) to document the analyses performed as specified in the NCS evaluation procedure. A hazard identification process (e.g., a "What-If" analysis) is used to identify and document potential upset conditions, or contingencies, presenting NCS concerns. Engineering judgment of the qualified NCS engineer may indicate the need for a more detailed study. For example, a hazards and operability study may be used if the operation is complex and involves multiple interacting systems that require substantial input from operations, maintenance, and other subject matter experts to identify the possible upset conditions. A contingency analysis is performed in which the subcriticality of a process, given the occurrence of the contingency, is assessed. This analysis demonstrates the double contingency principle for the proposed operation.

Fissile material operations must comply with the double contingency principle. The double contingency principle as stated in ANSI/ANS-8.1-~~1998,~~2014, Section 4.2.2, is "Process designs 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." The ACP NCS Program meets the double contingency principle by implementing at least one control on each of two different parameters or implementing at least two controls on one parameter. Controls include passive engineered barriers (e.g., structures, vessels, piping, etc.); active engineered features (e.g., valves, thermocouples, flow meters, etc.); reliance on the natural or credible course of events (e.g., relying on the nature of a process to keep the density of uranyl fluoride less than a specified fraction of theoretical); and administrative controls that require performance of human actions in accordance with approved procedures ~~or work instructions~~, or by other means that limit parameters within specified values. If two controls are implemented for one parameter, the violations or failure scenarios addressed by the controls will be independent. Application of this principle ensures that no single credible event can result in an accidental criticality or that the occurrence of events necessary to result in a criticality is not credible.

The NCSE will document the basis for the conclusion that a change in a process or parameter is "unlikely." The basis may be an engineered feature, administrative control, the natural or credible course of events, or any combination of these or other means necessary to ensure the change is unlikely to occur. Where practical, the use of explicit NCS controls will be used as the preferred approach over the reliance on natural and credible course of events. The parameters or conditions relied on and the limits must be specified and justified in the NCSE and controlled. Management measures described in Chapter 11.0 of this license application and other safety programs are sometimes used to help ensure a change in a process or parameter is "unlikely." For example, the Radiation Safety Program and/or the Fundamental Nuclear Material Control Plan may be credited with providing controls on fissile material handling; the Fire Safety Program may be credited with providing controls on combustible material loading and/or hot work activities in fissile material processing/storage areas; the Procedures Program may be credited with ensuring compliance with procedures; etc.

Where the natural or credible course of events is relied upon in whole or in part to prevent a process condition change, no specific additional controls will be necessary to maintain them. The factors that influence the process are described in sufficient detail in the NCSE as items related to NCS and programmatically controlled. For items that are established, maintained, and implemented by non-NCS programs, credit for availability and reliability is established as described in Section 11.1 of this license application without the need for additional NCS controls. For situations where the NCS-credited controls do not provide adequate assurance of availability or reliability (i.e., situations where non-NCS programmatic and physical plant changes could adversely affect the intended criticality safety function of the items relied upon for criticality safety), specific NCS controls are established, maintained, and implemented to ensure criticality safety.

~~Use of the natural and credible course of events or other means in lieu of specific administrative or engineered controls for double contingency protection requires prior NRC review and approval. The request for review and approval will include a justification of why administrative or engineered controls are not needed, a description of the proposed measures in sufficient detail to permit an understanding of their safety function, and a justification of their inherent unlikeliness. This requirement does not apply to NCS reliance on the proper implementation of other plant programs or management measures that are described in Chapter 11.0 of this license application. This requirement also does not apply to accident sequences determined to be non-credible or those sequences which do not result in a critical configuration even with the loss of both double contingency controls.~~

The NCS evaluation process involves a review of the proposed operation and procedures ~~or work instructions~~, discussions with the subject matter experts to determine the credible process upsets which need to be considered, development of the controls necessary to meet the double contingency principle, and identification of the assumptions and equipment (i.e., physical controls) needed to ensure criticality safety.

Engineering judgment of both the analyst and the technical reviewer is used to ascertain independence of events and their likelihood or credibility. The basis for this judgment is documented in the NCSEs. Depending on the complexity of the operation, analytical methods such as Fault Tree and Event Tree Analyses may be used in the evaluation process to examine potential accident scenarios. ~~When needed to support the analytical method, q~~Qualitative or quantitative estimates of event frequency ~~are~~ may be developed to support the determination of the likelihood of an event.

Once the NCSE is completed, a technical review of the evaluation is performed and documented. The technical review of an NCS evaluation is performed by a Senior NCS Engineer or ~~is~~ an NCS Engineer completing the technical review under the guidance of a Senior NCS Engineer.

The NCSE documents the NCS requirements for the operation. The NCS requirements include the process conditions that must be maintained to meet the double contingency principle or preserve the documented basis for criticality safety and restrict the modes of operation to those that have been analyzed in the NCSE. The requirements to be included in operating procedures ~~and/or work instructions,~~ and postings are identified.

The NCSE approval process ~~first~~ involves the acceptance of the NCSE by the technical reviewer. The supervisor of the affected operation also reviews the NCSE to confirm the NCSE adequately identifies normal and credible abnormal conditions and establishes requirements that are verifiable and compatible with the planned operation. A review is then performed by tThe Director, Nuclear Safety performs a review to ensure consistency with other NCSEs and other potentially conflicting requirements or regulations. After approval by the Director, Nuclear Safety, a review is performed in accordance with 10 CFR 70.72 as described in Section 11.1.4 of this license application to determine whether prior NRC approval of the NCSE is required. PSRC approval is required for initial NCSE approval and for changes that impact the ISA Summary. After initial approval, if NRC approval is not required and the change does not impact the ISA Summary, the NCSE is reviewed by the responsible organization manager. Editorial changes require only the approval of the Director, Nuclear Safety. Editorial changes are defined as changes that do not change the technical basis of the NCSE. Once approved, the NCS controls, limits, evaluation assumptions, and safety items are verified to be fully implemented in the field. The operationsoperating organization and NCS personnel perform this verification process. The documentation of this verification process is maintained as a quality record along with the NCSE.

Management of the operating organization is responsible for implementing, through training and procedures or work instructions, the conditions delineated in the NCSE. Operational aids such as postings, labels, boundaries for fissile material operations, and fissile material movement guidelines are providedmay be used to as specified inimplement the NCSE. The manager/supervisor ensures postings and labels are prepared and verify that they are properly installed as required by the to support implementation of the NCSE. The procedures and/or work instructions are prepared or modified to incorporate the NCSE requirements. Managers/supervisors are responsible for ensuring the employees understand the procedures and/or work instructions and understand the NCS requirements before the work begins.

Each completed NCSE is issued as a controlled document. Completed NCSEs are archived and retrievable as permanent quality records in accordance with the RMDC requirements described in Section 11.7 of this license application. The NCSE process provides assurance that operations will remain subcritical under both normal and credible abnormal conditions.

Emergencies arising from unforeseen circumstances can present the need for immediate action. If NCS expertise or guidance is needed immediately to avert the potential for a criticality accident, direction will be provided orally or in writing. Such direction can include a stop work order or other appropriate instructions. Documentation will be prepared within 48 hours after the emergency condition has been stabilized.

New operations must comply with the double contingency principle.

5.4.2.1 Non-Fissile Material Operations

Some operations involve situations in which the uranium has an enrichment of less than 1 wt. percent ^{235}U or an inventory of less than 100 g ^{235}U. These operations are termed "non-fissile material operations" and are performed without the need for NCS double contingency controls. The determination of which operations are fissile versus which operations are non-fissile are made by NCS and may be contained within a NCSE or as a separate document. When the determination is outside a NCSE, the determination need not be performed by a qualified NCS Engineer. The determination of an operation being non-fissile must include normal and credible abnormal upset conditions to ensure the enrichment and/or inventory are maintained below 1 wt. percent ^{235}U or below 100 g ^{235}U. Controls are sometimes applied to a non-fissile material operation to ensure it does not inadvertently involve fissile material. This determination is made by an NCS engineer in collaboration with the responsible line manager.

5.4.3 Design Philosophy and Review

Through the CM Program, designs of new fissile material equipment and processes must be approved by NCS before implementation. Where practical, the use of engineered controls on mass, geometry, moderation, volume, concentration, interaction, or neutron absorption will be used as the preferred approach over the use of administrative controls. Advantage will be taken of the nuclear and physical characteristics of process equipment and materials, provided control is exercised to maintain them if they may credibly degrade such that control of the parameter is jeopardized.

~~The preferred design approach includes two goals. The first is to design equipment such that NCS is independent of the amount of internal moderation or fissile concentrations, the degree of interspersed moderation between units, or the thickness of reflectors. The second is to minimize the possibility of accumulating fissile material in inaccessible locations and, where practical, to use favorable geometry for those inaccessible locations. Passive design controls are preferred to active design controls.~~ The preferred design approach establishes a ~~preferred~~ hierarchy of controls. The use of passive engineered controls; in particular, passive engineered geometry control is the most preferred. The order of preference for NCS controls is (1) passive engineered, (2) active engineered, (3) enhanced administrative, and (4) simple administrative controls. The adherence to ~~this~~the preferred design approach is ~~determined~~utilized during the preparation and technical review of the NCSE performed to support the equipment design. This preferred design approach is implemented as described in NCS procedures. Deviations from the preferred design approach are justified in supporting documentation to the NCSEs.

Fissile material equipment designs and modifications are reviewed to ensure that engineered controls are used for NCS to the extent practical. Administrative limits and controls will be implemented to satisfy the double contingency principle for those cases where the preferred design approach is not practical.

5.4.4 Criticality Accident Alarm System Coverage

A criticality accident alarm system (CAAS) that complies with 10 CFR 70.24 and ANSI/ANS~~I~~-8.3-1997 is provided to alert personnel if a criticality accident occurs. The system utilizes an audible and/or visual signal to alert personnel in the area to evacuate to reduce radiation exposure resulting from the incident.

The need for CAAS coverage is considered during the development process for NCS evaluations. In general, coverage is provided for fissile material operations, except the UF_6 cylinder storage yards as specified in Section 1.2.5 of this license application. Other exceptions to CAAS coverage are documented in NCS evaluations and are based on a conclusion in the NCSE that a criticality accident is non-credible in the area where the fissile material operation is ongoing. Conclusions of non-credibility require at a minimum that the inventory of ^{235}U in the area is less than 700 g. In addition, CAAS is not required for areas having material that is either packaged or stored in accordance with 10 CFR Part 71 or specifically exempt according to 10 CFR 71.15~~53~~. Areas that do not contain fissile material operations do not require a NCSE and do not require CAAS coverage.

The CAAS is designed to detect gamma ~~neutron~~ radiation levels that would result from the minimum criticality accident of concern as defined by ANSI/ANS 8.3-1997 and to provide ~~an audible evacuation alarm~~annunciation by audible evacuation alarms that are supplemented by visual alarms in some areas, such as high-noise areas. A secondary function is to activate the building radiation warning lights and alarms at the X-3012 Process Support Building Area Control Room (ACR). ~~and the X-1020 Emergency Operations Center~~

For each area requiring CAAS coverage, a monitoring system is installed that provides coverage of the area by at least ~~two~~ one independent detection unit~~s, each with the ability to actuate the alarm. This arrangement allows for one detection unit to be temporarily out of service with fissile operations continuing under the coverage of the other detection unit~~. A detection unit is a set of at least three ~~neutron sensitive~~ radiation detectors that may be co-located or may be distributed over the area. The detection logic of the system requires that two of the three ~~neutron~~ detectors must be activated to initiate the building evacuation alarm system. Each detector may be logically part of more than one detection unit.

The building evacuation alarm system includes interior evacuation horns and exterior radiation warning lights to deter personnel from re-entering the building after an evacuation. In addition, facilities within ~~200~~125 feet of a building/facility requiring CAAS coverage have radiation evacuation horns installed inside and radiation warning lights installed on the exterior. Personnel who have routine access to these facilities have been trained to recognize and respond to these indications as described in Section 11.3.1.1.2 of this license application.

To protect against the loss of coverage, the CAAS includes redundant decision logic, a backup power supply, detector status information and system self-diagnostic information are provided to the X-3012 building ACR ~~and X-1020 building~~. The CAAS has been designed to survive and/or withstand credible abnormal events as described in the accident analysis for a sufficient time to warn personnel to evacuate. In the event CAAS coverage is lost for an operation, plant procedures provide for compensatory actions, which may include shutdown of equipment, limiting access, halting movement of uranium-bearing material, or other actions, such as use of personal alarming dosimeters for personnel that must access the area during a CAAS outage.

Potential criticality accident locations and predicted accident characteristics are evaluated and documented in sufficient detail to assist in emergency planning as described in ANSI/ANS-8.23-2007. Additional information ~~provided by the CAAS includes a historical log of events and the capability to monitor and record the criticality accident for managing the post-accident situation and any remedial action. N~~regarding nuclear accident planning and response is discussed in ~~Section~~Chapter 8 ~~2.2.4 of the Emergency Plan for the American Centrifuge Plant~~.

5.4.4.1 Portable CAAS

In the event a fissile material operation requiring CAAS coverage is performed beyond the detection range of established CAAS instrumentation, a portable unit may be used. The portable unit has the same detection capabilities as the permanently installed units~~, although those capabilities may be based on gamma radiation~~. Alarm annunciation, however, is usually limited to the immediate area within the audible range ~~(confirmed to 65 feet or more)~~ of the unit's alarm with an additional telemetric link to the X-3012 ACR~~ and X-1020~~. This link will transmit the location of the unit, if mobile, and allow the use of the plant PA system to warn personnel within <u>125</u>~~200~~ feet of the area of the portable unit to evacuate. A portable unit will not be used for more than 24 continuous hours and it may be located indoors, outdoors, or on a vehicle.

If fissile material operations in an area without a permanently installed CAAS are required to exceed 24 continuous hours, all personnel not directly involved in the affected operations, or otherwise required for the safety or security of the facility, will be evacuated from an area within a ~~65~~<u>125</u> foot radius of the fissile material until the operations are concluded. In addition, affected operations shall be terminated as soon as safely achievable.

5.4.5 Technical Practices

5.4.5.1 Application of Parameters

<u>The primary parameters utilized in the NCSEs are summarized below, along with examples of how the parameters are controlled at the ACP. More details on the technical practices associated with evaluating and implementing controlled parameters is provided in the NCS program procedures.</u>

<u>Moderation</u>

Water is considered to be the most efficient moderator commonly found in the ACP. This is because optimally moderated UO_2F_2/water solutions are more reactive than hydrocarbon oil/UF_4 solutions at worst credible concentrations experienced in vacuum pumps (Reference ~~13~~<u>15</u>). When moderation is not controlled either optimum moderation or worst credible moderation is assumed as the normal case when performing analyses. When moderation is controlled, credible abnormal process upset conditions determine the worst-case moderated conditions. Generally, moderation control is not maintained by measurement; however, when used, dual independent sampling methods are implemented.

Moderation control is applied to <u>prevent moderators (other than moderation due to air in-leakage) from entering</u> plant equipment containing UF_6. In areas where greater than the safe mass of uranium (as defined below) is handled, processed, or stored and moderation controls are applied, that facility's pre-fire plan (reference Section 7.1.4 of this license application) includes any unique firefighting strategy or tactics that may be needed to limit the use of moderator material. However, even in these areas, the application of the double contingency principle ensures the worst credible loss of moderation control cannot result in a critical configuration without an additional independent and concurrent upset event.

The centrifuge process equipment is comprised of a variety of closed systems designed to process gaseous UF_6. This closed system ~~prevents~~ minimizes the introduction of moderation due to wet air in-leakage. ~~Also, b~~Because UF_6 reacts chemically with moisture (a moderator) to produce solid uranium-bearing compounds that impedes the proper operation of the process equipment, the UF_6 bearing systems are designed to minimize introduction of moisture.

Moderating materials can be present as interstitial moderators that are in solution or intermixed into the fissionable material compound (e.g., water in uranyl fluoride solution). Moderating materials may also be present as interspersed moderators that exist as moderating materials located between distinct lumps or regions of fissionable material (e.g. sprinkler activation). ~~Interstitial~~ Interspersed moderation issues are discussed in the *Reflection* section, below.

Volume

Volume limits are used as specified in NCSEs. The bases for volume limits are provided in each NCSE prepared for those operations requiring containers. Specific details of these bases can be obtained by referring to the applicable NCSE. When volume control is used, the size of the containers is ensured through the CM Program and/or by procedurally requiring the use of certain containers for fissile material operations.

Interaction

Interaction is controlled by spacing items bearing fissile material when those items could result in a criticality accident if not properly spaced. The spacing necessary to maintain a safe array of fissile material units is determined in the NCSE performed for the array. The amount of spacing needed between items is determined based on analysis of the normal and credible abnormal process upset conditions for the particular operation. The basis for the spacing is documented in NCSEs. In accordance with the preferred design approach, described in Section 5.4.3 of this chapter, passive engineered controls are used to the extent possible to ensure spacing requirements are maintained. When used, the structural integrity of the spacers or racks is sufficient to maintain spacing for normal and credible abnormal upset conditions.

Geometry

Geometry control is applied by limiting equipment dimensions for those systems that depend on the geometry for criticality safety. The geometry is determined in the NCSE that is performed for each system and depends on the normal and credible abnormal process upsets conditions related to the specific system. Geometry controls are specified in the NCSEs, are maintained by the CM Program, and are verified prior to authorizing initial operation. "Safe geometry" is a term typically used to describe systems that are not dependent on any other nuclear parameter for criticality safety. "Favorable geometry" is a term typically used to describe systems that rely on one or more stated parameters to maintain criticality safety. However, the use of these terms is not rigidly applied throughout the available literature. Both "safe geometry" and "favorable geometry" dimensions may be obtained from established standards or operation specific reactivity calculations.

Mass

Mass controls are applied on a case-by-case basis depending on the fissile material operation involved. The acceptable mass is determined based on the specific NCSE performed for the operation. The safe mass value depends on many factors including the geometry, the ^{235}U enrichment, composition, etc. Safe mass values may be obtained from established standards or operation specific reactivity calculations. "Safe mass" is defined as ~~being not more than 43.5 percent of minimum critical (k_{eff} ≅ 1.0) mass for specific system conditions of enrichment, geometry, moderation, reflection, etc.~~ the quantity of fissile material that is safely subcritical under the most reactive credible conditions (defined for a given isotopic composition and physiochemical form), including allowance for overbatching. Experimental data is not used as the sole source for safe mass values. Safe mass values are chosen to ensure no single credible upset can result in a critical configuration. When safe mass values are dependent on the geometry, enrichment, composition, or some other parameter, the combination of mass and the other parameter is used as one control to meet the double contingency principle. The safe mass values are communicated to the operating personnel via the operating procedures ~~and/or work packages~~.

Unless specifically controlled, an item containing enriched uranium is assumed to contain the most ^{235}U credible based on the available volume. When mass is determined through measurement, instrumentation that is subject to management measures is used.

Enrichment

Uranium-containing material in the ACP with ^{235}U enrichment less than 1 wt. percent is considered incapable of supporting a nuclear chain reaction, but interaction of such materials with materials of higher enrichment is taken into consideration in the specific NCSE for those operations which involve material enriched to greater than 1 wt. percent.

The ~~maximum~~ ^{235}U enrichment of UF_6 in the ACP HALEU cascade is ~~10~~ limited to less than 20 wt. percent with the potential for momentary enrichment transients up to 25 wt. % ^{235}U during HALEU cascade operations. Small quantities of greater than ~~10~~20 wt. percent ^{235}U may also be present outside of plant equipment in the form of laboratory samples or standards. Some buildings on the reservation may be used to process and/or store fissile material from both the ACP and Portsmouth Gaseous Diffusion Plant (GDP). Although the GDP has historically processed material at greater than 2~~1~~0 wt. percent ^{235}U, this material is no longer readily available to interact with ACP operations. However, for conservatism, some operations in these common buildings may be analyzed at greater than 2~~1~~0 wt. percent ^{235}U enrichment. HALEU Demonstration does not involve buildings that contain legacy equipment.

The maximum ^{235}U enrichment for each operation is established by the specific NCSE. The NCSE specifies the maximum acceptable enrichment for each operation. Credible process upset conditions that could alter the ^{235}U enrichment are also considered in the NCSEs. ~~Due to the difficulty in obtaining reliable, real-time enrichment measurements that are both accurate and precise enough to use as a NCS control, enrichment is assumed to be the maximum credible for each operation.~~ When the enrichment of uranium needs to be measured for an NCS control, the measurement is obtained using either installed equipment or based on samples analyzed in a laboratory.

Density

The density of materials used in a given operation is justified in the NCSE for the operation being considered. If the density must be controlled to maintain compliance with the double contingency principle, it will be documented in the specific NCSE for the operation and it will be measured using instrumentation.

UF_6 in the gaseous phase, at any credible pressures and temperatures existing in the plant equipment, is incapable of supporting a nuclear chain reaction even when intermixed with hydrogenous material (e.g., hydrogen fluoride [HF]). UF_6 in the gaseous phase in plant equipment has low material density.

Heterogeneity

Heterogeneous configurations are considered for those operations that involve small fissile material and moderator regions.

Heterogeneous groupings may occur for the handling of small sample containers; however, 10 wt. percent ^{235}U is assumed for samples handled on a safe mass basis. Using the homogeneous safe mass of 10 wt. percent ^{235}U is also safe for heterogeneous 10 wt. percent ^{235}U because, at this enrichment, the homogeneous and heterogeneous minimum critical masses are close in value.

Concentration

Concentration controls are used on a case-by-case basis. When the criticality safety of an operation depends on the concentration of fissile material, the medium is sampled twice, the samples are verified to be properly taken by a second individual, and the two samples are independently analyzed as required by the specific NCSE for the operation involved. The specific controls and details are documented in the NCSE for each operation that relies on concentration controls. No operations exist at the plant where concentration control is applied to an operation involving more than a safe mass of uranium. A container with concentration controlled solution is kept normally closed. Precipitating agents, including freezing, are controlled as necessary to ensure they do not inadvertently increase the concentration.

A typical operating limit is 5 g ^{235}U per liter, regardless of enrichment. A concentration of 11.6 g ^{235}U per liter is considered subcritical at any enrichment, as recognized by ANSI/ANS-8.1-2014. If, under all postulated conditions, the concentration is always less than 11.6 g ^{235}U per liter, the operation is considered subcritical.

Reflection

Normal and credible abnormal reflection is considered when performing NCS evaluations. The possibility of full water reflection is considered when performing analyses. Interstitial Interspersed moderation is evaluated with either full water reflection or water films with a bounding water density value to simulate sprinkler activation or precipitation combined with full density water blocks to simulate personnel. It is recognized that concrete can be a more efficient reflector than water, and its potential presence is considered. Reflection controls are used to limit the potential reactivity of a fissile material operation.

Neutron Absorption

When neutron absorbers are used as NCS controls, the intended distributions and concentrations under both normal and credible abnormal conditions are maintained in accordance with the requirements of the applicable NCSE and ANSI/ANS-8.21-1995. These requirements are: representative sampling of the neutron absorber, sampling at a frequency based on the environment to which the neutron absorber is exposed, analyzing of samples for all material attributes for which credit is taken in the NCSE, and periodic inspections of fixed neutron absorbers to ensure adequate distribution as specified in the NCSE.

An NCS evaluation can take credit for the neutron absorption properties of the materials (1) added specifically for the purpose of absorbing neutrons, and (2) of construction, provided an allowance has been made for manufacturing and dimensional tolerances, corrosion, chemical reactions, neutron spectra, and uncertainties in the neutron cross-sections.

5.4.5.2 Methods of Calculation

Experimental Data

~~Experimental data are not specific enough to allow evaluation of operations performed in the ACP. The generic nature of the experimental data does not address the variables present in the different operations. However, e~~Experimental data are used for validation of the computer code ~~(e.g., KENO V.a)~~ used to perform the calculations needed to support the development of NCSEs. The experimental data used are discussed in the code validation report (Reference ~~11~~14).

Handbooks and Standards

Handbooks and standards (e.g., ANSI/ANS-8.1-2014) are also used in some cases when simple systems are being evaluated. Handbooks and standards used for ACP operations are nationally recognized throughout the NCS industry as high quality analyses that have been confirmed through many years of use or based on experimental data. Most of the operations performed in the ACP are too complicated to be adequately addressed by data in a handbook/standard. When isolated operations are performed with small amounts of fissile material, referencing handbooks/standards is useful to support conclusions in the NCSE. Examples of the handbooks used include, but are not limited to, ARH-600, *Criticality Handbook* and LA-10860-MS, *Critical Dimensions of Systems Containing* ^{235}U, ^{239}Pu, *and* ^{233}U. Other handbooks are held to similar criteria for excellence, industry acceptance, and quality of data to be used at the ACP without further verification calculations.

Because handbooks and standards tend to give minimum critical or maximum subcritical values, use of these values for criticality controls is not appropriate to meet the double contingency principle. Instead, these values are reduced such that subcriticality can be demonstrated under normal and credible abnormal conditions.

Hand Calculations

Applicable methods for evaluating single units include Modified Two Group Diffusion Equation (i.e., Critical Equation), Buckling Conversion, and Comparative Analysis.

- **Modified Two Group Diffusion Equation** – This method is applicable to, and most widely used for, solution systems.
- **Buckling Conversion** – The method of buckling conversion or shape conversion is applicable to all materials.
- **Comparative Analysis** – This method involves direct comparison of the system configurations to subcritical data from NCS handbooks.

Applicable methods for evaluating arrays include the Solid Angle Method and the Surface Density Method using unit shape factor.

- **Solid Angle Method** – This method is applicable to solution systems. It is not useful if reflection is more effective than a thick water reflector located at the array boundary. The conditions that must be satisfied in order to successfully apply the solid angle method are (1) $k_{effective}$ (k_{eff}) of any unreflected unit does not exceed 0.80; (2) each unit is subcritical when completely reflected by water; (3) the minimum surface-to-surface separation between units is 0.3 meters; and (4) the allowed solid angle does not exceed 6 steradians.
- **Surface Density Method** using unit shape factor – This method can be used as an approximation for large arrays of identical units containing solutions and metals. This method determines the spacing and mass of units independent of the number of units. An important feature of the Surface Density Method is that it is equally applicable to more irregular geometries.

When hand calculations are used, the specific methodology employed will be ~~as described in "Nuclear Criticality Safety" by R.A. Kneif, American Nuclear Society, 1991 and subject to a total system reactivity of 0.95 for all credible off normal events.~~ based on industry-accepted methods (e.g., areal density, solid angle technique, etc.), subject to the limitations of those methods.

Computer Calculations

~~For those cases where adequate references are not available,~~ NCS computational analyses ~~are~~

performed, which involve the calculation of k_{eff}, may be used to determine whether the system will be subcritical under both normal and credible abnormal process conditions. Computer codes that simulate the behavior of neutrons in a process system or that solve the Boltzmann transport equation are used.

Computer calculations of k_{eff} provide a method to relate analytical models of specific system configurations to experimental data derived from critical experiments. A critical experiment is defined as a system that is intentionally constructed to achieve a self-sustaining neutron chain reaction or criticality. Critical experiments that have specific, well-defined parametric values and are adequately documented are termed benchmark experiments. Computer codes are validated using experimental data from benchmark experiments that, ideally, have geometries and material compositions similar to the systems being modeled. See Appendix F of this license application for the computer code validation applicable to the HALEU Demonstration Program.

Validation of the computer code determines its calculational bias or uncertainty as well as the effective margin of subcriticality. The validation involves the modeling of benchmark critical experiments over a range of applicability. Because the k_{eff} value of a critical experiment is essentially 1, the bias of the code is taken to be the deviation of the calculated values of k_{eff} from unity. Statistical analysis is employed to estimate the calculational bias, which includes the uncertainty in the bias and uncertainties due to extensions of the area of applicability, as well as the effective margin of subcriticality. Uncertainty in the bias is a measure of both the precision of the calculations and the accuracy of the experimental data. The validation of the computer code specifically defines the maximum acceptable k_{eff} used to determine subcriticality.

The margin of subcriticality used for the plant results in a k_{eff} upper safety limit that ensures that there is a 95 percent confidence that 99.9 percent of future k_{eff} values less than this limit will be subcritical. A minimum margin of subcriticality of 0.02 in k_{eff} is used to establish the acceptance criteria (i.e., upper safety limit) for criticality calculations for abnormal conditions at 5 percent ^{235}U enrichment and below. Above 5 percent ^{235}U enrichment, a minimum margin of subcriticality of 0.05 in k_{eff} is used. Also, for normal case calculations supporting processes that are not under moderation control, a minimum margin of subcriticality of 0.05 in k_{eff} is used. Abnormal conditions are changes to a controlled parameter that result in a violation of the limit on that parameter. For example, in an operation that relies on maintaining spacing between fissile units, an error that results in the units being closer than the limit would represent an abnormal condition. Similarly, operations that rely on moderation control of UF_6 would be in an abnormal condition when the moderation control was lost and operations that rely on control of ^{235}U mass would be in an abnormal condition when the mass limit was violated.

The upper safety limit varies with the computer system, codes, cross sections, and materials used in the validation.

The calculation of k_{eff} is accomplished by the use of computer codes that utilize Monte Carlo techniques to determine k_{eff} of a system. Computer models representing the geometrical configuration and material compositions of the system are developed for use within the code. The development of appropriate models must account for or conservatively bound both normal and credible abnormal process conditions.

When NCS is based on computer code calculations of k_{eff}, controls and limits are established to ensure that the maximum k_{eff} complies with the applicable code validation for the type of system being evaluated. For example, NCS related IROFS developed during initial license application were developed using reactivity calculations performed on personal computers running the Microsoft Windows XP operating system and validated as described in Reference 11. Generally, these calculations were performed with an upper safety limit of 0.955 up to5 percent ^{235}U enrichment; however, specific cases may use a higher or lower limit based on equations from Table 14 of Reference 11. Above 5 percent ^{235}U enrichment, a margin of subcriticality of 0.05 will be applied to calculations performed using the personal computers described above with a resulting upper safety limit of 0.925. Reactivity calculations, performed after initial license application, comply with the code validation for the specific system used to perform the calculation.

Scoping and analysis calculations may be performed utilizing various unvalidated computer codes; however, computer calculations of k_{eff} used as the basis for NCS evaluations are confirmed by, or performed using, configuration-controlled codes and cross-section libraries for which documented validations are performed with at least the same degree of conservatism as that presented in Reference 11 and are in accordance with ANSI/ANS-8.1-1998. Calculations are performed using materials of construction and other parameters consistent with the area of applicability described by the relevant validation report. The area of applicability used by Reference 11 covers enrichments from 2 percent to 30 percent ^{235}U enrichment with moderation levels from an $H/^{235}U$ of 8 to 1,438 with an average energy group of 151.7 to 220 using the 238-group ENDF/B-V cross section library. Moderating materials from Reference 11 include water and paraffin and reflectors range from bare systems to reflection with water, steel, paraffin, polyethylene, concrete, and lead. Other materials included in the area of applicability from Reference 11 are stainless steel, zirconium, aluminum, fluorine, and oxygen.

Extensions to the area of applicability are justified when using techniques described in NUREG/CR-6698. When materials of construction are used that are not represented in the area of applicability, the NCS engineer has several options available to address that situation. First, the specific material can be left out of the model. Second, a different material can be substituted that is within the AOA and provides a similar (or more conservative) amount of neutron moderation, multiplication, or reflection. Third, the material can be included based on a review of its neutron cross sections that conclude no significant impact can occur from that material. Fourth, the material can be included but with an adjustment in its density so that any unknown effect is minimized. Fifth, the material can be included with a reduction to the upper safety limit to account for the additional uncertainty. Lastly, additional benchmark experiments can be added to the validation to specifically include the material. The NRC will be notified in the event an extension to the area of applicability will not adequately encompass the parameters of interest for a specific calculation and a revision to Reference 11 is needed to establish a new area of applicability.

Prior to implementing changes to processes based on calculations requiring extension to the validated area of applicability as determined in the validation report, NRC review and approval shall be obtained. The request for NRC review and approval shall include a description of the change, the reason that such a change is needed, and the method used to extend the area of applicability.

The methodology used in a validation report involves statistical analysis to determine the bias and bias uncertainty for the critical experiments included in the validation. Guidance from NUREG/CR-6698, *Guide for Validation of Nuclear Criticality Safety Calculational Methodology*, is used to perform the validation. The upper safety limit is computed by subtracting the absolute value of the bias, the bias uncertainty, and the minimum margin of subcriticality from unity. Positive bias is not credited. The exact statistical technique used to obtain the bias and bias uncertainty depends on the specific validation report. The techniques used in Reference 11 included the lower tolerance limit or the lower tolerance band for normally distributed data and a non-parametric technique for non-normally distributed data.

The computer codes and cross sections used in performing k_{eff} calculations are maintained in accordance with a configuration control plan. Quarterly, or prior to use, one of the following is performed: a bit-by-bit comparison of the production version of the software (executable modules and data libraries) versus an archived production version; or a comparison of the output from all validation cases versus archived output of all validation cases from the original validation performed when the production version was installed to ensure no changes in the calculated k_{eff} for the validation cases.

Changes to the hardware or software are evaluated in accordance with 10 CFR 70.72 change requirements. Some changes are expected to result in changes to the calculational algorithm and will require a new validation. Such changes include revisions to the software used to calculate reactivity, updates to the cross section libraries, changes to the operating system kernel, changes to the central processing unit, or changes to the motherboard. Other changes are not expected to result in changes to the calculational algorithm and will require only that the validation cases be re-run and compared to the original results. Such changes include increasing the available RAM, changing a hard drive, graphics card, network interface card, or other peripheral. In the Microsoft Windows environment, periodic changes to components of the operating system are common as Microsoft issues updates or patches to the platform. Also, installation and modification of software not used to calculate reactivity will be performed to support day-to-day business needs. These minor changes are not expected to impact any reactivity calculations, but to ensure this, a verification of the validation cases will be performed at least quarterly as described above.

The System Administrator, an NCS engineer, is responsible for controlling access to the software.

5.5 References

1. ANSI/ANS-8.1-1998, 2014 *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*

2. ANSI/ANS-8.3-1997, *Criticality Accident Alarm System*

3. ANSI/ANS-8.19-20141996, *Administrative Practices for Nuclear Criticality Safety*

4. ANSI/ANS-8.20-1991, *American National Standard for Nuclear Criticality Safety Training*

5. ANSI/ANS-8.21-1995, *Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors*

6. ANSI/ANS-8.23-2007, *Nuclear Criticality Accident Emergency Planning and Response*

5.7. ANSI/ANS-8.24-2017, *Validation of Neutron Transport Methods for Nuclear Criticality Safety*

6.8. ARH-600, *Criticality Handbook*, Volumes I, II, and III, Atlantic Richfield Hanford Co. Report (1968)

7.9. LA-3605-0003, *Integrated Safety Analysis Summary for the American Centrifuge Plant*.

8.10. LA-10860-MS, *Criticality Dimensions of Systems Containing ^{235}U, ^{239}Pu, and ^{233}U*, 1986 Revision

9.11. NRC Regulatory Guide 3.71, Revision 30, *Nuclear Criticality Safety Standards for Fuels and Material Facilities*, Revision 3

10.12. NUREG-1513, *Integrated Safety Analysis Guidance Document*

11.13. NUREG-1520, *Standard Review Plan for the Review of a License Application for a Fuel Cycle Facilitiesy License Applications*, Revision 2

12.14. WSMS-CRT-03-0093, *United States Enrichment Corporation (USEC) PC-SCALE 4.4a Validation (U)*, Revision 2, November 2005EE-3101-0013, *NCS Code Validation of SCALE 6.2.3 and Cross Section Set v7-252 for k_{eff} Calculations*, Rev. 0, December 2019

13. NUREG/CR-6698, *Guide for Validation of Nuclear Criticality Safety Calculational Methodology*, January 2001

15. NCS-CALC-04-001, *Storage of UF_4-oil Mixtures in Safe Volume Containers*, September 2005 DAC-3101-0006, *Safe Mass Study for UF_4 and Oil*, February 2020

16. "International Handbook of Evaluated Criticality Safety Benchmark Experiments," NEA/NSC/DOC (95) (03), Nuclear Energy Agency Science Committee, Organization for Economic Co-Operation and Development, July 2018 Edition.

Jordan, W.C., Landers, N.F., Petrie, L.M., "Validation of KENO V.a Comparison with Critical Experiments," ORNL/CSD/TM-238, Martin Marietta Energy Systems, Contract Number DE-AC05-84OR21400, December 1986.

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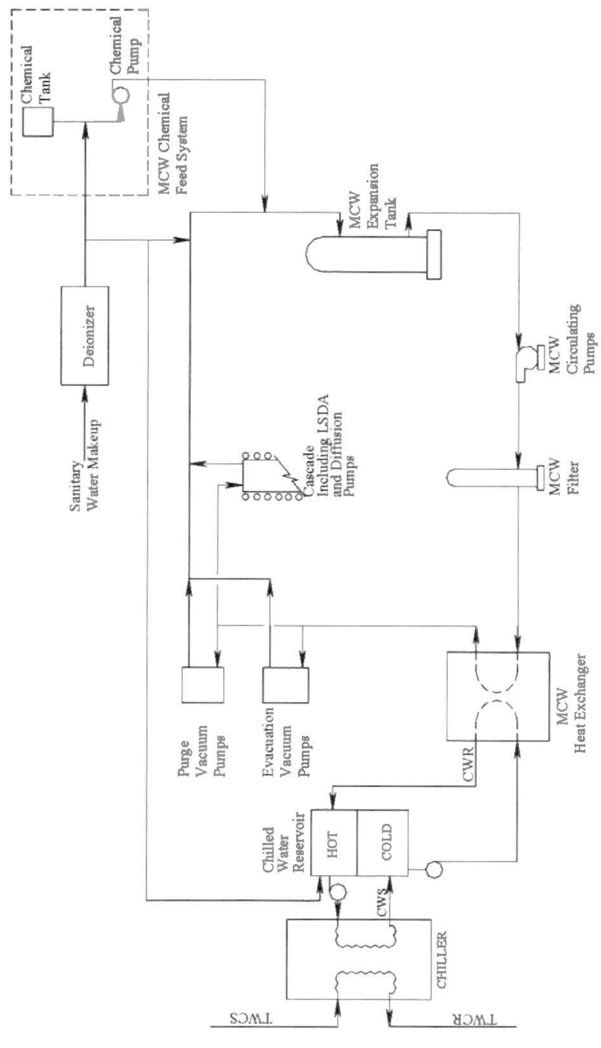

Figure 1.1-16 Machine Cooling Water System Flow Schematic
(For HALEU Demonstration, a molecular pump will be used in place of the diffusion pump and does not require MCW)

6.0 CHEMICAL PROCESS SAFETY

The American Centrifuge Plant (ACP) operations require limited quantities of radioactive, hazardous, and toxic chemicals for maintenance and production activities that are performed in support of the basic uranium enrichment process. For the ACP Commercial Plant, Tthese chemicals are discussed in the Integrated Safety Analysis (ISA) Summary for the American Centrifuge Plant, Chapters 5.0 and 6.0, as well as their appendices. For the ACP HALEU Demonstration, these chemicals are discussed in Addendum 1 of the ISA Summary for the American Centrifuge Plant HALEU – Demonstration, Chapters 5.0 and 6.0, as well as their appendices. Pursuant to 10 *Code of Federal Regulations* (CFR) 70.62, the plant safety program includes process safety information to address hazardous materials.

This chapter summarizes the chemical process safety program for the ACP, the integration of chemical safety with uranium enrichment operations, and the management systems used by the plant for chemical safety. A description of the plant and uranium enrichment process is provided in Section 1.1 and a description of the reservation is provided in Section 1.3 of this license application. The uranium hexafluoride (UF_6) inventory that is integral to enrichment is addressed in the ISA Summary. The risks associated with UF_6 and its airborne release reaction products, hydrogen fluoride (HF) and uranyl fluoride (UO_2F_2), are discussed in the ISA Summary, Sections 5.2.1, 5.2.1.1, 5.2.1.2, 6.1.1, 6.1.1.1, 6.1.1.2, 6.1.1.3, and 6.1.1.4; and Appendix D, Sections D.1 through D.16 for the ACP Commercial Plant. The risks associated with UF_6 and its airborne release reaction products, HF and UO_2F_2, are discussed in Addendum 1 of the ISA Summary for the American Centrifuge Plant HALEU – Demonstration, Sections 5.1, 6.1.1.1, 6.1.1.2, 6.1.1.3, 6.1.1.4, 6.1.1.6, and 6.1.1.7; and Appendix D, for the HALEU Demonstration.

The ACP chemical process safety program is implemented through written procedures. Records for process safety compliance are retained in accordance with records management and document control (RMDC) requirements described in Section 11.7 of this license application.

The Radiation Protection Manager/Supervisor is responsible for the plant chemical process safety program. Chemical safety incorporates engineering and administrative controls to manage risk. Prevention is the preferred approach. Workers use personal protective equipment (PPE) when it is specified in procedures.

6.1 Process Chemical Risk and Accident Sequences

Chemical inventories at the ACP are maintained below the threshold quantities set forth in the Occupational Safety and Health Administration (OSHA) Process Safety Management (PSM) Standard (29 CFR 1910.119) and the Environmental Protection Agency (EPA) Risk Management Program (RMP) Standard (40 CFR Part 68); therefore, these regulations do not apply to the ACP.

Chemical safety consists of the integration of environmental, safety, and health management systems to address chemical hazards. Chemical safety controls are designed to prevent the adverse effects of toxic materials used in the uranium enrichment process to workers, the public, and the environment. To achieve this objective, safety analyses and Industrial Hygiene and Safety (IHS) programs are utilized.

Chemical safety controls are limited to non-radiological materials. Radiological materials are addressed throughout the ISA Summary for the ACP Commercial Plant and Addendum 1 of the ISA Summary for the American Centrifuge Plant HALEU - Demonstration and in Chapter 4.0 of this license application. Chemical process safety is addressed in the ISA. The ISA Summary and Addendum 1 of the ISA Summary for the American Centrifuge Plant HALEU - Demonstration, Chapter 6.0 identifies potential accident sequences and Chapter 7.0 designates selected controls (i.e., items relied on for safety [IROFS]) to either prevent such accidents or mitigate their consequences to an acceptable level.

Chemicals with significant radiological impact are limited to UF_6 and its release products, HF and UO_2F_2, as indicated in Sections 5.1 and 5.2 of the ISA Summary and Addendum 1 of the ISA Summary for the American Centrifuge Plant HALEU - Demonstration. Other chemical hazards, which are not considered to have any radiological impact, are listed in Appendix B of the ISA Summary and Addendum 1 of the ISA Summary for the American Centrifuge Plant HALEU - Demonstration. Techniques and assumptions for estimating airborne concentrations and predicting toxic footprints from chemical releases are presented in Appendix D of the ISA Summary and Addendum 1 of the ISA Summary for the American Centrifuge Plant HALEU - Demonstration, which also presents source terms and vapor dispersion models used to calculate airborne concentrations of UF_6 and its release products. The American Industrial Hygiene Association (AIHA) Emergency Response Planning Guidelines (ERPGs) have been selected as the chemical response standard for the ACP. The ERPGs provide airborne concentration limits to effectively protect individuals against toxic exposure to hazardous chemicals. These guidelines are discussed in Appendix A of the ISA Summary and Addendum 1 of the ISA Summary for the American Centrifuge Plant HALEU - Demonstration.

Management measures are established to provide reasonable assurance of the availability and reliability of IROFS. The ISA includes consideration of the toxicity of uranium, radiological hazards, and chemical hazards that may impact radiological safety. The details of the analysis are provided in the ISA Summary.

6.2 Items Relied on for Safety and Management Measures

Safety in normal operations is maintained through implementation of the defense-in-depth engineering design philosophy. The ISA Summary and Addendum 1 of the ISA Summary for the American Centrifuge Plant HALEU – Demonstration describes the basis for providing successive levels of protection such that health and safety of employees and the public is not wholly dependent upon any single element of the design, construction, maintenance or operation of the facility. The schemes employed to ensure safe operation of the ACP include management measures that provide for the reliability of IROFS. These measures include configuration management (CM), maintenance, procedures, training, surveillance, and testing. Management measures are described in Chapter 11.0 of this license application.

6.2.1 Items Relied on for Safety

Chemical process safety controls that prevent accidents or mitigate their consequences are identified in Section 7.2 of the ISA Summary and Addendum 1 of the ISA Summary for the American Centrifuge Plant HALEU – Demonstration. These controls are designated as IROFS and address the chemical hazards that may impact radiological safety. Tables 6.1-1, 6.1-2, 6.1-3, and 6.1-4 of the ISA Summary and Addendum 1 of the ISA Summary for the American Centrifuge Plant HALEU – Demonstration, identify both radiological and non-radiological accident sequences with regard to performance criteria. These are also discussed in Section 7.3 of the ISA Summary and Addendum 1 of the ISA Summary for the American Centrifuge Plant HALEU – Demonstration.

6.2.2 Management Measures

Each of the management measures that helps ensure the IROFS are available and reliable, are briefly described in the following sections.

6.2.2.1 Procedures

6.2.2.1.1 Operating Procedures

Procedures are prepared in accordance with the requirements of a formal procedure system. The Procedures Program is described in Section 11.4 of this license application.

6.2.2.1.2 Safety and Health Program Procedures

Centrus Energy Corp., with approval of the DOE, assigned the sublease for the space for the ACP (including the HALEU Demonstration) to the Licensee, ACO. The Licensee subleases, from ~~the United States Enrichment Corporation~~Centrus Energy Corp., certain support buildings/facilities on the DOE reservation. The ACP and the DOE have their own chemical safety programs and share information regarding hazardous chemicals used by each entity. The DOE environmental restoration contractors and sub-contractors may also be present on the reservation. The DOE provides information regarding any hazardous chemicals used by these "third-parties" that could impact ACP operations. Third-party chemicals are covered by a shared site agreement with DOE and reviewed in accordance with procedures.

IHS programs used for chemical safety and implemented by safety and health program procedures include:

- Lockout/Tagout
- Hazard Communication
- Confined Space Entry
- Safety and Health Work Permit

- Hot Work Permit
- Personal Protective Equipment
- Signs/Labeling/Tagging
- Safety Training

These safety and health programs apply to chemical safety as described in the program implementation documents.

6.2.2.2 Training

The Training and Procedures Manager has overall responsibility for employee training. ACP operators, maintenance personnel, management, and emergency response personnel have prerequisite and periodic training requirements that are necessary for initial and continued job qualification.

Personnel who operate, maintain, manage, handle, and have emergency response duties for chemicals are adequately trained for the particular chemical system or related activity. This training supplements the plant Training Program described in Section 11.3 of this license application and occurs at the job-specific level.

Contractor (typically construction, maintenance, and service) personnel receive access training and plant-specific safety training prior to starting work. The contractor or the contractor-designated Safety and Health Officer has the contractual responsibility for internal contractor employee training. The Licensee also approves the contractor's Safety and Health Plan. The Site Technical Representative is the liaison between the contractor and the Licensee. If construction activities interface with chemical systems, ACP representatives ensure appropriate job review, training, and guidance is provided.

6.2.2.3 Maintenance and Inspection

Maintenance and inspection programs are summarized below and described in Sections 11.1 and 11.2 of this license application, and in the Quality Assurance Program Description (QAPD) for the American Centrifuge Plant.

Engineering develops maintenance and inspection requirements and criteria for chemical systems in conjunction with the specific plant maintenance organization, manufacturer's recommendations, and ISA Summary and Addendum 1 of the ISA Summary for the American Centrifuge Plant HALEU – Demonstration. These chemical safety requirements are based on the functions of IROFS identified in the ISA Summary, Addendum 1 of the ISA Summary for the American Centrifuge Plant HALEU – Demonstration, and manufacturer's recommendations for a particular chemical component/system.

6.2.2.3.1 Calibration and Inspection

Specific calibration and inspection requirements are based on operating characteristics, past operating experience, system operating environments, and manufacturer's recommendations.

Maintenance of chemical systems is performed in accordance with the plant maintenance programs. These plant programs are based upon calibration and inspection requirements from operational experience and characteristics of the system.

6.2.2.3.2 Maintenance Work Packages

Maintenance work packages are prepared to provide the necessary technical and safety guidance for maintenance activities as described in Section 11.2 of this license application. These work packages are applicable to chemical systems and equipment. Supporting maintenance procedures are subject to the requirements of the Procedures Program described in Section 11.4 of this license application.

