Enclosure 2 of ACO 20-0010

Proposed Changes for LA-3605-0001, ***License Application for the American Centrifuge Plant***

Information Contained Within **Does Not Contain** **Export Controlled Information**
Reviewing Official: #1014
Date: 04/22/2020

LA-3605-0001

License Application

for the American Centrifuge Plant
in Piketon, Ohio

The American Centrifuge™

Proposed Change~~Revision 54~~

Docket No. 70-7004

April 2020~~February 2020~~

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LA-3605-0001

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for the American Centrifuge Plant in Piketon, Ohio

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ACRONYMS AND ABBREVIATIONS

ACE	American Centrifuge Enrichment, LLC
ACH	American Centrifuge Holdings, LLC
ACL	Administrative Control Level
ACM	American Centrifuge Manufacturing, LLC
ACO	American Centrifuge Operating
ACP	American Centrifuge Plant
ACR	Area Control Room
ACS	Access Control System
ACT	American Centrifuge Technology, LLC
AEA	Atomic Energy Act
AHJ	Authority Having Jurisdiction
AIHA	American industrial Hygiene Association
ALARA	as low as reasonably achievable
amsl	above mean sea level
ANS	American Nuclear Society
ANSI	American National Standards Institute
ARA	Airborne Radioactivity Area
ARF	airborne release fraction
ASME	American Society of Mechanical Engineers
AST	above ground storage tank
ASTM	American Society for Testing and Materials
BCS	Boundary Control Station
BDC	Baseline Design Criteria
BEQ	Baseline Effluent Quantity
BOP	Balance of Plant
BUSTR	Bureau of Underground Storage Tanks
CA	Contamination Area
CAA	Controlled Access Area
CAAS	Criticality Accident Alarm System
CCZ	Contamination Control Zone
CEDE	Committed Effective Dose Equivalent
~~CER~~	~~Compliance Evaluation Reports~~
CERCLA	Comprehensive Environmental Response, Compensation, and Liabilities Act
CFR	*Code of Federal Regulations*
CM	Configuration Management
CVP	Cylinder Valve Protectors
CW	chilled water
CWA	Clean Water Act
CWIP	Construction Work in Progress
D&D	decontamination and decommissioning
DA	Design Authority
DAC	Derived Air Concentration
DBE	design basis earthquake
DCP	double contingency principle

DFP	Decommissioning Funding Plan
D-G	diesel generator
DID	defense in depth
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DP	Decommissioning Plan
DR	damage ratio
DSA	Decontamination Service Area
DUF6	depleted uranium hexafluoride
ECS	Engineering Consulting Services
EOC	Emergency Operations Center
EPA	Environmental Protection Agency
EPC	Engineering, Procurement, and Construction
EPCRA	Emergency Planning and Community Right to Know Act
ERPG	Emergency Response Planning Guidelines
ER	Environmental Report
EV	evacuation vacuum
FBP	Fluor-BWXT Portsmouth
FCA	Fixed Contamination Area
FHA	Fire Hazards Analysis
FM	Factory Mutual
FNAD	Fixed Nuclear Accident Dosimeters
FNMCP	Fundamental Nuclear Material Control Plan
FPPA	*Farm Protection Policy Act*
FSU	former Soviet Union
FWLA	Fugro, Williams, Lettis and Associates
FHA	Fire Hazards Analysis
FNAD	Fixed Nuclear Accident Dosimeters
FNMCP	Fundamental Nuclear Material Control Plan
GCEP	Gas Centrifuge Enrichment Plant
GDP	gaseous diffusion plant
GET	General Employee Training
GTC	Gas Test Stand Center
HA	Hazard Analysis
HALEU	High Assay Low Enriched Uranium
~~HAZCOM~~	~~hazardous communication~~
HAZMAT	hazardous material
HCA	High Contamination Area
HE	Hazard Evaluation
HEPA	high efficiency particulate air
HEU	high enriched uranium
HMTA	Hazardous Materials Transportation Act
HP	Health Physics
HRA	High Radiation Area
HVAC	Heating, Ventilation, and Air Conditioning
IC	initial condition

ICP/MS	Inductively Coupled Plasma/Mass Spectrometry
IDS	Intrusion Detection System
IEEE	Institute of Electrical and Electronics Engineers
IEU	intermediate enriched uranium
IHS	Industrial Hygiene and Safety
IPP	Interconnecting Process Piping
IROFS	items relied on for safety
ISA	Integrated Safety Analysis
ISTP	Integrated Systems Test Plan
LCC	local control center
LEC	Liquid Effluent Collector
LEPC	Local Emergency Planning Commission
LEU	low enriched uranium
LLMW	low level mixed waste
LLRW	low level radioactive waste
LPF	leak path factor
LSDA	Lower Suspension and Drive Assembly
M&TE	measuring and test equipment
MAR	material at risk
MCNP	Monte Carlo n-particle
MCS	Mid-America Conversion Services, LLC
MCW	machine cooling water
MDA	Minimum Detectable Activity
MEI	Maximally Exposed Individual
MM	Modified Mercalli
MSDS/SDS	Material Safety Data Sheet/Safety Data Sheet
NA	not applicable
NAAQS	National Ambient Air Quality Standards
M&TE	measuring and test equipment
NCS	Nuclear Criticality Safety
NCSE	Nuclear Criticality Safety Evaluation
NDA	Nondestructive Assay
NEMA	National Electrical Manufacturers Association
NEPA	National Environmental Protection Act
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NHPA	*National Historic Preservation Act*
~~NIOSH~~	~~National Institute for Occupational Health and Safety~~
NIST	National Institute of Standards and Technology
NMC&A	Nuclear Materials Control and Accountability
~~NMMSS~~	~~Nuclear Materials Management and Safeguards System~~
NPDES	National Pollutant Discharge Elimination System
NPH	natural phenomena hazard
NRC	U.S. Nuclear Regulatory Commission
NSPS	new source performance standards
NVLAP	National Voluntary Laboratory Accreditation Program

OAC	Ohio Administrative Code
OEPA	Ohio Environmental Protection Agency
OJT	on-the-job training
ORC	Ohio Revised Code
OSHA	Occupational Safety and Health Administration
PA	Public Address
PBT	