6.2.2.3.3 Preventive Maintenance and Quality Considerations

Manufacturers' recommendations are used as guides for preventive maintenance on specific chemical systems and equipment. If operational experiences or system characteristics indicate a need for a different preventive maintenance schedule, the preventive maintenance baseline can be changed after appropriate review. ACP personnel perform inspection and testing to fulfill requirements for quality in accordance with the CM Program, which is described in Section 11.1 of this license application.

Independent overview of maintenance activities on chemical system hardware and requirements are addressed by the QAPD and CM Program, as applicable. These independent overview programs include:

- Procurement Quality Requirements
- Construction Inspection
- Testing and Pre-Operational Inspection
- Pressure Vessel Inspection
- Crane Inspection
- Pre-Operational Safety Review and Pre Start-up Safety Review Programs
- Plant Safety Review Committee (PSRC)

The pre-operational safety review process is conducted in accordance with program implementing procedures. The scope of the safety review is determined by the PSRC which considers the specific issue and system being reviewed and the potential safety concerns present.

Deficiencies associated with maintenance activities are dispositioned in accordance with the QAPD and the Corrective Action Program, as described in Section 11.6 of this license application.

6.2.2.4 Configuration Management

The CM Program is described in Section 11.1 of this license application. Director, EngineeringTechnical Services, as the design authority for the ACP and HALEU Demonstration, administers the CM Program. The CM Program includes an organizational structure and administrative processes and controls to ensure that accurate, current design documentation is maintained that matches the building physical configuration.

6.2.2.5 Emergency Planning

Emergency Management is described in Chapter 8.0 of this license application. The Emergency Management Plan for the American Centrifuge PlantACP outlines the roles and responsibilities of personnel during an emergency and describes the emergency response measures, including on-site and off-site protective actions.

Chapter 8.0 Section 8.1 details that No Emergency Plan as discussed under 10 Code of Federal Regulations (CFR) 70.22(i) is needed for the HALEU Demonstration Program.

Personnel who have emergency response assignments or duties associated with chemical safety are adequately trained to respond to chemical and operational upsets per 29 CFR 1910.120(q) requirements.

Operators, in compliance with the plant "See and Flee" policy, are not expected to participate in emergency response activities for chemical releases. The policy specifies that employees promptly move to a safe location, away from the immediate release area. Mitigating actions, as described by procedure, may be performed during evacuation from the immediate release area if they do not hinder safe egress. Personnel outside the immediate release area may perform mitigating actions, as described by procedure, prior to evacuation. If plant procedures direct an employee response to a minor spill, an employee can implement the plant response procedure after "See and Flee" requirements have been accomplished and the area may be reentered.

6.2.2.6 Incident Investigation

Identification, reporting, and incident investigation, described in Section 11.6 of this license application, are conducted in accordance with plant procedures. The level of investigation is based upon severity and significance of the event, as well as the regulatory requirements involved. Unacceptable performance deficiencies are addressed in accordance with the ACP Corrective Action Program. Documentation is retained in accordance with RMDC requirements described in Section 11.7 of this license application.

Occupational injury and illness investigations related to chemical safety are part of the IHS programs. Investigations are conducted in accordance with OSHA requirements.

6.2.2.7 Audits and Inspections

Formal audit responsibilities are assigned to the Piketon Quality Assurance Manager. In addition, internal organizations have monitoring programs, assessments, and reviews as required by program implementation procedures. The Audit and Assessment Program is described in Section 11.5 of this license application and includes chemical safety.

6.2.2.8 Quality Assurance

The QAPD describes the programmatic requirements that apply to Quality Level (QL)-1 and QL-2 items. These quality assurance elements and requirements apply to chemical safety items classified as QL-1 or QL-2 in a graded approach, as described in the QAPD. Additional discussion regarding the ACP graded approach to quality assurance is provided in Chapter 11.0 of the License Application.

6.2.2.9 Human Factors

Human factors design responsibility for plant and system design in the ACP is assigned to engineering, with specific technical assistance from Industrial Safety personnel. Human factors reviews address the interface of people with processes and its impact on system operation. The Human Factors Engineering program is described in Section 2.6 of the ISA Summary.

6.2.2.10 Detection and Monitoring

Chemicals with significant radiological impact such as UF_6, HF, and UO_2F_2 that are processed in the various ACP facilities are provided with detection and monitoring systems to identify chemical releases as appropriate to the release event. Non-radiological chemicals that do not have significant radiological impact are maintained below PSM/RMP threshold quantities and do not require detection and monitoring.

6.2.2.11 Chemical Safety Control Strategy

The chemical safety control strategy first requires that the chemicals used be identified and the listing of chemicals be kept current. Then the chemicals are reviewed for potential hazards. In order of decreasing risk and decreasing significance, the chemical hazards are addressed within the ISA Summary, Addendum 1 of the ISA Summary for the American Centrifuge Plant HALEU – Demonstration, and by the applicable IHS programs.

6.2.2.11.1 Identification and Inventory Control

Three processes are used to identify hazardous or toxic chemicals to be evaluated/controlled and to ensure that inventories are maintained below PSM/RMP threshold quantities. Material Safety Data Sheets/Safety Data Sheets (MSDSs/SDSs) are maintained in a central location in the ACP and are available at all times to plant employees, including emergency response and fire department personnel from on- and off-site. The first process identifies and inventories chemicals used at the ACP. This process ensures that chemicals used at the plant are appropriately addressed for safety. The process includes:

- Purchase requisition reviews;
- A listing of chemicals used;
- A centrally-located MSDS/SDS library, which is maintained and routinely updated by Industrial Hygiene; and
- Identification of new chemicals for the review process.

The second process is the formal request for engineering services required for modifications to existing systems. The request process provides a mechanism that identifies new or revised usages of chemicals, chemical processes, and/or associated possible logistics that require engineering involvement. A request for engineering services may not be required unless physical modifications or updated engineering evaluations are needed. If changes to hazardous chemical inventories or locations exist as a result of a request for a new, modified, or decommissioned building, process or storage location, an appropriate chemical safety review is applied to address regulatory requirements. Physical changes to the plant, including inventory limits and changes of location for hazardous chemicals, are evaluated in accordance with the requirements of 10 CFR 70.72.

The third process is associated with contractors on-site. When work is to be performed by contractors, a review of the contractors' Safety and Health Plan is conducted to identify the presence of hazardous and toxic materials to be brought onsite by the contractor. The contractor provides the latest revision of MSDSs/SDSs for these chemicals. Hard copies are maintained by the contractor at the job site, by Industrial Hygiene in a central location, and by appropriate Facility Custodians.

6.2.2.11.2 Chemicals Addressed By Integrated Safety Analysis Summary

The ISA addresses risks associated with UF_6 and its airborne release reaction products, HF and UO_2F_2. Chapter 6.0 of the ISA Summary and Addendum 1 of the ISA Summary for the American Centrifuge Plant HALEU – provideDemonstration provides an evaluation of accidents that involve the release of UF_6, including both radiological and toxicological hazards. The HF, which evolves from a UF_6 release, is one of the toxicological hazards. The analyses identify IROFS. Appendix B of the ISA Summary and Addendum 1 of the ISA Summary for the American Centrifuge Plant HALEU – Demonstration identifieys other chemicals and typical industrial materials (e.g., acetone, solvents, acids, fuels, and oils) that are used in the ACP (including HALEU Demonstration) for assembly and maintenance activities.

6.2.2.11.3 Chemicals Addressed by Process Safety Management and the Risk Management Program

Chemical quantities are maintained below Process Safety Management (PSM)/Risk Management Program (RMP) threshold quantities as described in Sections 6.2.2.11.1 and 6.3 of this license application.

6.2.2.11.4 Industrial Hygiene and Safety Program Managed Chemicals

Hazardous and toxic chemicals are effectively managed using IHS programs. To address these hazards, the IHS program provides the necessary protective barriers and controls that enable safe use of these chemicals in accordance with OSHA requirements (29 CFR Part 1910).

Commercial chemicals have varying toxicity and hazardous ranges and categories. Because chemicals can be used within the facilities for various purposes, the IHS program applications to chemical safety are comprehensive and are based on industry accepted standards and regulatory requirements for controlling occupational exposures. To address the potential exposure risks associated with IHS program managed chemicals, the ACP uses chemical review programs, program procedures, and MSDSs/SDSs. Implementation of these IHS programs provides employee protection from hazardous chemicals during daily operations and emergency response.

6.2.2.12 Multi-Occupancy of the Department of Energy Reservation

The Licensee subleases, from ~~the United States Enrichment Corporation~~ Centrus Energy Corp., certain support buildings/facilities on the DOE reservation. The ACP and the gaseous diffusion plant are separate entities for purposes of chemical safety. Each has its own chemical safety programs and shares information regarding hazardous chemicals used by the other. The DOE environmental restoration contractors and sub-contractors use the remaining reservation sectors. The DOE provides information regarding any hazardous chemicals used by these "third-parties" that could impact ACP operations. Third-party chemicals are covered by a shared site agreement and reviewed in accordance with procedures.

6.3 Requirements for New Buildings/Facilities or New Processes at Existing Facilities

System design requirements adhere to the 10 CFR 70.64 Baseline Design Criteria for chemical protection in new ACP buildings/facilities. Revision or modification to an existing chemical system is initiated via a request for engineering services that initiates the design process and includes a 10 CFR 70.72 review. For systems that become subject to the requirements of the PSM/RMP program, a pre-startup safety review is performed based on changes to the process safety information. The pre-startup safety review is an independent review to address the readiness of the system hardware, associated hazard controls, personnel (including required training), procedures, and process safety information. Records of chemical releases and documentation relating to chemical process safety are retained in accordance with Records Management and

Document Control (RMDC) requirements described in Section 11.7.1.5 of this License Application to ensure compliance with NRC's chemical process safety requirements.

6.4 References

1. 29 CFR Part 1910, *Occupational Safety and Health Standards*

2. 29 CFR 1910.119, *Process Safety Management of Highly Hazardous Chemicals*

3. 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response*

4. 40 CFR Part 68, *Chemical Accident Prevention Provisions*

5. LA-3605-0003, *Integrated Safety Analysis Summary for the American Centrifuge Plant*

6. NR-3605-0003, *Quality Assurance Program Description for the American Centrifuge Plant*

7. NRC Information Notice No. 88-100: *Memorandum of Understanding between NRC and OSHA Relating to NRC-Licensed Facilities* (53 *Federal Register* 43950, October 31, 1988), December 23, 1988

8. NUREG-1513, *Integrated Safety Analysis Guidance Document*

9. NUREG-1520, *Standard Review Plan for ~~the Review of a License Application for a~~ Fuel Cycle ~~Facility~~Facilities License Applications*, Revision 2

10. NUREG-1601, *Chemical Process Safety at Fuel Cycle Facilities*

~~10.~~11. LA-3605-0003A, *Addendum 1 of the ISA Summary for the American Centrifuge Plant HALEU – Demonstration*

Document Control (RMDC) requirements described in Section 11.7.1.5 of this License Application to ensure compliance with NRC's chemical process safety requirements.

6.4 References

1. 29 CFR Part 1910, *Occupational Safety and Health Standards*

2. 29 CFR 1910.119, *Process Safety Management of Highly Hazardous Chemicals*

3. 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response*

4. 40 CFR Part 68, *Chemical Accident Prevention Provisions*

5. LA-3605-0003, *Integrated Safety Analysis Summary for the American Centrifuge Plant*

6. NR-3605-0003, *Quality Assurance Program Description for the American Centrifuge Plant*

7. NRC Information Notice No. 88-100: *Memorandum of Understanding between NRC and OSHA Relating to NRC-Licensed Facilities* (53 *Federal Register* 43950, October 31, 1988), December 23, 1988

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10. NUREG-1601, *Chemical Process Safety at Fuel Cycle Facilities*

~~10.~~11. LA-3605-0003A, *Addendum 1 of the ISA Summary for the American Centrifuge Plant – HALEU Demonstration*

7.0 FIRE SAFETY

The American Centrifuge Plant (ACP), including the HALEU Demonstration has provisions to provide adequate protection against fire and explosions. This chapter provides descriptions of the Fire Safety Program and fire protection systems and equipment used to ensure employee and public health and safety from fires in the ACP.

The Fire Safety Program is part of the safety program that is designed to meet the requirements established in 10 *Code of Federal Regulations* (CFR) 70.62(a). The Fire Safety Program complies with requirements established in 10 CFR 70.61, 10 CFR 70.62, and 10 CFR 70.64; and the guidance provided in NUREG-1520, *Standard Review Plan for the Review of a License Application for a Fuel Cycle FacilityFacilities License Applications* (Revision 2). The Fire Safety Program addresses fire safety requirements for the ACP.

The Fire Safety Program addresses requirements for ensuring the fire protection systems and fire services supporting the ACP are adequate and maintained properly. Fire services refer to emergency and fire response services, fire inspection services, and fire testing services. As discussed in Section 1.1.8 of this license application, ACO's long-term goal is to resume commercial enrichment production consistent with market demand. The ACP design is modular, with the basic building block of enrichment capacity being a cascade of centrifuges. Modular deployment would accommodate market demand on a scalable, economical gradation. The Fire Safety Program will be implemented to support the modular deployment, such that the fire protection systems/services are in place when needed.

The next phase of enrichment production includes the deployment of a cascade of centrifuges to demonstrate production of high-assay, low-enriched uranium (HALEU) fuel for advanced reactors. The primary building/facilities directly involved in HALEU Demonstration are the X-3001 Process Building, X-3012 Process Support Building, X-7725 Recycle/Assembly Building, X-7726 Centrifuge Training and Test Facility, and X-7727H Interplant Transfer Corridor. The Licensee will notify NRC well in advance of the transition into any future phases of ACP deployment.

The ACP is comprised of buildings/facilities located on the U.S. Department of Energy's (DOE) reservation in the former Gas Centrifuge Enrichment Plant (GCEP) buildings. Additional structures will be constructed to meet the specific needs of the ACP.

Many of the buildings/facilities that comprise the ACP were designed and constructed in the 1970s and 1980s to meet the codes and standards applicable at those times. These buildings/facilities have been analyzed for fire hazards, which are discussed further in Section 7.2 of this chapter. The fire protection equipment, structural features, and fire suppression systems are designed to detect, contain, and suppress fires. The major physical components of the fire protection system include fire detection, firewater supply system, pumps, sprinkler systems, fire alarms, and other firefighting equipment. The location and operating characteristics of these components are described in Section 7.3 of this chapter. Fire protection design provides for adequate protection against fires and explosions in accordance with the Baseline Design Criteria contained in 10 CFR 70.64(a) and the defense-in-depth requirements of 10 CFR 70.64(b).

The Fire Safety Program with regard to building/facility, system, and equipment design, maintains the fire protection systems in existing buildings/facilities in accordance with the codes and standards that were applicable at the time of construction and installation. New buildings/facilities meet codes and standards applicable at the time of design. Modifications to existing buildings/facilities are evaluated relative to the safety benefit that could be achieved from applying current codes and standards. Justification for any deviations from the codes and standards of record are documented in writing and approved by the Authority Having Jurisdiction (AHJ). The Configuration Management Program as described in Section 11.1 of this license application, identifies the applicable codes and standards via the system requirements documents for each building/facility. The Fire Hazard Analyses (FHA) also provide this information.

National Fire Protection Association (NFPA) 801-2020~~03~~, *Standard for Fire Protection for Facilities Handling Radioactive Materials*, addresses fire protection requirements for buildings/ facilities handling radioactive materials and generally references other NFPA codes and standards dealing with each specific type of equipment or program. The daughter standards are written for general commercial facilities and may not be applicable to uranium enrichment facilities. The Fire Safety Program and the ACP were reviewed to determine applicability and level of compliance with NFPA 801 and applicable daughter standards. Some ACP buildings/facilities do not meet NFPA 801 and the applicable daughter standards because they were built or established under earlier versions or different codes and standards applicable at the time of construction and installation. ~~The standards applicable to these ACP buildings/facilities will be documented during the baseline configuration assessment effort as described in Section 11.1 of this license application.~~

The Fire Safety Program consists of five parts to provide a defense-in-depth approach to reduce the likelihood of occurrence, consequences, and damage that results from fires. First, a number of management measures are in place to ensure the availability and reliability of the fire protection items relied on for safety (IROFS), prevent fires, and minimize the consequences and damage from fires. Second, FHAs have been performed to determine vulnerability of the ACP to fires. Third, the ACP design incorporates fire prevention and fire protection requirements. Fourth, process fire safety ensures that enrichment process hazards are properly identified and addressed to ensure the health and safety of the workforce and public. Fifth, fire protection equipment and emergency response personnel are in place to minimize the consequences and damage from fires.

7.1 Fire Safety Management Measures

Fire Safety management measures are in place to ensure that IROFS are available and reliable. This is accomplished through the following, which are described in Chapter 11.0 of this license application.

- The Configuration Management Program ensures that the ACP facilities are controlled in accordance with the baseline configuration.

- The Maintenance Program ensures that IROFS equipment is maintained and tested to ensure their reliability and availability.

- The Training and Qualification program ensures that personnel performing fire protection activities relied on for safety have the applicable knowledge and skills necessary to operate and maintain the ACP in a safe manner.

- Procedures are utilized to ensure safe operations and thorough response to upset conditions involving fires.

- Audits and assessments ensure that the Fire Safety Program is adequate and effectively implemented.

- Incident reporting and investigations are performed to identify and document fire incidents to continually improve operations and programs to ensure the health and safety of the workforce and public.

- Records are maintained and controlled to ensure that IROFS for fire protection are available and reliable.

The Fire Safety/Emergency Management Manager is responsible for the Fire Safety Program, including fire services and reports to the Production Support Manager. This manager has the authority to ensure that fire safety receives appropriate priority.

An experienced fire professional is assigned as the AHJ with the responsibility for the interpretation and application of applicable fire codes and standards. The AHJ is a qualified fire protection professional having a bachelor's degree in engineering or a technical curriculum and at least six years applicable experience. These requirements are similar to the eligibility requirements as Member grade in the Society of Fire Protection Engineers.

The specific NFPA standards applicable to the ACP are identified in Table 7.1-1 of this chapter. Any changes where full compliance with the applicable NFPA standards is not maintained will be documented and justified by the AHJ. Modifications to fire protection systems and programs are made in accordance with 10 CFR 70.72.

The Plant Safety Review Committee, as described in Chapter 2.0 of this license application, provides a review role of fire safety at the ACP. The membership, structure, and responsibilities of this multi-discipline committee are defined in a plant procedure. The procedure includes the responsibility to review fire safety issues and to integrate changes to the plant with adequate consideration of fire safety.

The ACP Fire Safety Program management measures are grouped into four areas:

- Fire prevention;

- Inspection, testing, and maintenance of fire protection systems;

- Emergency response organization qualifications, drills, and training; and

- Pre-fire plans.

7.1.1 Fire Prevention

Fire prevention is a program across the ACP to minimize the potential for an incipient fire. The following are the major points that are addressed by the program.

- Workers are required to review and understand fire safety information including fire prevention procedures, emergency alarm response, and fire reporting. Documented building/facility inspections are conducted periodically and remedial actions are taken when conditions of concern are identified (i.e., accumulation of unnecessary transient combustibles, the presence of uncontrolled ignition sources, or obstruction of egress routes).

- General housekeeping practices and control of transient combustibles are established.

- Control of flammable and combustible liquids and gases is handled in accordance with the NFPA 30–2018~~03~~, *Flammable and Combustible Liquids Code* and NFPA 55-2020~~05~~, *Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tank*.

- Ignitions sources are controlled.

- Fire reports documenting fire investigation and corrective actions are documented through the Corrective Action Program as described in Section 11.6 of this license application.

- Smoking is restricted to designated areas outside of ~~the~~ buildings/facilities.

- Construction activities are performed in a manner that meets the requirements of NFPA 241-2019~~00~~, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*.

7.1.1.1 Control of Impairment to Fire Protection Systems

Impairment of fire detection, fire alarms, and fire barriers requires notification to the building custodian of the reason for the impairment, the specific impairment, the expected duration of the impairment, and system restoration time. Compensatory actions are initiated when detection, alarms, or barriers are out of service and may include suspension of hot work or other hazardous processes, personnel notifications, fire patrols, or other action necessary as determined by the Fire Safety/Emergency Management Manager.

Closure of ACP valves on the water system supplying the fire suppression systems is controlled by a written permit system. Fire services controls the valve closure permit system; therefore, fire services is notified of the impairment of fire suppression systems. Only groups authorized by the Fire Safety/Emergency Management Manager have the authority to issue permits and operate fire protection valves.

The ACP firewater permit system provides for notification to the building custodian of the reason for the impairment, the expected duration of the impairment, system restoration time, and residual partial system impairment (e.g., branch line removed). Compensatory actions are initiated when building sprinkler systems are out of service and may include suspension of hot work or other hazardous processes, personnel notifications, fire patrols, or other action necessary as determined by the Fire Safety/Emergency Management Manager. ACP systems taken out of service for repair are usually returned to service within an eight-hour period; however, the extent of the actual repairs will affect completion time.

7.1.1.2 Hot Work Permits

Hot work is controlled by procedure complying with NFPA 51B-201903, *Standard for Fire Protection During Welding, Cutting, and Other Hot Work* and applicable Occupational Safety and Health Administration (OSHA) requirements per 2910 CFR Part 1910.252 The permit system ensures that cutting, welding, and other hot work conducted in plant areas not normally used for such purposes will be conducted utilizing a permit system/process and performed in a manner that is consistent with industry fire prevention practices. This includes pre-job inspection, stationing a fire watch during the hot work as required, and post-job fire watch to prevent delayed ignition of any combustibles.

Selected managers and supervisors are trained and authorized to write hot work permits. Personnel performing fire watches receive additional training. The Fire Safety/Emergency Management Manager, or designee, is notified by the line manager prior to the initial use of a hot work permit. The permits are logged and a field surveillance of work is conducted during routine building inspections and when concerns or unusual circumstances exist.

7.1.2 Inspection, Testing, and Maintenance

Fire protection equipment is inspected and tested upon installation in accordance with NFPA 25-20024, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*. Periodic inspection and testing of fire protection equipment are performed by or overseen by trained personnel to help ensure that fire safety related IROFS are available and reliable. The testing and inspection of equipment is performed in accordance with procedures that include test frequencies as defined by the Fire Safety/Emergency Management Manager. The major elements of the plant inspection program are identified as follows.

- Flow test sprinkler systems
- Test manual fire alarms (pull stations)
- Test sprinkler water flow alarms
- Test supervisory alarm devices including control valves, low air pressure, low temperature, and loss of power

- Operate sprinkler system control valves
- Test special fire alarm indicators, such as heat and smoke detection systems
- Inspect major buildings to evaluate housekeeping, check fire emergency equipment, and exit pathways
- Inspect sprinkler systems risers
- Inspect portable fire extinguishers

7.1.3 Emergency Response Organization Qualifications, Drills, and Training

The ACP relies upon a qualified provider to perform emergency response to fire and other types of accident scenarios occurring at the ACP. Employees receive initial and biennial fire safety training as part of General Employee Training (GET) on emergency preparedness. This includes emergency reporting, building/facility evacuation, and fire extinguisher familiarization. GET is described in Section 11.3.1.1 of this license application.

A qualified supplier provides fire department response to an emergency. This supplier is staffed, trained, and equipped adequately to meet the needs of the ACP and the commitments contained in this license application. The qualified provider will have adequate resources to meet the needs of the ACP. This requires appropriately trained and qualified ~~fire fighting~~firefighting personnel, available 24-hours per day, as well as a minimum complement of equipment. There will be a minimum of four qualified fire fighters and one supervisor available to respond per shift. These four fire fighters cover entry and backup (two each). Equipment requirements include one pumper truck with a minimum capacity of 1,000 gpm, one ambulance, and one HAZMAT truck with radiological and rescue equipment. The time to apply water onto a fire will not exceed 20 minutes, 90 percent of the time. This is assured through assessments performed in accordance with Section 11.5 of this license application that confirms that the level of service is consistent with performance requirements specified in a letter of agreement.

Firefighter training is equivalent to the state certified firefighter training curriculum. Emergency ~~medial~~medical response personnel meet requirements for state certification as emergency ~~medial~~medical technicians and are ~~usually~~ also firefighters.

Qualified instructors provide a range of classroom and hands-on training to maintain standards of performance for all response personnel. Training needs are reviewed annually and the training program modified to meet identified needs. Training records are kept of the training activities. Training is based on national standard emergency response methodology with plant-specific training on issues unique to the plant. Specific training activities include firefighting, hazardous material response, confined space rescue, emergency medical response, radiological emergencies, and rescue. Drills are conducted as part of the plant emergency plan.

7.1.4 PreFire Planning

Prefire plans are developed as part of the building emergency packet ~~for~~. Pre-fire plans for HALEU Demonstration include the following buildings and areas:~~;~~ X-3001 Process Building; ~~X3002 Process Building;~~ X-3012 Process Support Building; ~~X-3344 Customer Services Building; X3346 Feed and Withdrawal Building; X3346A Feed and Product Shipping and Receiving Building;~~ X-7725 Recycle/Assembly ~~Facility~~Building; X-7726 Centrifuge Training and Test Facility; and X-7727H Interplant Transfer Corridor~~; and the Cylinder Storage Yards (X745G2, X-745H, X7746S, and X7746W)~~. Pre-fire plans for other facilities will be developed prior to deployment of operations involving licensed materials in those facilities.

Each pre-fire plan contains the following applicable information about the building or area:

- Facility description/construction,
- Specific hazards to emergency responders,
- Search and rescue considerations,
- Fire protection equipment/systems available,
- Utility shut-offs/start-ups,
- Fire loading concerns,
- Unique fire fighting strategy and tactics,
- Fire extension concerns, and
- Ventilation methodology.

Trained personnel review these pre-fire plans as part of the building inspection. As buildings are modified to meet the changing operations, the pre-fire plans are scheduled for review and updates to assure the revised conditions are addressed. As new buildings are added to meet the changing operations, pre-fire plans will be developed prior to placing the buildings in operation.

Table 7.1-1 Applicable National Fire Protection Association Codes and Standards

Code No.	Title	Revision
NFPA 10	*Standard for Portable Fire Extinguishers*	2018~~02~~
NFPA 13	*Standard for the Installation of Sprinkler Systems*	20~~02~~19
NFPA 15	*Standard for Water Spray Fixed Systems for Fire Protection*	20~~01~~17

NFPA 25	*Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*	20024
NFPA 30	*Flammable and Combustible Liquids Code*	201803
NFPA 51B	*Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*	201903
NFPA 55	*Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks*	202005
NFPA 70	*National Electric Code*	2005
NFPA 72	*National Fire Alarm Code*	2002
NFPA 75	*Standard for the Protection of Electronic Computer/Data Processing Equipment*	2003
NFPA 80	*Standard for Fire Doors and Fire Windows*	1999
NFPA 101	*Life Safety Code*	201803
NFPA 220	*Standard on Types of Building Construction*	1999
NFPA 232	*Standard for the Protection of Records*	2000
NFPA 241	*Standard for Safeguarding Construction, Alternation, and Demolition Operations*	201900
NFPA 801	*Standard for Fire Protection for Facilities Handling Radioactive Materials*	202003

7.2 Fire Hazards Analysis

FHAs have been performed for the following buildings and areas; X-3001, X-3002, X-3012, X-7725, X-7726, X-7727H, X-3344, X-3346, X-3346A, X-745G-2, X-7746S, and X-7746W. The FHAs applicable to HALEU Demonstration include those for X-3001, X-3012, X-7725, X-7726, and X-7727H. These FHAs and supporting analyses ensure that the fire prevention and fire protection requirements have been evaluated and incorporated. The analyses consider the building's/facility's specific design, layout, and anticipated operating needs and considers acceptable means for separation or control of hazards, the control or elimination of ignition sources, and the suppression of fires. A FHA will be performed for the X-745H prior to construction.FHAs for other facilities will be developed and implemented prior to deployment of operations involving licensed materials in those facilities.

This informationThe FHAs and supporting analyses were was used in the Integrated Safety Analysis (ISA) for the ACP to determine the credible fire accident scenarios, their likelihood of occurrence, the associated consequences, and the necessary IROFS to reduce the likelihood of occurrence and/or the consequences to meet performance requirements. The results of the ISA are presented in the ISA Summary for the American Centrifuge Plant and Addendum 1 of the ISA Summary for the American Centrifuge Plant - HALEU Demonstration.

To ensure an adequate level of safety is maintained, fire hazards for each of the buildings are evaluated periodically and documented in a building survey. The building survey results are used to update the FHAs and ISA as necessary. Further discussion of the FHA, ISA, and building survey approaches are described below.

For new buildings or facilities, FHAs are performed during the design development process to ensure that the fire prevention and fire protection requirements have been evaluated and incorporated into the design. The analysis considers the facility's specific design, layout, and anticipated operating needs and considers acceptable means for separation or control of hazards, the control or elimination of ignition sources, and the suppression of fires.

7.2.1 Fire Hazards Analysis Approach

Fire Hazards Analyses provide a general description of the physical characteristics of the buildings/facilities that outlines the fire prevention and fire protection systems to be provided. A FHA defines the fire hazards that can exist, and states the loss limiting criteria to be used in the design of a building and/or facility. FHAs provide a formal review and periodic evaluation of the occupancy and the fire protection associated with a building/facility and includes the following elements:

- A listing of the codes and standards is used for the design of the fire protection systems, including the published standards of NFPA.

- The FHA defines and describes the characteristics associated with potential fires for areas that contain combustible materials, such as fire loading, hazards of flame spread, smoke generation, toxic contaminants, and contributing fuels.

- The FHA lists the fire protection system criteria and the criteria to be used in the basic design for such items as water supply, water distribution systems, and fire pump supply.

- The FHA describes the performance criteria for the detection systems, alarm systems, automatic suppression systems, manual systems, chemical systems, and gas systems for fire detection, confinement, control, and extinguishment.

- The FHA describes the design for suppression systems and for smoke, heat, and flame control; combustible and explosive gas control; and toxic and contaminant control as necessary. The FHA also describes the operating functions of the ventilating and exhaust systems to be used during the period of fire extinguishment and control.

- The FHA uses the features of building and facility arrangements and the structural design features to generally define the methods for fire prevention, fire extinguishing, fire control, and control of hazards created by fire. Fire barriers, egress, firewalls, and the isolation and containment features provided for flame, heat, hot gases, smoke, etc., are also addressed.

- The FHA identifies the dangerous and hazardous combustibles and the maximum quantities estimated to be present in the building/facility. The FHA also identifies where these materials can be located appropriately in the building/facility.

- Based on the expected quantities of combustible materials, the types of potential fires, their estimated severity, intensity, duration, and the potential hazards created for each fire scenario reviewed, the probable and possible maximum losses from fires are described in the FHAs.

- Where safe shut down of safety related equipment is necessary, the FHA will define the essential electric circuit integrity needed during fire, and evaluates the electrical and cable fire protection; the fire confinement control; and the fire extinguishing systems that will be needed to maintain their integrity.

- The FHA evaluates life safety, protection of critical process/safety equipment, lightning protection, provision to limit contamination, potential for radioactive release, and restoration of the building/facility after a fire.

7.2.2 Integrated Safety Analysis

An ISA of the design, construction, and operation of the commercial ACP was conducted in accordance with the guidance provided in NUREG-1513, *Integrated Safety Analysis Guidance Document* and the requirements of 10 CFR 70.62(c). An associated Addendum to the ISA Summary was also performed for the HALEU Demonstration applying the same guidance and process. The ISA contains the following elements:

- Accident analysis including major fire scenarios;

- The effects of fire safety measures in preventing fire scenarios;

- The effect of the fire protection system in controlling and mitigating the fire scenarios; and

- Toxic and radiological hazards from a release regardless of the initiator.

A number of the release scenarios evaluated in the ISA have an explosion or fire as the initiating event and are evaluated for the FHAs. The ISA determines the likelihood of occurrence for the fire scenarios and resulting consequences associated with the release of uranium hexafluoride (UF_6) and its airborne release reaction product, hydrogen fluoride (HF) assuming the fire is unmitigated. Then the ISA identifies IROFS and related management measures necessary to prevent the accident and/or mitigate the consequences in accordance with the performance criteria in 10 CFR 70.61. This information is presented in the ISA Summary for the American Centrifuge Plant and Addendum 1 of the ISA Summary for the American Centrifuge Plant - HALEU Demonstration.

UF_6 is the primary hazardous material in the commercial ACP operation and HALEU Demonstration and the ISA provides an evaluation of accidents that involve the release of UF_6, including both radiological and toxicological hazards. The HF, which evolves from a UF_6 release, is considered as one of the toxicological hazards from a UF_6 release and is also addressed in the ISA.

7.2.3 Building Surveys

The building surveys are conducted, in accordance with written procedures on a periodic basis, to ensure the buildings/facilities, systems, and operations continue to meet the codes and standards to which they were built and operated, and do not violate any safety basies that were established in the ISA for the credible accident scenarios. The building surveys also ensure no new credible fire scenarios have been created.

7.3 Building/Facility Design

There are fire hazards related to the enrichment process. Fire hazards are typical industrial hazards, including maintenance; incidental use of chemicals and flammable liquids; and energized electrical equipment in the buildings. Accident potentials are discussed in the FHAs and ISA.

The ACP buildings/facilities are large and spread across the DOE reservation, which minimizes the effects that a fire or explosion could have on adjacent buildings and operations. Ventilation supply and exhaust locations are considered with regard to contamination potential and smoke control. ~~Floor surfaces are finished to support contamination control.~~

The primary ACP buildings/facilities are X-3001, X-3002, X-3012, X-3344, X-3346, X-3346A, X-7725, X-7726 buildings/facilities, and X-7727H corridor. Only X-3001, X-3012, X-7725, X-7726, and X-7727H are used for HALEU Demonstration. The X-3001, X-3002, X-3012, X-3344, X-3346, X-3346A, X-7725, X-7726 buildings/facilities, and X-7727H corridor are constructed of heavy unprotected steel frame, concrete floors, insulated metal panel exterior walls, and a built up roofing and/or spray applied polyurethane, silicone material on a metal deck. Each building is considered a single fire area with exception of the X-3346, X-7725, X-7726 buildings/facilities, and X-7727H corridor. Sprinkler coverage is provided in each building/facility. The sprinkler and water systems are described below. There are no water-exclusion areas in the ACP. Combustible loading is typically low and the fire hazards are limited to normal industrial activities. Exceptions are identified in the building survey report or by the building/facility manager. These include such things as electrical switchgear and transformers, and maintenance activities.

Use of firewater and potential firewater accumulation has been reviewed in each of the buildings/facilities to assure no unsafe accumulations can occur with regard to criticality, equipment loss, or spontaneous combustion.

Firewater runoff to the environment is controlled by the presence of holding ponds that can reduce or terminate releases as necessary to minimize environmental impact. There are no credible accident scenarios that could result in a criticality event in the holding ponds.

As indicated previously, the X-3001, X-3002, X-3012, X-3344, X-3346A, X-745G-2, X-7746S, and X-7746W are each considered single fire areas, but the X-7725 building and X-7726 facilityies, and X-7727H corridor are considered as a single fire area and the X-3346 building is considered as two fire areas (Feed Area and Withdrawal Area). Fire areas are considered to be any location bounded by fire rated construction with a minimum rating of two hours and equivalently fire rated doors, dampers, or penetration seals. Building and area separation is used as a method of limiting fire spread. The X-7725 facility and X-3001 buildings are, connected by the X-7727H corridor, of the same construction. Each are protected by automatic sprinkler system, and have acceptable amounts of combustibles.

Review of the emergency egress paths for the existing buildings/facilities is accomplished using NFPA 101-201803, *Life Safety Code,* as guidance. Some buildings do not comply with the travel distances due to their size. Exit arrangements are adequate because of the low occupancy levels, low combustible loading, large number of exits, and fixed fire suppression systems in the buildings.

Combustible storage in the buildings is considered as part of the hazard evaluation described in Section 7.2 of this chapter. There are no significant quantities of flammable liquids or gases used in the enrichment process; however, centrifuge component manufacturing may be performed in the X-7725 and involve significant quantities of flammable liquids. The use of these liquids and incidental use of other flammable liquids and gases is controlled in accordance with NFPA 30-201803, *Flammable and Combustible Liquids Code* and NFPA 55-202005, *Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks.*

Electrical systems are installed in accordance with NFPA 70-2005, *National Electric Code.*

ACP building/facility design elements include fire protection lighting and fire barriers to ensure personnel safety in accordance with the applicable NFPA identified in Table 7.1-1.

Security provisions to maintain control of classified material during fire events are addressed in the *Security Plan for the Protection of Classified Matter* Security Program *for the American Centrifuge Plant* (Reference 22).

New buildings/facilities are designed, constructed, and operated to meet the codes and standards applicable at the time of design development.

The Cylinder Storage Yards (X-745G-2, X-745H, X-7746S, and X-7746W) have fire hydrants equipped with monitor nozzles. Workers are trained to initiate the nozzles should a fire occur within the yards.

~~Cylinder handling equipment for handling 2.5-ton cylinders or larger are equipped with fire suppresser systems for the engine compartments.~~

7.3.1 Fire Suppression Systems

Fire Suppression is provided in the following buildings/facilities to support HALEU Demonstration: X 3001, X-3012, X-7725, X-7726, and X-7727H. Fire suppression is provided in the following buildings/facilities to support commercial ACP operation: for the X-3001, X-3002, X-3012, X-3344, X-3346, X-3346A, X-7725, X-7726 buildings/facilities, and X-7727H corridor is provided by sprinkler systems. The systems are hydraulically designed and installed to meet or exceed the NFPA recommended sprinkler densities for Ordinary Hazard Group 1 occupancies and storage occupancies. The systems consist of sprinklers located at the ceilings/roof level and in other areas where needed. The sprinkler heads are supplied by piping fed from a riser connected to the firewater distribution system. This design is sufficient to ensure that credible fire related accident scenarios can be controlled given the building designs, equipment layout, and anticipated combustible loadings. Fire Suppression in other buildings/facilities (e.g., X-3002, X-3346, X 3346A) will be provided prior to deployment of operations involving licensed materials in those facilities.

Existing suppression systems are maintained in accordance with the applicable codes and standards enforced at the time of construction and installation. New suppression systems will meet NFPA 13-20192002, *Standard for the Installation of Sprinkler Systems* and NFPA 25-20172002, *Standard for Water Spray Fixed Systems for Fire Protection*. When modifying existing buildings/facilities, the safety benefit from applying current codes and standards will be evaluated to determine if the change is justified. The evaluation and decision made will be documented.

7.3.2 Fire Alarms

The sprinkler systems are connected to the Fire Alarm system. This system meets the requirements of NFPA 72-2002, *National Fire Alarm Code*. The system alarms include sprinkler water flow alarms from the sprinkler systems and manual pull stations located in the X-3001, X-3002, X-3012, X-3344, X-3346, X-3346A, X-7725, X-7726 buildings/facilities, and X-7727H corridor. Alarms are received in the X-1020 Emergency Operations CenterX-300 Plant Control Facility and the X-1007 Fire Station. Alarm announcement is not local, but building evacuation can be manually initiated from the X-1020 Emergency Operations Center, from the X-3012 Area Control Room, X-300, and X-1007 or locally in some areas.

7.4 Process Fire Safety

The ACP has addressed process fire safety through the design of the buildings and operations such that consideration is taken for fire hazards that may be present in order to protect the workforce and public. Hazardous areas are identified to ensure the workforce is cognizant of hazardous material and operations. The ISA has been performed to identify the credible accident scenarios and establish the necessary IROFS to ensure the health and safety of the workforce and public. The IROFS for the ACP are identified in the ISA Summary for the commercial ACP operation. The IROFS for HALEU Demonstration are identified in Addendum 1 of the ISA Summary. IROFS associated only with the commercial ACP operation will be implemented prior to deployment of operations involving licensed materials in those facilities.

The ACP buildings/facilities are designed in accordance with the codes and standards as identified in Section 7.1 above. The ACP hazardous areas are identified as part of the pre-fire plans required in Section 7.1.4 above. The ACP ISA is discussed in Section 7.2.2 of this chapter and Chapter 3.0 of this license application.

The ISA determines the likelihood of occurrence for the explosion and fire scenarios and resulting consequences associated with the release of UF_6 and its airborne release reaction product, HF assuming the accident is unmitigated. The ISA identifies IROFS and related management measures necessary to prevent the accident and/or mitigate the consequences in accordance with the performance criteria in 10 CFR 70.61. The IROFS identified by the ISA to prevent or mitigate explosion and fire related scenarios are grouped in the following three categories.

- Combustible Material Control
- Fire Suppression and Response
- Fire/Explosion Prevention

UF_6 is the primary hazardous material in the ACP. In the presence of moist air, UF_6 reacts to form HF gas and UO_2F_2. The ISA considers ~~U~~ UO_2F_2 for radiological and toxicological hazards and HF for toxicological hazards. Other chemicals evaluated are activated alumina pellets used in the alumina traps to filter UF_6 gas, compressed gases (e.g., nitrogen, acetylene), perfluorocarbon fluid used in the equipment brine heating/cooling system, other refrigerants used in the various process refrigeration systems, janitorial supplies, fire extinguishing agents, and non-flammable oils used within the centrifuge upper and lower support assemblies. These other chemicals are not considered to have a significant hazardous interaction capability.

If centrifuge component manufacturing is performed within the ACP, additional materials are required for the process that will present fire safety and health concerns. These additional materials include carbon fibers, resin systems (resins, hardeners, and modifiers), prepregs (fibers/resin system) and for cleaning chemicals such as acetone, alcohols, carbon dioxide, ethanol, and Freon 134.

7.5 Fire Protection and Emergency Response

The design and operation of the buildings/facilities are evaluated on a periodic basis to ensure fire hazards are controlled. Fire protection systems are present to further reduce the risk of fires that could result in a release of hazardous material. Emergency response is provided to add defense-in-depth to the fire protection systems and respond to areas where fire protection systems do not exist.

7.5.1 Fire Protection Engineering

Fire protection engineering support is available to evaluate fire hazards; review changes to maintenance and process systems; and provide in-house consultation under the direction of the Fire Safety/Emergency Management Manager. They also perform the building surveys as described in Section 7.2.3 of this chapter.

Fire protection engineers assist in the development of project design criteria, perform design review, and conduct routine engineering consultation as necessary. Fire protection engineering is part of project design teams and routinely reviews project design packages to ensure applicable fire safety issues are addressed. These issues may include construction, egress, building/facility protection, separation of fire areas, detection systems, and special hazard protection. Fire protection engineers are either graduates of a technical program or have at least six years experience in fire protection work.

Reported fires are investigated using a graded approach through the Corrective Action Program. This includes investigations by fire officers, engineers, or by multidiscipline teams as warranted. Results of investigations are considered for distribution throughout ACP operations to prevent future reoccurrences. Details of incident investigation in the ACP are described in Section 11.6 of this license application.

7.5.2 Alarm and Fixed Fire Suppression Systems

The ISA credits fire suppression to ensure that credible fire accident scenarios do not result in consequences that would exceed the performance criteria established in 10 CFR 70.61. The alarm and fire suppression systems are designed and installed with adequate capabilities to detect and suppress the credible accident scenarios identified by the ISA. The alarm and fixed fire suppression relied on for HALEU Demonstration is identified in Addendum 1 of the Integrated Safety Analysis – HALEU Demonstration.

The firewater supply to support fire suppression systems is provided by the DOE reservation system. The firewater supply is sufficient to meet the anticipated needs of the ACP. To ensure the firewater is available and reliable, assessment requirements of Section 11.5 of this license application are performed. See Section 7.5.3 of this chapter.

Fire detection is based upon heat and is an integral part of the fire suppression systems. Fire suppression systems have sprinkler heads with fusible links or gas expansion actuators to initiate water flow when specific temperatures are reached. Water flow alarms on the fire suppression systems provide fire detection. System flow is monitored to provide alarms for emergency response.

The fire alarm system monitors fire suppression systems in the ACP buildings. Alarms caused by non-fire conditions (i.e., spurious water flow alarms from pressure surges) are reviewed by fire safety personnel and identified for maintenance as needed. The system includes alarm notification to the ~~X-1020 Emergency Operations Center~~ X-300 and ~~the~~ X-1007 ~~Fire Station~~. Alarm rooms are manned as necessary to support prompt notification of emergency response personnel to investigate and respond to alarm conditions.

Manual pull stations are located throughout the buildings/facilities to provide additional alarm capability. Operation of a pull station initiates an alarm at the central alarm receiving locations (X-1007~~, X-1020,~~ and X-300~~X-3012~~ buildings)~~,~~ but is not announced locally.

The ACP has evacuation alarm initiation capability in areas that can be initiated locally, in addition to remote initiation capability from the ~~X-1020 and~~ X-3012 Area Control Room, X-300, and X-1007 buildings.

Fixed automatic fire suppression systems provide the means of detection, control, and suppression of fires at the ACP. These fixed fire suppression systems are inspected, tested, and maintained on a regular basis in accordance with approved procedures.

7.5.3 Firewater Distribution System

The ACP fire suppression systems are part of the DOE reservation firewater distribution system. This system is capable of supplying firewater at rates and durations adequate to meet the anticipated needs of the ACP. The firewater distribution system is an underground piping system laid out such that each ACP building/facility can be supplied from at least two sources. The fire hydrants adjacent to ACP buildings/facilities are also supplied by the firewater distribution system. Additional components that support firewater distribution of the firewater storage tanks and firewater pumps.

The firewater storage tanks include one 300,000 -gallon elevated tank and two 2,000,000 -gallon surface tanks. The firewater pumps include two electric pumps and one diesel pump each with a capacity to pump up to 4,000 gallons per minute. The diesel pump has enough fuel to run for the durations needed to meet the anticipated needs of the ACP.

7.5.4 Mobile and Portable Equipment

Mobile and portable fire protection equipment are provided by a qualified supplier. Portable fire extinguishers are available throughout the ACP. Size, selection, and distribution of extinguishers are determined in accordance with NFPA 10-201802, *Standard for Portable Fire Extinguishers*.

7.5.5 Emergency Response

The ISA credits emergency response to ensure that credible fire accident scenarios do not result in consequences that would exceed the performance criteria established in 10 CFR 70.61.

Fire department emergency response is provided by a qualified supplier. This supplier is staffed, trained, and equipped adequately to meet the needs of the ACP. See Section 7.1.3 of this chapter. ACP workers are trained as indicated in Section 11.3 of this license application to recognize emergency conditions and alert the emergency response group.

7.5.6 Control of Combustible Materials

The ISA credits combustible materials control programs inside and outside the ACP buildings/facilities to ensure that credible fire accident scenarios do not result in consequences that would exceed the performance criteria established in 10 CFR 70.61. This covers the ACP primary facilities and is addressed on a continuous basis by the building/facility custodians. It also includes limited use of fossil fuel and other combustible material. Combustible materials control is assured through training and procedures as discussed in Sections 11.3 and 11.4 of this license application.

7.5.7 Use of Noncombustible Materials

The ISA credits use of noncombustible materials in the construction and operation of the ACP buildings/facilities to ensure that credible fire accident scenarios do not result in consequences that would exceed the performance criteria established in 10 CFR 70.61. This includes use of construction material such as concrete, steel, insulation, and refrigerant. Use of noncombustible materials is assured through the Configuration Management Program discussed in Section 11.1 of this license application.

7.5.8 Control of Combustible Mixtures

The ISA credits control of combustible gases and mixtures in the construction and operation of the ACP buildings/facilities and manufacture of equipment to ensure that credible fire accident scenarios do not result in consequences that would exceed the performance criteria established in 10 CFR 70.61. Control of combustible mixtures is assured through the Maintenance Program discussed in Section 11.2 of this license application.

7.5.9 Placement of Equipment and Operations

The ISA credits placement of equipment in ACP buildings/facilities to ensure that credible fire accident scenarios do not result in consequences that would exceed the performance criteria established in 10 CFR 70.61. Proper placement of equipment and operations is assured through the Configuration Management Program discussed in Section 11.1 of this license application.

7.6 References

1. 29 CFR Part 1910.252, *Occupational Safety and Health Standards*

2. LA-3605-0003, Integrated Safety Analysis Summary for the American Centrifuge Plant

3. NFPA 10-201802, *Standard for Portable Fire Extinguishers*

4. NFPA 13-200219, *Standard for the Installation of Sprinkler Systems*

5. NFPA 15-200117, *Standard for Water Spray Fixed Systems for Fire Protection*

6. NFPA 25-20024, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*

7. NFPA 30-201803, *Flammable and Combustible Liquids Code*

8. NFPA 51B-201903, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*

9. NFPA 55-202005, *Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks*

10. NFPA 70-2005, *National Electric Code*

11. NFPA 72-2002, *National Fire Alarm Code*

12. NFPA 75-2003, *Standard for the Protection of Electronic Computer/Data Processing Equipment*

13. NFPA 80-1999, *Standard for Fire Doors and Fire Windows*

14. NFPA 101-201803, *Life Safety Code*

15. NFPA 220-1999, *Standard on Types of Building Construction*

16. NFPA 232-2000, *Standard for the Protection of Records*

17. NFPA 241-201900, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*

18. NFPA 801-202003, *Standard for Fire Protection for Facilities Handling Radioactive Materials*

19. NUREG-1513, *Integrated Safety Analysis Guidance Document*

20. NUREG-1520, *Standard Review Plan for the Review of a License Application for a Fuel Cycle FacilityFacilities License Applications*, Revision 2

21. LA-3605-0003A, *Addendum 1 of the ISA Summary for the American Centrifuge Plant – HALEU Demonstration*

20.22. SP-3605-0041, *Security Plan for the Protection of Classified Matter at the American Centrifuge Plant*

8.0 EMERGENCY MANAGEMENT

As discussed in Section 1.1.8 of this license application, it is the long-term goal of the Licensee to deploy the American Centrifuge Plant (ACP) in a modular fashion on a scalable, economical gradation consistent with market demand. American Centrifuge Operating, LLC (ACO), the Licensee, would develop and submit future license amendments to allow additional phases of modular deployment up to the currently U.S. Nuclear Regulatory Commission (NRC)-approved full capacity operation of 3.8 million separative work units. Pursuant to 10 *Code of Federal Regulations* (CFR) 70.22(i), the Licensee developed an NRC-approved an Emergency Plan for the fully deployed American Centrifuge Plant ACP has been developed. The Emergency Plan is written to encompass the American Centrifuge Plant and other on-going activities on the U.S. Department of Energy (DOE) reservation in Pike County Ohio. The previously NRC-approved plan conforms to the Regulatory Guide 3.67, *Standard Format and Content for Emergency Plans for Fuel Cycle and Materials Facilities*, dated January 1992. Although not required or implemented for the High Assay Low Enriched Uranium (HALEU) Demonstration Program, the Emergency Plan will support future ACP deployment phases.

The information documented in this plan the previously NRC-approved emergency plan includes: 1) description of the facility; 2) summary credible emergencies; 3) classification and notification of accidents; 4) responsibilities; 5) emergency response measures; 6) equipment and facilities designated for use during emergencies; 7) methods for maintaining emergency preparedness; 8) emergency records and reports; 9) recovery and restoration measures; and 10) a commitment to comply with the *Community Right-To-Know Act*.

The previously NRC-approved plan remains is submitted for review as part of this license application as document NR-3605-0008, *Emergency Plan for the American Centrifuge Plant* in Piketon, Ohio. The Licensee would notify the NRC well in advance of the transition into any future phases of deployment that would require use of this previously NRC-approved NR-3605-0008.

8.1 High Assay Low Enriched Uranium Demonstration

No Emergency Plan as discussed under 10 CFR 70.22(i) is needed for the HALEU Demonstration Program. DAC-3901-0005, *Evaluation of No Need for an Emergency Plan for the HALEU Demonstration*, provides the evaluation stipulated in 10 CFR 70.22(i)(1)(i) to demonstrate that no Emergency Plan is required for the HALEU Demonstration Program. The evaluation shows that the maximum dose to a member of the public offsite due to a release of radioactive materials would not exceed 1 roentgen equivalent man (rem) effective dose equivalent or an intake of 2 milligrams (mg) of soluble uranium (U).

DAC-3901-0005 uses "factors" provided in 10 CFR 70.22(i)(2) to support making the determination that no Emergency Plan is required. Relevant guidance provided in NUREG-1520, *Standard Review Plan for Fuel Cycle Facilities License Applications* (Revision 2), is also used. Key "factors" used in the HALEU Demonstration Program evaluation include recognition of engineered safety features as necessary and operating restrictions or procedures to prevent exceeding 1 rem or 2 mg U intake at the DOE reservation boundary. These were applied for the evaluation of certain fire scenarios. With engineered safety features as necessary and operating restrictions or procedures, no fire scenario can be identified that would cause consequences that would require an Emergency Plan.

Fluor BWXT Portsmouth, LLC (FBP); Portsmouth Mission Alliance, LLC; and Mid-America Conversion Services, LLC are the DOE's primary contractors at the DOE Portsmouth site. FBP currently serves as the Decontamination and Decommissioning contractor and provides emergency response capabilities at the site compliant under DOE Order 151.1D, *Comprehensive Emergency Management System*. Through a reverse work authorization arrangement, FBP provides emergency response to the ACP. With augmentation and coordination with ACO personnel where appropriate, FBP provides the following:

- Emergency Response Organization
- Emergency Facilities and Equipment/Systems
- Fire Department Response*
- Emergency Operations Center (EOC)
- Alternate EOC
- Joint Information Center
- Plant Shift Superintendent/Incident Command Support
- Emergency Medical Support
- Offsite Response Interfaces
- Announcement of Protective Actions
- Emergency Public Information
- Communications and Notifications, as appropriate
- Consequence Assessment
- Support with Termination and Recovery, as appropriate
- Support with Coordinating and Assessing Readiness Assurance

* FBP operates and maintains the X-1007 Fire Station on the DOE reservation. This is a 24 hours a day/7 days a week dedicated fire department which has minimum staffing requirements to maintain appropriate manpower for emergency response on the DOE reservation. Fire personnel are certified as State of Ohio Level II (Professional Firefighters) and minimum State of Ohio Emergency Medical Technicians with one Paramedic per shift.

8.1.1 Nuclear Criticality

The primary radiation alarm system is the Criticality Accident Alarm System (CAAS), designed to detect a nuclear criticality and provide annunciation by audible evacuation alarms that are supplemented by visual alarms in some areas, such as high-noise areas that will alert personnel to evacuate the immediate area.

Operations involving fissile material are evaluated for Nuclear Criticality Safety (NCS) considerations prior to initiation. The need for CAAS coverage is considered during the evaluation process. CAAS coverage is provided, unless it is determined that coverage is not required per the requirements of 10 CFR 70.24 and the finding is documented in an NCS Evaluation. CAAS coverage is provided for HALEU Demonstration fissile material operations.

The CAAS is designed to detect gamma radiation levels that would result from the minimum criticality accident of concern as defined in 10CFR70.24(a)(1). The CAAS is designed to provide annunciation by audible alarms that are supplemented by visual alarms in some areas, such as in high-noise areas.

The criticality detection system consists of detector clusters and an alarm system. When a criticality accident alarm activates, a radiation alarm is generated actuating building local horns. Alarm activation requires evacuation of personnel from the affected area to a designated monitoring station that is located a minimum evacuation distance of 125 ft from the facility with the active CAAS alarm. Trained emergency responders are dispatched to the facility evacuation point to provide evacuees and Incident Command with additional guidance, as appropriate. Based on the alarm location, Incident Command can direct the actions necessary to respond to the accident in coordination with technical personnel. The EOC is activated and provides coordinated support for the response. Emergency response to CAAS alarms and/or nuclear criticality events is consistent with guidance contained in ANSI/ANS-8.23-2007, *Nuclear Criticality Accident Emergency Planning and Response*.

Coordinated response exercises and local drills are performed periodically to familiarize personnel with proper response actions and assembly locations.

8.2 References

1. American National Standards Institute (ANSI)/American Nuclear Society (ANS) 8.3-1997, *Criticality Accident Alarm System*

2. American National Standards Institute (ANSI)/American Nuclear Society (ANS) 8.23-2007, *Nuclear Criticality Accident Emergency Planning and Response*

3. Regulatory Guide 3.67, *Standard Format and Content for Emergency Plans for Fuel Cycle and Materials Facilities*, Revision 1

4. NR-3605-0008, *Emergency Plan for the American Centrifuge Plant*

5. DAC-3901-0005, *Evaluation of No Need for an Emergency Plan for the HALEU Demonstration*

6. NUREG-1520, *Standard Review Plan for Fuel Cycle Facilities License Applications*, Revision 2

7. DOE Order 151.1D, *Comprehensive Emergency Management System*

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9.0 ENVIRONMENTAL PROTECTION

The American Centrifuge Plant (ACP) is located in Piketon, Ohio on the U.S. Department of Energy (DOE) reservation, adjacent to the former U.S. Nuclear Regulatory Commission (NRC) regulated Portsmouth Gaseous Diffusion Plant (GDP), ~~an existing facility with a similar mission~~. ~~The Portsmouth GDP has radioactive effluent controls and as low as reasonably achievable (ALARA) programs that meet U.S. Nuclear Regulatory Commission (NRC) requirements.~~ The ACP Environmental Protection Program is modeled ~~on~~ after the ~~existing~~ well-seasoned GDP environmental protection program. The ACP program thus takes advantage of the well-established programmatic elements and experience and many years of existing environmental data. This approach will provide maximum protection to the public and the environment. The Production Support Manager is responsible for the ACP Environmental Protection Program. Details of the minimum requirements for the managers and staff supporting the Environmental Protection Program are provided in Chapters 2.0 and 11.0 of this license application.

As discussed in Section 1.1.8 of this license application, American Centrifuge Operating, LLC's (ACO) long-term goal is to resume commercial enrichment production consistent with market demand. The ACP design is modular, with the basic building block of enrichment capacity being a cascade of centrifuges. Modular deployment would accommodate market demand on a scalable, economical gradation. As such, the Environmental Protection Program will be implemented to support the modular deployment.

The next phase of enrichment production includes the deployment of a cascade of centrifuges to demonstrate production of high-assay, low-enriched uranium (HALEU) fuel for advanced reactors. The primary building/facilities directly involved in HALEU Demonstration are the X-3001 Process Building, X-3012 Process Support Building, X-7725 Recycle/Assembly Building, X-7726 Centrifuge Training and Test Facility, and X-7727H Interplant Transfer Corridor. The Licensee will notify NRC well in advance of the transition into any future phases of ACP deployment. For further plant and process specifics related to the HALEU Demonstration Program, refer to LA-3605-0003A, *Addendum 1 of the ISA for the American Centrifuge Plant – HALEU Demonstration.*

The general use of the term ACP in the remainder of this chapter is intended to refer to both the commercial ACP operation and the HALEU Demonstration. HALEU Demonstration will be specifically noted, as necessary, when the context is uniquely applicable to HALEU Demonstration.

9.1 Environmental Report

The regulatory requirements for an Environmental Report are contained in 10 *Code of Federal Regulations* (CFR) Part 51. The NRC promulgated these regulations to implement the *National Environmental Policy Act* of 1969, which requires an assessment of the environmental impacts associated with all major Federal actions. For licensing actions that are not categorically excluded, the NRC conducts an independent assessment on the basis of the information submitted in the Environmental Report.

An update to the Environmental Report for the American Centrifuge Plant meeting the requirements of 10 CFR 51.45 was prepared and is submitted for review as part of this license application as document LA-3605-0002, *Environmental Report for the American Centrifuge Plant*, Revision 17.

9.2 Environmental Protection Measures

9.2.1 Radiation Protection Program

The ACP Environmental Radiation Protection Program is based on the following policies:

- The dose to members of the public resulting from gaseous emissions and liquid effluents shall be maintained in accordance with the ALARA principle and below legal limits.
- It is the responsibility of each employee to conduct their activities in such a manner so as to prevent or minimize the discharge of radioactive materials to the environment, and to report any unusual or excessive discharge of such material.

9.2.1.1 Radiological (As Low As Reasonably Achievable) Goals for Effluent Control

The ACP maintains and uses gaseous and liquid effluent treatment systems, as appropriate, to maintain releases of radioactive material to unrestricted areas below the limits specified in 10 CFR 20.1301 and 40 CFR Part 190, and in accordance with the ALARA policy described below. Gaseous effluent control systems are also used to maintain releases of radioactive material to unrestricted areas below the dose constraint in 10 CFR 20.1101 and the dose limit in 40 CFR 61.92. Unrestricted areas are those areas beyond the DOE reservation boundary and to which any member of the public has unrestricted access.

The ALARA goal for airborne radioactive releases from the ACP is five percent of the NRC constraint (10 CFR 20.1101) and Environmental Protection Agency (EPA) limit (40 CFR 61.92), or an annual Total Effective Dose Equivalent (TEDE) of 0.5 millirem (mrem) to the most exposed member of the public, calculated as described in Section 9.2.2.1.2. This is also less than 15 percent of the most restrictive limit under 40 CFR Part 190, based on site experience.

The ALARA goal for waterborne radioactive releases from the ACP is ten percent of the airborne ALARA goal, or an annual TEDE of 0.05 mrem to the most exposed member of the public. This is equivalent to 0.05 percent of the 10 CFR 20.1301 limit on annual public dose. This goal is based on the assumption that: 1) the effluent limits in 10 CFR Part 20, Appendix B, Table 2 are equivalent to an annual public dose of 50 mrem; and 2) maximum public exposure occurs in the Scioto River with a dilution factor of at least 100:1. The principal liquid effluent stream from the ACP discharges directly to the river via a buried pipeline and the actual dilution factor between site effluents and the Scioto River is on the order of 5,000:1. Consequently, the second assumption should be very conservative.

The ACP also establishes Baseline Effluent Quantities (BEQs) for each monitored vent and monitored outfall and compares measured weekly effluents to these BEQs. Weekly effluents that are less than the BEQs cannot approach the dose limit in 10 CFR 20.1301 or the dose constraint in 10 CFR 20.1101. Weekly effluents that are not less than the applicable BEQs are evaluated as described in Sections 9.2.2.1.3 and 9.2.2.2.3 of this chapter, to determine whether they may cause the ACP to exceed regulatory limits or the ALARA goals. Notifications and corrective actions are implemented as described in those sections and Table 9.2-1.

9.2.1.2 Effluent Controls

9.2.1.2.1 Control of Airborne Effluents

X-3346 Feed and Withdrawal Building

The X-3346 operations are applicable to commercial ACP operations only and are not used in the HALEU Demonstration. The Feed Area of the X-3346 building sublimes uranium hexafluoride (UF_6) for feed to the enrichment process and sublimes and desublimes UF_6 for blending/ transfer operations between cylinders and transfer of UF_6 material to customer cylinders for shipment as described in Section 1.1 of this license application and contains a variety of potential sources for radioactive effluents, both as gaseous UF_6 and particulate uranyl fluoride (UO_2F_2). These sources are vented to the atmosphere through an evacuation system located in the Withdrawal Area of this building, which has separate subsystems to control gaseous and airborne particulate effluents. Both sub-systems exhaust to a continuously monitored combined vent.

The Withdrawal Area of the X-3346 building withdraws and desublimes both the product and tail streams from the enrichment process as described in Section 1.1 of this license application and contains a variety of potential sources for radioactive effluents, both as gaseous UF_6 and particulate UO_2F_2. These sources are vented to atmosphere through an evacuation system located in the Withdrawal Area. There are separate evacuation systems, which have separate subsystems to control gaseous and airborne particulate effluents.

The cylinder burping/heeling system, feed ovens, freezer/sublimers, cold boxes, sampling system, and process piping in these areas are manifolded to the gaseous effluent side of their respective evacuation systems. Gases evacuated from process systems, which can contain high concentrations of UF_6, are processed through cold traps to desublime the UF_6 and separate it from the non-UF_6 gases. Residual gases leaving the cold trap have a very low concentration of UF_6, which is further reduced by passing the gas through an alumina trap. When an evacuation system cold trap becomes full, it is valved off from the vent and its contents sublimed to a dump cylinder so the material can be fed to the enrichment plant. The cold traps can be bypassed to allow rapid evacuation of a volume that does not contain radioactive material. The alumina traps cannot be bypassed.

Cylinder connections and disconnections have the greatest potential for small releases of UF_6 to the workspace. UF_6 released in this manner reacts quickly with ambient humidity to form UO_2F_2. A WISP system is used to collect these gases from fixed operational points (e.g. feed oven cylinder connection) through the evacuation system. Portable gulper systems are used to collect any small release of material during maintenance operations. Gulper systems utilize a flexible hose or hood to evacuate the air in the immediate area where the connection is being made or broken. The captured gases are passed through a roughing filter followed by a High Efficiency Particulate Air (HEPA) filter to collect the UO_2F_2 particulate. The portable gulpers are exhausted within the building in which they are being used.

The effluents from the WISP sub-systems are combined and vented to the atmosphere through a common vent after each subsystem associated with the evacuation system has removed the uranium. The vent is equipped with continuous gas flow monitoring instrumentation with local readout as well as the analytical instrumentation required to continuously sample, monitor and to alarm UF_6 breakthrough in the effluent gas stream. The continuous vent monitor/sampler is described in Section 9.2.2.1 of this chapter.

Ventilation air in the X-3346 is monitored under the Radiation Protection Program as described in Section 4.7 of this license application. Environmental Compliance personnel review summaries of the monitoring data at least quarterly to verify that ventilation exhausts are insignificant as defined in NUREG-1520, *Standard Review Plan for ~~the Review of a License Application for a~~ Fuel Cycle Facilities~~y~~ License Applications, Revision 2* (SRP) (i.e., less than 3 x 10^{-13} microcuries per milliliter [μCi/mL] uranium).

X-3001 and X-3002 Process Buildings

The process buildings house the operating centrifuges ~~machines~~ that separate the UF_6 into enriched product and depleted tails as described in Section 1.1 of this license application and contain a limited variety of potential sources for radioactive effluents, primarily as gaseous UF_6. These sources are vented to atmosphere through either the Purge Vacuum (PV) or Evacuation Vacuum (EV) Systems. Both systems exhaust to a common continuously monitored vent.

Enrichment equipment operates at sub-atmospheric pressures. Equipment operation requires the removal of any air that leaks into the process. The PV/EV Systems are used to remove air in the enrichment equipment. Since the air may contain traces of UF_6 the gas removed by these systems is passed through a shared set of alumina traps prior to venting. The PV/EV systems in each half (north and south) of each process building are manifolded to one process building vent. For HALEU Demonstration, the PV/EV system is only in the north half (Train 3) of the X-3001 Process Building. Additionally, for HALEU, there is also a bank of Sodium Fluoride (NaF) traps to facilitate removal of UF_6 inventory from the cascade should it be necessary. The discharge of the NaF traps is subsequently routed to PV/EV systems. Each process building vent is equipped with continuous gas flow monitoring instrumentation with local readout, as well as analytical instrumentation to continuously sample, monitor, and alarm UF_6 breakthrough in the effluent gas stream. The continuous vent monitors/samplers are described in Section 9.2.2.1 of this chapter.

~~Valving and piping allow the EV systems to bypass the chemical traps during the initial pump down of machines that have not been previously exposed to UF_6. This reduces the chances of desorbing previously trapped UF_6 from the traps. Otherwise, the EV systems throughput will pass through the chemical traps along with PV system throughput.~~

Ventilation air in the process buildings is monitored under the Radiation Protection Program as described in Section 4.7 of this license application. Environmental Compliance personnel review summaries of the monitoring data quarterly to verify that ventilation exhausts are insignificant as defined in the SRP (i.e., less than 3×10^{-13} μCi/mL uranium).

X-3344 Customer Services Building

The X-3344 operations are applicable to commercial ACP operations only and are not used in the HALEU Demonstration. The Customer Services Building liquefies UF_6 for quality control sampling of UF_6 material as described in Section 1.1 of this license application and also contains multiple potential sources for radioactive effluents, both as gaseous UF_6 and particulate UO_2F_2. These effluents are vented from X-3344 building through piping to an evacuation system in the X-3346 building through a continuously monitored combined vent.

The autoclaves, sampling manifolds, sample containers and piping and process piping are manifolded to the gaseous effluent side of the appropriate WISP evacuation system. Gases evacuated from process systems, which can contain high concentrations of UF_6, are processed through cold traps located in the X-3346 Withdrawal Area to desublime the UF_6 and separate it from the non-UF_6 gases. Residual gases leaving the cold trap have a very low concentration of UF_6, which is further reduced by passing the gas through an alumina trap. When an evacuation cold trap becomes full, it is valved off from the vent and its contents sublimed to a cylinder. The evacuation cold traps can also be bypassed to allow rapid evacuation of a volume that does not contain significant amounts of radioactive material. The alumina traps cannot be bypassed.

Cylinder connections and disconnections have the greatest potential for small releases of UF_6 to the workspace. UF_6 released in this manner reacts quickly with ambient humidity to form UO_2F_2. A WISP system is used to collect these gases from fixed operation points (e.g. feed oven cylinder connection) through the evacuation system. Portable gulper systems are used to collect any small release of material during maintenance operations. Gulper systems utilize a flexible hose or hood to evacuate the air in the immediate area where the connection is being made or broken. The captured gases are passed through a roughing filter followed by a HEPA filter to collect the UO_2F_2 particulate. The portable gulpers are exhausted within the building in which they are being used.

The effluents from the WISP sub-systems are combined and vented to the atmosphere through a common vent after each sub-system associated with the evacuation system in the X-3346 building has removed the uranium. The vent is equipped with continuous gas flow monitoring instrumentation with local readout as well as the analytical instrumentation required to continuously sample, monitor and to alarm UF_6 breakthrough in the effluent gas stream. The continuous vent monitor/sampler is described in Section 9.2.2.1 of this chapter.

Ventilation air in the X-3344 building is monitored under the Radiation Protection Program as described in Section 4.7 of this license application. Environmental Compliance personnel review summaries of the monitoring data at least quarterly to verify that ventilation exhausts are insignificant as defined in the SRP (i.e., less than 3 x 10^{-13} μCi/mL uranium).

X-3012 Process Support Building

The X-3012 building provides process control functions and maintenance support as described in Section 1.1 of this license application. The ACR provides central operating functions to monitor and control HALEU Demonstration processes in the X-3001 process building. Some small quantities of uranium materials may be present in this building associated with operation of mass spectrometers, maintenance activities, or other activities. From time to time, contaminated components may be serviced in the maintenance shops in the X-3012 building. Components requiring repair or examination that have been in service will be opened using appropriate personnel protective equipment (PPE), and may also include engineered local ventilation systems to capture any residual uranium.

Ventilation air in the X-3012 building is monitored under the Radiation Protection Program as described in Section 4.7 of this license application. Environmental Compliance personnel review summaries of the monitoring data quarterly to verify that ventilation exhausts are insignificant as defined in the SRP (i.e., less than 3 x 10^{-13} μCi/mL uranium).

X-7725 Recycle/Assembly FacilityBuilding; X-7726 Centrifuge Training and Test Facility; and X-7727H Interplant Transfer Corridor

Centrifuges are assembled and may be disassembled for repair or inspection as described in Section 1.1 of this license application in either the X-7725 building or X-7726 facilityies. The extent to which a centrifuge is disassembled depends upon the nature of the fault. Centrifuges requiring repair or examination that have been in service will be opened using appropriate PPE, and may also include engineered local ventilation systems to capture any residual uranium.

As described in Section 1.1 of this license application, some completely assembled centrifuges machines are tested with UF_6 in the Gas Test Stands in the commercial ACP operation. In the HALEU Demonstration, the X-7725 building will only be used for temporary storage and for interior transport to and from the X-7726 facility. This is a separate room within X-7725 facility building with its own ventilation and emission control system. UF_6 for the test stands is supplied from a small cylinder within this room. Exhaust from the test stands passes through alumina traps to a continuously monitored vent. The vent is equipped with continuous gas flow monitoring instrumentation with local readout, as well as the analytical instrumentation required to continuously sample, monitor, and to alarm UF_6 breakthrough in the effluent gas stream. The continuous vent monitor/sampler is described in Section 9.2.2.1 of this chapter.

Ventilation air in both the X-7725 building and X-7726 facilityies is monitored under the Radiation Protection Program as described in Section 4.7 of this license application. Environmental Compliance personnel review summaries of the monitoring data quarterly to verify that ventilation exhausts are insignificant as defined in SRP (i.e., less than 3 x 10^{-13} μCi/mL uranium).

As described in Section 1.1, the X-7727H corridor is used only to provide indoor transport for sealed components (e.g., individual centrifuges) between the X-7725 facility building and the process buildings and is closed off from these buildings except when such transport is actually occurring. Consequently, the X-7727H corridor is never directly exposed to a source of gaseous uranium although it does have some air transfer from the process buildings and X-7725 facilitybuilding. At worst, the airborne uranium concentration in the X-7727H corridor will not exceed that in the process buildings or X-7725 facilitybuilding. This is insignificant as defined in the SRP (i.e., less than 3 x 10^{-13} μCi/mL uranium).

Waste Management

The ACP obtains waste management services for various radiological and non-radiological materials. The radiological waste management services are obtained from a qualified provider licensed/certified by the NRC or an agreement state.

Laboratory Services

The ACP obtains analytical services for various radiological and non-radiological materials. The radiological analytical services are obtained from a qualified laboratory licensed/certified by the NRC or an agreement state.

9.2.1.2.2 Control of Liquid Effluents

The centrifuges and PV/EV vacuum pumps are cooled by a closed-loop Machine Cooling Water (MCW) system to minimize the amount of water potentially contaminated by uranium. There is no routine blowdown from the MCW system. Waste heat from the MCW system is discharged via heat exchangers to the Tower Water Cooling (TWC) system, which is cooled by a single cooling tower. Waste heat from the cold trap refrigeration systems in X-3346 and X-3356 buildings is also discharged to the TWC system. Currently, the TWC discharges its blowdown to the GDP Recirculating Cooling Water (RCW) system under a service agreement, which in turn discharges its blowdown directly to the Scioto River via an underground pipeline (National Pollutant Discharge Elimination System [NPDES] Outfall 004). The RCW system does not provide any treatment of the TWC blowdown; it simply provides a convenient pathway to a suitable permitted discharge point. At some point in the future, DOE is expected to decommission and decontaminate the GDP, including the RCW system. By that time, the TWC blowdown will have to be modified to bypass the RCW system and discharge directly to the RCW discharge pipeline. The schedule for this has not been established. There should be no licensed material in the TWC blowdown.

In the interim, the GDP RCW system has ample capacity to accept the TWC effluent without either physical modification or adjustment to its discharge limits. The GDP RCW system consists of three sequential loops, which have design capacities of 48,000 gallons per minute (X-626), 153,000 gallons per minute (X-630), and 489,000 gallons per minute (X-633). Current flow rates in these loops are only 8,000, 17,000, and 20,000 gallons per minute (17 percent, 11 percent, and 4 percent of design) and are not expected to increase. The TWC system is currently fitted with three 10,800 gallon per minute pumps and even assuming a conservative blowdown rate of ten percent, TWC blowdown flow will be no more than 3,240 gallons per minute. Adding this to the current flows in the GDP RCW loops gives maximum flows that are only 23 percent, 13 percent, and 5 percent of the respective design capacities of the three loops.

Discharges from the RCW System are monitored by an automated sampler, which collects a weekly composite sample of the liquid effluent for radiological analysis as well as sample(s) for NPDES-mandated analyses. This data is available to the ACP as assurance that no unanticipated discharge of licensed material has occurred.

Leakage from the MCW system and incidental spills of water elsewhere in the ACP, are collected by the Liquid Effluent Collection (LEC) system. The LEC system consists of a set of drains and underground collection tanks for the collection and containment of leaks and spills of chemically treated water. The drains are located throughout the ACP. The tanks have a capacity of 550 gallons (gal) each and are monitored by liquid level gauges mounted above grade on pipe stands. Water accumulated in the LEC tanks is sampled and analyzed prior to disposal. If the contents meet the requirements of 10 CFR 20.2003, they may be pumped to the reservation sanitary sewer system. Otherwise the tank contents will be containerized for off-site disposal. An integrity assurance plan developed by Engineering assures that the tanks are not leaking as the ACP take possession of them. This plan will be completed and will be added to this application as a reference prior to the NRC's pre-operational inspections. Following completion of this integrity assurance plan, inventory monitoring of the tank contents is used to detect leaks from the LEC System.

Storm water runoff from the ACP area, along with some once-through cooling water (sanitary water), drains to a pair of holding ponds.

- The X-2230N West Holding Pond (NPDES Outfall 012) provides a quiescent zone for settling suspended solids, dissipation of chlorine, and oil diversion and containment. The pond discharges to the same unnamed tributary of the Scioto River as X-230J-5. An automated sampler collects a weekly composite sample of the liquid effluent for radiological analysis as well as sample(s) for NPDES-mandated analyses.

- The X-2230M Southwest Holding Pond (NPDES Outfall 013) provides a quiescent zone for settling suspended solids, dissipation of chlorine, and oil diversion and containment. The pond discharges to an unnamed tributary of the Scioto River. An automated sampler collects a weekly composite sample of the liquid effluent for radiological analysis as well as sample(s) for NPDES-mandated analyses.

The X-6002 Recirculating Hot Water Plant, which provides heat to multiple buildings at the ACP, contains a particulate separator (NPDES Outfall 613) that removes suspended solids from the water used in the plant. Samples from the blowdown of the particulate separator are taken prior to its discharge to the DOE reservation sewage treatment plant (GDP NPDES Outfall 003).

Outdoor cylinder storage pads will be used in the commercial ACP operation; however, all cylinder storage will be maintained inside the X-3001 facility in the HALEU Demonstration. Most of the ACP cylinder storage pads are within the drainage of the X-2230M and X-2230N Holding Ponds. The ACP also uses cylinder storage pads on the north end of the reservation (X-745G-2 and X-745H). The ACP conducts an inspection and maintenance program for its UF_6 cylinders to ensure that no licensed material is released to the storage pads in accordance with USEC-651, *Uranium Hexafluoride: A Manual of Good Handling Practices*. Stormwater runoff from the north pads drains to holding ponds in accordance with a service agreement. Holding pond effluents are currently continuously monitored with automated samplers in accordance with the NRC-certified GDP environmental protection plan discussed in (POEF-FBP-001, *Basis for Interim Operation of Former Uranium Enrichment Facilities (FUEF) at the Portsmouth Gaseous Diffusion Plant, Piketon, OH*Chapter 5.1, USEC-02, Application for United States Nuclear Regulatory Commission Certification, Portsmouth Gaseous Diffusion Plant, Safety Analysis Report). This data is available to ACP environmental personnel as assurance that no unanticipated discharge occurred.

9.2.1.3 As Low As Reasonably Achievable Reviews and Reports to Management

Action levels for control of both gaseous and liquid radioactive effluents from the ACP have been established based on the ALARA philosophy. The action levels described in Table 9.2-1 ensure operational control system deficiencies are documented and acted upon in a responsible manner and in a timeframe to remain well within the regulatory limits and below ALARA goals. The required actions described in Table 9.2-1 include the analyses of trends in release data, evaluations of the probable impact of the releases and an assessment of the need for additional effluent controls to meet the ALARA goals. The Senior Shift Supervisor is responsible for assuring that action levels are acted upon.

The BEQs used in Table 9.2-1 is the maximum effluent expected under normal operation. BEQs have been established by the ACP environmental personnel and the responsible building management for every continuously monitored radiological vent and liquid discharge point to unrestricted areas. These BEQs are reviewed annually, at a minimum, by environmental personnel, the responsible building management and the ACP ALARA Committee to ensure the principles described in the ACP's ALARA policy are followed. This review also includes analyses of trends in radioactive effluents and environmental monitoring data. The results of this review are reported to the Production Support Manager and other senior management as described in Chapter 4.0 of this license application.

The specific values of the BEQs are listed in Table 9.2-2. The liquid release points are existing discharges and, while the ACP does not increase releases beyond historic levels, it does not decrease them either. Therefore, the liquid BEQs in Table 9.2-2 are based on GDP historic release rates.

9.2.1.4 Waste Minimization

Radioactive waste minimization and pollution prevention activities are coordinated by ACP environmental compliance and waste management personnel with the support of senior management.

Individual waste streams are identified and characterized based on process knowledge, routine radiation surveys as described in Chapter 4.0 and laboratory analysis, as needed. Generation of individual waste streams and waste management costs are tracked through a formal Request-for-Disposal database system administered by waste management personnel and the annual budgeting process.

Waste generating activities are evaluated for waste minimization opportunities with emphasis on those that generate hazardous wastes, low-level mixed wastes (LLMW), and low-level radioactive wastes (LLRW). Both LLMW and LLRW waste generation is inherently reduced in the ACP by the fact that the process operates under a high vacuum, which prevents radioactive material from escaping. Equipment that must be removed for maintenance is evacuated to the rest of the process first. The routine radiation surveys described in Chapter 4.0 of this license application verify that there is no spread of contamination within or out of the ACP. Hazardous waste generation is minimized by minimizing the procurement and use of hazardous substances. Waste that is generated is treated to the extent practical to reduce the volume, toxicity, or mobility before storage or disposal. The Licensee provides annual employee training that includes waste minimization information and encourages employee suggestions.

The Licensee provides environmental and waste management professionals with opportunities to attend offsite training and conferences for the purpose of seeking and exchanging technical information on waste minimization.

Waste minimization recommendations are evaluated by waste management and environmental compliance personnel and implemented, as appropriate, by waste management, materials procurement (for hazardous materials), and operations personnel.

This applies to ACP operations, associated support operations, and ACP subcontractors that generate waste.

9.2.2 Effluent and Environmental Monitoring

Based on historic GDP experience and operating plans, the radionuclides anticipated to be present in ACP gaseous effluents are ^{234}U, ^{235}U, and ^{238}U. The intention is to not introduce feedstock contaminated with significant concentrations of other nuclides into the process. Feed material that meets the American Standards for Testing and Materials (ASTM) specification for recycled feed may be used in the commercial ACP operation, which may contain radionuclides such as ^{236}U and Technetium (^{99}Tc). Feed material for the HALEU Demonstration could also be UF_6 meeting the ASTM UF_6 product standard, produced in former enrichment operations external to ACP (e.g. GDP operations). Based on historic GDP experience ^{99}Tc may eventually appear in some ACP gaseous effluents. The radionuclides anticipated to be present in ACP liquid effluents are ^{234}U, ^{235}U, ^{238}U, and ^{99}Tc, due to historic contamination of the reservation. Consequently, ACP effluents will be analyzed for these four nuclides as described in the applicable sections below.

9.2.2.1 Airborne Effluent Monitoring

9.2.2.1.1 Anticipated Effluent Levels

The maximum anticipated gaseous effluents from the ACP have been modeled using the EPA-approved and distributed dispersion model, CAP88-PC, and reservation meteorological data from calendar years 1998-2002. The results are summarized in Table 9.2-3. The maximum gaseous effluent anticipated under normal operations is 1.1 millicuries (mCi) of uranium over a week, or up to 0.057 curie (Ci) per year. The maximum exposed individual (MEI) for the ACP is located in the south-southwest sector of the reservation boundary. The projected maximum airborne concentration of total uranium due to ACP operations is only 3.2×10^{-15} μCi/mL, with an associated TEDE of 0.33 mrem. The uranium concentration is roughly three orders of magnitude lower than the applicable values in 10 CFR Part 20, Appendix B, Table 2. The projected TEDE due to ACP operations contributes roughly 66 percent to the ALARA goal given in Section 9.2.1.1 of this chapter, even assuming the average annual emission rates are equal to the maximum weekly emission rates. Average emission rates are expected to be much lower.

It is noted that HALEU Demonstration isotopic distributions may vary from these analyses performed for the commercial ACP operation, due to the use of enriched product as feed to the HALEU Demonstration. However, the HALEU Demonstration is limited to a cascade of only 16 centrifuges; whereas the original analyses for the commercial ACP operations were applicable to cascade containing thousands of centrifuges deployed in a cascade configuration with up to 3.8 million SWU/year. The commercial ACP analyses referenced in this section will conservatively bound any small variations in isotopic distribution that might be applicable to the HALEU Demonstration.

9.2.2.1.2 Demonstration of Compliance

Characterization of the radiological consequences of radionuclides released to the atmosphere from the ACP is accomplished by comparing measured emissions to the values in 10 CFR 20, Appendix B, Table 2 and the requirements of 10 CFR 20.1301, as applicable. The results are incorporated into semiannual reports submitted to the NRC in accordance with 10 CFR 70.59.

Characterization of the radiological consequences of radionuclides released to the atmosphere from the ACP is also accomplished by annually calculating the TEDEs to the maximally exposed person and to the entire population residing within 80 kilometers (km) (50 miles) of the plant. This approach is mandatory under the EPA regulations at 40 CFR Part 61 and has been accepted by the NRC for previous uranium enrichment operations at the reservation. The annual National Emission Standards for Hazardous Air Pollutants (NESHAP) Report includes the reservation identification, a description of plant operations (whether included under this license or not) during the previous year, the amount of radionuclides released to the atmosphere during the previous year, and the calculated TEDE to the most exposed member of the public.

Annual radionuclide releases to air are measured by the continuous vent samplers, as described in Section 9.2.2.1.3 of this license application, or estimated in accordance with guidance in 40 CFR Part 61, Appendices D and E. Atmospheric dispersion of the releases is modeled and the consequent public radiation dose is estimated using the EPA approved computer models in accordance with EPA guidance. An annual report summarizing the atmospheric releases and the dose assessment results is submitted in accordance with 40 CFR Part 61, Subpart H and EPA guidance. In accordance with EPA requirements, the reported public dose includes gaseous radioactive effluents from the DOE reservation.

The dose calculations are made using either the original CAP88 package of computer codes or the CAP88-PC package distributed by the EPA. The CAP88/CAP88-PC packages contain an EPA approved version of the AIRDOS-EPA and DARTAB computer codes and the ALLRAD88 radionuclide data file. The AIRDOS-EPA computer code implements a steady-state, Gaussian plume, atmospheric dispersion model to calculate concentrations of radionuclides in the air and on the ground based on radionuclide releases to the atmosphere and annualized meteorological data. It then uses Regulatory Guide 1.109, *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50,* Appendix I (October 1977), food-chain models to calculate radionuclide concentrations in foodstuffs (e.g., vegetables, meat, milk) and subsequent intakes by individuals. The DARTAB computer code then uses these calculated uptakes and radionuclide data from the ALLRAD88 data file to calculate annual radiation doses to members of the public.

The annualized meteorological data used in the calculations consist of joint frequency stability array distributions of wind direction, wind speed, and atmospheric stability that are prepared from data collected from the reservation meteorological tower. Data from the National Weather Service may be used in lieu of or to supplement reservation meteorological data in the event the on-site tower becomes inoperable. The reservation has a consistent annual pattern of low-level southwesterly winds predominating over the year. During the winter season, northeasterly winds are common though. This is largely attributable to the channeling effect of the hills and ridges on either side of the reservation, which runs roughly southwest to northeast.

Distances to the nearest residences are taken from U.S Geological Survey maps and population distributions are from the 2000 census data. EPA published default values for other off-site parameters (such as local crop productivity) are used in the AIRDOS-EPA model and, in accordance with EPA recommendations; rural patterns for food sources (i.e., home grown versus local production versus national supermarket chains) are assumed.

It is noted that HALEU Demonstration isotopic distributions may vary from these analyses performed for the commercial ACP operation, due to the use of enriched product as feed to the HALEU Demonstration. However, the HALEU Demonstration is limited to a cascade of only 16 centrifuges; whereas the original analyses for the commercial ACP operations were applicable to cascade containing thousands of centrifuges deployed in a cascade configuration with up to 3.8 million SWU/year. The commercial ACP analyses referenced in this section will conservatively bound any small variations in isotopic distribution that might be applicable to the HALEU Demonstration.

9.2.2.1.3 Monitoring of Gaseous Release Points

Each process vent in the X-3001, X-3002, X-3346, and X-7725 buildings has gas flow monitoring instrumentation with local readout as well as analytical instrumentation to continuously sample, monitor and to alarm UF_6 breakthrough in the effluent gas stream. The locations of these vents are shown in Figure 9.2-1. The continuous vent sampler draws a flow proportional sample of the vent stream through two alumina traps in series by way of an isokinetic probe. Both vent and sampler flows are monitored by the sampler's electronic controller. The controller adjusts a control valve in the sample line to maintain a constant ratio between the vent and sample flows. The flow instruments are calibrated at least annually. The primary sample trap is equipped with an automated radiation monitor to continuously monitor the accumulation of uranium in the sampler. This radiation monitor provides the real-time indicator of effluent levels for operational control of the gaseous effluent control systems.

Detailed effluent calculations are based on laboratory analysis of the collected samples. Each vent sampler has two traps permanently dedicated to each trap position, with one in-service and the other either being processed or standing by to replace the in-service trap. Normally, the primary sample traps are replaced weekly and the secondary traps are replaced quarterly. In the event of an unplanned or seriously elevated release, the involved sampler traps are collected for immediate analysis as soon as the situation has stabilized. Alternatively, the sampling period may be extended, provided the sampler is operating continuously while the vent is operating. A hydrated alumina is used in the vent samplers to convert absorbed UF_6 to UO_2F_2. The UO_2F_2 does not easily separate from the alumina, so no special handling is necessary to avoid loss of uranium between sample collection and analysis. Annually, the sampler tubing and traps are also replaced and rinsed, and the rinsates analyzed for the same parameters as the alumina.

Vent samples are analyzed for ^{234}U, ^{235}U, ^{238}U, and ^{99}Tc as described in Section 9.2.2.5 of this chapter. GDP experience in uranium enrichment has shown that these three uranium isotopes account for more than 99 percent of the public dose due to uranium emissions. ^{99}Tc is a fission product that has contaminated much of the fuel cycle. Feed material that meets the ASTM specification for recycled feed may be used in the commercial ACP operation, which may contain additional radionuclides (i.e., ^{236}U and ^{99}Tc). Feed material for the HALEU Demonstration could also be UF_6 meeting the ASTM UF_6 product standard, produced in former enrichment operations external to ACP (e.g. GDP operations). Based on GDP historic experience ^{99}Tc may eventually appear in some ACP gaseous effluents. The ACP therefore monitors process vent samples for technetium as a precautionary measure.

Weekly gaseous effluents are calculated based on the primary trap analytical results and measured flows. These are compared to the action levels in Table 9.2-1 to determine whether gaseous effluents are threatening to exceed regulatory limits or ALARA goals. The weekly effluents are also accumulated to provide source terms for the annual public dose assessment required under 40 CFR Part 61. Quarterly and annual corrections to the accumulated weekly effluents are calculated based on the secondary trap and rinsate analyses, respectively, to complete the source terms.

Anticipated radionuclide concentrations in ventilation exhausts from occupied areas are insignificant as defined in the SRP. Radionuclide concentrations in room air are monitored as described in Section 4.7 of this license application. The results are reviewed by environmental engineers at least quarterly to verify that airborne concentrations are less than ten percent of the applicable values in 10 CFR Part 20, Appendix B, Table 2.

In the event of a radionuclide release outside the effluent monitoring system, the activity of the release will be estimated based on available data and engineering calculations (i.e., inventory data and mass balances).

9.2.2.1.4 Action Levels

Action levels for control of gaseous radioactive effluents from ACP operations have been established based on the ALARA philosophy. The action levels described in Table 9.2-1 ensure operational control system deficiencies are documented and acted upon in a responsible manner and in a timeframe to remain well within the regulatory limits and below ALARA goals. The BEQs used in Table 9.2-1 are the maximum effluents expected under normal operating conditions. BEQs have been established for every continuously monitored radiological vent. The specific BEQ values established for the monitored ACP vents are listed in Table 9.2-2.

9.2.2.1.5 Other Permits and Licenses

New air pollutant sources or modifications of existing sources in the State of Ohio are required to have a Permit-to-Install (PTI) from the Ohio EPA prior to installation of the source. The ACP therefore needs PTIs for its process vents. Within one year of the PTI being issued, the ACP also needs to apply to the Ohio EPA for a modification to its Title V permit to incorporate the entire ACP into the existing permit. The Title V permit supersedes the PTI once it is modified.

Sources of airborne radionuclides at DOE-owned plants are covered by an EPA Permit-By-Rule issued under 40 CFR Part 61, (NESHAP) Subpart H. This rule imposes a limit on airborne effluents of 10 mrem/year to the MEI, which applies to the entire reservation regardless of who “owns” any individual source within the reservation. The rule also requires an annual report, submitted by June 30 of the following year, detailing the processes at the reservation, the airborne effluents from each source, and annual TEDE to the MEI as calculated by a method approved by the EPA. A copy of this report is available to NRC as described in Section 9.3.2 of this chapter.

Also, under the NESHAP rule, new or modified sources of airborne radionuclides at DOE-owned plants are required to have prior Permission to Construct from EPA unless the change has a projected maximum public TEDE of less than 0.1 mrem/year. This will be necessary for the ACP since it has the potential to exceed this threshold.

9.2.2.2 Liquid Effluent Monitoring

9.2.2.2.1 Anticipated Effluent Levels

Anticipated routine radioactive effluents from the ACP are expected to be minimal. The bulk of liquid radioactive effluents from a uranium enrichment plant are decontamination and cleaning solutions. Centrifuges will not be routinely changed out, but routine maintenance such as instrument repair or repair to the PV/EV systems occurs. There are also maintenance activities that require cleaning and/or decontamination. The ACP uses dry decontamination methods to the extent practical to minimize liquid releases.

Spills are accumulated in the LEC system. The LEC collection tanks are sampled and analyzed for radioactive constituents prior to being emptied. If analysis indicates that LEC tank contents meet the criteria of 10 CFR 20.2003, the contents may be discharged to the reservation sanitary sewer. Otherwise, LEC tank contents will be containerized for disposal off-site. These are the only anticipated liquid discharges of licensed material from the ACP.

Actual sanitary wastewater (i.e., excluding LEC discharges) from the ACP is not anticipated to contain licensed radioactive material. Any licensed material that may be discharged will be released in accordance with the requirements of 10 CFR 20.2003. Consequently, anticipated radionuclide concentrations in the sanitary wastewater itself are anticipated to be insignificant as defined in the SRP.

There are no anticipated radioactive effluents from the MCW system, since it is a closed-loop system with no routine blowdown. The TWC system is a standard industrial recirculating water system with a routine blowdown stream to control the accumulation of solids within the cooling water. The TWC does not come in contact with licensed material unless there is leakage from the process to the MCW and then from the MCW to the TWC. This is unlikely since the MCW lines are on the outside of the centrifuge casings. Consequently, radionuclide concentrations in the TWC blowdown are also anticipated to be insignificant as defined in the SRP.

Storm water runoff and some once-through cooling water (sanitary water) flows through two holding ponds as described in Section 9.2.1.2.2 of this chapter, then discharges to the Scioto River in accordance with 10 CFR 20.1301. Radioactive materials in these streams are dominated either by naturally occurring radioactive materials or existing contamination from previous reservation operations. ACP effluents are not expected to cause any significant difference from historic release levels, which are insignificant as defined in the SRP.

The commercial ACP operation will use cylinder storage pads on the north end of the plant (X-745G-2 and X-745H). All cylinder storage will be maintained inside the X-3001 facility in the HALEU Demonstration. A cylinder inspection and maintenance program ensures that no licensed material is released to the storage pad. Nevertheless, runoff from the pads may drain to the existing X-230L North Holding Pond. This pond is maintained and monitored in accordance with 10 CFR 20.1301 and the monitoring data is available to the ACP. ACP operations are not expected to have any measurable impact on these ponds.

Anticipated radioactive releases from these points are summarized in Table 9.2-4, along with the limits from 10 CFR Part 20, Appendix B, Table 2 for comparison. The anticipated discharge levels are at least one order of magnitude below the Table 2 limits even before they mix with the Scioto River. Activity concentrations in the table are based on monthly grab samples from 1995 through 2000 for the X-2230M and X-2230N holding ponds. Activity concentrations for the other ACP-influenced continuous discharges are based on weekly composite samples from

1998 through 2002. Activity concentrations for the LEC system are based on the effluent being characterized prior to discharge.

No other ponds or impoundments at the ACP manage special nuclear material (SNM) and since the concentrations involved are well below the 10 CFR Part 20, Appendix B discharge limits, leakage to the soil is not a concern. The only underground tanks that potentially manage SNM are the LEC System described in Section 9.2.1.2.2 of this chapter. Inventory monitoring will be used to detect leakage from these tanks.

9.2.2.2.2 Demonstration of Compliance

Characterization of the radiological consequences of radionuclides released in liquid effluents from the ACP is accomplished by comparing measured concentrations to the values in 10 CFR Part 20, Appendix B, Tables 2 and 3 and the requirements of 10 CFR 20.1301 and 10 CFR 20.2003, as applicable. The results are incorporated into semiannual reports submitted to the NRC in accordance with 10 CFR 70.59.

Accumulated liquids in the LEC tanks are sampled for uranium and technetium prior to being removed from the tanks. ACP environmental personnel track the analytical results, volumes and disposition of the liquids. LEC liquids that do not meet the requirements of 10 CFR 20.2003 and 10 CFR Part 20, Appendix B, Table 3 are containerized for disposal at a suitable NRC-licensed site. LEC liquids that do meet the requirements of 10 CFR 20.2003 and 10 CFR Part 20, Appendix B, Table 3 may be either containerized for disposal off-site or discharged to the reservation sanitary sewer.

Sanitary wastewater from the ACP (exclusive of LEC effluents) is not expected to be contaminated with licensed material. Therefore, the ACP does not sample or analyze the untreated sewage. The sanitary sewer discharges to a sewage treatment plant located on the reservation that is regulated by both the ~~NRC~~ DOE and the OEPA for radionuclides and which does sample and analyze it's effluent for uranium and technetium. This data is available to the ACP and is tracked by ACP environmental personnel against the applicable values 10 CFR Part 20, Appendix B, Table 2.

The other liquid effluent streams from the ACP are monitored as described in Section 9.2.2.2.3 of this chapter and compared to the applicable values in 10 CFR Part 20, Appendix B, Table 2 to demonstrate compliance with 10 CFR 20.1301. These streams are the TWC blowdown, X-2230M Southwest Holding Pond discharge, and X-2230N West Holding Pond discharge.

The ACP will use existing cylinder storage pads at the north end of the plant (X-745G-2 and X-745H). Runoff from the pads drain to the X-230J-5 Northwest Holding Pond and X-230L North Holding Pond, both of which are sampled and analyzed for uranium and technetium. This data is available to the ACP and these discharges will be tracked against the applicable values in 10 CFR Part 20, Appendix B, Table 2.

9.2.2.2.3 Monitoring of Liquid Release Points

There are only two ACP outfalls that discharge directly to publicly accessible areas, the X-2230M and X-2230N holding ponds. The locations of these outfalls are shown in Figure 9.2-2. The TWC blowdown discharges to a utility system (the RCW system) that provides a pathway to the Scioto River but does not provide any radiological treatment. These three discharges are equipped with automated samplers and continuous flow measurement. The flow monitors are calibrated at least annually. The combined discharge of the RCW system, the DOE reservation sewage treatment plant discharge and other reservation holding ponds are also equipped with automated samplers and continuous flow measurement. The data from these outfalls are available to the ACP as a defense in depth.

Outfall samples are analyzed for Gross Alpha and Gross Beta Activities, ^{99}Tc Activity and Total Uranium concentration as described in Section 9.2.2.5 of this chapter. Measurable Gross Alpha Activity is presumed to be due to uranium discharges from uranium enrichment operations, while Gross Alpha Activities below the Minimum Detectable Activity (MDA) are presumed to be due to naturally occurring radioactive materials. The isotopic distribution of enriched uranium discharges (i.e., ^{234}U, ^{235}U, and ^{238}U) is estimated to match the measured Gross Alpha Activity based on process knowledge. ^{99}Tc is a fission product that has contaminated much of the national fuel cycle and is present on the reservation. Measured ^{99}Tc~~technetium~~ concentrations in reservation outfalls have been falling for several years, but are detected occasionally. The ACP therefore routinely monitors radioactive effluents for technetium.

The only underground tanks in the ACP used to collect material that might contain radionuclides are the tanks of the LEC system. The LEC system consists of a set of drains and collection tanks primarily for collecting leaks and spills of chemically treated water. The drains are located throughout the process buildings. The tanks have a capacity of 550 gal each. Liquid level gauges mounted above grade on pipe stands monitor the tanks. Routine monitoring of the tanks' contents is based on observing and tracking the levels indicated on the gauges. Inventory tracking is relied on to indicate any leaks from the tanks. The contents of the LEC system will be sampled and analyzed for the same parameters as the continuous outfalls prior to disposal.

If analytical results indicate that LEC contents meet the requirements of 10 CFR 20.2003, they may be released to the reservation sanitary sewer system. Otherwise they will be containerized for disposal off-site.

9.2.2.2.4 Action Levels

Action levels for control of liquid radioactive effluents from the ACP have been established based on the ALARA philosophy. The action levels described in Table 9.2-1 ensure operational control system deficiencies are documented and acted upon in a responsible manner and in a timeframe to remain well within the regulatory limits and below ALARA goals. The BEQs used in Table 9.2-1 are the maximum effluents expected under normal operating conditions. BEQs have been established for every ACP liquid discharge point to unrestricted areas (i.e., X-2230M and X-2230N holding ponds) and for the TWC blowdown to the GDP area. BEQs have also been established for the LEC discharges, which are characterized before they are discharged, based on ten percent of the 10 CFR 20.2003 requirements. The specific BEQ values established for the ACP outfalls are listed in Table 9.2-2.

The ACP sanitary sewers, TWC blowdown, and runoff from the north cylinder storage pads discharge to ~~NRC~~ DOE regulated units operated a service provider. The service provider has established and administers BEQ-based action levels for these discharges as documented in POEF-FBP-001, *Basis for Interim Operation of Former Uranium Enrichment Facilities (FUEF) at the Portsmouth Gaseous Diffusion Plant, Piketon, OH.* ~~USEC-02, *United States Nuclear Regulatory Commission Certification of Compliance for the Portsmouth Gaseous Diffusion Plant*.~~

9.2.2.2.5 Other Permits and Licenses

Point discharges to waters of the State of Ohio are required to be authorized under a NPDES Permit issued by the Ohio EPA. There are ~~two~~three NPDES Permits currently issued to the site, with two of them ~~Between them, these permits already~~ covering all liquid discharges from the ACP. The third site NPDES permit is for the DUF_6 conversion facility. The ACP is required to submit a permit modification to collect all its discharge points into one or the other of the permits.

9.2.2.3 Waste Management

9.2.2.3.1 Waste Segregation and Collection

ACP generated wastes are collected and packaged by the individual(s) generating the waste. However, this is not appropriate in cases where waste would have to be "double handled" (e.g., surveying wastes expected to be contamination-free). In this case, it is most appropriate to survey prior to packaging. Wastes known to be suitable for release to unrestricted areas based on the point and process of generation are segregated at the source, when possible, from wastes not suitable for release to unrestricted areas. Wastes from areas controlled for loose radioactive contamination are considered to be potentially contaminated until characterized. Wastes requiring characterization to determine whether they may be released to unrestricted areas are segregated upon completion of such characterization.

9.2.2.3.2 Waste Packaging and Labeling

Containers known to contain radioactive waste, including packaging, are labeled in accordance with procedural requirements developed in accordance with the commitments in Section 11.4 of this license application and 10 CFR Part 20.

Waste is packaged in appropriate containers to meet U. S. Department of Transportation (DOT) and 10 CFR Part 71 requirements. Some general types of waste packaging include, but are not limited to:

- Solid Waste (5-, 30-, 55-, or 110-gal drums)
- Liquid Wastes (5-, 30-, or 55-gal drums)

- Corrosives, Acids (Polybottles or polydrums)
- Scrap Metal (B-25 boxes or other similar boxes, and various drums)

In addition, 85- and 110-gal overpacks may be used for damaged containers if the wastes are appropriate for these size containers.

9.2.2.3.3 Radioactive Waste Storage

Those ACP wastes that are regulated for radiological content only are removed from the generating building and stored at an on-site radioactive waste storage area prior to final disposal. Those ACP wastes that are regulated for both radiological content and hazardous constituents and/or characteristics are stored at an on-site radioactive waste storage area under a conditional exemption for mixed waste (40 CFR Part 266, Subpart N [Federal] and Ohio Administrative Code-3745-266 [State]) prior to final disposal.

Other areas may be utilized as waste storage areas as required by plant operations. If outdoor storage is necessary, radioactive wastes with removable contamination are packaged in containers, and wrapped or covered to prevent the release of radioactivity. Storage areas are posted in accordance with procedural requirements.

Access to waste storage containers is restricted to trained personnel in accordance with 10 CFR 20.1905. Containers are inspected quarterly, at a minimum, to ensure container integrity and to identify and correct any leaks or other problems.

9.2.2.3.4 Radioactive Waste Treatment

Mixed aqueous wastes that cannot be processed on-site are stored until treatment is available at commercial treatment plants that are licensed in accordance with 10 CFR Part 61, or applicable NRC Agreement State requirements.

9.2.2.3.5 Off-site Waste Shipments

For Commercial ACP operation, Ooff-site shipments of radioactive wastes are manifested in accordance with 10 CFR 20.2006. Waste shipments are packaged, labeled, and manifested in accordance with applicable State, DOT, NRC, and EPA requirements.

9.2.2.3.6 Waste Disposal

ACP generated radioactive wastes are disposed of at commercial disposal facilities that are licensed in accordance with 10 CFR Part 61 or applicable NRC Agreement State requirements. Packages are inspected prior to shipment, as appropriate, to verify compliance with applicable packaging and transportation requirements. Copies of the disposal site license are retained in accordance with procedural requirements.

Waste disposals are in compliance with 10 CFR Part 20, Subpart K. Waste disposal records are retained in accordance with 10 CFR 20.2108. Classified waste is disposed of in accordance with 10 CFR Part 95 and Security ~~Program~~ Plan requirements.

9.2.2.3.7 Waste Tracking and Documentation

LLRW and LLMW generated at the ACP are tracked through a Request for Disposal system. Each waste container is given a unique identification number. The identification numbers are entered and maintained in a computer-based database. The database is updated to reflect location, characterization, treatment data, and waste disposal information.

9.2.2.3.8 Other Permits and Licenses

The ACP is a generator of *Resource Conservation and Recovery Act* of 1976 hazardous wastes, which transfers solid wastes to appropriately permitted Treatment, Storage, and Disposal Facilities in accordance with applicable state and federal regulations.

9.2.2.4 Environmental Monitoring

The ACP is located contiguous to an existing uranium enrichment plant (the GDP) with approximately 50 years of accumulated experience in managing uranium and UF_6. The GDP was operated by the United States Enrichment Corporation, a subsidiary of USEC, from 1993 until it was placed in standby, and by predecessor organizations of the United States Enrichment Corporation prior to 1993. The environmental monitoring system for the ACP is based on the experience and data accumulated at the GDP.

9.2.2.4.1 Air Monitoring

Between 1980 and 1999, annual gaseous uranium effluents from the GDP ranged between 0.97 and 0.010 Ci/yr. Ambient air samples collected over this period by the GDP operators showed that these levels of effluents do not produce a quantifiable difference in ambient air concentrations in unrestricted areas. ACP operations are not expected to exceed these levels of effluents. Consequently, ambient air monitoring is not useful in detecting or evaluating a public impact due to routine gaseous effluents from the ACP.

In addition, experience at the GDP has shown that any release large enough to produce high or intermediate consequences will first produce a large and very visible cloud of white smoke at the point of release. The ACP has a written procedure for dealing with unplanned releases ("See and Flee") that includes the immediate reporting of observed releases to the Senior Shift Supervisor (Operations Shift Supervisor during HALEU Demonstration) and evaluation by environmental professionals based on available credible information. Effluent monitoring will quantify routine gaseous effluents, but some accidental release scenarios may require information such as mass balances or measured environmental contamination to quantify an accidental release that did not pass through a monitored vent.

The United States Enrichment Corporation ceased sampling ambient air and returned the reservation's network of permanent air samplers to DOE in 1999, which upgraded the samplers for its own purposes. Based on the DOE Annual Environmental Reports published since 1999, average airborne uranium concentrations have been 1.1 x 10^{-15} micrograms per milliliter (μg/mL) on-site (i.e., within the DOE reservation), 7.4 x 10^{-16} μg/mL in unrestricted areas, and 5.5 x 10^{-16} μg/mL at the DOE background station. These results are consistent with the gross activity monitoring conducted prior to the turnover/upgrade. They are also a minimum of three orders of magnitude less than the applicable discharge limits for uranium isotopes in 10 CFR Part 20, Appendix B.

The reservation maintains a meteorological tower that is located on the southern section of the reservation. The tower is equipped with instruments at the ground, 10-, 30-, and 60-meter levels. Among the parameters measured are air temperature, wind speed, wind direction, relative humidity, solar radiation, barometric pressure, precipitation, and soil temperature. Data from the National Weather Service or other local sources may be used in lieu of or to supplement reservation data.

The effluent monitoring and meteorological data are used to calculate the environmental impacts of airborne effluents from the ACP using EPA-approved dispersion models as described in Section 9.2.2.1 of this chapter.

9.2.2.4.2 Soil and Vegetation

Between 1980 and 2002, annual gaseous uranium effluents from the GDP have ranged between 0.97 and 0.005 Ci/yr. Soil and vegetation samples collected over this period by the GPD operators show that these levels of effluents do not produce a statistically significant difference in soil and vegetation concentrations in unrestricted areas. (Liquid effluents do not have a direct impact on soil and terrestrial vegetation around the reservation.) ACP operations are not expected to exceed these levels of effluents. Consequently, soil and vegetation monitoring is not useful in detecting a public impact due to gaseous effluents from the ACP. Therefore, atmospheric impacts of ACP operation, including action levels, will be based on gaseous effluent monitoring or other effluent information and atmospheric dispersion modeling as described in Section 9.2.2.1 of this chapter.

Soil and vegetation monitoring may be useful in assessing the long-term impacts of effluents from ACP operations or DOE environmental remediation projects or in assessing the impact of a high or intermediate consequence release that has already been detected and controlled. Therefore, the ACP maintains a soil and vegetation monitoring program for these purposes.

Soil and vegetation (wide-blade grass, typical of local cattle forage) samples are collected semiannually. The sampling networks completely surround the reservation, including the predominant downwind directions, and are administratively divided into on-site, off-site (up to 5 kilometers) and remote (5 to 16 kilometers off-site). A map of sampling locations in each group is provided in Figure 9.2-3. Soil samples are analyzed for gross alpha activity, gross beta activity, technetium beta activity, and total uranium concentration. Vegetation samples are analyzed for technetium beta activity and total uranium concentration. Specific details of the analytical methods are presented in Section 9.2.2.5 of this chapter. See Table 9.2-5 for a summary ~~of the last five calendar years~~ of soil and vegetation results (1998-2002).

In addition to the semiannual vegetation samples, the ACP also collects annual crop samples from local gardeners and farmers on a voluntary basis. Because of the voluntary nature of these samples, the sampling locations change from year to year. Crop samples are normally analyzed for technetium beta activity and total uranium concentration only. The analytical methods are the same as for the vegetation samples. No contamination has been found in crop samples.

9.2.2.4.3 Surface Water

Between 1980 and 2002, annual waterborne uranium effluents from the GDP have ranged between 0.71 and 0.026 Ci/yr. Surface water samples collected over this period by the GDP operators show that these levels of effluents do not produce a statistically significant difference in the Scioto River. ACP operations are not expected to exceed these levels of effluents. Consequently, surface water monitoring is not useful in detecting or evaluating a public impact due to liquid effluents from the ACP. Therefore, impacts of ACP operation on local receiving waters, including action levels, will be based on effluent monitoring and pathways modeling as described in Section 9.2.2.2 of this chapter.

Surface water monitoring may be useful in assessing impacts of effluents from DOE environmental remediation projects or historical contamination. The ACP maintains a surface water monitoring program for this purpose.

Radiological analyses are performed on grab samples from upstream and downstream locations in Little Beaver Creek, Big Beaver Creek, Big Run Creek, and the Scioto River. A map of the sampling locations is found in Figure 9.2-4. Samples are collected weekly from the Scioto River and one location (RW8) in Little Beaver Creek. Other locations are sampled monthly. Specific details of the analytical methods are presented in Section 9.2.2.5 of this chapter. See Table 9.2-6 for a summary ~~of the last five calendar years~~ of surface water results (1998-2002).

9.2.2.4.4 Sediment Monitoring

Between 1980 and 2002, annual waterborne uranium effluents from the GDP have ranged between 0.71 and 0.026 Ci/yr. Sediment samples collected over this period by the GDP operators show that these levels of effluents do not produce a statistically significant difference in the Scioto River. ACP operations are not expected to exceed these levels of effluents. Consequently, sediment monitoring is not useful in detecting a public impact due to liquid effluents from the ACP. Therefore, impacts of ACP operation on local receiving waters, including action levels, will be based on effluent monitoring and pathways modeling as described in Section 9.2.2.2 of this chapter.

Sediment monitoring may be useful in assessing the long-term impacts of effluents from DOE environmental remediation projects or historical contamination. The ACP maintains a sediment monitoring program for this purpose.

Sediment sampling around the reservation is conducted semiannually to assess potential radionuclide accumulation in the surrounding receiving streams. The sampling locations include both upstream and downstream locations. A map of the sample locations is provided in Figure 9.2-5. Sediment sample analyses include gross alpha activity, gross beta activity, and technetium beta activity and total uranium concentration. Specific details of the analytical methods are presented in Section 9.2.2.5 of this chapter. See Table 9.2-7 for a summary ~~of the last five calendar years~~ of sediment results (1998-2002).

9.2.2.4.5 Groundwater

Due to historical operations, the reservation has multiple plumes of groundwater contamination. The primary contaminate in the plumes is the halogenated solvent trichloroethylene, but limited areas of technetium contamination also exist.

DOE is conducting a site-wide environmental remediation program under an Agreed Order with the State of Ohio. As part of this program, reservation groundwater monitoring is under the control of DOE and the data is reported as part of DOE's Annual Environmental Report for the reservation. The ACP does not conduct a separate groundwater monitoring program. The current nuclides of interest in the DOE groundwater monitoring program are ^{99}Tc, ^{234}U, ^{235}U, ^{236}U, ^{238}U, ^{237}Np, ^{238}Pu, ^{240}Pu, and ^{241}Am.

9.2.2.4.6 Direct Gamma Radiation Monitoring

The only significant sources of environmental gamma radiation introduced to the reservation by man are the uranium isotope ^{235}U and the short-lived ^{238}U daughters. There are small amounts of other gamma emitters present on site as sealed sources and laboratory standards, but these are not detectable at any large distance. Gamma radiation levels in unrestricted areas around the ACP are dominated by naturally occurring radioactive materials.

The reservation conducts external gamma radiation monitoring consisting of lithium fluoride thermoluminescence dosimeters (TLDs) positioned at various site locations and at locations off-site. There are nine dosimeters spaced within Perimeter Road on the reservation; eight dosimeters spaced around the reservation boundary; and two dosimeters located off-site. Maps of the TLD locations are presented in Figures 9.2-6 and 9.2-7. These dosimeters are collected and analyzed quarterly. Processing and evaluation are performed by a processor holding current accreditation from the National Voluntary Laboratory Accreditation Program of the National Institute of Standards and Technology (NIST). See Table 9.2-8 for a summary ~~of the last five calendar years~~ of TLD results (1998-2002).

9.2.2.5 Laboratory Standards

A National Voluntary Laboratory Accreditation Program-certified service provider processes the site's environmental TLDs as described in Section 9.2.2.4.6. A laboratory licensed/certified by the NRC or an Agreement State provides other radiological and chemical analyses. The following description is based on ~~current~~ services that have been provided by ~~the on-site X-710 building laboratory, which is certified by the NRC~~on-site laboratory in the past, but is not part of the ACP. ~~Off-site vendors providing a~~Analytical laboratory services for the ACP will be ~~required~~ conducted by certified provider to meet the equivalent standards as part of the contract.

Vent samples (i.e., activated alumina) are analyzed for uranium isotopes (^{234}U, ^{235}U, and ^{238}U) and ^{99}Tc. Uranium isotope concentrations are determined using either alpha spectrometry or Inductively Coupled Plasma/Mass Spectrometry (ICP/MS). Technetium concentrations are determined using liquid scintillation counting. Analytical results are reported in micrograms of analyte per gram of alumina. These results are converted to grams released using recorded flow data and the measured weight of alumina in the sampler and to activity using published specific activities for individual isotopes. Gaseous effluents equivalent to an annual public dose of less than 0.1 mrem are routinely quantified. Since the airborne concentrations in 10 CFR Part 20, Appendix B, Table 2 are equivalent to an annual dose of 50 mrem, the MDA of these methods are equivalent to less than 0.2 percent of the 10 CFR Part 20, Appendix B, Table 2 values.

Water samples from NPDES outfalls are analyzed for gross alpha and gross beta activity, technetium beta activity, and total uranium concentration. The gross activities are determined by proportional counter and the technetium activity by liquid scintillation. The MDAs are 5×10^{-9} μCi/mL for gross alpha, 1.5×10^{-8} μCi/mL for gross beta, 2×10^{-8} μCi/mL for technetium beta. The total uranium concentration is determined by ICP/MS, with a minimum detectable concentration of 0.001 μg/mL. The isotopic distribution of the total uranium is estimated to match the calculated uranium alpha activity to the measured gross alpha activity. The Table 2 values for liquid releases are 3×10^{-7} μCi/mL for each of the uranium isotopes and 6×10^{-5} μCi/mL for technetium. Consequently, the MDAs for liquid effluents are less than two percent of the applicable 10 CFR Part 20, Appendix B, Table 2 values.

Environmental samples are analyzed for gross activities by proportional counter and technetium activity by liquid scintillation. Uranium concentrations in environmental samples are determined either by alpha spectrometry or ICP/MS. The minimum detectable activities/concentrations are comparable to those for effluent samples.

Laboratory quality control (QC) includes the use of a dedicated Chain of Custody system, formal written procedures, NIST-traceable standards, matrix spikes, duplicate, and replicate samples, check samples, and blind and double-blind QC samples.

The laboratories used shall participate in appropriate performance testing (PT) programs and maintain appropriate certifications for the types of analyses requested. For example, personnel safety monitoring analyses shall be performed by a laboratory certified by the American Industrial Hygiene Association for the analytes of interest, which would require them to successfully participate in PT programs for these analytes by performing them using National Institute of Occupational Safety and Health or Occupational Safety and Health Administration (OSHA) methodology.

Samples analyzed for environmental programs shall be performed by laboratories participating in appropriate certified PT programs, such as the following:

- EPA Discharge Monitoring Report-Quality Assurance Study for NPDES and Clean Water Act samples
- EPA Water Pollutant for waste water samples
- EPA Water Supply for drinking water samplesAny laboratory providing analytical services to the ACP will be required to participate in at least one laboratory intercomparison program covering each type of analysis contracted for. IntercomparisionIntercomparison programs that the United State Enrichment Corporation's X-710 building laboratory currently participates in include: the EPA Discharge Monitoring Report Study; National Institute of Occupational Safety and Health (NIOSH) Proficiency Analytical Testing Program; EPA Water Pollution Performance Evaluation Study; EPA Water Supply Study; NIOSH Environmental Lead Proficiency Analytical Testing Program; Proficiency Environmental Testing program, a commercial program sponsored by the Analytical Products Department of Belpre, Ohio; DOE Environmental Measurements Laboratory Radionuclide Quality Assessment Program; and DOE's Mixed Analyte Performance Evaluation Program.

9.2.2.6 Description of Status of Federal/State/Local Permits/Licenses

The ACP must comply with the applicable regulations under the *Atomic Energy Act* of 1954, as amended; 10 CFR Part 40; and 10 CFR Part 70 to hold a license to possess and use source and SNM. In addition, the ACP must comply with pertinent NRC regulations in 10 CFR Part 20 related to radiation dose limits to individual workers and members of the public. USEC The Licensee submittedis submitting an an update to the previously approved Environmental Report to the NRC for the HALEU Demonstration program in accordance with 10 CFR Part 51.

As described in previous sections, the ACP will require PTIs from the State of Ohio to install all new air emission sources followed by a modification to the existing Title V air permit for the operation of those sources. The ACP will also be subject to the Radionuclide NESHAP administered by the EPA Region V. An additional PTI from the State of Ohio will be needed if the ACP installs any new wastewater lines. A modification to the existing NPDES permit will be needed to allow construction and operation of the ACP. These are the only Federal, State and local permits or other authorizations that the Licensee expects will be necessary for the ACP. Table 9.2-9 gives a full listing of the Federal, State and local permits and other authorizations and consultations that potentially could be required and the current status of each.

The ACP permit and reporting requirements will be incorporated and administered in the United States Enrichment CorporationAmerican Centrifuge Operating, LLC permits and reporting requirements until the Licensee establishes a compliance organization. The Lead CascadeHALEU Demonstration Facility, X-3001 purge vacuum and evacuation vacuum system, is currently incorporated in the United States Enrichment CorporationAmerican Centrifuge Operating, LLC Title V air permit (PTI number 06-07470ermit Number P0115127).

Informal consultations have been made with the responsible agencies in compliance with the following:

- Section 7 of the *Endangered Species Act*
- *Fish and Wildlife Coordination Act*
- *National Historic Preservation Act* (NHPA), Section 106
- *Farmland Protection Policy Act* (FPPA)/Farmland Conservation Impact Rating

Consultation letters and responses are included in Appendix B of the accompanying Environmental Report.

9.2.3 Integrated Safety Analysis Summary

An Integrated Safety Analysis (ISA) Summary, meeting the requirements of 10 CFR 70.65(b), was prepared in accordance with the guidance contained in Chapter 3.0 of the SRP and NUREG-1513, *Integrated Safety Analysis Guidance Document*. The ISA Summary for the American Centrifuge PlantACP is submitted for review (separate from this license application) as document LA-3605-0003, Integrated Safety Analysis Summary for the American Centrifuge Plant. Additionally, LA-3605-0003A, *Addendum 1 of the Integrated Safety Analysis Summary for the American Centrifuge Plant – HALEU Demonstration*, has also been developed and summarizes the ISA Summary for the ACP for the HALEU Demonstration Program award by the DOE for the demonstration of the HALEU production to support DOE research and development activities and programs.

9.3 Reports to the Nuclear Regulatory Commission

9.3.1 10 *Code of Federal Regulations* 70.59 Reports

The ACP submits a written report to the NRC Regional Office and the Office of Nuclear Material Safety and Safeguards by March 1 and August 30 of the each year detailing: uranium and technetium (if any) amounts and concentrations in gaseous and liquid effluents during the previous reporting period (July through December and January through June, respectively) in accordance with 10 CFR 70.59. These reports also include an estimate of the public dose due to gaseous effluents over the previous year.

9.3.2 National Emission Standards for Hazardous Air Pollutants Reports

The ACP submits a written report to the EPA and OEPA by June 30 of each year detailing: plant operations and gaseous effluent monitoring during the previous calendar year, gaseous radioactive effluents over the previous year, an assessment of the public TEDE caused by those effluents, and an explicit comparison of the calculated TEDE to the EPA public dose limit (10 mrem annually). This report would become monthly if the maximum public TEDE exceeds 10 mrem annually.

This report is required under 40 CFR 61.94 and by the conditions of the Title V Permit issued by the State of Ohio. It also supports the requirement to demonstrate compliance with 10 CFR 20.1301 and 10 CFR 20.1101 as described in Section 9.2.2.1.2 of this chapter and is available upon request for inspection at the plant.

9.3.3 Baseline Effluent Quantity Reports

The ACP assesses any weekly effluent that exceeds any of the action levels as described in Table 9.2-1. Many years of experience by the GDP operators have shown that radioactive effluents less than the action levels in Table 9.2-1 cannot produce a public radiation dose that is within an order of magnitude of the dose restriction in 10 CFR 20.1101, let alone the dose limit of 10 CFR 20.1301. Any weekly effluent that exceeds the action levels in Table 9.2-1 requires a written estimate of the probable impact of the effluent, in conjunction with other monitored effluents from ACP operations, on the annual public radiation dose.

These reports are available on request by the NRC. They are not routinely submitted to outside authorities because they are considered interim assessments that are ~~superceded~~ superseded by the semiannual reports and annual public dose assessment described in Sections 9.3.1 and 9.3.2 of this chapter.

In the event that evaluated releases threaten to exceed the public dose constraint in 10 CFR 20.1101, the NRC will be notified according to written procedures.

9.4 References

1. LA-3605-0002, *Environmental Report for the American Centrifuge Plant*

2. NUREG-1520, *Standard Review Plan for ~~the Review of a License Application for a~~ Fuel Cycle Facilitiesy License Applications*, Revision 2

3. U.S. Department of Energy, Portsmouth Annual Environmental Report for 2000, DOE/OR/11-3077&D1, December 2001

4. U.S. Department of Energy, Portsmouth Annual Environmental Report for 2001, DOE/OR/11-3106&D1, November 2002

5. Regulatory Guide 1.109, *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I*, October 1977

6. USEC-02, United States Nuclear Regulatory Commission Certification of Compliance for the Portsmouth Gaseous Diffusion Plant POEF-FBP-001, *Basis for Interim Operation of Former Uranium Enrichment Facilities (FUEF) at the Portsmouth Gaseous Diffusion Plant, Piketon, OH*

7. LA-3605-0003, *Integrated Safety Analysis Summary for the American Centrifuge Plant*

8. LA-3605-0003A, *Addendum 1 of the Integrated Safety Analysis Summary for the American Centrifuge Plant – HALEU Demonstration*

8 9. USEC-651, *Uranium Hexafluoride: A Manual of Good Handling Practices*, *Revision 9*

Table 9.2-1 American Centrifuge Plant Action Levels for Radionuclide Effluents

Weekly Sample Results		**Required Actions** [b]
Uranium [a]	**Technetium** [a]	
BEQ	BEQ	Review release data for previous six months for trends~~,~~ and estimate probable impact over calendar year. Evaluate whether additional controls would significantly reduce public exposure.
10 x BEQ or 2 x BEQ averaged over 6 months	80 x BEQ or 16 x BEQ averaged over 6 months	Determine whether increased releases are ongoing or a single spike. Initiate investigation into cause(s) of increased releases. Evaluate whether mitigative and/or corrective measures are necessary to reduce public dose. Implement mitigative and/or corrective measures as needed.
EPA Reportable Quantity[c] (RQ) (0.1 Ci in 24 hours)	EPA RQ[c] (10 Ci in 24 hours)	Notify Operations Shift Supervisor [HALEU Demonstration operations] or Senior Shift Supervisor [commercial operations only] Trace source of abnormal releases and establish control or shutdown as needed. If releases cannot be mitigated within 24 hours, elevate to next level.
1 Ci[d]	8 Ci[d]	Close affected discharge points until control of releases is re-established.

[a] Uranium has an approximately 8-fold greater dose rate response than ^{99}Tc over air dominated exposure pathways. Uranium dose response completely dominates ^{99}Tc over water dominated exposure pathways.

[b] Required actions for any level include required actions listed under lower emission levels.

[c] RQ does not include permitted emissions. The ACP is regulated under 40 CFR Part 61, Subpart H for release of airborne radionuclides from the entire reservation up to the equivalent of 10 mrem/year TEDE to the most exposed member of the public.

[d] 1 Ci or 8 Ci in one weekly sample analysis.

Note: The Operations Shift Supervisor [HALEU Demonstration operations] or Senior Shift Supervisor [commercial operations only] has the authority to allow a restart.

Table 9.2-2 Baseline Effluent Quantities for American Centrifuge Plant Discharges

Release Point	Total Uranium	Technetium
Vents		
X-3001 North Vent	0.2 mCi/week	0.1 mCi/week [a]
X-3001 South Vent	0.2 mCi/week	0.1 mCi/week [a]
X-3002 North Vent	0.2 mCi/week	0.1 mCi/week [a]
X-3002 South Vent	0.2 mCi/week	0.1 mCi/week [a]
X-3346 Vent [b]	0.08 mCi/week	0.1 mCi/week [a]
X-7725 Gas Test Stands Vent	0.01 mCi/week	0.1 mCi/week [a]
Outfalls		
LEC Effluents [c]	3×10^{-7} µCi/ mL or	6×10^{-5} µCi/ mL or
	0.1 Ci/year	
X-2230N West Holding Pond (NPDES 012)	2.5×10^{-8} µCi/ mL	1.0×10^{-7}µCi/ mL
X-2230M Southwest Holding Pond (NPDES 013)	2.5×10^{-8} µCi/ mL	1.0×10^{-7}µCi/ mL
TWC System Blowdown	5.9×10^{-8} µCi/ mL	1.0×10^{-7}µCi/ mL

[a] Technetium BEQs for vents are based on five times the MDA.

[b] X-3346 Vent serves the X-3346 Feed and Withdrawal Areas and X-3344 Customer Services Building.

[c] LEC effluents are characterized <u>before</u> being discharged to the site sanitary sewer. The 100 mCi/yr standard includes uranium and technetium isotopes discharged to the site sanitary sewer during a calendar year.

Table 9.2-3 Anticipated Gaseous Effluents

Discharge Point	Total Uranium [a]		Technetium	
	μΦCi/ mL [b]	mCi/wk [c]	μΦCi/ mL [b]	mCi/wk [c]
X-3346 Feed and Withdrawal Building (1 vent)	$<3.2 \times 10^{-15}$	<0.08	1.2×10^{-16}	0
X-3001 and X-3002 Process Buildings (4 vents)		<0.8		0
X-7725 Gas Test Stands Vent		<0.01		0
XT-847 Glovebox Vent		0.0004		0.005
Laboratory Hoods [d]		0.17		0.035
10 CFR Part 20, App. B, Table 2	3×10^{-12}	------	8×10^{-9}	------

[a] Since uranium isotopes present at the ACP have the same discharge limit, uranium isotope activities are combined into a Total Uranium activity for simplify comparison to the Table 2 limits.

[b] Anticipated concentrations are maximum ambient concentrations at the DOE reservation boundary due to emission sources and are based on emission estimates and atmospheric dispersion modeling. Anticipated technetium concentration is based on no detectable releases from the X-7725 facility building and X-3000 series buildings.

[c] Anticipated discharges are measured at the vent and, by definition, are less than the Baseline Effluent Quantities. Anticipated technetium discharges from the X-7725 facility building and X-3000 series buildings are zero.

[d] Bounding case for associated analytical services.

Table 9.2-4 Anticipated Liquid Effluents [a]

Discharge Point	**Total Uranium [b]** µΦCi/ mL	**Technetium** µΦCi/ mL
LEC Effluents	<3 x 10^{-7} and <0.1 Ci/yr	<2 x 10^{-8} (<MDA)
TWC System Blowdown	<3 x 10^{-8}	<2 x 10^{-8} (<MDA)
X-2230N West Holding Pond (NPDES Outfall 012) [e]	<1 x 10^{-8}	<2 x 10^{-8} (<MDA)
X-2230M Southwest Holding Pond (NPDES Outfall 013) [e]	<1 x 10^{-8}	<2 x 10^{-8} (<MDA)
Sanitary wastewater (excluding LEC effluents)	<3 x 10^{-8}	<2 x 10^{-8} (<MDA)
North Cylinder Pad Runoff	<1 x 10^{-8}	<2 x 10^{-8} (<MDA)
10 CFR Part 20, App. B, Table 2	3 x 10^{-7}	6 x 10^{-5}
10 CFR Part 20, App. B, Table 3	3 x 10^{-6}	6 x 10^{-4}

[a] ACP contributions only. Combined effluents from other site operations remain the responsibility of the individual operator.

[b] Since uranium isotopes present at the ACP have the same discharge limit, uranium isotope activities are combined into a Total Uranium activity to simplify comparison to the Table 2 limits.

[c] By definition, anticipated activity discharges are less than the BEQ.

[d] LEC effluents are characterized prior to discharge. One Ci/yr limit applies to combined uranium and technetium activities.

[e] Anticipated concentrations are annual averages based on monthly grab samples from 1995 through 2000.

Table 9.2-5 Environmental Baseline Activities/Concentrations 1998-2002

	Total Uranium µg/g	Technetium pCi/g	Gross Alpha pCi/g	Gross Beta pCi/g
Reservation (9 Sampling Locations) Soil				
Num. of Samples	117 (0)	117 (93)	117 (59)	117 (64)
Average	2.8	<0.2	<8	<14
Minimum	0.6	<0.1	<2	8
Maximum	4.4	1.5	21	36
Vegetation				
Num. of Samples	116 (113)	116 (103)	-----	-----
Average	<0.25	<0.3	-----	-----
Minimum	<0.04	<0.1	-----	-----
Maximum	0.9	7.3	-----	-----
Off Reservation (6 Sampling Locations) Soil				
Num. of Samples	74 (0)	74 (32)	74 (38)	74 (41)
Average	2.9	<0.2	<7	<14
Minimum	0.7	<0.1	<2	<8
Maximum	4.6	3.8	14	47
Vegetation				
Num. of Samples	73 (73)	73 (61)	-----	-----
Average	<0.24	<0.3	-----	-----
Minimum	<0.05	<0.1	-----	-----
Maximum	<0.34	3.3	-----	-----

The "number of samples" shows the total number of samples collected, including replicate and duplicate samples collected for quality assurance (QA) purposes, followed by the number of samples that were lower than the Minimum Detectable Concentration in parentheses. QA sample locations for soil and vegetation are assigned independently, so the number of samples in each group does not necessarily match.

Table 9.2-5 Environmental Baseline Activities/Concentrations 1998-2002

	Total Uranium μg/g	**Technetium** pCi/g	**Gross Alpha** pCi/g	**Gross Beta** pCi/g
Remote (12 Sampling Locations) Soil				
Num. of Samples	139 (0)	139 (133)	139 (73)	139 (77)
Average	3.0	<0.2	<7	<14
Minimum	0.7	<0.1	<3	<7
Maximum	5.9	0.8	16	22
Vegetation				
Num. of Samples	137 (80)	137 (128)	-----	-----
Average	<0.23	<0.2	-----	-----
Minimum	0.08	<0.1	-----	-----
Maximum	<0.28	<0.5	-----	-----
Background (4 Sampling Locations) Soil				
Num. of Samples	40 (0)	40 (36)	40 (17)	40 (26)
Average	3.5	<0.2	<8	<14
Minimum	1.7	<0.1	<5	<8
Maximum	6.8	0.5	16	25
Vegetation				
Num. of Samples	40 (23)	40 (37)	-----	-----
Average	<0.24	<0.2	-----	-----
Minimum	<0.14	<0.1	-----	-----
Maximum	0.28	0.5	-----	-----

The "number of samples" shows the total number of samples collected, including replicate and duplicate samples collected for QA purposes, followed by the number of samples that were lower than the Minimum Detectable Concentration in parentheses. QA sample locations for soil and vegetation are assigned independently, so the number of samples in each group does not necessarily match.

Table 9.2-6 Environmental Baseline Activities/Concentrations 1998 - 2002

	Total Uranium µg/L	**Technetium** pCi/L	**Gross Alpha** pCi/L	**Gross Beta** pCi/L
Surface Water/Upstream Big Run Creek				
Num. of Samples	60 (56)	60 (60)	60 (57)	60 (39)
Average	<1.3	<15	<5	<13
Minimum	<0.1	<6	<1	<6
Maximum	23.5	<28	<8	30
Surface Water/Downstream Big Run Creek				
Num. of Samples	118 (68)	118 (116)	118 (106)	118 (82)
Average	<1.5	<15	<6	<13
Minimum	0.2	<6	1	6
Maximum	23.2	<28	<140	33
Surface Water/Upstream Little Beaver Creek				
Num. of Samples	60 (59)	60 (60)	60 (56)	60 (41)
Average	<0.9	<15	<5	<11
Minimum	<0.1	<6	<1	<6
Maximum	1.3	<28	<12	<22
Surface Water/Downstream Little Beaver Creek				
Num. of Samples	321 (34)	322 (246)	322 (182)	322 (101)
Average	<1.7	<16	<6	<15
Minimum	<0.6	<8	2	<7
Maximum	9.4	43	44	78
Surface Water/Upstream Big Beaver Creek				
Num. of Samples	60 (36)	60 (58)	60 (48)	60 (25)
Average	<1.2	<16	<5	<14
Minimum	0.3	<8	2	<7
Maximum	5.8	<28	37	62
The "number of samples" shows the total number of samples collected, including replicate and duplicate samples collected for QA purposes, followed by the number of samples that were lower than the Minimum Detectable Concentration in parentheses.				

Table 9.2-6 Environmental Baseline Activities/Concentrations 1998 - 2002

	Total Uranium µg/L	**Technetium** pCi/L	**Gross Alpha** pCi/L	**Gross Beta** pCi/L
Surface Water/Downstream Big Beaver Creek				
Num. of Samples	60 (50)	60 (58)	60 (51)	60 (36)
Average	<1.1	<16	<6	<14
Minimum	<0.1	<6	<1	<6
Maximum	5.2	<28	72	108
Surface Water/Upstream Scioto River				
Num. of Samples	261 (8)	261 (251)	261 (213)	261 (151)
Average	<1.9	<15	<6	<13
Minimum	<1.0	<6	2	<6
Maximum	32.6	<28	<13	40
Surface Water/Downstream Scioto River				
Num. of Samples	261 (6)	261 (254)	261 (206)	261 (156)
Average	<1.8	<16	<6	<13
Minimum	<1.0	<6	2	<7
Maximum	9.5	<29	86	34
Surface Water/Background Creeks				
Num. of Samples	240 (214)	240 (237)	240 (223)	240 (179)
Average	<1.0	<16	<4	<11
Minimum	<0.1	<6	<1	<6
Maximum	6.9	114[a]	11	46

The "number of samples" shows the total number of samples collected, including replicate and duplicate samples collected for QA purposes, followed by the number of samples that were lower than the Minimum Detectable Concentration in parentheses.

[a] One sample from a background location was analyzed at 114 picocuries per liter (pCi/L) of technetium, a beta emitter, but only 12 pCi/L of gross beta activity. The technetium activity is believed to be a case of cross contamination. The next highest technetium activity at the background locations was 28 pCi/L.

Table 9.2-7 Environmental Baseline Activities/Concentrations 1998 - 2002

	Total Uranium µg/g	**Technetium** pCi/g	**Gross Alpha** pCi/g	**Gross Beta** pCi/g
Sediment/X-2230M Southwest Holding Pond Discharge				
Num. of Samples	10 (0)	10 (6)	10 (4)	10 (4)
Average	3.8	<0.2	<9	<16
Minimum	1.8	<0.1	<4	<7
Maximum	6.2	0.3	18	<36
Sediment/X-2230N West Holding Pond Discharge				
Num. of Samples	13 (0)	13 (4)	13 (4)	13 (11)
Average	3.2	<0.3	<7	<11
Minimum	2.3	<0.1	<3	<7
Maximum	4.9	0.6	10	<17
Sediment/Upstream Little Beaver Creek				
Num. of Samples	15 (0)	15 (13)	15 (6)	15 (11)
Average	2.8	<0.1	<7	<13
Minimum	1.5	<0.1	<4	<7
Maximum	5.7	0.2	11	18
Sediment/X-230J-7 Discharge				
Num. of Samples	17 (0)	17 (0)	17 (7)	17 (4)
Average	5.9	7.1	<16	<32
Minimum	2.7	0.7	<5	<7
Maximum	21.2	31.3	83	170
Sediment/Downstream Little Beaver Creek				
Num. of Samples	28 (0)	28 (6)	28 (3)	28 (9)
Average	7.0	<64.5	<17	<85
Minimum	1.8	<0.1	<5	<10
Maximum	35.1	801[a]	61	924

The "number of samples" shows the total number of samples collected, including replicate and duplicate samples collected for QA purposes, followed by the number of samples that were lower than the Minimum Detectable Concentration in parentheses.

Table 9.2-7 Environmental Baseline Activities/Concentrations 1998 - 2002

	Total Uranium µg/g	Technetium pCi/g	Gross Alpha pCi/g	Gross Beta pCi/g
Sediment/Upstream Big Beaver Creek				
Num. of Samples	10 (0)	10 (2)	10 (4)	10 (6)
Average	2.1	<0.3	<7	<13
Minimum	0.9	<0.1	<5	<7
Maximum	4.6	0.7	9	25
Sediment/Downstream Big Beaver Creek				
Num. of Samples	10 (0)	10 (0)	10 (1)	10 (2)
Average	4.0	4.7	<11	<18
Minimum	2.8	1.1	<6	<12
Maximum	5.5	14.6	33	24
Sediment/Upstream Big Run Creek				
Num. of Samples	11 (0)	11 (8)	11 (3)	11 (8)
Average	3.8	<0.2	<7	<13
Minimum	2.3	<0.1	4	9
Maximum	4.8	<0.2	13	<17
Sediment/Downstream Big Run Creek				
Num. of Samples	29 (0)	29 (6)	29 (6)	29 (18)
Average	4.1	<0.8	<9	<14
Minimum	1.1	<0.1	<4	<7
Maximum	5.9	2.7	33	28
Sediment/Upstream Scioto River				
Num. of Samples	11 (0)	11 (11)	11 (7)	11 (8)
Average	2.1	<0.1	<7	<12
Minimum	0.9	<0.1	3	<7
Maximum	4.6	<0.2	<9	<17

The "number of samples" shows the total number of samples collected, including replicate and duplicate samples collected for QA purposes, followed by the number of samples that were lower than the Minimum Detectable Concentration in parentheses.

Table 9.2-7 Environmental Baseline Activities/Concentrations 1998 - 2002

	Total Uranium µg/g	Technetium pCi/g	Gross Alpha pCi/g	Gross Beta pCi/g
Sediment/Downstream Scioto River				
Num. of Samples	10 (0)	10 (8)	10 (5)	10 (6)
Average	2.1	<0.2	<9	<14
Minimum	1.4	<0.1	5	<8
Maximum	4.4	0.4	17	19
Sediment/Background Creeks				
Num. of Samples	40 (0)	40 (37)	40 (22)	40 (25)
Average	3.2	<0.2	<6	<13
Minimum	1.3	<0.1	<3	<7
Maximum	6.8	2.7	13	24

The "number of samples" shows the total number of samples collected, including replicate and duplicate samples collected for QA purposes, followed by the number of samples that were lower than the Minimum Detectable Concentration in parentheses.

[a] In Fall 2002, duplicate samples taken at the RM8 sample point contained 689 and 801 pCi/g of technetium. A replicate sample taken at the same time and a few yards away contained only 13 pCi/g of technetium. The RM8 sample taken the following spring contained only 13 pCi/g, which is consistent with previous samples.

Table 9.2-8 Environmental Baseline Radiation Levels 1998-2002

Area of Readings	Average	Minimum	Maximum
Reservation (includes 518, 737, 862, 906, 933, 1404A, A35, A36, and A40)	10.5 µRad/hr	6.4 µRad/hr	17.9 µRad/hr
X-746 Cylinder Yard (includes 874)	70.5 µRad/hr	60.1 µRad/hr	82.3 µRad/hr
Boundary (includes A3, A8, A9, A12, A15, A23, A24, and A29)	10.5 µRad/hr	6.2 µRad/hr	22.6 µRad/hr
Piketon (includes A6)	9.6 µRad/hr	7.4 µRad/hr	13.9 µRad/hr
Camp Creek (includes A28)	10.4 µRad/hr	7.8 µRad/hr	14.9 µRad/hr

Note: Locations ACP-1, ACP-2, ACP-3, ACP-4, and ACP-5 are new monitoring locations that will be established as the ACP is built.

Table 9.2-9 Potentially Applicable Consents for the Construction and Operation of the American Centrifuge Plant

License, Permit, or Other Consent	Responsible Agency	Authority	Relevance and Status
Air Quality Protection			
Title V Operating Permit: Required for sources that are not exempt and are major sources, affected sources subject to the Acid Rain Program, sources subject to new source performance standards (NSPS), or sources subject to National Emission Standards for Hazardous Air Pollutants (NESHAPs).	Ohio Environmental Protection Agency (OEPA); U.S. Environmental Protection Agency (EPA)	*Clean Air Act* (CAA), Title V, Sections 501-507 (*U.S. Code*, Title 42, Sections 7661-7661f [42 USC 7661-7661f]); *Ohio Administrative Code* (OAC) 3745-77-02	Centrus Energy Corp. (the Licensee)~~United States Enrichment Corporation~~ is the holder of a final Title V Operating Permit (Facility ID 0666000000) with an issue date of ~~July 31, 2003~~July 27, 2017 and effective date of ~~August 21, 2003~~August 17, 2017. The plant is subject to *Code of Federal Regulations*, Title 40, Part 61, Subpart H (40 CFR Part 61, Subpart H), "National Emissions Standards for Emissions of Radionuclides which is included in the terms and conditions of the Title V Operating Permit.
Ohio Permit to Install (PTI): Required for (1) any source to which one or more of the following CAA programs would apply: prevention of significant deterioration (PSD), nonattainment area, NSPS, and/or NESHAPs; and (2) any source to which one or more of the following state air quality programs would apply; Gasoline Dispensing Facility Permit, Direct Final Permit, and/or Small Maximum Uncontrolled Emissions Unit Registration.	OEPA	CAA, Title I, Sections 160-169 (42 USC 7470-7479); OAC 3745-31-02	~~USEC~~ The Licensee has determined that the PSD, nonattainment area, and NSPS programs do not apply to the ACP. However, air emission sources requiring an Ohio PTI would apply to the ACP and the Licensee~~USEC~~ will submit a timely PTI application to the OEPA.

Table 9.2-9 Potentially Applicable Consents for the Construction and Operation of the American Centrifuge Plant

License, Permit, or Other Consent	Responsible Agency	Authority	Relevance and Status
Air Quality Protection (Cont.)			
Ohio Permit to Operate: Required for (1) any source to which one or more of the following CAA programs would apply; PSD, nonattainment area, NSPS, NESHAPs; and (2) any source to which one or more of the following state air quality programs would apply: State Permit to Operate and/or registration of operating unit with potential air emissions of an amount and type considered minimal; this permit is not required, however, for any facility that must obtain a Title V Operating Permit.	OEPA	CAA, Title I, Sections 160-169 (42 USC 7470-7479); OAC 3745-35-02	Centrus Energy Corp. (the Licensee)United States Enrichment Corporation is the holder of a final Title V Operating Permit (Facility ID 0666000000) with an issue date of July 27, 2017 and effective date of August 17, 2017issue date of July 31, 2003 and effective date of August 21, 2003. Sources requiring a PTI will be incorporated in the Title V Operating Permit.
Risk Management Plan (RMP): Required for any stationary source that has regulated substance (e.g., chlorine, hydrogen fluoride, nitric acid) in any process (including storage) in a quantity that is over the threshold level.	EPA; OEPA	CAA, Title 1, Section 112(r) (7) (42 USC 7412); 40 CFR Part 68; OAC 3745-104	USEC The Licensee has determined that no regulated substances would be stored at the ACP in quantities that exceed the threshold levels. Accordingly, an RMP will not be required.

Table 9.2-9 Potentially Applicable Consents for the Construction and Operation of the American Centrifuge Plant

License, Permit, or Other Consent	Responsible Agency	Authority	Relevance and Status
Air Quality Protection (Cont.)			
CAA Conformity Determination: Required for each criteria pollutant (i.e., sulfur dioxide, particulate matter, carbon monoxide, ozone, nitrogen dioxide, and lead) where the total of direct and indirect emissions in a nonattainment or maintenance area caused by a federal action would equal or exceed threshold rates.	OEPA	CAA, Title 1, Section 176 (c) (42 USCUSEC 7506); 40 CFR 93; OAC 3745-102;	Pike County, Ohio has been designated as "Cannot be Classified or Better Than Standard" for criteria pollutants. Because the county is in attainment with National Ambient Air Quality Standards for criteria pollutants and contains no maintenance areas, no CAA conformity determination is required for any criteria pollutant that would be emitted as a result of the proposed action. Existing air quality on the site is in attainment with National Ambient Air Quality Standards (NAAQS) for the criteria pollutants.
Water Resources Protection			
National Pollutant Discharge Elimination System (NPDES) Permit – Construction Site Storm Water: Required before making point source discharges into waters of the state of storm water from a construction project that disturbs more than 5 acres (2 ha) of land.	OEPA	*Clean Water Act* (CWA) (33 USC 1251 et seq.); 40 CFR Part 122; OAC-3745-33-02, 3745-38-02, and 3745-38-06	The LicenseeUSEC has determined that construction of the ACP and new cylinder storage yards would require an NPDES Permit for the construction site storm water discharges. Centrus Energy Corp.United States Enrichment Corporation is the holder of NPDES Permit number 0IS00023AD0IS00023ED. If requested, a Storm Water Pollution Prevention Plan (SWPPP) will be submitted to the OEPA at the appropriate time. Storm water will discharge through existing outfalls covered by a NPDES Permit.

Table 9.2-9 Potentially Applicable Consents for the Construction and Operation of the American Centrifuge Plant

License, Permit, or Other Consent	Responsible Agency	Authority	Relevance and Status
Water Resources Protection (Cont.)			
National Pollutant Discharge Elimination System (NPDES) Permit – Industrial Facility Storm Water: Required before making point source discharges into waters of the state of storm water from an industrial site.	OEPA	CWA (33 USC 1251 et seq.); 40 CFR Part 122; OAC-3745-33-02, 3745-38-02, and 3745-38-06	The LicenseeUSEC has determined that storm water would be discharged from the ACP site during operations. Storm water will discharge through existing outfalls covered by a NPDES Permit.
National Pollutant Discharge Elimination System (NPDES) Permit – Process Water Discharge: Required before making point source discharges into waters of the state of industrial process wastewater.	OEPA	CWA (33 USC 1251 et seq.); 40 CFR Part 122; OAC-3745-33-02, 3745-38-02, and 3745-38-06	The ACP will process industrial wastewater through an existing NPDES permitted facility and through existing outfalls covered by the NPDES Permit.
Ohio Surface Water PTI: Required before constructing sewers or pump stations.	OEPA	OAC-3745-31-02	If required, before construction of sewer lines and pump stations at the ACP a PTI to modify the existing NPDES permit would be submitted to the OEPA at the appropriate time.
Ohio Surface Water PTI: Required before constructing any wastewater treatment or collection system or disposal facility.	OEPA	OAC-3745-31-02	If required, a PTI to modify the existing NPDES permit would be submitted to the OEPA at the appropriate time.

Table 9.2-9 Potentially Applicable Consents for the Construction and Operation of the American Centrifuge Plant

License, Permit, or Other Consent	Responsible Agency	Authority	Relevance and Status
Water Resources Protection (Cont.)			
CWA Section 404 (Dredge and Fill) Permit: Required to place dredged or fill material into waters of the United States, including areas designated as wetlands, unless such placement is exempt or authorized by a nationwide permit or a regional permit; a notice must be filed if a nationwide or regional permit applies.	U.S. Army Corps of Engineers (USACE)	CWA (33 USC 1251 et seq.); 33 CFR Parts 323 and 330	The LicenseeUSEC believes that construction of the ACP would not result in dredging or placement of fill material into wetlands within the jurisdiction of the USACE. If construction activities are subject to the CWA Section 404 Permit program, they may be covered under a USACE Nationwide CWA Section 404 Permit (i.e., No. 14 [Linear Transportation Projects], 18 [Minor Discharges], or 19 [Minor Dredging]). If necessary, USEC the Licensee will consult with the USACE concerning the project and, if appropriate, submit either a pre-construction notification about activities covered by a nationwide permit or an application for an individual Section 404 Permit.
Ohio General Permit for Filling Category 1 and Category 2 Isolated Wetlands: Required where the proposed project involves the filling or discharge of dredged material into Category 1 and Category 2 isolated wetlands, causing impacts that total 0.5 acre (0.20 ha) or less.	OEPA	*Ohio Revised Code* (ORC) Sections 6111.021-6111.029	USEC The Licensee believes that construction of the ACP would not result in dredging or placement of fill material into wetlands within the jurisdiction of the OEPA isolated wetlands program. However, if necessary, submit to the OEPA a Pre-Activity Notice of activities covered under the General Permit for Filling Isolated Wetlands.

Table 9.2-9 Potentially Applicable Consents for the Construction and Operation of the American Centrifuge Plant

License, Permit, or Other Consent	Responsible Agency	Authority	Relevance and Status
Water Resources Protection (Cont.)			
Ohio Individual Isolated Wetland Permit: Required where the proposed project involves the filling or discharge of dredged material into Category 1 and Category 2 isolated wetlands, causing impacts that total greater than 0.5 acre (0.20 ha) for Category 1 isolated wetlands and/or greater than 0.5 acre (0.20 ha) but not exceeding 3 acres (1.21 ha) for Category 2 isolated wetlands.	OEPA	ORC Sections 6111.021-6111.029	~~USEC~~ The Licensee believes that construction of the ACP would not result in dredging or placement of fill material into wetlands within the jurisdiction of the OEPA isolated wetlands program. Accordingly, ~~USEC~~ the Licensee will consult, if necessary, with the OEPA concerning the project and, if appropriate, submit to the OEPA an application for an Individual Isolated Wetland Permit.
Spill Prevention Control and Countermeasures (SPCC) Plan: Required for any facility that could discharge oil in harmful quantities into navigable waters or onto adjoining shorelines.	EPA	CWA (33 USC 1251 et seq.); 40 CFR Part 112	~~A~~ SPCC plan ESH-343-09-018 has been developed and approved for the American Centrifuge Plant. ~~SPCC plan would be required. USEC The Licensee will develop and implement a SPCC plan at the appropriate time.~~
CWA Section 401 Water Quality Certification: Required to be submitted to the agency responsible for issuing any federal license or permit to conduct an activity that may result in a discharge of pollutants into waters of a state.	OEPA	CWA, Section 401 (33 USC 1341); ORC Chapters 119 and 6111; OAC Chapters 3745-1, 3745-32, and 3745-47	~~USEC~~ The Licensee believes that it would not be required to obtain a CWA Section 401 Water Quality Certification for construction or operation of the ACP or new cylinder storage yards. If ~~USEC~~ the Licensee determines that a federal license or permit is required (e.g., a CWA Section 404 Permit), a CWA Section 401 Water Quality Certification will be requested from the OEPA at the appropriate time.

Table 9.2-9 Potentially Applicable Consents for the Construction and Operation of the American Centrifuge Plant

License, Permit, or Other Consent	Responsible Agency	Authority	Relevance and Status
Water Resources Protection (Cont.)			
Public Water System: A completed application for an initial public water system license is required prior to the operation of the public water system.	OEPA	OAC-3745-84-01(B)(b)	The Licensee will procure services from a qualified vendor.
Underground Storage Tank (UST) Installation Permit: Required before beginning installation of a UST system (i.e., a tank and/or piping of which 10 percent or more of the volume is underground and that contains petroleum products or substances defined as hazardous by the Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA], except those hazardous substances that are also defined as hazardous waste by the RCRA).	Ohio Department of Commerce, Ohio Bureau of Underground Storage Tank Regulations (BUSTR)	OAC 1301:7-9-06(D)	~~Two~~ One UST systems ~~are~~is installed at the ACP. Registration number: 66005107-R00010 Tank Number: ~~T00007~~ T00016
New UST System Registration: Required within 30 days of bringing a new UST system into service.	EPA; Ohio BUSTR	RCRA, as amended, Subtitle I (42 USC 6991a-6991i); 40 CFR 280.22; OAC 1301:7-9-04	If new UST systems would be installed at the ACP the Registration would be filed at the appropriate time.

Table 9.2-9 Potentially Applicable Consents for the Construction and Operation of the American Centrifuge Plant

License, Permit, or Other Consent	Responsible Agency	Authority	Relevance and Status
Water Resources Protection (Cont.)			
Above Ground Storage Tank (AST): A PTI required to install, remove, repair or alter any stationary tank for the storage of flammable or combustible liquids.	Ohio Department of Commerce, State Fire Marshal	OAC 1301:7-7-28(A)(3) 40 CFR 112.8	AST fuel storage tanks will be required for the ACP. Permits to install will be filed at the appropriate time.
Waste Management and Pollution Prevention			
Submit Determination Results: Required when a person who generates waste in the State of Ohio or a person who generates waste outside the state that is managed inside the state determines that the waste he/she generates is hazardous waste.	OEPA	OAC 3745-52-11	Upon characterization of newly generated waste streams from the ACP, notification would be made to the OEPA.
Registration and Hazardous Waste Generator Identification Number: Required before a person who generates over 220 lb (100 kg) per calendar month of hazardous waste ships the hazardous waste off-site.	EPA; OEPA	*Resource Conservation and Recovery Act* (RCRA), as amended (42 USC 6901 et seq.), Subtitle C; OAC 3745-52-12	Centrus Energy Corp.~~United States Enrichment Corporation~~ Hazardous Waste Generator Identification Number OHD987054723.

Table 9.2-9 Potentially Applicable Consents for the Construction and Operation of the American Centrifuge Plant

License, Permit, or Other Consent	Responsible Agency	Authority	Relevance and Status
Waste Management and Pollution Prevention (Cont.)			
Construction and Demolition Debris Facility License: Required before establishing, modifying, operating, or maintaining a facility to dispose of debris from the alteration, construction, destruction, or repair of a man-made physical structure; however, the debris to be disposed of must not qualify as solid or hazardous waste; also, no license is required if debris from site clearing is used as fill material on the same site.	OEPA or Pike County Board of Health	OAC 3745-37-01	Construction debris would not be disposed of on site at the ACP. Therefore, no Construction and Demolition Debris Facility License would be required.
Low-Level Radioactive Waste Generator Report: Required within 60 days of commencing the generation of low-level waste in Ohio.	Ohio Department of Health	OAC 3701:1-54-02	The Licensee will file a Low-Level Radioactive Waste Generator Report with the Ohio Department of Health at the appropriate time. ODH ID Number 52-~~2109255~~ 2107911

Table 9.2-9 Potentially Applicable Consents for the Construction and Operation of the American Centrifuge Plant

License, Permit, or Other Consent	Responsible Agency	Authority	Relevance and Status
Waste Management and Pollution Prevention (Cont.)			
Hazardous Waste Facility Permit: Required if hazardous waste will undergo nonexempt treatment by the generator, be stored on site for longer than 90 days by the generator of 2,205 lb (1,000 kg) or more of hazardous waste per month, be stored on site for longer than 180 days by the generator of between 220 and 2,205 lb (100 and 1,000 kg) of hazardous waste per month, disposed of on site, or be received from off-site for treatment or disposal.	EPA; OEPA	RCRA, as amended (42 USC 6901 et seq.), Subtitle C; OAC 3745-50-40	Hazardous waste would not be disposed of on site at the ACP. Should ACP become a large quantity generator and waste require storage on site for greater ~~then~~ than 90 days for characterization, profiling, or scheduling for treatment or disposal a Hazardous Waste Facility Permit would be required and submitted at the appropriate time.
Low-Level Mixed Waste (LLMW): LLMW is a waste that contains both low-level radioactive waste and RCRA hazardous waste.	OEPA	OAC 3745-266; 40 CFR Part 266 Subpart N	The Licensee will manage LLMW in compliance with 40 CFR Part 266 Subpart N and Ohio Administrative Code Chapter 3745-266.
Industrial Solid Waste Landfill Permit to Install: Required before constructing or expanding a solid waste landfill facility in Ohio.	OEPA	OAC 3745-29-06	Industrial solid waste would not be disposed of on site at the ACP. Therefore, no Industrial Solid Waste Landfill Permit to Install would be required.

Table 9.2-9 Potentially Applicable Consents for the Construction and Operation of the American Centrifuge Plant

License, Permit, or Other Consent	Responsible Agency	Authority	Relevance and Status
Emergency Planning and Response			
List of Material Safety Data Sheets: Submission of a list of material Safety Data Sheets is required for hazardous chemicals (as defined in 29 CFR Part 1910) that are stored on site in excess of their threshold quantities.	Local Emergency Planning Commission (LEPC); Ohio State Emergency Response Commission (SERC)	*Emergency Planning and Community Right-to-Know Act* of 1986 (EPCRA), Section 311 (42 USC 11021); 40 CFR 370.20; OAC 3750-30-15	The Licensee will prepare and submit a List of Material Safety Data Sheets at the appropriate time.
Annual Hazardous Chemical Inventory Report: Submission of the report is required when hazardous chemicals have been stored at a facility during the preceding year in amounts that exceed threshold quantities.	LEPC; Ohio SERC; local fire department	EPCRA, Section 312 (42 USC 11022); 40 CFR 370.25; OAC 3750-30-01	United States Enrichment CorporationThe Licensee will prepare and submit an Annual Hazardous Chemical Inventory Report each year. Centrus Energy Corp.United States Enrichment Corporation Facility ID Number 45661NTDST3930U

Table 9.2-9 Potentially Applicable Consents for the Construction and Operation of the American Centrifuge Plant

License, Permit, or Other Consent	Responsible Agency	Authority	Relevance and Status
Emergency Planning and Response (Cont.)			
Notification of On-Site Storage of an Extremely Hazardous Substance: Submission of the notification is required within 60 days after on-site storage begins of an extremely hazardous substance in a quantity greater than the threshold planning quantity.	Ohio SERC	EPCRA, Section 304 (42 USC 11004); 40 CFR 355.30; OAC 3750-20-05	~~United States Enrichment Corporation~~The Licensee will prepare and submit the Notification of On-Site Storage of an Extremely Hazardous Substance at the appropriate time, if such substances are determined to be stored in a quantity greater than the threshold planning quantity at the ACP. Facility ID Number 45661NTDST3930U
Annual Toxic Release Inventory (TRI) Report: Required for facilities that have 10 or more full-time employees and are assigned certain Standard Industrial Classification (SIC) codes.	EPA:OEPA	EPCRA, Section 313 (42 USC 11023); 40 CFR Part 372; OAC 3745-100-07	~~United States Enrichment Corporation~~The Licensee will prepare and submit a TRI Report to the EPA ~~each year~~as appropriate. Facility ID Number 45661NTDST3930U.

Table 9.2-9 Potentially Applicable Consents for the Construction and Operation of the American Centrifuge Plant

License, Permit, or Other Consent	Responsible Agency	Authority	Relevance and Status
Emergency Planning and Response (Cont.)			
Transportation of Radioactive Wastes and Conversion Products Certificate of Registration: Required to authorize the registrant to transport hazardous material or cause a hazardous material to be transported or shipped.	U.S. Department of Transportation (DOT)	*Hazardous Materials Transportation Act* (HMTA), as amended by the *Hazardous Materials Transportation Uniform Safety Act* of 1990 and other acts (49 USC 1501 et seq.); 49 CFR 107.608(b)	Centrus Energy Corp. ~~United States Enrichment Corporation~~ Certificate of Registration Number 052803005022LN.

Table 9.2-9 Potentially Applicable Consents for the Construction and Operation of the American Centrifuge Plant

License, Permit, or Other Consent	Responsible Agency	Authority	Relevance and Status
Emergency Planning and Response (Cont.)			
Transportation of Radioactive Wastes and Conversion Products Packaging, Labeling, and Routing Requirements for Radioactive Materials: Required for packages containing radioactive materials that will be shipped by truck or rail.	DOT	HMTA (49 USC 1501 et seq.); *Atomic Energy Act* (AEA), as amended (42 USC 2011 et seq.); 49 CFR Parts 172, 173, 174, 177, and 397	When shipments of radioactive materials are made, the Licensee will comply with DOT packaging, labeling, and routing requirements.

Table 9.2-9 Potentially Applicable Consents for the Construction and Operation of the American Centrifuge Plant

License, Permit, or Other Consent	Responsible Agency	Authority	Relevance and Status
Other			
Land Resources			
Farmland Protection and Policy Act (FPPA): Prime farmland is land that has the best combination of physical and chemical characteristics for producing crops of statewide or local importance. Prime farmland is protected by the Farmland Protection and Policy Act (FPPA) of 1981 which seeks "... to minimize the extent to which federal programs contribute to the unnecessary and irreversible conversion of farmlands to nonagricultural uses..."	U.S. Department of Agriculture	Farmland Protection and Policy Act (FPPA) of 1981 Public Law 97-98; 7 USC 4201[b]; 7 CFR Part 7, paragraph 658	Consultation letters are included in Appendix B ~~of this ER~~LA-3605-0002, Environmental Report for the American Centrifuge Plant.
Biotic Resources			
Threatened and Endangered Species Consultation: Required between the responsible federal agencies and affected states to ensure that the project is not likely to (1) jeopardize the continued existence of any species listed at the federal or state level as endangered or threatened or (2) result in destruction of critical habitat of such species.	U.S. fish and Wildlife Service; Ohio Department of Natural Resources	*Endangered Species Act* of 1973, as amended (16 USC 1531 et seq.); ORC 1531.25-26 and 1531.99	Consultation letters are included in Appendix B ~~of this ER~~LA-3605-0002, Environmental Report for the American Centrifuge Plant.

Table 9.2-9 Potentially Applicable Consents for the Construction and Operation of the American Centrifuge Plant

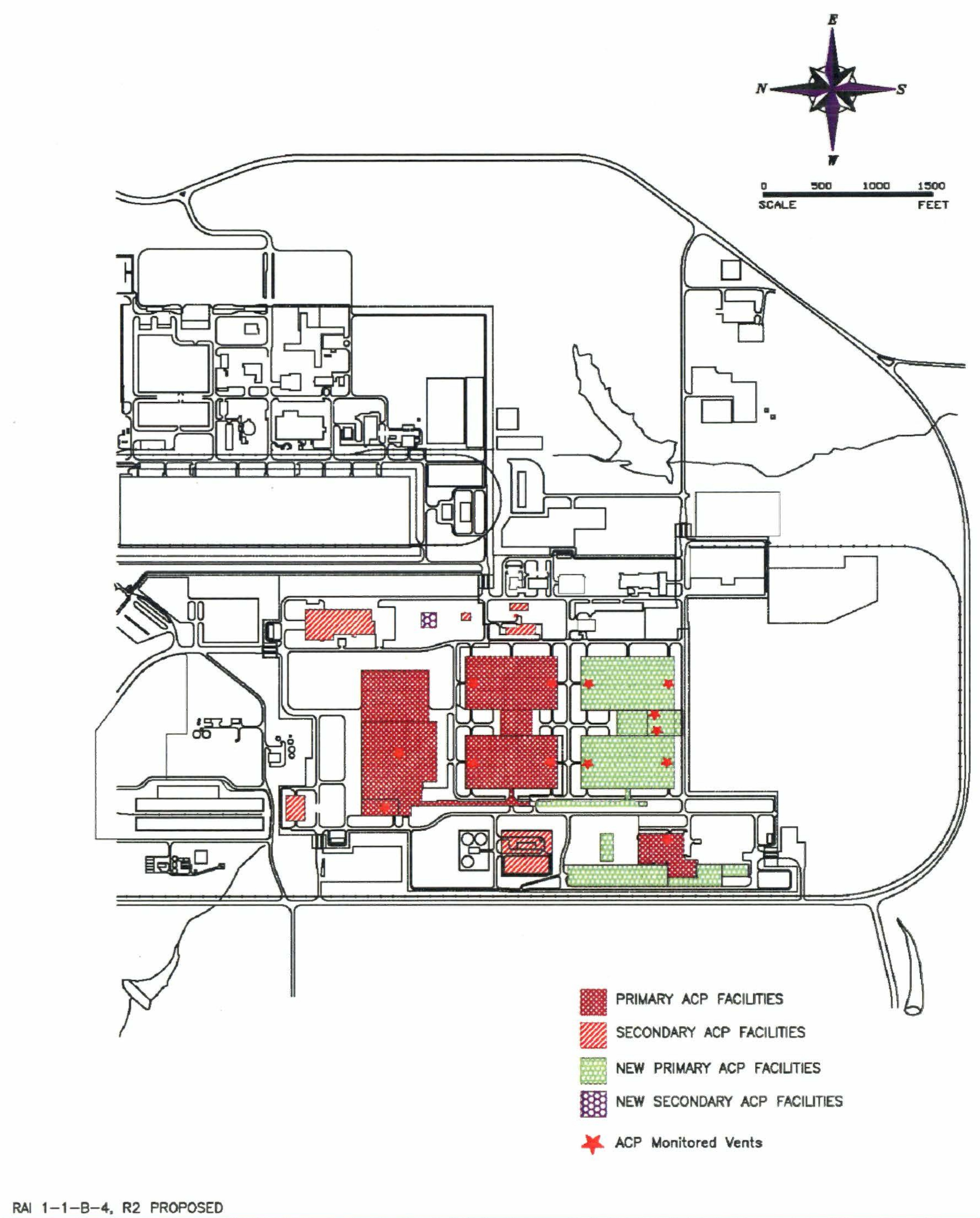
License, Permit, or Other Consent	Responsible Agency	Authority	Relevance and Status
Cultural Resources			
Archaeological and Historical Resources Consultation: Required before a federal agency approves a project in an area where archaeological or historic resources might be located.	Ohio State Historic Preservation Officer (SHPO)	*National Historic Preservation Act* of 1966, as amended (16 USC 470 et seq.); *Archaeological and Historical Preservation Act* of 1974 (16 USC 469-469c-2); *Antiquities Act* of 1906 (16 USC 431 et seq.); *Archaeological Resources Protection Act* of 1979, as amended (16 USC 470aa-mm)	~~USEC~~ The Licensee has consulted with the Ohio SHPO regarding previous archeological and architectural surveys at the DOE reservation. Consultation letters are included in Appendix B of LA-3605-0002, *Environmental Report for the American Centrifuge Plant*.

Table 9.2-9 Potentially Applicable Consents for the Construction and Operation of the American Centrifuge Plant

License, Permit, or Other Consent	Responsible Agency	Authority	Relevance and Status
Other (cont.)			
Environmental Report (ER) Required by 10 CFR Part 51, this ER is being submitted to the U.S. Nuclear Regulatory Commission (NRC) to support licensing of the ACP.	NRC	*National Environmental Policy Act* of 1969, as amended (NEPA) (42 USC 4321 et seq.); 40 CFR Parts 1500-1508; 10 CFR Part 1021; 10 CFR Part 51 P.L. 91-190	LA-3605-0002, *Environmental Report for the American Centrifuge Plant* This ER was prepared in accordance with the *U.S. Code of Federal Regulations*, 10 CFR Part 51, which implements the requirements of the National Environmental Policy Act (NEPA) of 1968, as amended (P.L.91-190).
Depleted UF_6 Management Measures: Establishes requirements for management, inspection, testing, and maintenance associated with the ACP Depleted UF_6 storage yards and cylinders owned by the LicenseeUSEC at the DOE reservation as stipulated in the ACP License Application.	OEPA	OAC 3745-266; 40 CFR Part 266 Subpart N	The Licensee will manage the ACP Depleted UF_6 tails cylinders in accordance with 40 CFR Part 266 Subpart N and Ohio Administrative Code Chapter 3745-266 while in storage.

Table 9.2-9 Potentially Applicable Consents for the Construction and Operation of the American Centrifuge Plant

License, Permit, or Other Consent	Responsible Agency	Authority	Relevance and Status
Other (Cont.)			
Standard Industrial Classification (SIC): The SIC system serves as the structure for collection, aggregation, presentation, and analysis of the U.S. economy. An industry consists of a group of establishments primarily engaged in producing or handling the same product or group of products or in rendering the same services.	OSHA	SIC system	SIC 2819 Industrial Inorganic Chemicals, Not Elsewhere Classified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SCALE FEET
PRIMARY ACP FACILITIES
SECONDARY ACP FACILITIES
NEW PRIMARY ACP FACILITIES
NEW SECONDARY ACP FACILITIES
ACP Monitored Vents
RAI 1-1-B-4, R2 PROPOSED

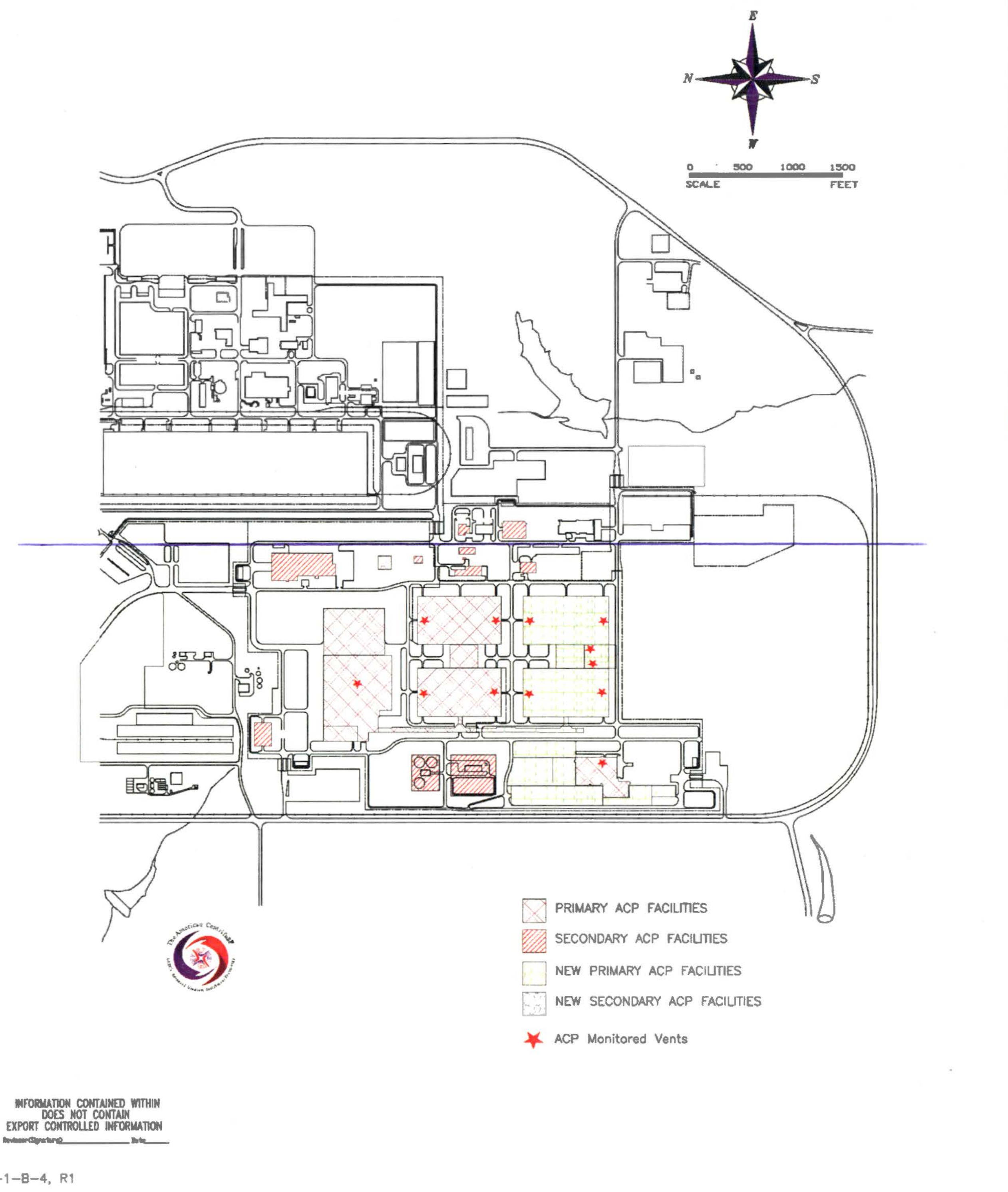
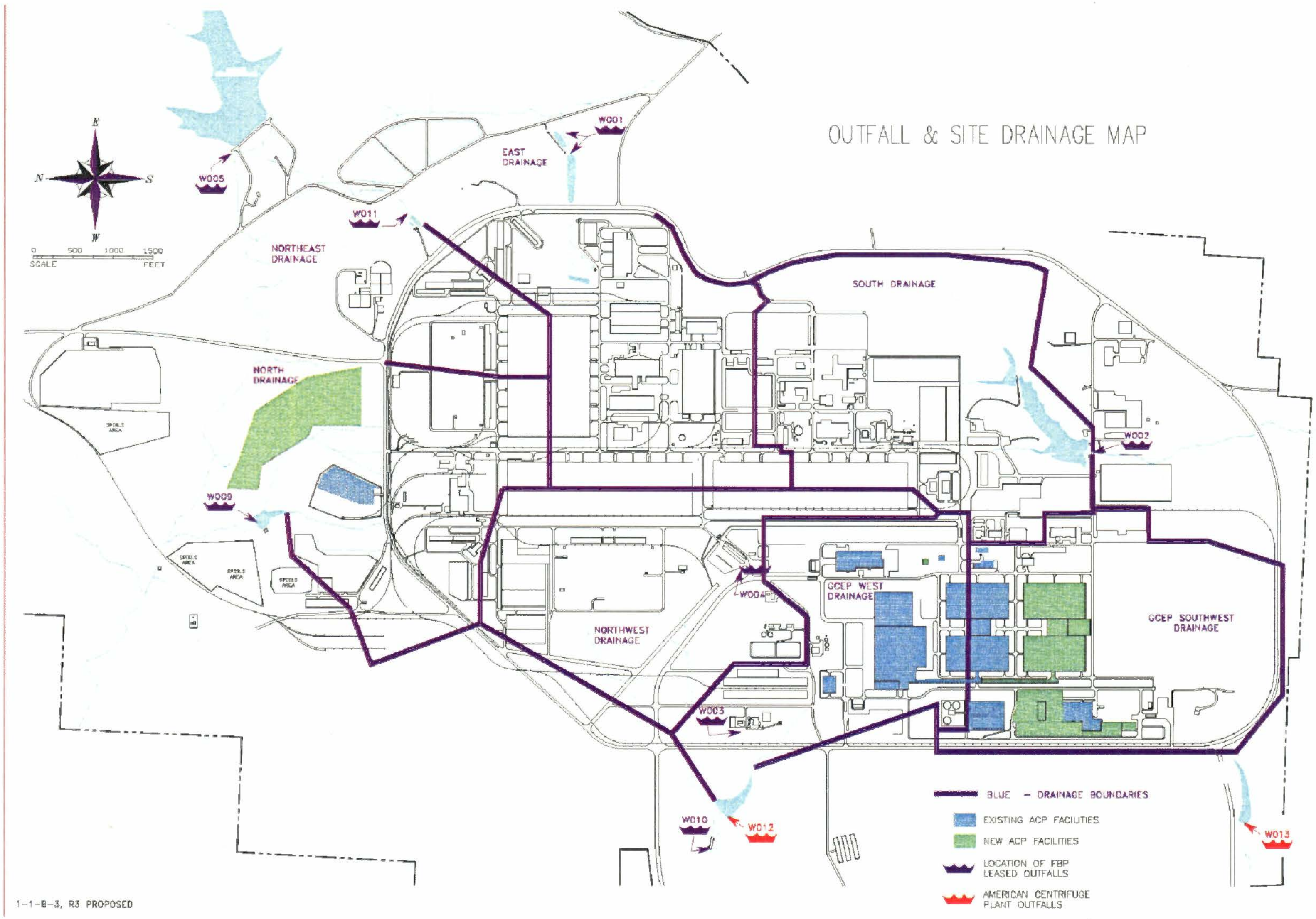


Figure 9.2-1 Locations of American Centrifuge Plant Monitored Vents


OUTFALL & SITE DRAINAGE MAP
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SCALE FEET
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EAST DRAINAGE
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NORTH DRAINAGE
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W004
GCEP WEST DRAINAGE
GCEP SOUTHWEST DRAINAGE
NORTHWEST DRAINAGE
W003
W010
W012
W013
BLUE - DRAINAGE BOUNDARIES
EXISTING ACP FACILITIES
NEW ACP FACILITIES
LOCATION OF FBP LEASED OUTFALLS
AMERICAN CENTRIFUGE PLANT OUTFALLS
1-1-B-3, R3 PROPOSED

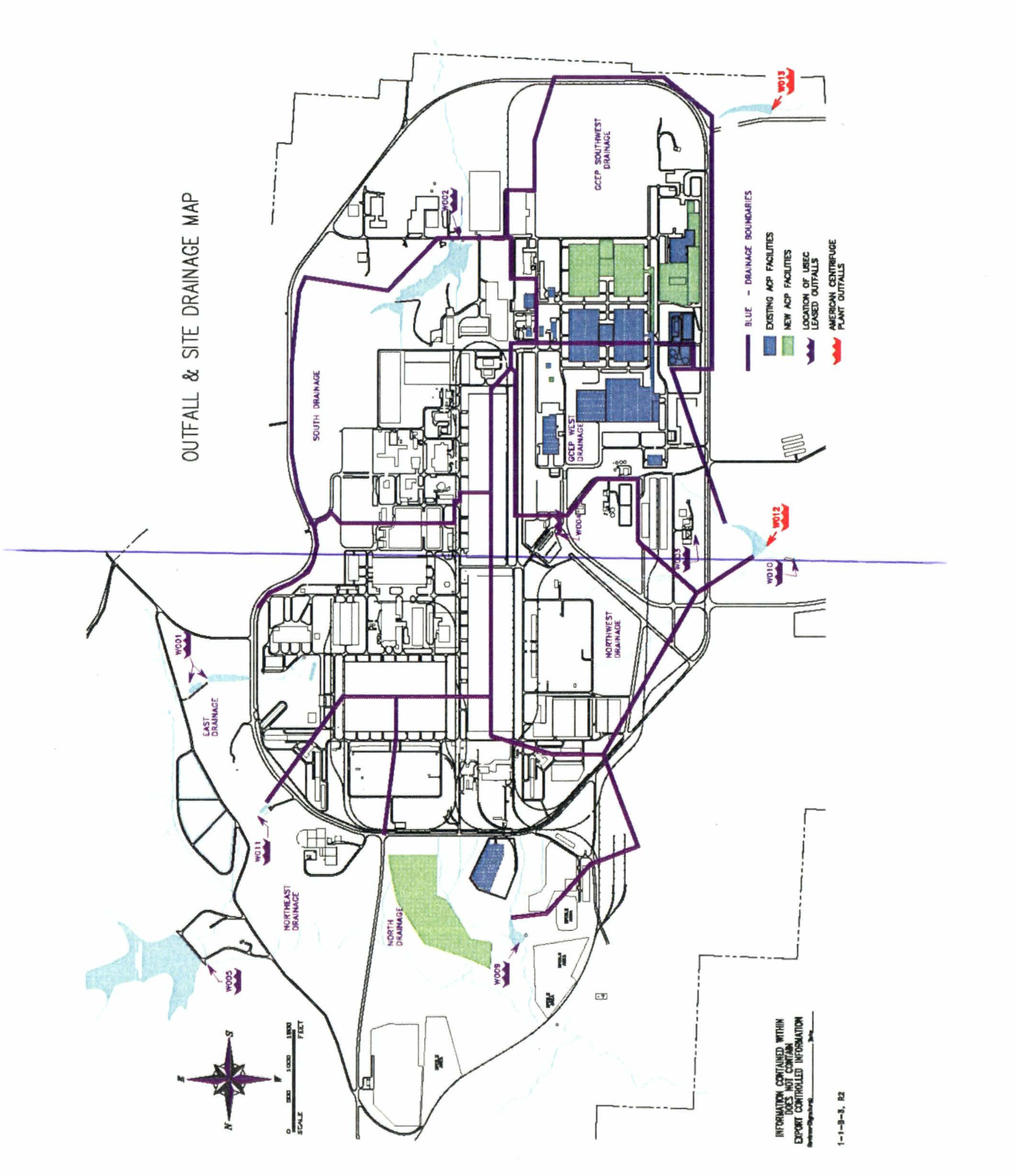

Figure 9.2-2 Locations of American Centrifuge Plant Outfalls Discharging to Waters of the United States

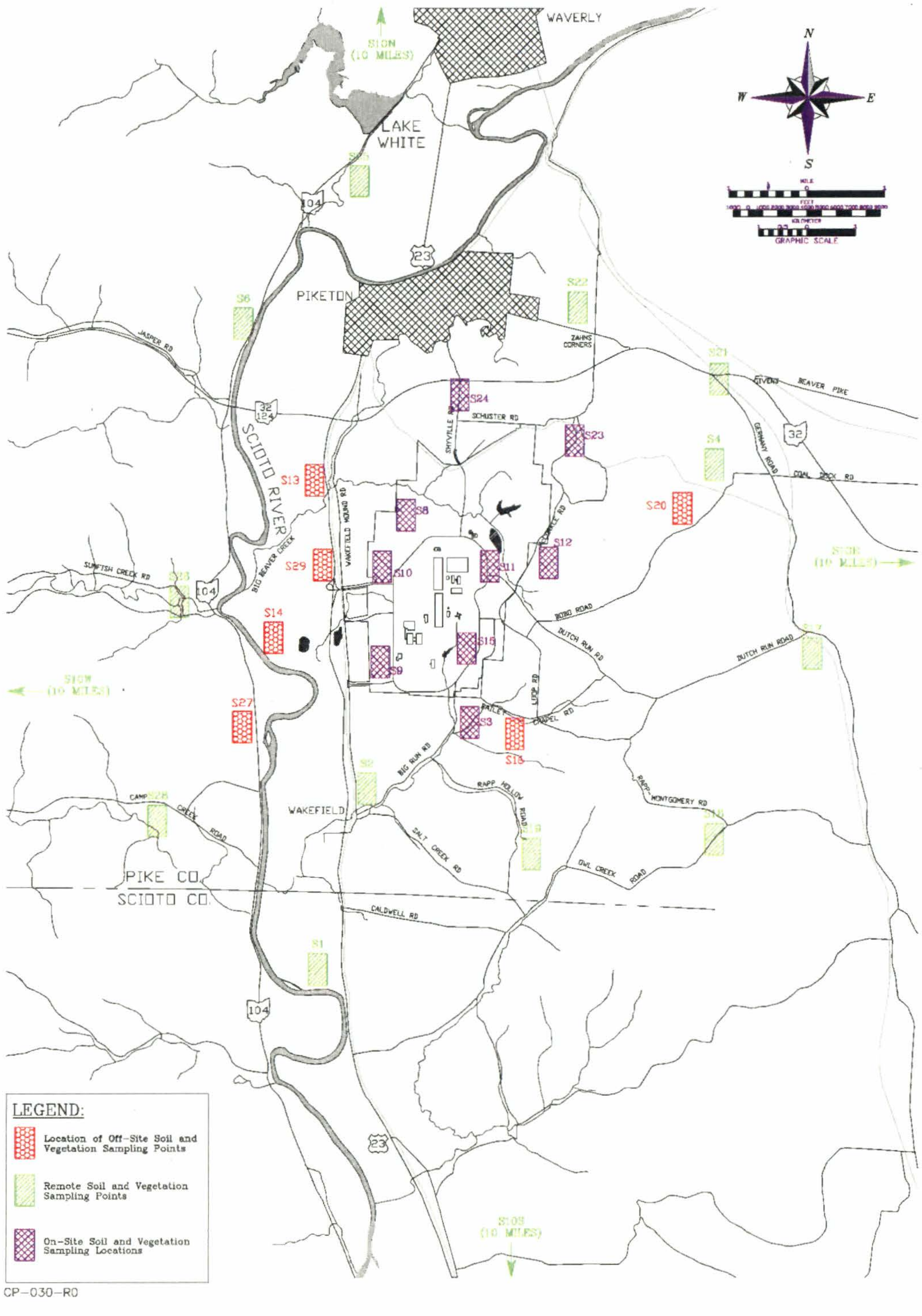

Figure 9.2-3 Locations of Soil and Vegetation Sampling Points

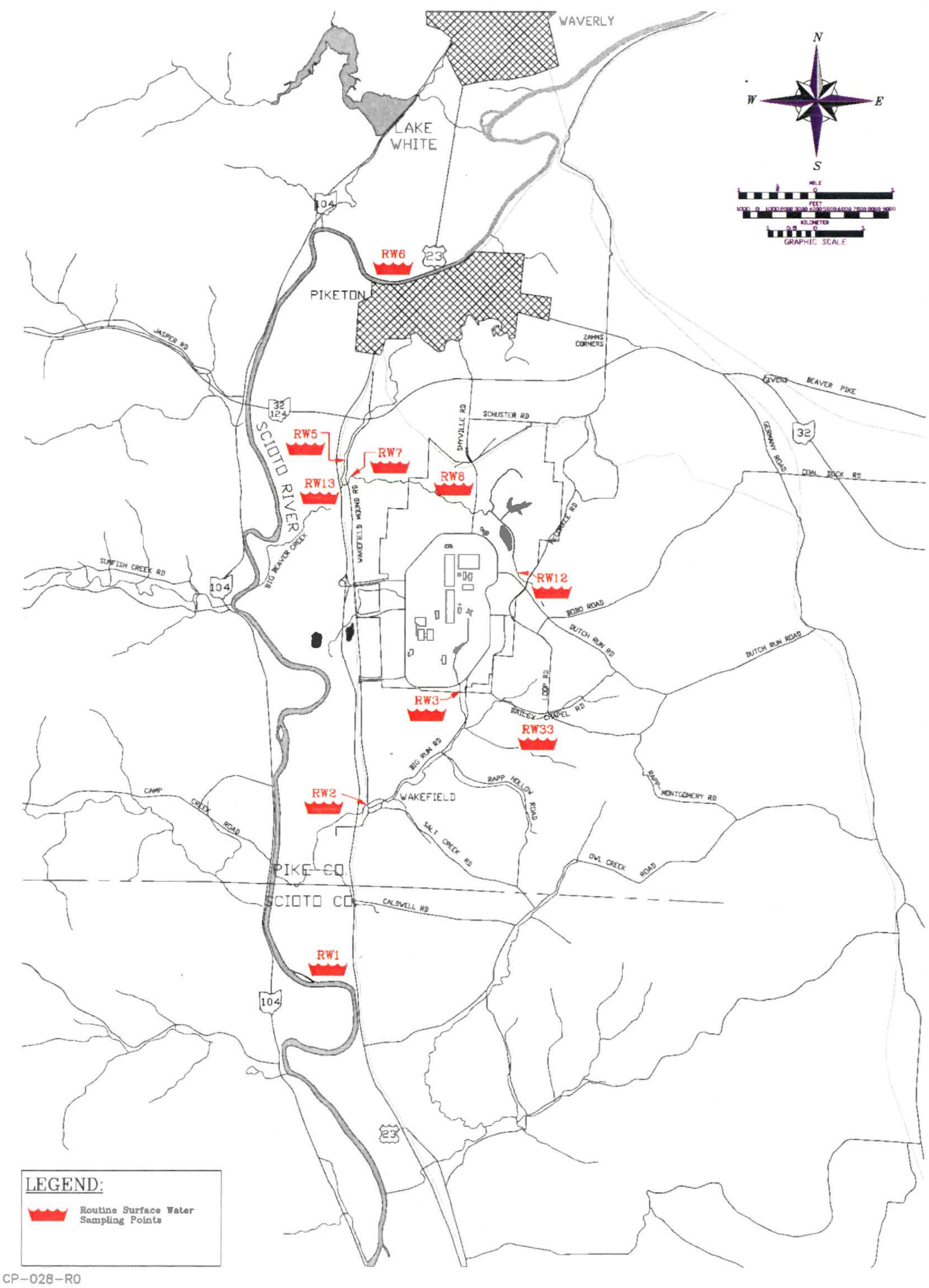

Figure 9.2-4 Locations of Surface Water Sampling Points

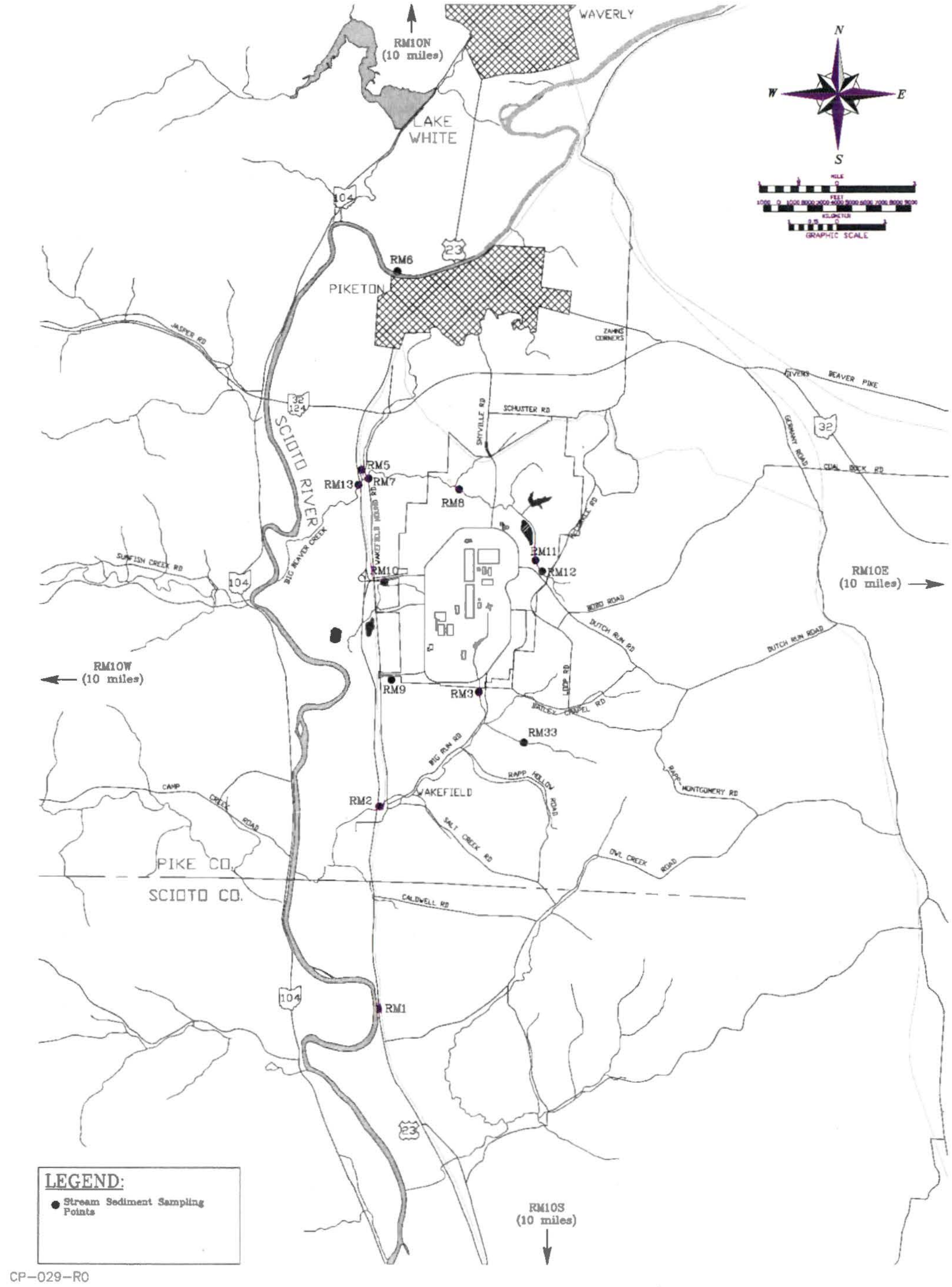

Figure 9.2-5 Locations of Stream Sediment Sampling Points

This figure is withheld pursuant to 10 CFR 2.390 and is located in Appendix B of this license application

Figure 9.2-6 Locations of Environmental Thermoluminescence Dosimeters on the U.S. Department of Energy Reservation

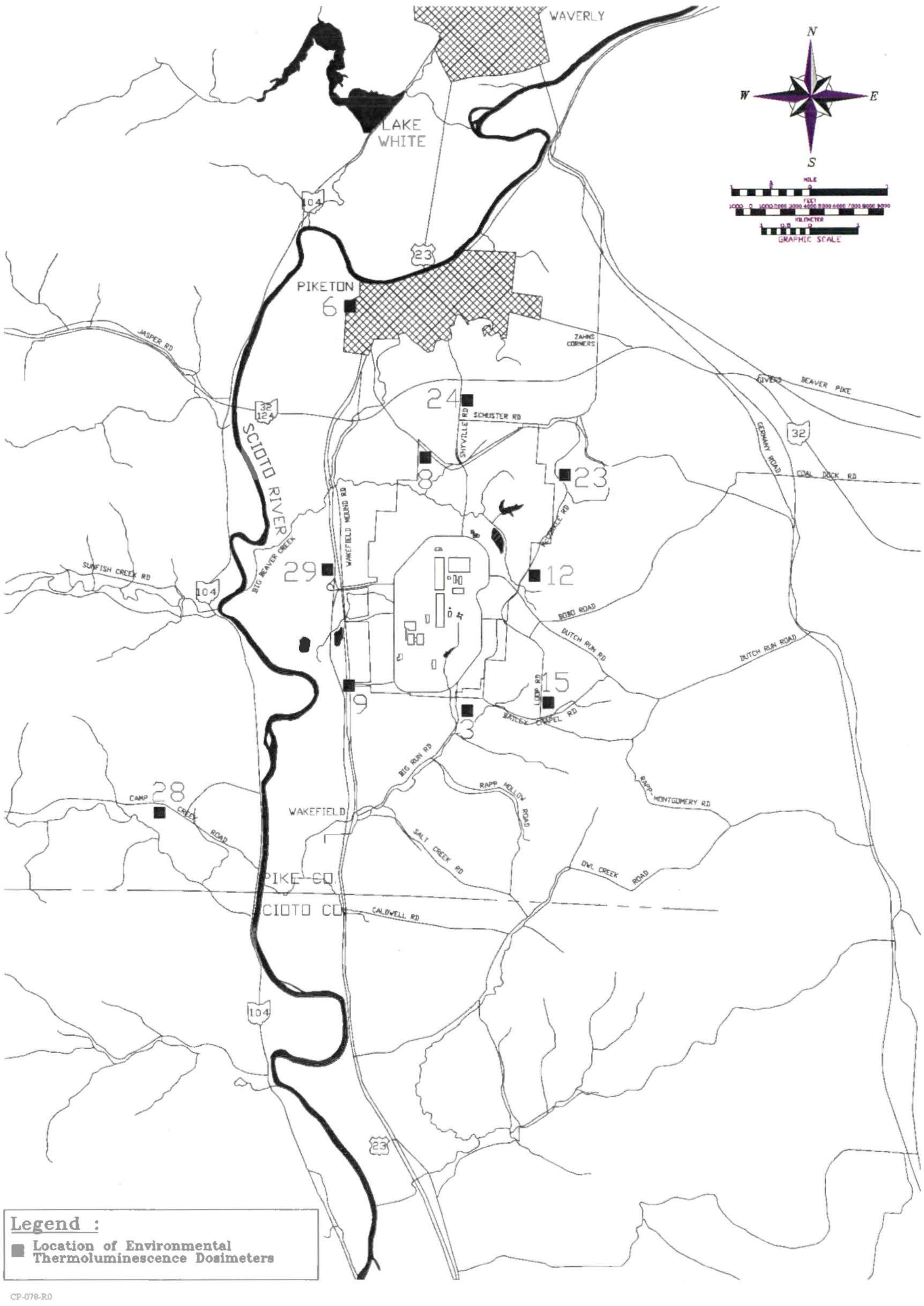

Figure 9.2-7 Locations of Environmental Thermoluminescence Dosimeters Outside the U.S. Department of Energy Reservation Boundary

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10.0 DECOMMISSIONING

In accordance with NUREG-1520, *Standard Review Plan for Fuel Cycle Facilities License Applications* (Revision 2), this chapter provides an overview of proposed decommissioning activities for the American Centrifuge Plant (ACP). The ACP is located in a leased area of the U.S. Department of Energy's (DOE) reservation in Piketon, Ohio.

10.1 High Assay, Low-Enriched Uranium (HALEU) Demonstration Program

The Licensee, American Centrifuge Operating, LLC (ACO or Corporation), is deploying a 16-machine AC100M HALEU cascade in leased areas under contract with the U.S. Department of Energy (DOE or Department). In support of this HALEU Demonstration Program, DOE amended the *Appendix 1 Lease Agreement between the U.S. Department of Energy and United States Enrichment Corporation for the Gas Centrifuge Enrichment Plant* (GCEP Lease Agreement). The amended GCEP Lease Agreement renewed and extended the term of the lease through May 31, 2022. Additionally, the amended GCEP Lease Agreement permits the construction and operation of the demonstration cascade by the Corporation (Licensee), the sublessee of the GCEP Lease and holder of the U.S. Nuclear Regulatory Commission (NRC) American Centrifuge Plant (ACP) Materials License.

The amended GCEP Lease Agreement includes the following statements pertaining to decommissioning liability:

- As of May 31, 2019, the Corporation (Licensee) had fully satisfied the lease turnover conditions and any existing financial assurance provided under Section 4.3 (of the GCEP Lease Agreement) was released, surety bonds were cancelled, and collateral returned to the Corporation (Licensee).

- Any facilities or equipment constructed or installed by the Corporation (Licensee) under the Demonstration Contract with the Department shall be included in Exhibit B (of the GCEP Lease Agreement) as Leased Personality and may be returned to the Department in an "as is" condition at the end of the lease term (May 31, 2022).

- The Department hereby assumes all liability for the decontamination and decommissioning of such facilities and equipment installed, and any work performed, under the Demonstration Contract with the Department including any materials or environmental hazards on the site. Therefore, no financial assurance for any liability or lease turnover conditions shall be required from the Corporation (Licensee).

- The parties agree that any work performed under the HALEU Demonstration Contract on the leased premises shall be considered a permitted use; any alternations or changes to the premises pursuant to the Demonstration Contract with the DOE shall be a permitted change to the premises; and any liabilities of the Corporation (Licensee) arising from or incident to the performance of work under the Demonstration Contract with the DOE shall be governed solely by such contract and any financial protection afforded to the Corporation (Licensee) as a person indemnified under the Act.

Title to depleted uranium hexafluoride (UF_6) by-product (tails) from the HALEU enrichment process has yet to be determined. However, should the DOE determine that the Licensee owns the tails material, the Licensee commits to the submittal to the NRC a license amendment request to provide the required decommissioning surety required by 10 CFR 30.35, 40.36, and 70.25 for prior review and approval.

At the conclusion of the HALEU Demonstration Program, the facilities will be either returned to the Department in accordance with the requirements of the GCEP Lease Agreement or the Licensee will amend the ACP Materials License to allow phased implementation of expanded centrifuge enrichment cascades as described in Section 1.1.8 of the license application. At that time, a revised decommissioning funding plan, including an updated decommissioning cost estimate would be provided to the NRC for prior review and approval to reflect any new decommissioning liabilities.

10.2 American Centrifuge Plant (ACP) Decommissioning

In accordance with Reference 1, this chapter provides an overview of proposed decommissioning activities for the American Centrifuge Plant (ACP). The ACP is located in a leased area of the U.S. Department of Energy's (DOE) reservation in Piketon, Ohio. USEC Inc. (USEC)The Licensee previously requested a 30-year license to operate the ACP. At the end of useful plant life, the ACP will be decommissioned such that the facilities will be either returned to the DOE in accordance with the requirements of the Lease Agreement with the DOE or will be released for unrestricted use. The criteria for final disposition of facilities will be established in the Decommissioning Plan (DP) which, as noted below, will be submitted prior to license termination. Nevertheless, for the purposes of the License Application for the American Centrifuge PlantACP, the decommissioning discussions in this Aapplication and the decommissioning estimated costs are based on decontaminating the plant to the radiological criteria for unrestricted use in 10 *Code of Federal Regulations* (CFR) 20.1402. Information about the Licensee, the location of the site, and the types and authorized uses of licensed material are provided in Section 1.2 of the license application and a description of the site and immediate environs is provided in Section 1.3 of the license application.

Similar to the successful decommissioning efforts for the American Centrifuge Lead Cascade Facility, Aa more detailed DP for the ACP will be submitted by the Licensee in accordance with 10 CFR 30.36 (g), 10 CFR 40.42 (g), and 10 CFR 70.38(g) and applicable risk-informed U.S. Nuclear Regulatory Commission (NRC) guidance provided in NUREG-1757, *Consolidated Decommissioning Guidance* (References 2, 3, and 4Volumes 1 - 3) prior to the time of license termination. Prior to decommissioning, an assessment of the radiological status of the ACP will be made. Enrichment equipment will be removed, leaving only the building shells and the plant infrastructure, including equipment that existed at the time of lease with the DOE (e.g., rigid mast crane, utilities, etc.). Classified material, components, and documents will be destroyed or disposed of in accordance with the *Security Plan for the Protection of Classified Matter Program for at the American Centrifuge Plant* (Reference 5). Requirements for nuclear material control and accountability will be maintained during decommissioning in a manner similar to the programs in force during ACP operation (Reference 6NR-3605-0005). Depleted uranium hexafluoride (UF$_6$) material (tails), if not sold or disposed of prior to decommissioning, will be sold, or converted to a stable, non-volatile uranium compound and disposed of in accordance with regulatory requirements utilizing facilities constructed by DOE, as authorized by the *USEC Privatization Act*, and/or other licensed facilities. Radioactive wastes will be disposed of at licensed low-level waste disposal sites. Hazardous wastes will be treated or disposed of in licensed hazardous waste facilities.

The DP submitted at the time of license termination consists of several interrelated components, including (1) site characterization information, (2) remediation plan, and (3) a final status survey plan. The costs for activities required for these components have been identified in this chapter and estimated in the Decommissioning Funding Plan (DFP). Costs projected were developed based on the experience at the Portsmouth Gaseous Diffusion Plant during the transition to Cold Standby operation and decommissioning cost estimates developed for the American Centrifuge Demonstration Facility. Additionally, USEC the Licensee hads performed dismantling and decontamination work at the gaseous diffusion plants. Data and experience from these activities allowed a realistic estimation of expected decommissioning financial expenditures.

Using the cost data as a basis, financial arrangements are made to cover costs required to release the ACP for unrestricted use and to dispose of the tails. Updates on cost and funding will be provided periodically as described in Section 10.2.10.4. In accordance with 10 CFR 70.22(a)(9), and 30.35, 40.36, and 70.25(a)(1), a DFP (NR-3605-0006) is was previously submitted as part of the original license application for the ACP (Reference 7).

The following assumptions are utilized in the plan for decommissioning:

- No credit is taken for salvage value of equipment or materials.
- Decontamination liability is anticipated in the X-3001 and X-3002 Process Buildings, X-3012 Process Support Building, X-3344 Customer Services Building, X-3346 Feed and Withdrawal Building, X-3346A Feed and Product Shipping and Receiving Building, X-7725 Recycle/Assembly FacilityBuilding, X-7726 Centrifuge Training and Test Facility, X-7727H Interplant Transfer Corridor, X-2232C Interconnecting Process Piping, and miscellaneous cylinder storage yards.
- No decontamination is anticipated for the other ACP leased facilities.
- Decommissioning estimated costs are based on decontaminating the plant to the radiological criteria for unrestricted use in 10 CFR 20.1402.

The centrifuge assembly area in the X-7725 facility building is identified as the Decontamination Service Area (DSA). The centrifuge machine transport system is used to transport the centrifuges machines from the cascade area to the DSA.

The remaining sections of this chapter describe decommissioning plans and funding arrangements, and provide a detailed examination of the decontamination aspects of the program. The information herein was developed in connection with the decommissioning cost estimate and is provided for information. Specific elements of the planning may change with the submittal of the detailed DP required near the time of license termination.

~~10.1 Decommissioning Program~~

The plan for decommissioning is to decontaminate or remove materials from the facilities promptly after cessation of ACP operations. Decommissioning planning begins by incorporating special design features into the plant. These features simplify dismantling and decontamination. The plans are implemented through proper management of Radiation Protection and Industrial Health and Safety programs for the ACP. Decommissioning policies address radioactive waste management, physical security, and nuclear material control and accountability.

10.2.1.~~1~~ Decommissioning Design Features

Specific features are incorporated into the plant design to accommodate decontamination and decommissioning activities. The major features are described below.

10.2.1.1.~~1~~ Radioactive Contamination Control

The following features primarily serve to minimize the spread of radioactive contamination during operation, and simplify the eventual plant decommissioning. As a result, worker exposure to radiation and radioactive waste volumes are maintained as low as reasonably achievable (ALARA).

- Areas of the plant are sectioned off into clean areas and potentially contaminated areas, called Contamination Control Zones (CCZs) that have access control requirements. CCZs are buffer zones established where discrete areas of contamination might be occasionally encountered. Areas that are contaminated are called Contamination Areas (CAs). Figure 10.2.1-1 (located in Appendix B of this license application) provides a diagram showing the CCZ boundary. Procedures for these areas are encompassed by the Radiation Protection Program~~,~~ and serve to minimize the spread of contamination and simplify eventual decommissioning.

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

10.2.1.~~1~~.2 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.

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

- Connections in the process systems are provided for thorough purging. This removes a significant portion of radioactive contamination prior to disassembly.
- Design drawings prepared for the plant, simplify the planning and implementing of decontamination procedures.
- Worker access to contaminated areas is controlled to assure that workers wear proper protective equipment and limit their time in the areas.

The information within this figure has been determined to contain Export Controlled Information and is located in Appendix B of this license application

Figure 10.2.1-1 Commercial ACP Contamination Control Zone

10.2.2 Decommissioning Steps

Decommissioning may begin immediately following termination of operation, since only low radiation levels exist at this plant. Overall, the decommissioning is estimated to require approximately six years from plant shutdown to completion of the final status survey of radiological conditions. The order of activities to support decommissioning will generally be: planning and preparation; process system purging; equipment dismantling and removal; decontamination; disposition of equipment and material (including classified items); disposal of wastes; completion of a final status survey. The following sections provide an overview and explanation of each of these steps.

10.2.2.1 Overview

The intent of decommissioning is to return the ACP to an unrestricted use state. Removed equipment includes the centrifuges, the feed and withdrawal equipment, piping and components from systems providing UF_6 containment, systems in direct support of the centrifuges (e.g., cooling water), radioactive and hazardous waste handling systems, contaminated air filtration systems, etc. The remaining plant infrastructure includes utility services such as electrical power supply, sanitary water, fire suppression, ventilation, communications, and sewage treatment.

Decontamination of the plant will not require the installation of a new facility dedicated for that purpose since the X-7725 ~~facility~~ building will serve as the DSA and will accommodate repetitive equipment decontamination of centrifuges and other components. The DSA is described in Section 10.2.8.1 of this license application and will be the location for decontamination activities.

Although certain unclassified components may be reused or sold as scrap, for conservatism this plan assumes only that components will be decontaminated in accordance with radiation protection requirements. Classified parts will be dispositioned in accordance with an approved~~the~~ Security Plan~~Program~~. Table 10.2.2-1 of this license application lists components for potential decontamination at decommissioning.

The Licensee intends to evaluate possible commercial uses of UF_6 tails. UF_6 tails which are not commercially reused will be converted to a stable form and disposed of in accordance with the *USEC Privatization Act* and other applicable statutory authorizations and requirements at DOE's UF_6 conversion facilities and/or other licensed facilities. UF_6 tails are stored in steel cylinders until the tails material can be processed in accordance with the disposal strategy established by the Licensee. The Licensee provides financial assurance to fund the estimated cost of conversion and disposal of the depleted uranium inventory as it is generated during operation. This funding is described in the DFP and is in addition to the funding requirements for decommissioning the ACP. At full capacity, the ACP will generate approximately 8,400 Metric Ton (MT) of UF_6 tails annually. Over the 30-year license, that is a total of approximately 214,400 MT of UF_6 tails, as noted in Table C3.19 of the DFP. Depending on technological developments and the existence of facilities available prior to ACP shutdown, the tails may have commercial value and may be marketable for further enrichment or other processes. However, funding provisions are made to dispose of the tails should that become necessary.

Contaminated portions of the buildings will be decontaminated. Structural contamination is expected to be limited to the areas indicated on Figure 10.2.1-1 (located in Appendix B) inside the CCZ of the plant. The remainder of the ACP is not expected to require decontamination. Good housekeeping practices during normal operation and cleanup activities following spills or contamination events will maintain these other areas contamination free. Decontamination activities will continue until facilities satisfy the specified radiological criteria.

10.2.2.2 Purging

At the end of useful operation, the ACP is shut down and UF_6 material is removed to the fullest extent possible by normal process operation. This is followed by evacuation and purging of process systems. This shutdown and purging portion of the decommissioning process is estimated to take approximately three months.

10.2.2.3 Dismantling and Removal

Dismantling is the process of unbolting, disconnecting, cutting, etc., of components requiring removal. The dismantling and removal activities are simple but labor intensive. They generally require the use of protective equipment. The work process will be optimized, considering the following:

- Minimize spread of contamination and the need for protective equipment;
- Balance the number of cutting and removal operations with the resultant decontamination and disposal requirements;
- Optimize the rate of dismantling with the rate of decontamination plant throughput;
- Provide storage and laydown space required, as impacted by retrievability, criticality safety, security, etc.; and
- Balance the cost of decontamination with the cost of disposal.

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

10.2.2.4 Decontamination

The decontamination process is addressed separately in Section 10.2.8 of this chapter. The decommissioning estimated costs are based on decontaminating the plant to the radiological criteria for unrestricted use in 10 CFR 20.1402.

10.2.2.5 Salvage and Sale

Items to be removed from the facilities can be categorized as potentially re-usable equipment (whether contaminated or decontaminated), recoverable decontaminated scrap, and wastes. Based on a 30-year plant operating life, operating equipment is not assumed to have a significant reuse value. Uranium-bearing equipment that remains in the plant will be treated and disposed of appropriately. Smaller amounts of steel, copper, and other metals can be recovered and sold at market price. However, for conservatism, no credit is taken for salvage value in the DFP.

Other items are considered waste. Wastes have no salvage value.

10.2.2.6 Disposal

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 low-level mixed (LLMW) and radioactive (LLRW) wastes. The radioactive waste will primarily be 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 76,388 cubic feet of compacted radioactive waste will be generated during the decommissioning operation. This waste may be subject to further volume reduction prior to disposal.

Radioactive wastes (both LLRW and LLMW) will ultimately be disposed of in licensed low-level radioactive waste disposal facilities (this includes radioactive source and byproduct material sources). 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 applicable regulations. A more complete estimate of the wastes and effluent to be produced during decommissioning will be provided in the DP to be submitted at or about the time of license termination.

The ultimate disposal of UF_6 tails remains to be determined between potential commercial uses or processing at the DOE UF_6 conversion facility in Piketon, Ohio. However, for conservatism, the Licensee provides financial assurance to fund the estimated cost of conversion and disposal of the depleted uranium inventory. This funding is described in the DFP and is in addition to the funding requirements for decommissioning the ACP. Classified components and documents will be disposed of in accordance with the requirements of the *Security ~~Program~~ Plan for the Protection of Classified Matter ~~for~~ at the American Centrifuge Plant*.

10.2.2.7 Final Status Survey

A final status survey of the radiological conditions of the plant is performed to verify proper decontamination. The evaluation of the final radiation survey is based, in part, on an initial radiation survey performed prior to operation. The initial survey determines the background radiation of the area; providing a datum for measurements that determine any increase in levels of radioactivity.

The final status survey will systematically take measurements and perform sampling to describe radioactivity over the ACP. The intensity of the survey will vary depending on the location (i.e., the buildings, the immediate area around the buildings, the controlled fenced area, and the remainder of the site). The survey procedures and results will be documented in a report. The results of the report will become part of the application to terminate the license. The format and content of the report will follow current NRC guidance (Section 4.5 of ~~Reference 3~~Volume 2 of NUREG-1757).

Table 10.2.2-1 Components for Potential Decontamination/Disposal at Decommissioning

Components	Description [units]	Estimated Quantity
Centrifuges [1, 2]	Internals: Rotor Assemblies, Motors, Suspensions and Mounts (Classified)	12,000
Service Modules [2]	Structural Components	0
Piping	Less than 1 in. Process Piping length (Lft) Includes Tubing [3]	0
	1-16 in. Process Piping length (Lft)	271,840
Blowers	Feed/Withdrawal Exhaust Blowers	2
Pumps	Vacuum (Evacuation/Purge); RHW Pumps	119
Ventilation	Ductwork; Miscellaneous WISP Ducting (ft^3) [3]	3,677
Surfaces	Building Floors, Yards, Equipment (ft^2) [4]	2,494,819
Valves	Process valves and MIVs (excluding Sheetmetal)	18,631
	Miscellaneous valves	1,385
Sources	Source and byproduct material sources used at the Lead Cascade	11
Process Equipment	Feed Ovens, Autoclaves, Cold Boxes	91
Cranes	Ridge Mast (RMC), Bridge, Wall and Jib Cranes; Cylinder Transporters, Trolleys	29
Scales	Process Weighing Equipment	12
Compressors	Process Gas Compressors	4
Heat Exchangers (HX)	Machine Cooling Water HX, Freezer/Sublimers, Tails Coolers	36
Traps	Chemical traps (8 banks of 4), Cold Traps, Roughing Filters, Miscellaneous Traps	71
Tanks (UF_6)	Holdup, Surge, and Dump Tanks	3
Upender	Trailer Upender (X-7725)(ft^3)	3
Cylinders	Tails – 48G/48X (14, 10 Ton)	17,191
Cylinders	Product and Feed (2.5 Ton) Gas Test Area (12B)	450
Other Equipment	UF_6 Portable Carts; Buffer Storage Stands; Mass Spectrometers; Contaminant Monitors; Miscellaneous Platforms; and Gas Test Stand Center (GTC) Stand Structures	69

Note 1: Amount includes 11,520 operational units plus 480 contaminated spare centrifuges.

Note 2: Centrifuge casings and service module structural steel is not considered waste. These items are to be removed, disassembled, decontaminated to NRC 'Free Release' criteria, and stored for later disposition.

Note 3: Piping <1" (assumed to be instrument piping/tubing), ventilation ductwork, and heat exchangers are assumed to not be internally contaminated. Therefore, these components can be externally decontaminated and remain as part of the building Balance of Plant.

Note 4: Amount of wall area (ft^2) not provided, because it is not anticipated to need decontamination at the time of decommissioning.

Note 5: Equipment re-utilized from operational phase (not new or purchased).

Note 6: Equipment procured (see Table C3.15 of the Decommissioning Funding Plan for the ACP).

Components	Description [units]	Estimated Quantity
Decontamination Equipment	Centrifuge Transporter[5]	2
	Cranes (Process Area - RMC)[5]	8
	Cranes, Bridge X-7725[5]	2
	Centrifuge Mobile Equipment[5]	4
	Centrifuge Dismantling Equipment (6/X-7725 and 2/X-7726 Assembly Stands)[6]	8
	Cutting Machines[6]	2
	Degreasers[6]	2
	Decontamination Tanks[6]	4
	Wet Blast Cabinets[6]	2
	Crusher[6]	1

10.2.3 Management/Organization

Management of the decommissioning program will assure proper training and procedures are provided to assure worker health and safety. The programs will focus on minimizing waste volumes and worker exposure to hazardous or radioactive materials. Qualified contractors assisting with decommissioning will be subject to ACP security and training requirements, and procedural controls.

10.2.4 Health and Safety

Consistent with the policy during ACP operation, the policy during decommissioning is to keep individual and collective occupational radiation exposure with the ALARA principle. A Radiation Protection Program will identify and control sources of radiation, establish worker protection requirements and direct the use of survey and monitoring instruments.

10.2.5 Waste Management

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

10.2.6 Security and Nuclear Material Control

Requirements for physical security and for nuclear material control and accountability will be maintained during decommissioning in a manner similar to the programs in force during ACP operation. This includes requirements for control of classified information and classified equipment described in the *Security Plan for the Protection of Classified Matter ~~Program for~~ at the American Centrifuge Plant* and the requirements for control of nuclear materials in the *Fundamental Nuclear Material Control Plan for the American Centrifuge Plant*. The DP is submitted near the end of plant life and will provide a description of revisions to these programs.

10.2.7 Record Keeping

Records important for safe and effective decommissioning of the ACP are maintained in accordance with established Records Management and Document Control procedural requirements. Information maintained in these records include:

- Records of spills or other unusual occurrences involving the spread of contamination in and around the plant, equipment, or site. Records of spills or other unusual occurrences may be limited only 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 radionuclides, quantities, forms, and concentrations;

- As-built drawings and modifications of structures and equipment in areas where radioactive materials are used and/or stored, including locations that possibly could be inaccessible (e.g., buried pipes which may be subject to contamination); and

- A list contained in a single document that is updated every two years of the following:

  - Areas designated and formerly designated as restricted areas as defined under 10 CFR 20.1003.

  - Areas outside of restricted areas that require documentation under 10 CFR 70.25(g)(1).

  - Areas outside of restricted areas where current and previous wastes have been buried as documented under 10 CFR 20.2108.

  - 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 Part 20, Subpart E or would apply for NRC approval for disposal under 10 CFR 20.2002.

- Records of the cost estimate performed for the DFP, and records of the funding method used for assuring funds, including a copy of the financial assurance mechanism and any supporting documentation.

10.2.8 Decontamination

The DSA, the general procedures used to decontaminate, and the expected results of decontamination are described in the paragraphs below. Table 10.2.2-1 lists the major components and structures that may need to be decontaminated to some extent at the plant. Other components and structure will generally not require any decontamination. The Licensee anticipates low amounts and areas of actual contamination due to strict adherence to ALARA principles throughout the plant's life.

There are two general methods of decontamination, which may be used to decontaminate the ACP: dry and wet. Dry involves using an always safe vacuum cleaner (vacuuming), scooping up the material with a dust pan (low abrasive materials), sweeping material up with a brush or broom, or high abrasive (chipping or wire brush). Wet decontamination involves using films of cleaning solutions with mops, squeegees, rags, or dip tanks. Although wet decontamination or a dry decontamination variation, such as dry ice blasting, may be utilized for decontamination of the ACP, these methods are not anticipated to be utilized to a significant extent, and, therefore, are not included in the DFP estimate. For decontamination and decommissioning of the ACP and establishing the associated funding, it is assumed that a dry decontamination process is utilized throughout. The actual decontamination method or methods to be utilized to decontaminate and decommission the ACP will be established based upon the site characterization survey performed during the decommissioning planning and preparation phase and will be described in the Decommissioning Plan.

The DFP estimate does consider scarifying, to a 1/8-inch depth, the cylinder yard areas in their entirety as a conservative action. Any time surfaces are disturbed, such as with scarifying concrete, there is a potential to produce airborne radioactivity. To mitigate these concerns, airborne monitoring for the personnel performing the work would be provided, these individuals would be included in the internal monitoring program (urinalysis), and if the conditions exist, respiratory protection may be required. Furthermore, scarifying equipment may use a water spray to minimize dust, cool the cutting wheels, or use a limited amount of water as a media, but this is not considered to be a liquid waste as it is anticipated to evaporate to leave a dry debris for solid waste disposal.

10.2.8.1 Decontamination Service Area

The centrifuge assembly area within X-7725 ~~facility~~ building is identified as the DSA. The centrifuge ~~machine~~ transport system would be used to transport the centrifuges ~~machines~~ from the process buildings to the DSA. The DSA handles centrifuges, feed, withdrawal, sampling and transfer equipment to be disassembled and dispositioned along with the UF_6 vacuum pumps, valves, piping, and other miscellaneous equipment. Unusable material will be destroyed. The DSA will have four functional areas: disassembly area, buffer stock area, decontamination area, and scrap storage area. Equipment in the decontamination area may include:

- Transport and manipulation equipment
- Dismantling area
- Cutting machines
- Dismantling boxes and tanks (e.g., B-25 boxes)
- Degreasers

- Citric acid and demineralized water baths
- Contamination monitors
- Wet blast cabinets
- Crushers or size reduction equipment
- Shredding equipment
- Scrubbing facility

There is no normal operational need for the ACP to have a decontamination facility readily available.

10.2.8.2 Procedures

Procedures for decontamination 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. At the end of useful plant life, some of the equipment, most of the buildings, and the outdoor areas should already be acceptable for release for unrestricted use in accordance with 10 CFR 20.1402. If these areas were inadvertently contaminated during ACP operation, they would likely be cleaned up when the contamination is discovered. This limits the scope of necessary decontamination at the time of decommissioning.

The centrifuges will be processed and 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; and
- Destruction of classified parts by shredding, crushing, burial, etc.

10.2.8.3 Results

Recoverable items will be externally decontaminated and suitable for reuse except for a very small amount of internally contaminated items where recovery and reuse is not feasible. There is potentially a small amount of salvageable scrap material. Material requiring disposal will be process piping, trash, and residue from the effluent treatment systems. No problems are anticipated which will prevent the facilities from being released for unrestricted use.

10.2.9 Agreements with Outside Organizations

The decommissioning activities described herein and in the DFP provide for decontamination of the ACP for unrestricted use. As such, no agreements with outside organizations are required for control of access to the plant following shutdown and decommissioning.

10.2.10 Arrangements for Funding

This section provides a general estimate of plant decommissioning costs and UF_6 tails disposition costs, as well as explains the arrangements made to assure funding is available to cover these costs. A more detailed description of these costs and the financial assurance mechanism is provided in the DFP.

10.2.10.1 Plant Decommissioning Costs

Table 10.2.10-1, provides a summary of the cost estimates of the major decommissioning activities described in Section 10.2.2. Costs are provided in 2008 dollars with a 25 percent contingency factor added based on the NRC guidance (~~Reference 4~~Volume 3 of NUREG-1757). As noted below, the total estimated cost to decommission the 3.8 million SWU ACP, excluding UF_6 tails disposition, is $377.3 million. Since costs will likely change between the time of license issuance and actual decommissioning, the Licensee will adjust the cost estimate annually prior to operation of the facility at full capacity, and after full capacity is reached, no less frequently than every three years consistent with the requirements of 10 CFR 70.25(e) and recent NRC changes to financial assurance requirements for materials licensees (~~Reference 8~~Federal Register, Volume 192). The method for adjusting the cost estimate will consider the following:

- Changes in general inflation (e.g., labor rates, consumer price index);
- Changes in price of goods (e.g., packing materials);
- Changes in price of services (e.g., shipping and disposal costs);
- Changes in plant condition or operations; and
- Changes in decommissioning procedures or regulations.

These costs are estimated as explained below:

Planning and Preparation: $3.3 million

Scope to be completed in one year and includes developing and submitting a detailed DP as a license amendment for NRC review and approval. Activities anticipated during this phase include:

- Develop Project Execution Plan and Schedule (including the organization and staffing plan and needed services);

- Develop and submit the Decommissioning Plan;
- Develop/implement Site Characterization Plan;
- Review/approve Site Decommissioning Plan by the NRC;
- Develop Decommissioning Activity Procedures; and
- Design Decommissioning Service Area (DSA).

Decontamination and/or Dismantling of Radioactive Facilities: $51.5 million

This is based upon utilizing salary and hourly workers at their respective average cost over a five-year duration. For conservatism, decommissioning estimated costs are based on decontaminating the plant to the radiological criteria for unrestricted use in 10 CFR 20.1402. Activities anticipated during this phase include:

- Prepare the decontamination Service Area;
- Internal decontamination of facilities;
- Dismantle centrifuges ~~machines~~ to include waste segregation and staging;
- Dismantle facilities and components; and
- Tails cylinder movement/disposition to include material title transfer to DOE.

Restoration of Contaminated Areas On Plant Grounds: $0.9 million

This is based upon utilizing salary and hourly workers at their respective current average cost distribution over a two-year duration. This assumes the contamination of the plant grounds from the ACP operations will be minimal. Activities anticipated during this phase include:

- External decontamination of facilities;
- Perform Health Physics surveys;
- Scarify cylinder storage yard surfaces; and
- Collect/dispose of yard debris.

Final Status Survey: $1.6 million

This is based upon utilizing salary technicians at their current average cost distribution for a period of 2.5 years. Costs do not include any NRC confirmatory surveys to verify the results of the Final Status Survey. Activities anticipated during this phase include:

- Develop/implement survey plans;
- Collect/analyze data;
- Perform confirmatory surveys;
- Develop final survey report; and
- Prepare License Amendment to terminate the license.

Site Stabilization and Long-Term Surveillance: $3.0 million

As previously stated, the intent of decommissioning is to return the plant to the radiological criteria for unrestricted use. To accomplish this activity, stabilization and surveillance is required due to the number of components involved and the duration of the decommissioning effort. This scope of work occurs throughout the six year decommissioning period and involves maintenance and surveillance activities on IROFS, as required, until the license is terminated.

Packing Materials, Shipping, and Waste Disposal: $61.6 million

This is based upon shipping and disposal of the internals for 12,000 centrifuges ~~machines~~ (which includes operating ~~machines~~ centrifuges as well as contaminated spares), feed and withdrawal equipment, and other components totaling approximately 76,388 cubic feet of solid waste, 16,225 gallons of liquid waste from the centrifuge internals and 1,728,000 cubic feet of classified waste in non-reusable packaging.

Equipment and Supply: $19.6 million

This includes the purchase or lease of dismantling, cutting, degreasing, and crushing equipment; decontamination tanks, wet blast cabinets, and over 20,000 containers (i.e., B-25 boxes and 55 gallon drums).

Laboratory: $1.5 million

This includes labor costs for sampling, transport, testing, and analysis of samples.

Indirect Services: $71.9 million

This includes support services (such as laundry, janitorial, etc.) and infrastructure costs (such as water, power, etc.) not included in other tasks.

Miscellaneous: $41.6 million

This includes direct costs of $2.9 million for miscellaneous material for decommissioning and $38.7 million for indirect costs, such as NRC review fees for the submitted DP, license fees, DOE lease fees, and business insurance.

Subtotal	**$256.5 million**
General and Administrative (6 percent)	**$15.4 million**
Contractor Profit (15 percent)[1]	**$29.9 million**
Contingency (25 percent)	**$75.5 million**
Total Plant Decommissioning Cost Estimate	**$377.3 million**

[1] Contractor Profit = 0.15[Subtotal + General and Administrative - Other Indirect Costs (excluding insurance) – Outside Services portion of the Packaging, Shipping, and Waste Disposal Costs]

10.2.10.2 UF_6 Tails Disposition Costs

Cost estimates to dispose of UF_6 tails generated during ACP operation are separate from the cost estimates to decommission the plant. As noted previously, the ultimate disposal of UF_6 tails remains to be determined. The Licensee intends to evaluate possible commercial uses of UF_6 tails before having the tails processed by the DOE UF_6 conversion facility in Piketon, Ohio. UF_6 tails are stored in steel cylinders until they can be processed in accordance with the disposal strategy established by the Licensee. Depending on technological developments and the existence of facilities available prior to ACP shutdown, the tails may have commercial value and may be marketable for further enrichment or other processes. However, for the purposes of calculating the UF_6 tails disposition cost, the Licensee assumes that the total quantity of tails generated during ACP operation are processed by the DOE UF_6 conversion facility in Piketon, Ohio.

For conservatism, the Licensee provides financial assurance to fund the estimated cost of conversion and disposal of the depleted uranium inventory as it is generated during ACP operation. This funding is described in the DFP and is in addition to the funding requirements for decommissioning the ACP. As with plant decommissioning, the cost estimate will likely change between the time of license issuance and actual decommissioning. The Licensee commits to adjust the cost estimate for tails disposal annually. The method for adjusting the cost estimate will consider the same factors as previously described in Section 10.2.10.1 of this chapter.

At full capacity, the ACP will generate approximately 8,400 MT of UF_6 tails annually. As with other decommissioning costs, the disposal cost estimate for UF_6 tails disposal is provided in 2008 dollars. Consistent with the recommendation in the NRC's guidance on decommissioning (Section A.3.1.2.3 of Volume 3 of NUREG-1757Reference 4), a 25 percent contingency factor is applied to the tails disposal cost estimate. The total estimated cost to dispose of UF_6 tails over the 30-year license, including a four-year ramp up to full capacity and the 25 percent contingency factor, is $896.9 million. The basis for this estimate is provided in the DFP.

10.2.10.3 Total Decommissioning Liability

The Licensee's total decommissioning liability is the sum of the total plant decommissioning costs and the tails disposition costs. The Licensee's total liability for decommissioning the ACP, including applicable contingencies, is:

Plant Decommissioning Cost	$ 377.3 million
UF_6 Tails Disposition Cost	$ 896.9 million
Total Decommissioning Liability	$1,274.2 million

10.2.10.4 Funding Arrangements

Per the exemption request in Section 1.2.5 of this license application, the financial assurance for a portion of the decommissioning costs to include disposition of centrifuges ~~machines~~ and UF_6 tails will be provided incrementally as centrifuges are built/installed and UF_6 tails generated. The modular aspect of the American Centrifuge technology allows enrichment operations to begin well before the full capacity of the plant is reached. Thus, the decommissioning liability for centrifuges ~~machines~~ and UF_6 tails is incurred incrementally as more centrifuges ~~machines~~, and associated equipment, are added to the process, until such time as full capacity of the facility (i.e., 3.8 million SWU) is achieved. Once full capacity of the facility is achieved, the UF_6 tails are generated at a relatively constant rate throughout the life of the plant.

Full funding for decommissioning of the facilities will be provided in the initial executed financial assurance instrument. To ensure adequate financial assurance is in place as centrifuges ~~machines~~, and associated equipment, are added to the process and placed into operation, the Licensee will forecast and update the cost estimates and provide a revised funding instrument to NRC annually to cover the upcoming year of operation. This incremental funding approach will be utilized until operation at full capacity. Once full capacity of the facility is achieved, the Licensee will annually adjust the cost estimate for UF_6 tails disposal and all other decommissioning costs will be adjusted periodically, and no less frequently than every three years. In this way, financial assurance will be made available as the decommissioning liability is incurred. This exemption is justified based on the unique modularity aspects of centrifuge technology that allow enrichment operations to begin well before the full capacity of the plant is reached. In addition, the NRC has accepted an incremental approach to funding disposal cost of tails for the ~~G~~gaseous ~~D~~diffusion ~~P~~plants. Financial assurance will be provided in the form of a surety method or other guarantee method as required by 10 CFR 70.25(f). The selected guarantee method is described in the DFP, included as part of this license application. In the DFP, methods are described for periodic adjustments in the cost estimate and resulting necessary adjustments to the funding method.

10.3~~11~~ References

1. *Appendix 1 Lease Agreement between the U.S. Department of Energy and United States Enrichment Corporation for the Gas Centrifuge Enrichment Plant* (GCEP Lease Agreement), Amendment dated May 31, 2019

2. Federal Register, Volume 68 Number 192, *Financial Assurance for Materials Licensees*, Final Rule, October 3, 2003

3. HALEU Demonstration Contract Number 89303519CNE000005, awarded May 31, 2019 and definitized on October 31, 2019

~~1.~~ 4. NUREG-1520, *Standard Review Plan for ~~the Review of a License Application for a~~ Fuel Cycle Facilities~~y~~, License Applications,* Revision 2~~March 2002~~

~~2.~~ 5. NUREG-1757, Consolidated ~~NMSS~~ Decommissioning Guidance, Volume 1, ~~Revision 1~~, *Decommissioning Process for Materials Licensees,* Revision 2~~Final Report, September 2003.~~

~~3.~~ 6. NUREG-1757, Consolidated ~~NMSS~~ Decommissioning Guidance, Volume 2, *Characterization, Survey, and Determination of Radiological~~egulation~~ Criteria,* Revision 1~~Final Report, September 2003~~

~~4.~~ 7. NUREG-1757, Consolidated ~~NMSS~~ Decommissioning Guidance, Volume 3, *Financial Assurance, Recordkeeping, and Timeliness,* Revision 1~~Final Report, September 2003~~

~~5. NR-3605-0004, *Security Program for the American Centrifuge Plant*~~

~~6.~~ 8. NR-3605-0005, *Fundamental Nuclear Material Control Plan for the American Centrifuge Plant*

~~7.~~ 9. NR-3605-0006, *Decommissioning Funding Plan for the American Centrifuge Plant*

~~8.~~ 10. SP-3605-0041, *Security Plan for the Protection of Classified Matter at the American Centrifuge Plant*

11. W. Brown (DOE) letter to Mr. Phil Sewell (USEC), *Conversion and Disposal of Depleted Uranium Hexafluoride (DUF6) Generated by USEC at the American Centrifuge Plant in Piketon, Ohio*, dated February 10, 2006

~~9. Federal Register, Volume 68 Number 192, *Financial Assurance for Materials Licensees*, Final Rule, October 3, 2003~~

Table 10.2.10-1 Plant Decommissioning Cost Estimates and Expected Duration

Task/Item	Cost Estimate (Millions, 2008 dollars)	Approx. Percentage
Planning and Preparation	$3.3	1%
Decontamination and/or Dismantling of Radioactive Facilities	$51.5	20%
Restoration of Contaminated Areas On Plant Grounds	$0.9	1%
Final Status Survey	$1.6	1%
Site Stabilization and Long-Term Surveillance	$3.0	1%
Packing Materials, Shipping, and Waste Disposal	$61.6	24%
Equipment and Supply	$19.6	8%
Laboratory	$1.5	1%
Indirect Services	$71.9	28%
Miscellaneous	$41.6	16%
Subtotal	$256.5	100%
General and Administrative (6%)	15.4	
Contractor Profit (15%)	29.9	
Contingency (25%)	$75.5	
Total Plant Decommissioning Cost	**$377.3**	
UF_6 Tails Disposal Costs **UF_6 Tails Contingency (25%)**	**$717.6** **$179.4**	
Total UF_6 Tails Disposition Cost	**$896.9**	
Total Decommissioning Liability	**$1,274.2**	

11.0 MANAGEMENT MEASURES

Management measures are functions that are applied to items relied on for safety (IROFS) to provide reasonable assurance that the IROFS are available and reliable to perform their functions when needed. The phrase "available and reliable," as used in 10 *Code of Federal Regulations* (CFR) Part 70, means that, based on the analyzed, credible conditions in the Integrated Safety Analysis (ISA), IROFS will perform their intended safety function when needed to prevent accidents or mitigate the consequences of accidents to an acceptable level. Management measures are implemented to provide reasonable assurance of compliance with the performance requirements, considering factors such as necessary maintenance, operating limits, common-cause failures, and the likelihood and consequences of failure or degradation of the IROFS and the measures. This chapter addresses each of the management measures included in the 10 CFR Part 70 definition of management measures, i.e., configuration management (CM), maintenance, training and qualifications, procedures, audits and assessments, incident investigations, records management, and other quality assurance (QA) elements. Management measures are applied in a graded approach. The degree to which management measures are applied to the IROFS is a function of the item's importance in terms of meeting the performance requirements as evaluated in the ISA. The Licensee will periodically review IROFS per the requirements of 10 CFR 70.62(a)(3) to ensure their availability, reliability, and have not changed. As the final design is developed for the American Centrifuge Plant (ACP), the management system and design approach will require that the final designs be reviewed against the ISA to ensure the ISA is bounding.

As discussed in Section 1.1.8 of this license application, American Centrifuge Operating, LLC's (ACO) long-term goal is to resume commercial enrichment production consistent with market demand. The ACP design is modular, with the basic building block of enrichment capacity being a cascade of centrifuges. Modular deployment would accommodate market demand on a scalable, economical gradation. As such, the Management Measures will be implemented to support the modular deployment.

The next phase of enrichment production includes the deployment of a cascade of 16 centrifuges to demonstrate production of high-assay, low-enriched uranium (HALEU) fuel for advanced reactors. The primary building/facilities directly involved in HALEU Demonstration are the X-3001 Process Building, X-3012 Process Support Building, X-7725 Recycle/Assembly Building, X-7726 Centrifuge Training and Test Facility, and X-7727H Interplant Transfer Corridor. The Licensee will notify NRC well in advance of the transition into any future phases of ACP deployment. For further plant and process specifics related to the HALEU Demonstration Program, refer to LA-3605-0003A, *Addendum 1 of the ISA for the American Centrifuge Plant – HALEU Demonstration.*

The general use of the term ACP in the remainder of this chapter is intended to refer to both the commercial ACP operation and the HALEU Demonstration. HALEU Demonstration will be specifically noted, as necessary, when the context is uniquely applicable to HALEU Demonstration.

11.1 Configuration Management

The Configuration Management (CM) Program for the American Centrifuge Plant (ACP) is described in the following paragraphs.

11.1.1 Configuration Management Policy

In accordance with 10 CFR 70.72, a CM Program is implemented to ensure that changes from the plant baseline configuration are identified and controlled to help ensure safety through consistency among the plant design and operational requirements, the physical configuration, and the plant documentation. The CM Program includes:

- Identification and documentation of IROFS;
- Organizational descriptions of duties and responsibilities; and
- Administrative controls, procedures and policies, to implement and document activities that maintain the plant's configuration.

The goal of the CM program is to ensure that the ACP has accurate, current documentation that matches the plant's physical/functional/operational configuration, while complying with applicable requirements.

11.1.1.1 Program Overview

The Piketon Engineering Manager has primary responsibility for the implementation of the CM Program for the ACP. The CM Program is applicable to the plant, structures, processes, systems, equipment, components, computer programs, and activities of personnel, regardless of the item's Quality Level (QL) classification.

CM Program procedures provide for a graded application of resources taking into consideration:

- QL (risk significance);
- Applicable regulations, industry codes, and standards;
- Complexity or uniqueness of an item or activity and the environment in which it has to function;
- Quality history of the item in service;
- Degree to which functional compliance can be demonstrated or assessed by test, inspection, or maintenance methods;

- Anticipated life span;
- Degree of standardization;
- Importance of data generated;
- Reproducibility of results; and
- Consequence of failure.

QLs are established in accordance with their importance to safety as follows:

Level Criteria

QL-1 A single IROFS that prevents or mitigates a high consequence event.

QL-2 Two or more IROFS that prevent or mitigate a high consequence event; or one or more IROFS that prevents or mitigates an intermediate consequence event.

QL-3 Any item other than QL-1 and QL-2.

The CM Program implementing procedures provide a management system to evaluate, implement and track each change to the plant, structures, processes, systems, equipment, components, computer programs, and activities of personnel. Procedures are utilized to ensure that the following items are addressed, in accordance with 10 CFR 70.72(a)(1) through (6), prior to implementing any change:

- The technical basis for the change;
- Impact of the change on safety and health or control of licensed material;
- Revisions, if required, to existing operating procedures, including any necessary training or retraining before operation;
- Authorization requirements for the change;
- For temporary changes, the approved duration (i.e., expiration date) of the change; and
- The impacts or modifications to the ISA, ISA Summary, Addendum 1 of the ISA Summary for the ACP – HALEU Demonstration, or other safety program information that is part of this application.

11.1.1.2 Key Program Responsibilities

The following responsibilities are identified by the responsible ACP manager and functional area:

11.1.1.2.1 Piketon Engineering Manager

- Manages and maintains the CM Program.
- The Design Authority (DA) resides with the Director, Engineering and is delegated to the Piketon Engineering Manager.~~Is the delegated Design Authority (DA)~~ The DA is responsible for:
  - Establishing the design requirements
  - Ensuring design output information (documents and data) appropriately and accurately reflects the design input
- Performs and approves design/modification processes that implement the design control and design change control requirements established in the Quality Assurance Program Description (QAPD) for the American Centrifuge Plant, which includes controls for design bases, inputs, ~~design~~ verification (including analysis software), ~~design~~ changes, ~~design~~ interfaces and ~~design~~ documentation and records.
- Develops Integrated Systems and Test Plans (ISTPs).
- Manages the Temporary Change Process.
- Performs reviews of facility changes in accordance with the requirements of 10 CFR 70.72.
- Establishes inspection and acceptance criteria for IROFS.
- Ensures that appropriate documents and procedures are updated to be consistent with modifications.
- Issues the documentation that defines boundaries for IROFS in the CM Program.
- Establishes and maintains a controlled database for IROFS information.
- Assists in work package preparation and identification of post-maintenance test requirements to assure that the critical design characteristics of IROFS are satisfied.

11.1.1.2.2 Director, Nuclear Safety

- Maintaining the plant's ISA~~, and~~ ISA Summary, and Addendum 1 of the ISA Summary for the ACP – HALEU Demonstration.

- Identifies and defines IROFS as part of the ISA process.

11.1.1.2.3 Procurement Manager

- Develops procedures in accordance with the QAPD for procurement and control of items.
- Purchases IROFS and replacement parts only from authorized vendors and in accordance with the requirements and technical specifications as identified by the Engineering organization.

11.1.1.2.4 Operations Manager

- Ensures modifications are not made to a design or operational configuration without proper review and approval.
- Assists in pre-operational tests/checks, operational, post maintenance tests/checks and post-modification tests are performed and documented to assure IROFS are operating as intended.
- Ensures work requests or other authorizations are issued prior to maintenance, testing, or modification activities.
- Ensures the occurrence of tests, calibrations, and maintenance activities are recorded.
- Ensures approved procedures are used for operations involving the replacement or adjustment of IROFS.

11.1.1.2.5 Maintenance Work Center Supervisor

- Develops and implements procedures to execute a work control process which provides for:
  - Verification of data, performance or documentation where specified by the DA; and
  - Documentation of material used to ensure design specifications are met.
- Ensures maintenance personnel are knowledgeable of requirements for working on IROFS.
- Performs work on IROFS only after receiving issuance of an approved maintenance work package.
- Ensures modifications are not made to a design or operational configuration without proper review and approval.

- Identifies and transmits completed work packages for IROFS to Records Management and Document Control (RMDC) in a timely manner.
- Ensures that only accepted IROFS are stored and issued for work.
- Maintains items in a manner that complies with engineering issued requirements.

Maintenance is described in Section 11.2 of this license application.

11.1.1.2.6 Training and Procedures Manager

Procedures

The Procedures process is described in Section 11.4 of this license application. A procedures control program is utilized to ensure technical, operations, maintenance, and administrative procedures used to apply the CM Program processes are properly developed, reviewed, approved, revised, and controlled.

Training

- Provides technical training support to plant personnel who are relied upon to operate, maintain, inspect, or modify IROFS.
- Provides training support to engineering, operations, and maintenance personnel to ensure training is updated as a result of changes to the plant.

Training and Qualification is described in Section 11.3 of this license application.

Records Management and Document Control

- Develops and operates a RMDC program that controls and issues designated documents and acts as the repository with retrieval capabilities for controlled documents and records necessary to maintain the plant's design history.
- Maintains an index of documents and software that are required to be controlled.

RMDC is described in Section 11.7 of this license application.

11.1.1.2.7 Piketon Quality Assurance Manager

- Assists in the development and implementation of the acceptance process to assure that the critical design characteristics are satisfied for non-commercial grade IROFS.
- Assists in the acceptance process for commercial grade IROFS.
- Verifies that DA supplied acceptance criteria are met and that accepted items are appropriately identified.

- Establishes a program for in-process inspection of maintenance work in accordance with acceptance criteria contained in maintenance procedures or provided by the DA to assure that the critical design characteristics of IROFS are satisfied.

- Conducts audits and surveillances of processes that implement the CM Program, as specified by the QAPD.

- Audits vendors and suppliers in accordance with the QAPD.

11.1.1.2.8 Integrated Systems Test/Start-up Manager

- Assists in the development of and execution of the ISTPs which demonstrate the proper operation of completed systems to ensure that the systems meet their intended design functions.

- Ensures acceptance of turnover from the Engineering, Procurement, and Construction contractors/vendors to the Licensee, initial acceptance testing, and initial start-up of equipment and support systems.

11.1.2 Design Requirements

- Design requirements are developed to support safety functions, environmental impact-oriented functions, and mission-based functions. Defense in depth practices are applied to design, to the extent practicable. This includes the preference for engineered controls over administrative controls and minimizing challenges to IROFS.

  - IROFS are identified in the ISA Summary and Addendum 1 of the ISA Summary for the ACP – HALEU Demonstration, with the emphasis for engineered controls over administrative controls when possible. Design requirements for IROFS or for other systems or components are required to meet the baseline design criteria (BDC) as defined in 10 CFR 70.64.

  - IROFS and other systems or components that support environmental impact-oriented functions and mission-based functions are identified in System Requirements Documents (SRDs).

- The design requirements to support the IROFS and other systems or components are developed by the ~~Piketon~~ Engineering organization and documented in Design Input and Output Documents written for each system, area, and/or function. Prior to approval, these documents are reviewed to determine their adequacy, accuracy, and completeness.

- Design Input Documents provide the design basis and design requirements for the ACP. The design basis and design requirements information ~~is~~ are found in the ISA Summary, Addendum 1 of the ISA Summary for the ACP – HALEU Demonstration, and SRDs.

- The DA approves Design Output Documents.

- After approval by the DA, the Design Output Documents provide the baseline configuration for the plant. Drawings and specifications are examples of Design Output Documents.
- Changes to any design basis or design requirements that modify the site, structures, processes, systems, equipment, components, computer programs, or activities of personnel are controlled by the change control process described in Section 11.1.4 of this license application.
- The Design Input and Output Documents are controlled documents. When modifications result in changes to these documents, the changes are controlled in accordance with the RMDC requirements described in Section 11.7 of this license application.

11.1.3 Document Control

Procedures, documents, and records control programs provide for centralized control and issuance of documents necessary for the maintenance of the ACP configuration and provide a repository for records to verify this maintenance. RMDC requirements are described in Section 11.7 of this license application.

11.1.3.1 Procedures

The procedure control program assures that procedures are generated, reviewed, approved, and distributed in a controlled manner. Section 11.4 of this license application describes the procedure control program.

11.1.3.2 Records Management and Document Control

A document control program ensures that changes to approved and controlled documents are:

- Issued in a timely manner;
- Distributed to controlled copy holders; and
- Maintained available to support daily work activities.

Controlled documents, in support of the CM Program, are identified in the procedures that require generation of the documents. RMDC personnel maintain an index of documents that are required to be controlled. The documents include, but are not limited to, such documents as:

- Procedures addressing activities affecting IROFS
- Design documents (e.g., drawings, analyses, and calculations)
- The IROFS database change records

- Engineering specification data sheets, which include the technical requirements, vendor data requirements, and if applicable, the commercial grade dedication requirements
- The ISA Summary, Addendum 1 of the ISA Summary for the ACP – HALEU Demonstration, and other hazard analyses
- Procedures and plans addressing emergency operating and response plans
- Records to support maintenance and verification of the plant configuration such as:
  - Design modification packages
  - Acceptance records for receipt of material, shop and field inspection of work processes supporting maintenance, repair, and testing records
  - Maintenance, repair, and modification construction and installation work packages
  - Documentation used by operations to record verification and test data

The RMDC Program is described in Section 11.7 of this license application.

11.1.4 Change Control

In accordance with 10 CFR 70.72, the Licensee may make changes to the plant, structures, processes, systems, equipment, components, computer programs, and activities of personnel, without prior U.S. Nuclear Regulatory Commission (NRC) approval, if the change:

- Does not:
  - Create new types of accident sequences that, unless mitigated or prevented, would exceed the performance requirements of 10 CFR 70.61 and that have not previously been described in the ISA Summary; or
  - Use new processes, technologies, or control systems for which the licensee has no prior experience.
- Does not remove, without at least an equivalent replacement of the safety function, an IROFS that is listed in the ISA Summary;
- Does not alter any IROFS, listed in the ISA Summary, that is the sole item preventing or mitigating an accident sequence that exceeds the performance requirements of 10 CFR 70.61; and
- Is not otherwise prohibited by 10 CFR 70.72, a license condition, or an NRC order.

In accordance with the requirements of 10 CFR 70.72, the ACP implements change control processes for changes to the physical plant and for changes to procedures and controlled documents. These processes are described in Sections 11.1.4.1 and 11.1.4.2 of this license application, respectively. The Plant Safety Review Committee reviews appropriate changes to the ACP or to ACP operations, including tests and experiments, as specified in procedures. Procedures also specify the approval authority for the changes.

11.1.4.1 Control of Changes to the Physical Plant

The ACP has implemented a change control process using written procedures to control changes to the physical plant. This change control process meets the requirements established in 10 CFR 70.72 and in the QAPD. Key elements of the change control process are described in the following paragraphs:

- Requests for engineering assistance, after initiator's management approval, are forwarded to the DA for:
  - Review to determine if the proposed change is acceptable based upon scope, applicability, justification, and/or technical merit;
  - Engineering approval; and
  - Disposition and assignment to the appropriate engineering discipline.
- Construction Project requests for plant modifications, additions, or changes have a 10 CFR 70.72 review performed to determine if the change can be made without prior NRC approval. Information utilized in the 10 CFR 70.72 review includes the following, as appropriate:
  - SRDs;
  - Drawings/specifications; and
  - Other documentation providing a project description.
- Modifications (permanent and temporary) are evaluated, as appropriate, for any required changes or additions to the plant's procedures, personnel training, testing programs, ~~or~~ the ISA Summary, or Addendum 1 of the ISA Summary for the ACP – HALEU Demonstration. Modifications are also evaluated, as appropriate, for potential radiation exposure, potential chemical exposure, and worker safety requirements and/or restrictions. Other areas of consideration in evaluating modifications may include: modification costs, similar completed modifications, QA aspects, potential equipment availability or maintainability concerns, constructability concerns, environmental considerations, and human factors. Modifications that establish new fissile material operations or affect existing fissile material operations are evaluated by nuclear criticality safety (NCS).
- Critical repair parts for IROFS are identified during the design process.

- Proposed plant changes receive an independent, technical review that considers the technical feasibility and merit of the proposed change and the identification of appropriate interfaces for inclusion in the change package (e.g., procedures, training, safety).

A final review prior to release for operation is conducted which verifies that:

- The safety analysis documentation is complete and approved
- Operational procedure changes, if required, are completed and other supporting procedure changes have been initiated
- Operational training and qualification changes, if required, have been completed
- Design changes are completed and any as-built changes are identified and approved
- Document changes, if required, are completed
- For temporary changes, the change duration is documented and the modified equipment tagged
- Post-modification testing has been successfully completed
- Appropriate approvals have been obtained

11.1.4.2 Control of Changes to Procedures and Controlled Documents

Changes to procedures and controlled documents are controlled in accordance with the programs described in Sections 11.4 and 11.7 of this license application, respectively.

11.1.5 Assessments

The CM Assessment Program systematically evaluates the development and effective implementation of the CM Program processes. It assesses the adequacy of the implementation of administrative requirements, the configuration of items, and their documentation. The CM Assessment Program includes both initial and periodic assessments. Both document assessments and physical assessments (system walk downs) are conducted periodically to confirm the adequacy of the CM function.

Initial assessments of the CM program are performed during readiness reviews of the ACP. The initial assessment provides for field verification of design requirements and design documentation, verification of procedures, and verification of training.

Periodic assessments of the CM Program are performed as part of the commitments contained in Section 11.5 of this license application and the QAPD.

Any deficiencies or recommendations for programmatic improvements are identified, documented, and addressed in accordance with the requirements established in the ACP's Corrective Action Program, described in Section 11.6 of this license application.

11.1.6 Design Verification

Many of the structures for the ACP were built by the U.S. Department of Energy (DOE) for the Gas Centrifuge Enrichment Plant program and are leased by the Licensee. Where the ACP uses existing structures, systems, or components (SSCs), the design and construction of those SSCs are verified to ensure they meet the design requirements for the ACP.

The verification process includes:

- An assessment of the SSC is conducted to compare the configuration of the SSC with original drawings, construction specifications, and procedures to the extent possible and to determine the current condition of the SSCs to the extent possible. Where appropriate, system walk-downs are performed as part of the assessment.

- The assessment results are evaluated to determine if there is a discrepancy between the installed SSC and the baseline configuration information.

- If it is determined there is a discrepancy, the necessary changes are made to correct the discrepancy.

- When it is verified that the SSC, or modified SSC, meets the design requirements, the SSC is incorporated into the baseline configuration information.

11.2 Maintenance

The Maintenance organization provides reliable and cost-effective maintenance of the ACP equipment. Maintenance programs related to corrective and preventive maintenance are established to provide a level of inspection, calibration, repair, replacement, and testing that ensures each IROFS will be available and reliable to perform its intended function.

11.2.1 Maintenance Organization and Administration

The Maintenance Organization has policies, procedures, and programs that establish requirements and standards related to maintenance of plant equipment. These policies, procedures, and programs address:

- Personnel qualification and training

- Design/work control

- Corrective maintenance

- Preventive maintenance
- Surveillance/monitoring
- Post-maintenance testing
- Control of measuring and test equipment
- Equipment/work history

These requirements and standards are established for compliance with the QA and configuration management programs. Effective implementation and control of maintenance activities are achieved through application of these standards that are periodically reviewed and assessed for compliance.

The Operations Manager is responsible for the overall coordination and management of the organization to provide safe and efficient performance during maintenance of plant equipment.

Maintenance Work Center Supervisor reports to the Operations Manager. The Maintenance Work Center Supervisor is responsible for directing the activities of the Balance of Plant Operations Shift Supervisors and of the Maintenance Shift Supervisors in the performance of preventive, predictive, and corrective maintenance to provide support on facilities and equipment, with the exception of centrifuges machines, within approved programs, processes, and procedures, and personnel training limitations. These activities may include maintenance of electrical equipment; electronic and pneumatic instrumentation and controls; computers and programmable controllers; and mechanical maintenance, such as valve, pump, and mechanical equipment repair and replacement.

Maintenance Shift Supervisors, who report to the Maintenance Work Center Supervisors, are responsible for execution of maintenance on equipment. These responsibilities include:

- Supervision of craft personnel
- Coordination with support groups
- Ensuring that maintenance activities are appropriately planned in accordance with the work control process
- Qualification of personnel assigned to perform maintenance on equipment
- Review of work practices by craft for compliance with maintenance and plant safety procedures

Craft personnel are responsible for:

- Compliance with safety procedures while performing maintenance
- Compliance with maintenance procedures while performing maintenance
- Completion of documentation related to the maintenance activity

11.2.2 Personnel Qualification and Training

The selection and qualification of personnel in the Maintenance organization is documented and implemented through procedures. Qualification requirements are established for craft maintenance positions.

Qualification requirements for craft positions are established specific to each classification. The level of knowledge of each candidate in the related field is described in Section 11.3.9 of this license application. Employees are required to successfully complete classroom and on-the-job training programs. An analysis of the responsibilities of each classification is performed to establish the content and type of training required for the position. This review considers each of the activities performed by each classification and the importance of that activity to safe operation of the ACP and maintenance of IROFS. Consideration is also given to the complexity of the activity, frequency performed by maintenance personnel, and the consequences if an error is made during the evolution. Skill-of-the-craft and availability of procedures or other approved technical documents that direct performance of the maintenance activity is also considered as part of this task analysis.

Contractors that work on or are performing activities that could affect IROFS follow the same maintenance guidelines as maintenance personnel. In addition, a member of the ACP organization provides oversight of contractor activities.

11.2.3 Design/Work Control

Maintenance of ACP equipment is performed in a manner that maintains the documented configuration of plant systems. Prior to modification of systems, it is necessary to complete actions required by Section 11.1 of this license application. A work control process establishes the necessary control, review, and approval process to maintain the documented configuration of ACP systems.

The need for maintenance is identified when an equipment owner initiates a request for work or by the generation of preventive maintenance (PM) tasks or surveillances. The activity described by the request is evaluated to determine the class of work specified for the item requiring maintenance. The ~~Piketon~~ Engineering organization classifies plant equipment to a specific QL. QLs are established in accordance with the equipment's relation to safety as determined by the ISA, or Addendum 1 of the ISA Summary for the ACP – HALEU Demonstration. Additional information regarding the graded approach taken to determine the QL of an item is found in Section 11.1 of this license application and in Section 2.0 of the QAPD.

The QL of an item requiring maintenance establishes the level of planning, extent of reviews, and approval required to perform the maintenance task. A work package is developed to direct and document maintenance activities involving QL-1 and QL-2 items. Work packages contain, as a minimum, a task description, approved work instructions or procedure, post-maintenance tests and equipment history documentation. The package contents may also include equipment drawings, vendor manuals, and safety permits. Compensatory actions are established prior to an IROFS being removed from service for maintenance.

Minor maintenance may be performed on equipment classified as QL-3. Such activities can normally be considered within the skill and training of the craft. These minor maintenance activities do not require work instructions, procedures, or development of a work package. A QL-3 work package is required when the maintenance activity would result in a change to or creation of a quality record or a change to the configuration of the system or for a complex evolution, even though working on a non-safety system.

The planning process addresses support required of other ACP organizations. The repair and/or replacement of IROFS are performed with like-for-like parts or substitute parts approved by the ~~Piketon~~ Engineering organization. Modifications to ACP systems may only be performed following evaluation and approval of the ~~Piketon~~ Engineering organization.

The work package to perform the maintenance activity is reviewed and approved by the appropriate disciplines. Appropriate technical and safety reviews and approvals are performed. At a minimum, review and approval of a representative from maintenance and the equipment owner is required before a work package can be used to perform maintenance on ACP equipment. The ~~Piketon~~ Engineering organization is required to review and approve work packages created for maintenance of QL-1 and QL-2 items and packages developed for modification of ACP systems.

Maintenance activities are scheduled through an established work control process. The equipment owner establishes priorities for maintenance in his/her area of responsibility. A schedule is created and published which establishes a date for execution of the maintenance activity. The work is scheduled in advance to accommodate completion of the planning process. The process accommodates emergent, high priority work. Operations authorizes the performance of maintenance and removal of an IROFS from service. Operations is also responsible for ensuring safe operations during removal of IROFS from service, including establishing any necessary compensatory measures. Operations is notified upon completion of maintenance activities.

The work control process provides configuration control of ACP equipment. This process requires an evaluation for availability of:

- Qualified personnel to perform the maintenance;
- Approved work instructions and/or procedures;

- Approved parts or substitutes;
- Drawings; and
- Safety permits.

Other documentation related to the maintenance activity may be included in the package.

11.2.4 Corrective Maintenance

Corrective Maintenance is the action to check, troubleshoot, and repair equipment that has degraded or failed. The identification, prioritization, planning, and scheduling of corrective maintenance activities are accomplished following the work control process described in Section 11.2.3 of this license application. Corrective actions are performed to remediate unacceptable performance deficiencies in an IROFS and to eliminate or minimize the recurrence of these deficiencies.

11.2.5 Preventive Maintenance

Preventive Maintenance (PM) is the activity performed on a periodic basis to prevent failures, facilitate performance, and maintain or extend the life of equipment. PMs help ensure that IROFS are available to perform their function and are reliable. The bases for PM tasks are developed through a review of manufacturer recommendations, available industry standards, and historical operating information, where available. The rationale for any deviations from industry standards or manufacturer's recommendations is documented. PMs are included in the work control process to facilitate planning, scheduling, and execution of these tasks. The identification, prioritization, planning, and scheduling of preventive maintenance activities are accomplished following the work control process described in Section 11.2.3 of this license application.

Establishment of a PM task is coordinated by engineering and maintenance and requires input from various disciplines within the ~~Piketon~~ Engineering organization, as well as operations and maintenance personnel, as appropriate. The formal documented bases for the tasks are developed, evaluated, and approved by the ~~Piketon~~ Engineering organization. PM tasks may be changed, new tasks added or deleted, and recommendations made by operations, maintenance, or engineering personnel. Changes to tasks may be warranted as a result of a review of a system's performance. Feedback from PM, corrective maintenance, and incident investigations is used, as appropriate, to modify the frequency or scope of a PM activity. Specifically, preventive measures to alleviate premature failure may be added to the PM activity, or a reduction in frequency of a particular PM due to as-found conditions indicating that the PM is occurring more often than necessary, may be initiated.

11.2.6 Surveillance/Monitoring

Surveillances and monitoring at specified intervals are performed to verify the proper operation of IROFS and to measure the degree to which IROFS meet performance specifications.

These surveillances are in the form of performance checks, calibrations, tests, and/or inspections. The ISA Summary, or Addendum 1 of the ISA Summary for the ACP – HALEU Demonstration identifies the IROFS that are credited to be available and reliable to perform their design function for mitigation of credible events. The Surveillance Program provides a periodic check of the ability of these IROFS to perform their design safety function when called upon to do so. The Surveillance Program design adheres to the 10 CFR 70.64, *Inspection, Testing, and Maintenance Baseline Design Criteria.*

Surveillances are included in the work control process to permit timely planning, scheduling, establishment of system or plant conditions, execution of the activity, and creation of documentation that identifies the results of the surveillance. The established frequencies are determined by the IROFS degree of safety importance. The results of surveillance activities are trended to support the determination of performance trends for IROFS. When indicated by potential performance degradation, preventive maintenance frequencies are adjusted or other corrective actions taken as appropriate.

11.2.7 Functional Testing

A post-maintenance testing (PMT) program is established to provide assurance IROFS that require a work package will perform their intended function following maintenance activities. This test confirms that the maintenance performed was satisfactory, the identified deficiency has been corrected, and the maintenance activity did not adversely affect the reliability of the IROFS. This test is performed with acceptable results prior to return of the equipment for service.

PMT requirements are developed and included in work packages during the work planning process. The Piketon Engineering organization may provide support to the Operations and Maintenance organizations in identifying PMT requirements. The PMT meets applicable codes and technical requirements and specifies acceptance criteria. The results of the PMT are documented and retained in the work package with other documentation generated during the maintenance evolution.

11.2.8 Control of Measuring and Test Equipment

Maintenance programs include control of measuring and test equipment (M&TE) used during maintenance of ACP equipment. These programs require M&TE to be properly controlled, calibrated and adjusted, if necessary, at specified periods. The following are elements of the M&TE Control Program:

- M&TE is assigned a unique identifier
- Calibration intervals are defined
- M&TE is labeled to identify calibration/certification status

- An M&TE inventory is maintained
- M&TE determined to be out of tolerance during calibration is identified and an investigation conducted of equipment use since the previous calibration
- Calibration records are retained
- Control and storage requirements are defined for M&TE

Standards used for calibration of M&TE have the required accuracy, range and stability for the application. These standards are certified and traceable to the National Institute of Standards and Technology. If no national standard exists, the bases for calibration is documented and approved by the ~~Piketon~~ Engineering organization.

Additional requirements and standards are established as necessary to ensure compliance with Section 12.0 of the QAPD.

11.2.9 Equipment/Work History

Maintenance programs include data collection in the work control process. Maintenance on an IROFS requires the preparation of a work package that contains an equipment history form. This form is used to collect information from the craft personnel that are performing PM and corrective maintenance activities on an IROFS. The work package also contains a work-in-progress log used to document actions taken during the maintenance activity. This documentation provides information regarding the as-found condition of an IROFS. This data is used to identify the need for modifications and improvements for the maintenance program, to improve the reliability of an IROFS, and to ensure maintenance personnel are devoting their efforts to activities important to safety.

The information obtained from work packages is retained in a database for historical reference. The ~~Piketon~~ Engineering organization may use this database to evaluate the reliability of IROFS. This data, in addition to other indicators (e.g., results of incident investigations, the review of failure records required by 10 CFR 70.62(a)(3), and identified root causes) of item performance allow for a thorough review to determine if modifications to a system or a change in the maintenance program is necessary to ensure that IROFS are reliable and available when called upon. The actual documentation generated at the time of the maintenance evolution is retained in the work package and is controlled according to RMDC program practices.

11.3 Training and Qualification

The Training and Qualification program is designed to ensure that those personnel who perform activities relied on for safety have the applicable knowledge and skills necessary to design, operate, and maintain the plant in a safe manner. The Performance Based Training (PBT) methodology is used for those tasks associated with the design, modification, operation, or maintenance of IROFS identified in the ISA Summary, or Addendum 1 of the ISA Summary for the ACP – HALEU Demonstration. Personnel are indoctrinated, trained and tested as necessary to ensure that they are qualified on practices important to public and worker safety, safeguarding of licensed material, and protection of the environment.

11.3.1 Organization and Management of the Training Function

The Training and Procedures Manager is responsible for establishing procedures governing the application of the PBT methodology for the analysis, design, development, implementation and evaluation of the training programs. Training personnel are assigned by the Training and Procedures Manager to interface with line managers for training development and implementation.

Instructors and subcontractors hired to develop training materials have ready access to designated subject matter experts (SMEs) who assist them when developing training materials. Training program materials are reviewed and approved by SMEs, training, and line management prior to implementation.

The functional organization managers are responsible for defining the job-specific training needs and ensuring completion of indoctrination, training, and qualification for personnel within their organization. Training attendance is tracked by training and line management. The training group notifies line management of personnel who have not successfully completed initial training or who are past due for identified continuing training. Line management is responsible for placing work restrictions or removing employees from duty where training is deficient.

Workers relied upon to design, operate, or maintain IROFS are trained and evaluated for qualifications prior to assignment of these duties. Initial training contains the classroom and on-the-job training (OJT) necessary to provide an understanding of the fundamentals, basic principles, systems, procedures, and emergency responses involved in an employee's work assignments. Initial task or duty area qualification is granted by line management based on successful evaluation of the employee's mastery of the learning objectives presented during the training. Maintenance of qualification is contingent upon successful completion of continuing training and/or through satisfactory OJT evaluations.

Personnel may be exempted from training as defined in training procedures. New hires or position incumbents may be considered for exemption from segments of classroom training and OJT. Exemptions are based on one of the following methods:

- Management review of an individual's prior training records and/or job performance history provides information demonstrating that the individual has achieved the necessary required skills; or
- Employee demonstrates minimum knowledge requirements by passing module examination in lieu of training (test-out); or

- Employee demonstrates minimum skills/proficiency requirements by successfully completing task performance evaluations in lieu of OJT.

Training materials are linked to the CM system to provide reasonable assurance that design changes and modifications are accounted for in the training. The training materials are matrixed to procedures such that design changes or plant modifications are analyzed by line and training personnel for impact on training.

Training attendance records, examinations, employee qualification records, and program needs are maintained in an accurate, auditable manner to document each employee's training. The programmatic and individual training and qualification records are maintained in accordance with RMDC guidelines.

Plant functional organization managers develop and maintain a description of each individual's training requirements within their organization. These requirements are identified in individual Training Requirement Matrices (TRMs) approved by the line and training management. The TRMs include training required by regulatory and or corporate requirements in addition to the applicable Performance Based Training Requirements. Plant personnel, contractors, and visitors receive the following training as applicable to their position or function:

- **General Employee Training** for persons who require unescorted access (Section 11.3.1.1).
- **Security Education** is provided to personnel requiring plant access (Section 11.3.1.2).
- **Radiation Worker Training** for personnel whose job requires them to have unescorted access to radiological restricted areas (Section 11.3.1.3).
- **Nuclear Criticality Safety Training** for personnel who handle or manage the handling of fissile material and work within Fissile Material Operations Areas (Section 11.3.1.4).
- **Environmental, Safety, and Health Training** for those persons who have training requirements defined by laws and regulations (as defined in Section 11.3.1.5).
- **Operations and Maintenance Personnel Training** for those persons relied upon to operate or maintain IROFS. This training includes the operations and maintenance first line supervisors. (Section 11.3.1.6).
- **System Engineer Training** for those persons who review design modifications to IROFS (Section 11.3.1.7).
- **Nuclear Criticality Safety Engineer/Specialist Training** for those persons who perform the Nuclear Criticality Analyst functions described in Chapter 5.0, Nuclear Criticality Safety, of this license application (Section 11.3.1.8).

- **Health Physics Technician Training** for those persons responsible for the evaluation of radiological conditions in the plant and the implementation of the necessary radiological safety measures identified in Chapter 4.0, Radiation Protection, of this license application (Section 11.3.1.9).

- **Laboratory Technician Training [commercial ACP operations only]** for those persons who work in the laboratory technician classification (Section 11.3.1.10).

- **Fire Protection and Emergency Management Training** for those persons identified in the Emergency Plan for the American Centrifuge Plant (Section 11.3.1.11).

- **Visitor Site Access Orientation** is provided for plant visitors who are escorted. It utilizes self-study of an orientation handbook and covers the following general information:

  - Driving Rules
  - Compliance with postings and signs
  - Use of eye, head, hearing, and respiratory protection
  - Emergency Phone Numbers
  - Radiological protection concerns
  - Emergency Preparedness
  - Security requirements and limitation of access and items prohibited

11.3.1.1 General Employee Training

General Employee Training (GET) provides awareness level training on the hazards and proper response to alarms that a person may encounter. It is required for personnel having unescorted access to the plant. GET includes the following subject areas:

- General Employee Radiological Safety

- NCS

- General Topics

- Hazard Communication

- Emergency Preparedness

11.3.1.1.1 General Employee Radiological Safety

General Employee Radiological Training covers the individual's responsibilities for maintaining exposures to radiation and radioactive materials in accordance with the as low as reasonably achievable (ALARA) philosophy. This training reviews natural background and manmade sources of radiation, the whole body radiation dose limit for non-radiological workers, the potential biological effects from chronic radiation doses, embryo and fetus protection, ALARA concepts and practices, and methods used to control radiological materials and contamination. If a person requires unescorted access to a radiological restricted area, additional radiological safety training is provided as discussed in Section 11.3.1.3 of this license application.

11.3.1.1.2 Nuclear Criticality Safety

An overview of the NCS program is provided. The training emphasizes the prevention of accidental nuclear criticality, describes the hazards and risks of a nuclear criticality accident, explains NCS responsibilities, and teaches the proper response to a nuclear criticality alarm.

Additional NCS training based on American National Standards Institute (ANSI)/American Nuclear Society (ANS) ANSI/ANS-8.20-1991, *American National Standard for Nuclear Criticality Safety Training*, is provided for personnel who handle or manage the handling of fissile material and work within Fissile Material Operations Areas.

11.3.1.1.3 General Topics

General Topics include a general overview of: (1) health and safety awareness programs; (2) the employee's rights and responsibilities and the employer's duties as defined by laws and regulations; and (3) use of procedures and conduct of operations.

11.3.1.1.4 Hazard Communication

The purpose of this awareness-level training is to inform personnel that hazardous chemicals are present in the work place and to help them understand the function of warning labels and signs, Material Safety Data Sheets/Safety Data Sheets, and the written Hazard Communication Program.

Additional chemical safety training is provided to those personnel who handle or supervise the handling of hazardous chemicals identified in Chapter 6.0, Chemical Process Safety, of this license application.

11.3.1.1.5 Emergency Preparedness

This training introduces personnel to basic emergency response ~~Emergency Plan~~ elements including: (1) emergency plan safety objectives and priorities; (2) ways to report emergencies; (3) recognition and correct responses to plant alarm signals; (4) evacuation guidelines for radiological and non-radiological emergencies; (5) personnel accountability procedures; (6) fire extinguisher familiarization; and (7) personnel responsibilities during emergencies.

11.3.1.2 Security Education

Security Education briefings are described in the Security Program for the American Centrifuge Plant. These include Initial Briefings, Refresher Briefings, Termination Debriefings, and Foreign Travel Briefings.

11.3.1.3 Radiation Worker Training

Radiation Worker Training is a biennial training requirement for personnel whose job requires them to have unescorted access to radiological restricted areas. The training includes a comprehensive curriculum consisting of the following, as appropriate:

- Fundamentals of atomic structure, radiological definitions, types of ionizing radiation, units of measurement, dose, and dose rate calculations
- Biological effects of ionizing radiation including cell sensitivity and chronic and acute exposure
- Radiation work permit applications and use
- Radiation limits for occupational and non occupational workers as well as the general public
- ALARA practices for protection from exposure to radiation or radioactive materials
- Personnel Monitoring Programs in place to monitor the worker's exposure to radiation
- Radioactive Contamination Control to minimize and control the spread of contamination
- Radiological Postings and Controls for familiarization with the signs and postings in the work area
- Emergencies involving radiological material and the correct response
- Chemical Toxicity of Soluble Uranium Compounds

This training includes knowledge examinations and practical factor examinations of the personal protective equipment, personnel monitoring, and radiation measurements, if needed. Radiation Worker Training is reviewed and approved by the Radiation Protection Manager. The extent of the course material is commensurate with the potential for exposure. The training program is reviewed and evaluated every two years.

11.3.1.4 Nuclear Criticality Safety Training

NCS training based on ANSI/ANS-8.20-1991 is provided for personnel who manage, work in, or work near ~~handle or manage~~ the handling of fissile material and ~~work within~~ Fissile Material Operations Areas. This training is reviewed and approved by the NCS technical staff and includes a discussion of the following:

- The fission process
- Controllable factors and examples of their application at this plant

- NCS postings
- NCS emergency procedures
- Consequences of historical criticality accidents

Personnel are trained to report defective or anomalous NCS conditions and to perform actions only in accordance with written, approved procedures. Personnel are trained that unless a specific procedure deals with the situation, they will take no action until the NCS personnel have evaluated the situation and provided recovery guidance. NCS refresher training is required every two years.

Managers of personnel described above receive additional training on the managerial responsibilities relating to NCS. In addition to demonstrating a basic knowledge of NCS concepts, the principles associated with the management of fissile material workers, and the oversight responsibilities of fissile material operations, NCS training for managers includes the following topics:

- Description of the plant's nuclear criticality safety policy;
- Explanation for the use of check lists, sign-off sheets, and documentation in the execution of procedures that are pertinent to criticality safety;
- Discussion of relevant procedures that pertain to criticality safety with emphasis given to criticality safety limits, controls, and emergency procedures;
- Description of the policy that relates to situations not covered by procedure and to situations in which the safety of the operation is in question; and
- Emphasizing the fact that employees are to be informed of their right to question any operation they believe may not be safe.

11.3.1.5 Environmental, Safety, and Health Training

This training covers environmental, worker safety, and health subject areas required by applicable local, state and federal regulations. It is provided to personnel commensurate with their job assignments. Specific modules identified as required compliance training for plant employees are contained in each individual's training requirement matrix. Some of the areas include:

- Radiological Worker Safety
- NCS
- Respiratory Training

- Hearing Conservation
- Occupational Safety and Health Administration (OSHA) Hazard Communication
- Hoisting and Rigging
- Mobile Equipment Operations
- Lockout/Tagout Work Permits
- Safety and Health Work Permits
- *Resource Conservation and Recovery Act* for Hazardous Waste Generators
- OSHA Hazardous Waste Operations and Emergency Response Standard
- Personal Safety
- Spill Prevention Control and Countermeasure Plan

11.3.1.6 Operations and Maintenance Personnel Training

Training is designed, developed, and implemented to assist plant employees in gaining an understanding of applicable fundamentals, procedures, and practices specific to the plant. It is also used to develop the skills necessary to perform assigned work in a safe manner. If a task is identified to operate or maintain an IROFS, then the PBT methodology is used. Initial and continuing training is provided for the following operations and maintenance job categories relied on to operate and/or maintain IROFS.

11.3.1.6.1 Operations Technician

This program is designed for personnel who monitor and operate centrifuge feed, withdrawal, product, equipment and supporting systems. They operate systems necessary to support the plant, perform integrated system testing, execute valving orders, adjust equipment settings, start-up, and shutdown equipment. The Operations Technician also assemble, transfer, install, repair, and test centrifuges ~~machines~~. The Operations Technician training and qualification program is separated into three sequential phases:

- **Phase I** provides classroom training on basic fundamentals and consists of the following: Centrifuge Operations Orientation; Uranium Enrichment Technology; Operating Principles and Theory of Centrifuge Equipment; Process Control; and Process Support Systems.

- **Phase II** provides classroom and OJT on the design, assembly, transport, and repair of centrifuges machines.

- **Phase III** provides classroom and OJT on the IROFS identified in the ISA Summary, or Addendum 1 of the ISA Summary for the ACP – HALEU Demonstration; NCS limits and controls; equipment operations; support systems; and normal, off-normal, and emergency alarm response operating procedures for the plant.

11.3.1.6.2 Operations Shift Supervisor

This program is designed for personnel who supervise the Operations Technician and make operational decisions during normal, off normal, and emergency operations. The Operations Shift Supervisor is the senior person on shift and directs equipment start-up, shutdown, and changes in system alignments. The Operations Shift Supervisor training and qualification program is separated into four sequential phases:

- **Phase I** provides classroom training on basic fundamentals and consists of the following: Centrifuge Operations Orientation; Uranium Enrichment Technology; Operating Principles and Theory of Centrifuge Equipment; Process Control; and Process Support Systems.

- **Phase II** provides classroom and OJT on the design, assembly, transport, and repair of centrifuges machines.

- **Phase III** provides classroom and OJT on the IROFS identified in the ISA Summary, or Addendum 1 of the ISA Summary for the ACP – HALEU Demonstration; NCS limits and controls; operations; support systems; and normal, off-normal, and emergency alarm response operating procedures for the plant.

- **Phase IV** provides classroom and OJT on the supervisory roles and responsibilities for the safe operation of the plant.

11.3.1.6.3 Maintenance Support Technician

This program is designed for maintenance personnel who service and repair computers, programmable controllers, and electrical, electronic, and pneumatic support systems and components. The Maintenance Support Technician training and qualification program is separated into three sequential phases:

- **Phase I** provides classroom training on Centrifuge Operations Orientation and Operating Principles and Theory of Centrifuge Equipment.

- **Phase II** provides classroom and OJT on the plant electrical, instrument, and electronic control systems and components.

- **Phase III** provides classroom and OJT on maintenance procedures, programs, and practices.

11.3.1.6.4 Maintenance Technician

This program is designed for maintenance personnel who install, remove, repair, and service mechanical equipment and systems in the field and in shop locations. The Maintenance Technician training and qualification program is separated into three sequential phases:

- **Phase I** provides classroom training on Centrifuge Operations Orientation and Operating Principles and Theory of Centrifuge Equipment.
- **Phase II** provides classroom and OJT on the plant mechanical systems and components.
- **Phase III** provides classroom and OJT on maintenance procedures, programs, and practices.

11.3.1.6.5 Maintenance Shift Supervisor

This program is designed for the supervisors of the Maintenance and Maintenance Support Technicians. The Maintenance Shift Supervisor training and qualification program is separated into four sequential phases:

- **Phase I** provides classroom training on Centrifuge Operations Orientation and Operating Principles and Theory of Centrifuge Equipment.
- **Phase II** provides classroom and OJT on the plant mechanical, electrical, instrument, and electronic control systems and components.
- **Phase III** provides classroom and OJT on maintenance procedures, programs, and practices.
- **Phase IV** provides classroom and OJT on the supervisory roles and responsibilities for the safe operation of the plant.

11.3.1.7 System Engineer Training

System Engineer training is provided to those persons who provide engineering support; review of the design and modifications of IROFS; and review process equipment operational parameters, analyze the data and determine equipment settings. System Engineers are responsible for reviewing design proposals and modifications; ensuring that the appropriate documents and procedures are updated to be consistent with modifications; and assisting in work control preparation and identification of post-maintenance test requirements for IROFS. The System Engineer has, as a minimum, a bachelor's degree in engineering or the physical sciences or equivalent technical experience, and three years of nuclear experience. The training is based on a review of job analysis data, training requirements for specific systems, and existing training materials.

11.3.1.8 Nuclear Criticality Safety Engineer Training

Qualified Nuclear Safety personnel administer Nuclear Criticality Safety Engineer training and qualification. Training is based on ANSI/ANS-8.20-1991 and ANSI/ANS-8.19-~~1996~~2014, *Administrative Practices for Nuclear Criticality Safety*. NCS procedures define educational and experience prerequisites, along with required training courses and OJT activities to be completed prior to qualification.

11.3.1.9 Health Physics Technician Training

Health Physics support training and qualification is administered in accordance with guidelines provided in the Training Development and Administrative Guide (TDAG) for Health Physics Technicians. It utilizes the performance -based training methodology and applies to those individuals, both plant and contractor, who are engaged in the evaluation of radiological conditions in the plant and the implementation of the necessary radiological safety measures as they apply to nuclear plant workers and members of the general public.

11.3.1.10 Laboratory Technician Training [commercial ACP operations only]

Laboratory support training and qualification is administered in accordance with the guidelines set down in the TDAG for the Laboratory and Technician Training Program. The training utilizes the performance -based training methodology. Training is provided in the areas of Laboratory Controls and Standards, Mass Spectrometry, Process Services, Chemical Technology, Uranium Sampling, and Uranium Analysis.

11.3.1.11 Fire Protection and Emergency Management Training

11.3.1.11.1 Fire Protection Training

State certification requirements provide the basis for firefighter training programs. Emergency medical response personnel meet requirements for state certification as emergency medical technician (these are usually also firefighters). Qualified instructors provide a range of classroom and hands-on training to maintain standards of performance for response personnel. Training needs are reviewed annually and the training program modified to meet identified needs. Drills are conducted quarterly, as part of the Emergency Plan training.

11.3.1.11.2 Emergency Management Training

Training is conducted in the areas of:

- General ~~Emergency Plan~~emergency response training

- Specialized ~~Emergency Plan~~emergency response training for the Emergency Response Organization

- Off-site Emergency Management training

Emergency Management drills and exercises are conducted to develop, maintain, and test the response capabilities of personnel, facilities, equipment, and training.

11.3.2 Analysis and Identification of Functional Areas Requiring Training

A needs/job analysis is used to identify the tasks affecting worker or public safety, safeguards of regulated material, or protection of the environment as identified in the ISA Summary, or Addendum 1 of the ISA Summary for the ACP – HALEU Demonstration. The analysis is conducted with applicable program area SMEs and training personnel. The training programs for the following plant job positions/worker classifications are based on a needs/job analysis:

- Operations Technician
- Operations Shift Supervisor
- Maintenance Technician
- Maintenance Support Technician
- Maintenance Shift Supervisor
- System Engineer
- NCS Engineer
- Health Physics Technicians
- Laboratory Technicians

The plant-specific task list is developed for each of the above positions/classifications. The task lists are analyzed based on input from line management and SMEs, rating each task on degree of difficulty, importance of the task, and frequency of task performance. From this analysis, the tasks are selected for training based on their rating. The ratings are:

- **Overtrain** - requires initial and continuing training;

- **Train** - requires initial training;

- **Pre-train** or **just-in-time** - requires training but is not taught until that specific knowledge or skill is needed; or

- **No train** -formal training is not required.

The tasks selected for training are matrixed to the associated procedures and training materials. The matrices are reviewed and updated in conjunction with the periodic review of the associated procedures.

Procedure changes, equipment changes, job scope changes, plant modifications and other changes affecting task performance are monitored and evaluated for their impact on the development or modification of initial and continuing training programs. The affected training materials are modified or new materials developed, based on the significance of the change, and modifications are documented in the program files. The training materials are updated prior to conducting training.

11.3.3 Position Training Requirements

Plant procedures and individual TRMs delineate initial and continuing training requirements for employees. The training program requirements for those positions relied on for safety or personnel who perform actions that prevent or mitigate accident sequences described in the ISA Summary, or Addendum 1 of the ISA Summary for the ACP – HALEU Demonstration, are defined in TDAGs. The TDAGs include:

- Organization and Administration Responsibilities

- Trainee Selection Criteria, including the minimum educational, technical, experience, and physical requirements

- Course Loading for Initial and Continuing Training

- Test/Evaluation Guidelines

- Training and Evaluation Documentation Guidelines

- Training Courses or Modules for Specific Qualification Areas

11.3.4 Development of the Basis for Training, Including Objectives

Learning objectives are established to identify the training content and to define satisfactory trainee performance for the task or group of tasks selected for training from the job analysis. Learning objectives state the requisite knowledge, skills, and abilities the trainee must demonstrate. The conditions under which the required actions take place and the standards of performance required of the trainee are also determined in development of the learning objectives.

Learning objectives are sequenced within training materials based on their relationship to one another.

Learning objectives are documented in lesson plans and training guides and are revised as necessary based on changes in procedures, plant systems/equipment, or job scope.

11.3.5 Organization of Instruction, Using Lesson Plans and Other Training Guides

Learning objectives derived from the rated task lists are analyzed to determine the appropriate training setting. Classroom lesson plans, OJT guides, or other instructional materials are procured or developed based on this instructional analysis and design. Lesson plans and other training guides provide the guidance and structure necessary to ensure consistent delivery of training material from trainer to trainer and class to class. The lesson plans and other training guides provide the evaluation tools necessary to ensure mastery of the learning objectives.

Classroom lessons are used primarily to provide cognitive learning on the fundamentals, theory, basic operating and maintenance principles, individual systems, system inter-relations, safety requirements, and processes used in the plant.

Other forms of instructional materials, such as video, computer-based training and self-study may be used as alternatives or supplements to classroom instruction.

Classroom lesson plans, OJT guides, and other instructional materials receive technical reviews by designated SMEs and instructional reviews by training management as part of the approval process. The responsible line managers and Training and Procedures Manager approve training materials before issuance.

Designated SMEs or technical trainers provide classroom training and/or OJT evaluations. These personnel receive training and are qualified on the instructional methods and techniques applicable to the training setting.

11.3.6 Evaluation of Trainee Learning

Within the job position/worker classification, training programs are logical instructional blocks or "modules" presented in such a manner that specific learning objectives are accomplished. Trainee progress is evaluated by line and training management through a variety of performance demonstrations such as written examinations, oral examinations, and practical tests to ensure mastery of the job performance requirements or learning objectives contained in these modules. Comprehensive qualification programs contain periodic evaluations of trainee performance. Remediation is provided as appropriate.

11.3.7 Conduct of On-The-Job Training

OJT is a systematic method of providing training on job-related skills and knowledge for a position. This training is conducted in the work environment and demonstrates actual task performance whenever practical. When the actual task cannot be performed, the conditions are documented and the task may be simulated. Applicable tasks and related procedures for each technical area provide the input for the OJT that is designed to supplement and complement training received through formal classroom or laboratory training and to ensure personnel are qualified to perform their assigned tasks.

11.3.8 Evaluation of Training Effectiveness

Systematic evaluations of training effectiveness and its relation to on-the-job performance are used to ensure that the training program conveys required skills and knowledge and to revise the training, where necessary, based on the performance of trained personnel in the job setting. The student feedback of the training received and the line manager's evaluation of the student's performance on the job after training is completed are utilized to determine the training effectiveness and areas for refinement. Student feedback occurs at several points in the training program. At the completion of training, the student evaluates the instructor and course. Post training evaluations of the effectiveness of training is requested from students and supervisors after completion of training. Each of these evaluations is specified in plant training procedures.

Plant design changes, modifications, or changes in task performance are analyzed by line and training personnel for impact on training. Corrective actions involving training are assigned, scheduled and tracked to completion. Lessons learned, which have an impact on initial training, are factored into training materials prior to the delivery of the next training session.

Line and training management conduct self-assessments and evaluations of the individual training programs. QA auditors provide additional assessments through the audit program. These assessments and evaluations are used to determine training program strengths and weaknesses for continuous improvement of the training.

11.3.9 Personnel Qualification

Personnel are selected for entry into the training and qualification programs in conformance with the established general employment policies. The minimum education, experience, and qualification requirements for engineers, and technical professional staff, technicians, and maintenance personnel are described below. The minimum education, experience, and qualification requirements for managers and supervisors are provided in Chapter 2.0, Organization and Administration, of this license application.

Engineers and other technical professional staff, who affect the design, modification, operation, or maintenance of IROFS identified in the ISA Summary, or Addendum 1 of the ISA Summary for the ACP – HALEU Demonstration, have, as a minimum, a bachelor's degree in engineering or the physical sciences or equivalent technical experience, and three years of nuclear experience. Other technical professional staff, whose actions are not relied upon for safety, have, as a minimum, a bachelor's degree in engineering or the physical sciences or equivalent technical experience, and one year of nuclear experience.

Operations technicians, maintenance personnel and technicians, and other staff whose actions are relied upon for safety have as a minimum a high school diploma or satisfactory completion of the General Education Development test and three years of industrial/chemical/nuclear plant operations, maintenance, engineering, or support experience. Technician candidates not meeting the experience requirements are placed into entry-level associate technician positions.

Construction personnel, plant technicians, maintenance personnel, and other staff whose actions are relied upon for safety complete the applicable training programs or have equivalent experience or training.

11.3.10 Provisions for Continuing Assurance

Continuing training and periodic requalification is provided for employees in the interest of promoting safety, safeguards and security, and environmental protection awareness. Continuing training is also provided as a means to maintain and improve job-related knowledge and skills and is based on the following factors:

- Frequency required by regulatory agencies and national standards
- Overtrain tasks identified in PBT-based programs
- Training needs as determined by line management. This includes, but is not limited to, nuclear criticality safety assessments, plant or system changes, component changes, procedure changes, lessons learned (including industry and in-house operating experiences, and event reports), and emergency response procedures.

11.3.11 References

1. ANSI/ANS-8.20-1991, *American National Standard for Nuclear Criticality Safety Training*

2. ANSI/ANS-8.19-~~1996~~2014, *Administrative Practices for Nuclear Criticality Safety*

11.4 Procedures

The Licensee is committed to the use of approved and controlled written procedures to conduct nuclear safety, safeguards, and security activities for the protection of the public, plant employees, and the environment. Procedures are used to ensure safe work practices and apply to workers, visitors, contractors, and vendors. A balanced combination of written guidance, craftsman skills, and work site supervision is utilized. The procedure process utilizes a graded approach to provide the necessary rigor for safe plant operation, meet regulations and standards, and assure a balance of effective safety with practical efficiency in plant operations. Activities involving nuclear material and/or IROFS are conducted in accordance with approved procedures.

A management controls program for procedures includes the basic elements of identification, development, verification, review and comment resolution, approval, validation, issuance, and change control, and periodic review. These elements are outlined in a procedures management writer's guide and described in implementing procedures.

11.4.1 Types of Procedures

Procedures are intended to prescribe those essential actions or steps needed to safely and consistently perform operations and maintenance activities. Procedures that are related to the operation of IROFS where human actions are important and for the management measures supporting those IROFS are governed by the requirements of this section. The two general types of procedures used at the ACP are Operating and Administrative.

11.4.1.1 Operating Procedures

Operating procedures are used to directly control process operations at the workstation and include, as necessary, direction for normal operations, off-normal operations, maintenance, alarm response, and emergency operations caused by failure of an IROFS or human error. These procedures provide reasonable assurance of NCS, chemical safety, fire safety, emergency planning, and environmental protection. Operating procedures contain the following elements, as applicable:

- Purpose of the activity
- Regulations, policies, and guidelines governing the procedure
- Type of procedure
- Steps for each operating process phase
- Initial start-up
- Normal operations
- Temporary operations
- Emergency shutdown
- Emergency operations
- Normal shutdown
- Start-up following an emergency or extended downtime
- Hazards and safety considerations

- Operating limits
- Precautions necessary to prevent exposure to hazardous chemicals (resulting from operations with special nuclear material) or to licensed special nuclear material
- Measures to be taken if contact or exposure occurs
- IROFS associated with the process and their functions
- The timeframe for which the procedure is valid

Maintenance procedures involving IROFS for corrective and preventative maintenance, functional testing after maintenance, and surveillance maintenance activities describe:

- Qualifications of personnel authorized to perform the maintenance or surveillance
- Controls on and specification of any replacement components or materials to be used
- Post-maintenance testing to verify operability of the equipment
- Tracking and records management of maintenance activities
- Safe work practices (e.g., lockout/tagout; confined space entry; moderation control or exclusion area; radiation or hot work permits; and criticality, fire, chemical, and environmental issues)
- Pre-maintenance activities require reviews of the work to be performed, including procedure reviews for accuracy and completeness
- Steps that require notification of affected parties (technicians and supervisors) before performing work and on completion of maintenance work. The discussion includes potential degradation of IROFS during the planned maintenance.

Alarm Response Procedures provide information that identifies the symptoms of the alarm, possible causes, automatic actions, the immediate operator action to be taken, and the required supplementary actions.

Off-Normal Procedures describe actions to be taken during unusual or out-of-the ordinary situations.

Emergency Operating Procedures direct actions necessary to mitigate potential events or events in progress that involve needed protection of on-site personnel; public health and safety; and the environment.

11.4.1.2 Administrative or Management Control Procedures

Administrative procedures or "management control procedures" are used for activities that support the process operations. These procedures are used to manage activities such as configuration management, radiation protection, maintenance, QA, training and qualification, audits and assessments, incident investigations, record keeping, and reporting. Administrative procedures direct the following activities:

- Design
- Configuration Management
- Procurement
- Construction
- Radiation safety
- Maintenance
- QA elements
- Training and qualification
- Audits and assessments
- Incident investigations
- Records management
- Criticality safety
- Fire safety
- Chemical process safety and reporting requirements

11.4.2 Procedure Process

Procedures are developed or modified through a formal process incorporating the change controls described in Section 11.1 of this license application. The procedure process ensures that:

- Procedures are identified and developed as needed;
- Procedures are provided for those operations of IROFS where human actions are necessary and for the Management Measures described in this chapter;

- Essential elements that are generic are included as applicable. These include: nuclear criticality; chemical process and fire safety; warnings and cautions; notes or reminders of pertinent information regarding specific hazards or concerns; Material Safety Data Sheet/Safety Data Sheet availability; special precautions; radiation and explosive hazards; and special personal protective equipment;
- Procedures are approved under the guidelines of the configuration management program by personnel responsible and accountable for the operation;
- Procedures are verified and validated through field tests by workers and technicians during procedure development to provide assurance that they are usable and accurate;
- Procedures are periodically reviewed and re-verified and validated;
- Current procedures are available to personnel and that users are qualified on the latest version;
- Operating limits and IROFS are specified in the procedure;
- Safety limits and IROFS will be clearly identified, as such, in the procedure for operations;
- Procedures include required actions for off-normal conditions of operation, as well as normal operations;
- If needed, hold points or safety checkpoints are identified at appropriate steps in the procedure;
- A mechanism is specified for revising and reissuing procedures in a controlled manner;
- Current procedures are available and used at work locations; and
- The plant Training Program trains the required persons in the use of the latest procedures available.

The procedure process utilizes nine basic elements to accomplish procedure development, review, approval, and control: Identification; Development; Verification; Validation; Review and Comment Resolution; Approval; Issuance; Change Control; and Periodic Review. These elements are discussed in the following sections.

11.4.2.1 Identification

ACP organization managers have the responsibility for identifying which tasks will be proceduralized within their areas of control, using the criteria in the following paragraphs below and Section 11.4.9 of this license application.

As a minimum, a procedure is required for:

- The operation of IROFS and the management measures supporting those IROFS as identified in the ISA Summary and Addendum 1 of the ISA Summary for the ACP – HALEU Demonstration
- Operator actions necessary to prevent or mitigate the consequences of accidents described in the ISA Summary and Addendum 1 of the ISA Summary for the ACP – HALEU Demonstration
- Safe work practices to control processes and operations with special nuclear material, IROFS, and/or hazardous chemicals incident to the processing of licensed material.

A detailed procedure is normally not needed if the task analysis determines that:

- The work is not complex or only involves a few actions (unless failure to properly conduct those actions could result in significant consequences)
- The task requires those skills normally possessed by a qualified person (otherwise known as "skill-of-the-craft"
- The consequences of an error would be minimal

Maintenance activities can be addressed by written procedures, documented work instructions, or drawings appropriate to the circumstances as discussed in Appendix A.6, paragraph (a), of ANSI/ANS 3.2-1994, *Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants*.

11.4.2.2 Development

Procedure development and quality is the user organization's responsibility. Procedure development is accomplished in accordance with procedural guidance. A general description follows:

- A system is in place to track and document the procedure process.
- The following elements will be considered for procedure incorporation:
  - Title and identifying information, such as number, revision, and date
  - Statement of applicability and purpose

- Prerequisites
- Precautions (including warnings, cautions, and notes)
- Important human actions
- Limitations and actions
- Acceptance criteria
- Checkoff lists
- Reference material

- Interviews with procedure users and process walk downs are utilized to ensure procedures are usable; reflect as-built conditions and process operations; and maintain management controls for nuclear safety, safeguards, and security.

- The procedure use category is determined. This determination documents the designation of a procedure as In-Hand (Continuous Use), Reference Use, or Information Use. The designation is based on the administrative or non-administrative use of the procedure, and the safety or financial consequences of failing to adhere to procedural requirements. Procedure use is discussed in Section 11.4.7 of this license application.

- As the procedure is drafted, attributes that enhance procedural use are included, such as standard style organization, format, cautions, and warnings.

- Input and review by affected parties is required. Other selected reviews are obtained, such as QA to ensure that QA requirements are identified and included in operating procedures.

- The approval process for the procedure is described in Section 11.4.2.6 of this license application.

11.4.2.3 Verification

Verification is a process that ensures the technical accuracy of the procedure and that it can be performed as written. Procedures are verified by the procedure owner/user during the procedure development/change process. There are two basic attributes of the verification process. The first attribute relates to the technical accuracy of the procedure. It ensures that technical information including formulas, set points, and acceptance criteria are correctly identified in the procedure. The second attribute is administrative, in that it verifies the procedure format and style and that it is consistent with the procedure-writing guide. A standard checklist is used to ensure required attributes are included.

11.4.2.4 Validation

The purpose of procedure validation is to ensure that no technical errors or human factor issues were inadvertently introduced during the procedure review process. Validation is required for new procedures or for intent changes to the procedure. Validation is performed in the field by qualified personnel, and may be accomplished by detailed scrutiny of the procedure as part of a walk-through exercise or as part of a walk-through drill (particularly for emergency or off-normal procedures). If the particular system or process is not available for a walk-through validation, talk-through may be performed in the particular shop or training environment. Performance of procedure validation is documented.

11.4.2.5 Review

Drafts of new procedures and procedure changes are distributed for technical reviews, safety discipline reviews (e.g., nuclear criticality, fire, radiation, industrial, and chemical process safety), and cross-discipline reviews, as needed. Nuclear criticality safety reviews drafts of new procedures and procedure changes that could affect fissile material operations.

Functional area and cross-discipline reviews are performed for the new procedure or procedure change. Comments/questions generated during the review process are resolved with the originating organizations. 10 CFR 70.72 and intent/non-intent screenings are performed for new and changed procedures (except minor administrative changes that are processed according to the procedure process).

Any new or revised NRC requirements that are promulgated are evaluated to determine the impact on existing implementing procedures or to identify the need for new implementing procedures. Procedures are reviewed following unusual incidents; such as an accident, unexpected transient, significant operator error, or equipment malfunction to determine if changes are appropriate based on the cause and corrective action determination for the particular incident. Procedure changes that are necessary because of a system modification are addressed in Section 11.1 of this license application, as part of the modification control process.

In addition, the Plant Safety Review Committee will review:

- Each new procedure required by Section 11.4.2.1 for this license application
- Each proposed change to procedures required by Section 11.4.2.1 of this license application, if the proposed change constitutes an intent change (i.e., a change in scope, method, or acceptance criteria that has safety significance)

11.4.2.6 Approval

Following the resolution of review comments, procedures are approved. Approval authority rests with the applicable ACP organization manager responsible for the activity.

Managers ensure that appropriate training is completed on new and revised procedures.

11.4.2.7 Issuance and Distribution

Procedures are issued and controlled in accordance with the RMDC program procedures. Copies of current approved procedures are available to users via electronic and/or hard copy distribution in the work areas.

11.4.3 Procedure Hierarchy

The procedure hierarchy is established in four levels. The levels are:

- **Level 1** - Policy statements issued by executive management that apply to ACP personnel
- **Level 2** - Standard Practice Procedures that apply to more than one organization
- **Level 3** - Procedures issued at the organization level that apply to more than one group within a larger group or specific organization
- **Level 4** - Procedures issued within a group or sub-function

11.4.4 Temporary Changes

Temporary changes to procedures required by Section 11.4.2.1 of this license application can be made, provided:

- The temporary change does not result in a change to the ISA, or Addendum 1 of the ISA Summary for the ACP – HALEU Demonstration as determined by the 10 CFR 70.72 review
- The temporary change does not constitute an intent change (i.e., a change in scope, method or acceptance criteria that has safety significance)
- The change is documented utilizing the procedure process

These temporary changes to procedures may be used for a period of time, which should not exceed 30 days or a period for which the temporary condition exists whichever is greater. Temporary changes that need to exceed this period are assessed to ensure it is appropriate to extend the use of the temporary change or to process a permanent change. Temporary changes to procedures may be made permanent once the change is reviewed and approved as required by Section 11.4.2.4 of this license application.

11.4.5 Temporary Procedures

Temporary procedures may be issued only when permanent procedures do not exist to:

- Direct operations during testing, maintenance, and modifications

- Provide guidance in unusual situations not within the scope of permanent procedures

- Ensure orderly and uniform operations for short periods when the building, a system, or component of a system is performing in a manner not covered by existing permanent procedures, or has been modified or extended in such a manner that portions of existing procedures do not apply

These temporary procedures may be used for a period of time, which should not exceed 60 days or a period for which the temporary condition must exist, whichever is greater. Temporary procedures that need to exceed this period are assessed to ensure it is appropriate to extend the use of the temporary procedure or to develop a permanent procedure. These temporary procedures are subject to the same level of review and approval as required for permanent procedures.

11.4.6 Periodic Review

Approved procedures are periodically reviewed to ensure their continued accuracy and usefulness. Procedures are periodically reviewed according to established criteria. The periodicity of these reviews is based on procedure content as follows:

Periodic Review Cycle	Procedures to Be Reviewed
1 year	Emergency Operating, Alarm Response and procedures dealing with highly hazardous chemicals as defined by the chemical safety program
5 years	Procedures not included as part of the one-year review cycle

When conducting the periodic review, the procedure owner or SME performs a complete administrative and technical (requirements and references) review ensuring information is complete and accurate and that the procedure is usable as written.

11.4.7 Use and Control of Procedures

In-Hand (Continuous Use) procedures are followed step-by-step and are present in the work area while the task is being performed. In-Hand procedures, approved equipment alignment check sheets (e.g., valve lineups or electrical switching orders), or approved operator aids (e.g., process flow-charts or component identification tables) are developed for IROFS that have:

- Extensive or complex tasks;

- Tasks which are infrequently performed; or

- Tasks in which operations must be performed in a specified sequence.

Reference Use procedures are provided for routine procedural actions that are frequently repeated or of minimal complexity, and can be performed from memory. Reference Use procedures are not required to be present in the work area.

Information Use procedures are followed to implement administrative or programmatic requirements.

Hard copy controlled copies of procedures are marked "Controlled Copy." Working copies of procedures are marked "Working Copy," and verified as the latest version prior to use. Information Only copies of In-Hand (Continuous Use) or Reference Use procedures are marked "Information Only" to indicate they are not controlled copies and are not used to perform work. Procedures may be accessed and used directly from the electronic document management system.

If a step of a procedure cannot be performed as written, work is stopped, the system is immediately placed in a safe condition, and corrective actions are initiated in accordance with plant procedures.

Responsible managers ensure personnel are trained on the use of procedures and are appropriately trained and qualified on the current version of the procedure as described in Section 11.3 of this license application.

11.4.8 Records

Records generated during procedure use are identified in the governing procedure and controlled according to the ACP RMDC program practices as described in Section 11.7 of this license application.

11.4.9 Topics to be Covered in Procedures

Activities defined by Section 11.4.2.1 of this license application are the minimum activities that are to be covered by written procedures. In addition, any activity described in Section 11.4.2.1 of this license application and listed below is covered by a written procedure (except for the maintenance activities listed below which may be covered by written procedures, documented work instructions, or drawings appropriate to the circumstances). This list is not intended to be all-inclusive, because many other activities carried out during plant operations may be covered by procedures not included in this list. Similarly, this listing is not intended to imply that procedures need to be developed with the same titles as those in the list. This listing provides guidance on topics to be covered rather than specific procedures.

- **ADMINISTRATIVE PROCEDURES (Management Control)**
  - Training
  - Internal audits and inspections

- Incident investigations and reporting
- Records Management Document Control (RMDC)
- Configuration Management
- Changes in facilities and equipment
- Modification design control
- Quality Assurance
- Equipment control (lockout/tagout)
- Shift turnover
- Work control
- Management control
- Procedures management
- Nuclear Criticality Safety
- Fire safety or protection
- Radiation protection
- Radioactive waste management
- Maintenance
- Environmental protection
- Chemical process safety
- Operations
- IROFS surveillances
- Calibration control
- Preventive maintenance
- Procurement

OPERATING PROCEDURES

- **SYSTEM PROCEDURES THAT ADDRESS START-UP, OPERATION, AND SHUTDOWN**
  - Electrical power
  - Ventilation
  - Shift routines, shift turnover, and operating practices
  - Sampling
  - UF_6 cylinder handling
  - UF_6 material handling equipment
  - Decontamination operations
  - Facility utilities (for example: air, nitrogen, cooling water, sanitary water, site water)
  - Temporary changes in operating procedures
  - Purge and evacuation vacuum systems
  - Installation and removal of centrifuges ~~machines~~
- **ABNORMAL OPERATION/ALARM RESPONSE**
  - Loss of cooling
  - Loss of instrument air
  - Loss of electrical power
  - Fires
  - Chemical process releases
  - Loss of feed capacity
  - Loss of withdrawal capacity
  - Loss of purge vacuum

- **MAINTENANCE ACTIVITIES THAT ADDRESS SYSTEM REPAIR, CALIBRATION, INSPECTION, AND TESTING**
  - Repairs and preventive repairs of IROFS
  - Calibration of IROFS
  - Functional testing of IROFS
  - High-efficiency particulate air filter maintenance
  - Safety system relief valve replacement
  - Surveillance/monitoring
  - Piping integrity testing
  - Containment device testing
  - Repair of UF_6 valves
  - Testing of cranes
  - UF_6 cylinder inspection and testing
  - Centrifuge assembly/installation
- **EMERGENCY PROCEDURES**
  - Toxic chemical releases (including UF_6)

11.4.10 References

1. ANSI/ANS 3.2-1994, *Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants*

2. LA-3605-0003, In*tegrated Safety Analysis Summary for the American Centrifuge Plant*

1 3. LA-3605-0003A, *Addendum 1 of the* Integrated *Safety Analysis Summary for the American Centrifuge Plant - HALEU Demonstration*

11.5 Audits and Assessments

The ACP implements a system of audits and assessments to help ensure that the health, safety, and environmental programs, as described in this license application are adequate and effectively implemented. The system is designed to ensure comprehensive independent oversight of the QA program at least once every three years (except as noted below). The system is comprised of two distinct levels of activities. These are audits and assessments.

11.5.1 Audits

Audits are conducted by the Piketon QA ~~O~~organization in accordance with written procedures or checklists by qualified auditors. The audit<u>ors</u>~~ing organizations~~ are independent from ~~operations of the plant~~<u>activities being audited</u>. Audits verify the effectiveness of health, safety, and environmental programs and their implementation and determine the effectiveness of the process being assessed. Audits further verify that the plant operations are being conducted safely in accordance with regulatory requirements, license application commitments, and the ISA.

These audits and their associated frequencies are conducted in accordance with Section 18.0 of the QAPD and use written procedures or checklists. Audits are performed under the direction of a Lead Auditor, qualified in accordance with the American Society of Mechanical Engineers (ASME) NQA-1<u>-2008</u>, <u>Part 1,</u>~~Supplement 2S-3~~<u> Requirement 2, Section 300, *Qualification Requirements*, and Section 400, *Records of Qualification*</u>. Lead Auditors and staff auditors are functionally and organizationally independent of the programs and activities that are examined. Where appropriate, audit teams are supplemented with plant and/or external technical specialists.

In addition to periodically evaluating aspects of the QAPD, audits are conducted for the areas of radiation safety; NCS [every two years]; nuclear safety; chemical safety; fire safety; environmental protection; emergency management; QA; CM, maintenance; training and qualification; procedures; incident investigation; records management; security (every two years); and operations.

Audit results are documented and reported to the plant senior management as specified in plant procedures. Provisions are made for reporting and corrective action, where warranted. The plant Corrective Action Program, described in Section 11.6 of this license application, is administered by the Regulatory Organization to ensure proper control of corrective actions as defined in Section 16.0 of the QAPD.

11.5.2 Assessments

Management responsible for implementing portions of the QAPD performs assessments to verify the adequacy of the part of the QAPD for which they are responsible and to assure its effective implementation. Results of assessments are documented. The responsible organization manager resolves any observations from these programmatic assessments.

Organization managers maintain an assessment process within their organization to assess the adequacy of, and effectiveness of, the implementation of the programs under their cognizance. As a minimum, these assessments are conducted for the areas of radiation safety, NCS; nuclear safety; chemical safety; fire safety; environmental protection; emergency management; QA; CM; maintenance; training and qualification; procedures; incident investigation; records management;

and operations. Operational assessments will also be performed to ensure the operational assumptions as defined in the ISA Summary and Addendum 1 of the ISA Summary for the ACP – HALEU Demonstration are valid.

Assessment results are documented and reported as specified in the plant procedures. Provisions are made for reporting and corrective action, where warranted, in accordance with the plant's Corrective Action Program.

Additional requirements for performing Nuclear Criticality Safety Assessments are specified in Chapter 5.0 of this license application.

11.6 Incident Investigations

This section encompasses the identification, reporting, and investigation of abnormal events or conditions, including precursor events that may occur during operation of the ACP. This includes identification and categorization of the incident, as well as an analysis to determine the specific or generic causes, as well as generic implications.

The ACP is required by 10 CFR 70.50 and 70.74 to notify the NRC of certain events and conditions and to determine the root cause of the event, including all factors that contributed to the event and the manufacturer and model number (if applicable) of any equipment that failed or malfunctioned. Corrective actions taken or planned to prevent occurrence of similar or identical events in the future and the results of any evaluations or assessments must also be provided.

The ACP satisfies these requirements by following administrative procedures relating to incident identification and reporting. These procedures work together to ensure that abnormal events and conditions occurring at the ACP are promptly reported to appropriate personnel, assessed, and when required, reported to the NRC Operations Center or designated NRC office.

11.6.1 Incident Identification, Categorization, and Notification

In accordance with procedures, plant personnel are required to report to their line manager or directly to the Operations Shift Supervisors and/or Plant Shift Superintendent (PSS) abnormal events or conditions that may have the potential to harm the safety, health, or security of on-site personnel, the general public, or the environment, including precursor events. These conditions may require an emergency response.

The Operations Shift Supervisors and/or PSS, in accordance with procedures, assesses and categorizes abnormal events or conditions using the notification and reporting criteria set forth in 10 CFR 70.50 and 70.74 and other applicable regulations. In making the assessment, the Operations ~~Senior~~ Shift Supervisor may consult with ACP senior management or other personnel possessing expertise or knowledge concerning the type of event or condition being assessed.

If an event or condition within the plant is categorized as a reportable event, the PSS makes initial notification to the NRC Operations Center or designated NRC office and provides, to the extent known at the time of notification, the information specified in 10 CFR 70.50(c)(1). Notification is made as soon as possible, but not later than the time period stated in the regulations. Notification time periods vary between 30 minutes and 24 hours. Verbal and/or written communication involving classified information is conducted in accordance with the SP-3605-0041, *Security Plan for the Protection of Classified Matter* ~~*Chapter 2.0 of the Security Program for*~~ *at the American Centrifuge Plant*.

11.6.2 Conduct of Incident Investigations

The level of investigation of abnormal events and precursor events is based on a graded approach relative to the severity of the incident. Each reportable event where a follow-up written report to the NRC is required is investigated to determine the cause and corrective actions necessary to prevent recurrence. This investigation is conducted and documented in accordance with procedures. Other events not requiring a written report are evaluated using the Corrective Action Program to determine actions to be taken.

The investigation process includes a prompt risk-based evaluation and, depending on the complexity and severity of the event, one individual may suffice to conduct the evaluation or an event investigation team may be warranted. Investigations will begin within 48 hours of the abnormal event, or sooner, depending on the safety significance of the event and commensurate with the safety of the investigators. The investigator(s) are independent from the line function involved with the incident under investigation. A procedure provides a documented plan for investigating abnormal events and includes the functions, responsibilities, and scope of authority of investigators. This plan is separate from any required Emergency Plan or emergency response. A reasonable, systematic, structured approach is used to determine the specific or generic root causes and generic implications of abnormal events~~, such as the TapRooT® methodology~~. The record of IROFS failures required by 10 CFR 70.62(a)(3) for IROFS is reviewed as part of the investigation and updated in accordance with regulatory requirements.

For each event or condition that requires a follow-up written report to the NRC, the incident investigation report includes a description, contributing factors, a root cause analysis, and findings and recommendations. Auditable records and documentation related to abnormal events, investigations, and root cause analyses are maintained. Documentation relating to the investigation is retained for two years or for the life of the operation, whichever is longer. The original investigation reports are available to the NRC upon request.

The investigator(s) have the authority to obtain all the information considered necessary during the course of the investigation and participants of an investigation team are assured of no retaliation for participation in an investigation. Line management cooperates fully with the investigators. The individual leading the investigation is trained and qualified in root cause analysis techniques. This individual is responsible for ensuring the conduct of the investigation is in accordance with procedures and that the outcome of the investigation is properly documented and reported to appropriate levels of management with responsibility for the abnormal event. If a team is used, it includes at least one process expert in addition to the trained root cause investigator. An individual is chosen to lead the incident investigation based on experience and knowledge of the particular area involved with the event or condition.

11.6.3 Follow-up Written Report

When required by regulations, a report summarizing the results of the event investigation is prepared in accordance with procedures. The report contains, at a minimum, the information specified in 10 CFR 70.50(c)(2). The written report is forwarded to the NRC within the time limit specified in the applicable NRC regulations, with the exception that the follow-up written reports required by 10 CFR 70.50(c)(2) are submitted within 60 days.

The 10 CFR 70.50(c)(2) reporting criteria require that the ACP submit a written follow-up report within 30 days of the initial report required by 10 CFR 70.50 (a) or (b) or by 10 CFR 70.74 and Appendix A of Part 70. In lieu of the 30-day requirement described in 10 CFR 70.50(c)(2), NRC approval to submit the required written reports within 60 days of the initial notifications is hereby requested. This exemption request is provided in Section 1.2.5 of this license application.

11.6.4 Corrective Actions

For each significant condition adverse to quality or reportable event where a follow-up written report to the NRC is required, corrective actions to prevent recurrence are developed by responsible management, tracked in a database, and monitored through completion in accordance with the Corrective Action Program. Corrective actions are taken within a reasonable period, commensurate with the safety significance of the event. Evidence files used to support action closure are maintained in accordance with approved records management procedures.

Documentation is maintained so that "lessons learned" may be applied to future operations of the ACP. Details of the event sequence are compared with accident sequences already considered in the ISA. Should it be necessary, the ISA Summary and Addendum 1 of the ISA Summary for the ACP – HALEU Demonstration is are modified to include evaluation of the risk associated with accidents of the type actually experienced. Relevant findings from incident investigations are reviewed with affected ACP personnel.

The Corrective Action Program also requires that initiating events, as defined in the ISA Summary and Addendum 1 of the ISA Summary for the ACP – HALEU Demonstration, will be reviewed and tracked to ensure that the frequency with which they occur does not exceed the assumptions made in the ISA. Should those reviews indicate that the frequencies are not conservative, appropriate actions will be taken to ensure the 10 CFR 70.61 Performance Requirements are met.

11.7 Records Management and Document Control

RMDC programs are established to ensure records and documents required by the QAPD are appropriately managed and controlled. These programs are designed to meet the specific record keeping and document control requirements set forth in 10 CFR Part 70 and the applicable provisions of other parts of 10 CFR. These programs provide administrative controls that establish standard methods and requirements for collecting, maintaining, and disposing of records. These programs also ensure that documents are controlled and distributed in accordance with identified written requirements and authorizations. The administrative controls for the generation and revision of records and documents are contained in implementing procedures. The principal elements of each of the RMDC programs and a brief description of the manner in which the functions associated with each element are performed are provided below, along with a list of the types of records that are retained for the duration of the licensed activities.

11.7.1 Records Management Program

The Records Management program provides direction for the handling, transmittal, storage, and retrievability of records. Records Management design provides for adequate assurance that the appropriate records of IROFS are maintained in accordance with the BDC contained in 10 CFR 70.64(a) and the defense in depth requirements of 10 CFR 70.64(b)~~.~~, and the requirements contained in the Quality Assurance Program Description (QAPD). Records maintained pursuant to 10 CFR Part 70 may be the original, a reproduced copy, electronic media, or microform, if such reproduced copy, electronic media, or microform is duly authenticated by authorized personnel and is capable of producing clear, complete, accurate and legible copies through storage for the period specified by regulation. Records such as letters and check lists must include pertinent information such as stamps, initials, and signatures. Initials and signatures may be authenticated electronic reproductions. Records are categorized and handled in accordance with their relative importance to safety and storage needs. Special provisions are made for handling contaminated records and ensuring their inclusion in the program. This program is implemented through procedures that provide guidance for the following program elements.

11.7.1.1 Legibility, Accuracy, and Completeness

Documents designated to become records must be legible, accurate, complete, and contain an appropriate level of detail commensurate with the work being performed and the information required for that type of record.

11.7.1.2 Identification of Items and Activities

Records clearly and specifically identify the items or activities to which they apply.

11.7.1.3 Authentication

Records are authenticated or validated by the manager of the organization that originates the record, or his designee, as specified in the procedure, which controls the generation and revision of these records.

11.7.1.4 Indexing and Filing

Methods are specified for indexing, filing, and locating records within the record system to ensure the records can be retrieved in a timely manner.

11.7.1.5 Retention and Disposition

Records retention times are specified by the manager, or designee, of the organization that originates the record. Lifetime records are retained for the life of the item to which they apply or as required by a regulatory agency. The process for disposition of records that have reached the end of their retention lifetime is specified by procedures and conforms to applicable requirements.

11.7.1.6 Corrections

Corrections to records are approved by the organization that created the record unless other organizations are specifically designated. Changes are made by clearly indicating the correction, the date of the correction and the identification of the individual making the correction.

11.7.1.7 Protection of Records

Controls are established for protection of records from deterioration, loss, damage, theft, tampering, and/or unauthorized access for the life of the record. Requirements include instructions on protection of records by the record originator until they are transferred to Records Management. Lost or damaged records are replaced, unless deemed impractical with the concurrence of the QA organization. Single copy records are checked out of storage only if they cannot be copied and then only for a limited period. Temporary protection in such cases is provided by prudent business practices (e.g., record of custody, office environment, and workplace security). Instructions for the protection of special record media such as radiographs, photographs, negatives, microform and magnetic media are provided to prevent damage from excessive light, stacking, electromagnetic fields, temperature, humidity, or any other condition adverse to the preservation of those records. Records, which cannot be duplicated, are stored in a fashion that minimizes deterioration.

11.7.1.8 Storage Requirements

Records encompassed by the QAPD are stored in authorized facilities or containers providing protection from fire hazards, natural disasters, environmental conditions, and infestations of insects, mold, or rodents and dust or airborne particles. The applicable document that specifies the record indicates those to be forwarded for lifetime storage. Storage facilities are maintained to ensure continuous protection of the records. Requirements are specified for both permanent and temporary storage of records.

- **Permanent Storage**

  Records are permanently stored in facilities satisfying the following requirements:

  - Single Sstorage consist of facility, vault, room or container with a minimum 2-hour fire rating. The design and construction of a single storage facility, vault room, or container shall be reviewed for adequacy by a person competent in fire protection or contain a certification or rating from an accredited organization. 2-hour-rated containers meeting National Fire Protection Association (NFPA) 232-2000 with the clarification that if the NFPA 232 method of storage in 2-hour-rated containers is used, any exceptions to this standard will be documented and justified by the authority having jurisdiction; or

  - Dual Storage facilities, containers or a combination thereofof duplicate copies in separate facilities that are sufficiently remote from each other to eliminate the possibility of exposure to simultaneous hazards.; or

  - Storage in facilities that have the following: doors, structures, frames, and hardware that comply with a minimum 2-hour fire rating; a fire protection system; 2-hour fire rated dampers on boundary penetrations; sealed floor surface to minimize concrete dust; adequate access and aisle ways; and a prohibition on eating, drinking, or smoking and performing work other than that associated with records storage or retrieval.

- **Temporary Storage**

  The RMDC process requires that those completed records documenting nuclear safety or safeguards and security matters, which are being held temporarily by originating organizations, be properly protected by maintaining them in 1-hour, fire-rated facility or containers. If 1-hour fire-rated containers is are used they either bear an Underwriters Laboratory label (or equivalent) certifying 1-hour fire protection, or the containers are is certified for 1-hour fire protection by an authorized individual competent in the field of fire protection. Procedural requirements are used to limit the length of time during which records may be maintained in temporary storage, based on the significance of the record.

11.7.1.9 Receipt of Records

A record transmittal process is used to formally transmit records to Records Management. The process includes a receipt acknowledgment that notifies the sending organization that the records have been received and accepted.

11.7.1.10 Access to Records and Accountability for Removed Records

Requirements for controlling access to records and maintaining accountability for records are provided to ensure that only authorized personnel have access to records and to prevent loss, damage, or inadvertent destruction of records.

11.7.1.11 Records Requirements for Procured Goods or Services

Records management requirements for goods or services procured from outside suppliers are specified in the applicable procurement documents. These requirements cover:

- Supplier methods for collection, storage, and maintenance of records
- Identification of required records and applicable retention periods
- Records submittal plans or indexes
- Availability, accessibility, and if applicable, disposition criteria for records retained by the supplier
- Accessibility of the supplier's records prior to the final transfer to the purchaser

11.7.1.12 Control of Sensitive Records

Control, accountability, protection, and disposition of classified and sensitive records are in accordance with SP-3605-0041, *Security Plan for the Protection of Classified Matter*~~*Chapter 2.0 of the Security Program for*~~ at *the American Centrifuge Plant* and any other applicable security and privacy requirements. Control of contaminated records is in accordance with applicable radiological control requirements.

11.7.1.13 Types of Records

The requirements for records management vary according to the nature of the plant and the hazards and risks posed by it. Examples of the records required by 10 CFR Parts 19, 20, 21, 25, and 70 are identified in Section 11.7.5 of this license application. The records are listed under the chapter headings of the NUREG-1520, *Standard Review Plan for Fuel Cycle Facilities License Applications* ~~(SRP)~~. The list is not intended to be exhaustive or prescriptive. Different or additional records may be required in certain circumstances.

11.7.1.14 Usage and Control of Computer Codes and Data

Computer programs used in the Records Management program are controlled and maintained in accordance with classified information systems security and administration procedure requirements, unclassified computer security plan requirements, and information technology operations guidance. These requirements and practices provide for virus protection as well as access control to the Records Management program database and ensure continuing usability of the codes as hardware and software technology change. Routine backups of the Records Management database are performed by application administrators. Precautions are taken to ensure that computer data that constitute a record are stored in a format that is readily retrievable even as hardware and software technology evolve. The storage format of computer data is reviewed as required to determine threats to future retrievability, and if necessary, the data are translated to an updated format and verified acceptable.

11.7.1.15 Items Relied On For Safety Failures

Records of IROFS failures are kept and updated in accordance with 10 CFR 70.62 (a)(3). Record revisions necessitated by post-failure investigation conclusions will be made promptly in accordance with 10 CFR 70.62(a)(3) based on the nature of the record, extent of revision necessary, and potential safety significance. Necessary record revisions will be made within 30 days of the completion of the investigation, unless specifically approved by ACP management

11.7.1.16 Assessment

The overall effectiveness of the Records Management program is evaluated through the audit program described in the Section 18 of the QAPD. Deficiencies identified are corrected in a timely manner in accordance with the procedures described in Section 11.6 of this license application.

11.7.2 Document Control Program

The Document Control program provides direction for the handling, distribution, and transmittal of documents important to nuclear safety and safeguards and security that specify quality requirements or prescribe activities affecting quality, such as procedures, drawings, and calculations. This program is implemented through procedures that provide guidance on the following program elements.

11.7.2.1 Unique Identifier

A unique identification number is assigned or obtained by the generator for each document requiring controlled distribution. Document Control concurs with the numbering scheme for each document type.

11.7.2.2 Approval and Release of Documents

For documents and changes to documents required by the QAPD, requirements are ~~established for~~verified adequate, approved~~al~~ and released ~~of those documents~~ for distribution. Organizations that are authorized to approve and distribute controlled documents are identified in the plant procedures. Changes to controlled documents are approved. After approval, the documents are forwarded to Document Control for control and distribution pursuant to the personnel on the approved distribution list.

11.7.2.3 Master Copy

A master copy of approved controlled documents is maintained by Document Control to ensure the document is available for controlled copy issuance.

11.7.2.4 Controlled Document Index and Distribution Lists

Creation and maintenance of a controlled document index and controlled distribution list(s) for each document or document type are required. The controlled document index is used to maintain a list of controlled documents and to track the current (latest) approved revision levels of those documents. The index is available to users to verify current document revision levels. The controlled document index and the distribution lists are maintained and updated by Document Control.

11.7.2.5 Copies of Controlled Documents

Each controlled copy is stamped, marked, or otherwise identified. A method is established in procedures for duplicating and marking controlled documents so that duplicates are distinguishable from the controlled version. Copies of controlled documents that are not marked or otherwise identified in accordance with procedural requirements are considered information only.

11.7.2.6 Distribution

Controlled documents are distributed in accordance with controlled distribution lists to ensure that they are available in a timely manner at locations where work is being performed. Specific time requirements are established for controlled document distribution and receipt acknowledgment. Document Control uses a transmittal form to distribute controlled documents to copyholders. Copyholders sign, date, and return the transmittal form to confirm that they have received the documents. Document Control tracks the issuance and receipt of transmittals.

11.7.2.7 Voided, Canceled, or Superseded Documents

When notified by the generator of a controlled document that the document has been voided, canceled, or superseded, Document Control removes the document from distribution and notifies copyholders of the changed status.

The approved revised document is distributed at the time that the original document is superseded. The Document Control database is updated to identify the latest approved revision of the document. Distribution of revised documents is described in the Document Control Program procedure and using a Transmittal Form distributed by either interoffice mail or hand delivery. The holder of the Controlled Copy is required to acknowledge receipt by returning a signed Transmittal Form to Document Control. Document distribution is completed in accordance with the safety significance of the document being distributed.

11.7.2.8 Marking Sensitive Documents

Proper marking and handling of documents designated as classified or sensitive documents is accomplished in accordance with SP-3605-0041, *Security Plan for the Protection of Classified Matter at the American Centrifuge Plant* ~~Chapter 2.0 of the Security Program for the American Centrifuge Plant~~ and any other applicable security and privacy requirements.

11.7.2.9 Change Documents

Change documents are documents that are used to modify controlled documents. Controls are also applied to the change documents to provide revision approval and distribution controls equivalent to the original document until completion of installation, at which time the original document is revised. Documents showing the current configuration are not changed until the modifications are completed.

11.7.2.10 Revision Identification

The controlled document revision level is clearly identified on the document.

11.7.2.11 Document User Responsibilities

Responsibilities of the end user and copyholders are defined. Responsibilities include requirements for the use of controlled documents and working copies. Copyholders of controlled documents update their controlled documents each time a revision or change is sent out, and promptly return the transmittal form acknowledging receipt.

11.7.2.12 Usage and Control of Computer Codes and Data

Computer programs used in the Document Control program are controlled and maintained in accordance with classified information systems security and administration procedure requirements, unclassified computer security plan requirements, and information technology operations guidance. These requirements provide for virus protection as well as access control to the Document Control program database and ensure continuing usability of the codes and data as hardware and software technology change. For example, procedures allow older forms of information and codes for older computing equipment to be transferred to contemporary computing media and equipment. Routine backups of the Document Control database are performed by application administrators.

11.7.2.13 Assessment

The overall effectiveness of the Document Control program is evaluated through the audit program described in Section 18.0 of the QAPD. Deficiencies identified are corrected in a timely manner in accordance with the requirements described in Section 11.6 of this license application.

11.7.2.14 Archiving Documents

Revisions of controlled documents are transmitted to RMDC and the previous revision of the document is archived in accordance with the requirements of the Document Control Process.

11.7.3 Organization and Administration

11.7.3.1 Responsibilities

The Training and Procedures Manager is responsible for the RMDC program. These responsibilities include:

- Directing the activities and personnel of the RMDC programs
- Directing the development, implementation, and maintenance of methods and procedures encompassing a records management program
- Directing the development, implementation, and maintenance of methods and procedures encompassing a document control program
- Assuring that the laws, codes, standards, regulations, and company procedures pertaining to record keeping and document control requirements are met
- Select RMDC activities may be contracted from a qualified provider.

11.7.3.2 Training and Qualifications

Appropriately trained and qualified personnel manage the RMDC programs. No specific experience related to the control of documents or management of records is required, although previous technical or RMDC experience is recommended.

11.7.4 Employee Training

General training in RMDC is provided to employees as part of the general topics covered in GET, as described in Section 11.3 of this license application.

11.7.5 Examples of Records

The following are examples of the types of records maintained by RMDC.

- **Chapter 1.0 - General Information**
  - Construction records

  - Plant and equipment descriptions and drawings
  - Design criteria, requirements, and bases for IROFS as specified by the ACP CM function
  - Records of plant changes and associated integrated safety analyses, as specified by the ACP CM function
  - Safety analyses, reports, and assessments
  - Records of site characterization measurements and data
  - Records pertaining to on-site disposal of radioactive or mixed wastes in surface landfills
  - Procurement records, including specifications for IROFS
- **Chapter 2.0 - Organization and Administration**
  - Administrative procedures with safety implications
  - Change control records for nuclear material control and accounting program
  - Organization charts, position descriptions, and qualification records
  - Safety and health compliance records, medical records, personnel exposure records, etc.
  - QA records
  - Safety inspections, audits, assessments, and investigations
  - Safety statistics and trends
- **Chapter 3.0 - Integrated Safety Analysis**
- **Chapter 4.0 - Radiation Safety**
  - Bioassay data
  - Exposure records
  - Radiation protection (and contamination control) records

  - ➢ Radiation training records

  - ➢ Radiation work permits

- **Chapter 5.0 - Nuclear Criticality Safety**

  - ➢ Nuclear criticality control written procedures and statistics

  - ➢ NCS evaluations

  - ➢ Records pertaining to nuclear criticality inspections, audits, investigations, and assessments

  - ➢ Records pertaining to nuclear criticality incidents, unusual occurrences, or accidents

  - ➢ Records pertaining to NCS evaluations

- **Chapter 6.0 - Chemical Safety**

  - ➢ Chemical process safety procedures and plans

  - ➢ Records pertaining to chemical process inspections, audits, investigations, and assessments

  - ➢ Chemical process diagrams, charts, and drawings

  - ➢ Records pertaining to chemical process incidents, unusual occurrences, or accidents

  - ➢ Chemical process safety reports and analyses

  - ➢ Chemical process safety training

- **Chapter 7.0 - Fire Safety**

  - ➢ Fire Hazard Analysis

  - ➢ Fire prevention measures, including hot-work permits and fire watch records

  - ➢ Records pertaining to inspection, maintenance, and testing of fire protection equipment

  - ➢ Records pertaining to fire protection training and retraining of response teams

  - ➢ Pre-fire emergency plans

- **Chapter 8.0 - Emergency Management**
  - Emergency plan(s) and procedures
  - Comments on emergency plan from outside emergency response organizations
  - Emergency drill records
  - Memoranda of understanding with outside emergency response organizations
  - Records of actual events
  - Records pertaining to the training and retraining of personnel involved in emergency preparedness functions
  - Records pertaining to the inspection and maintenance of emergency response equipment and supplies
- **Chapter 9.0 - Environmental Protection**
  - Environmental release and monitoring records
  - Environmental report and supplements to the environmental report, as applicable
- **Chapter 10.0 - Decommissioning**
  - Decommissioning records
  - Financial assurance documents
  - Decommissioning cost estimates
  - Site characterization data
  - Final survey data
  - Decommissioning procedures
- **Chapter 11.0 - Management Measures**
  - Section 11.1 - Configuration Management
    - Safety analyses, reports, and assessments that support the physical configuration of process designs, and changes to those designs

- ❖ Validation records for computer software used for safety analysis or nuclear material control and accounting
- ❖ ISA documents, including process descriptions, plant drawings and specifications, purchase specifications for IROFS
- ❖ Approved, current operating procedures and emergency operating procedures

➢ Section 11.2 - Maintenance

- ❖ Record of IROFS failures (required by 10 CFR 70.62)
- ❖ PM records, including trending and root cause analysis
- ❖ Calibration and testing data for IROFS
- ❖ Corrective maintenance records

➢ Section 11.3 - Training and Qualification

- ❖ Personnel training and qualification records
- ❖ Training procedures
- ❖ Training modules

➢ Section 11.4 - Procedures

- ❖ Standard operating procedures
- ❖ Functional test procedures

➢ Section 11.5 - Audits and Assessments

- ❖ Audits and assessments of safety and environmental activities

➢ Section 11.6 - Incident Investigations

- ❖ Investigation reports
- ❖ Changes recommended by investigation reports, how and when implemented
- ❖ Summary of reportable events for the term of the license
- ❖ Incident investigation policy

- Section 11.7 - Records Management
  - Policy
  - Material storage records
  - Records of receipt, transfer, and disposal of radioactive material
- Section 11.8 - Other QA Elements
  - Inspection records
  - Test records
  - Corrective action records

11.8 Other Quality Assurance Elements

The plant has developed QA principles as described in Section 1.0 of the QAPD.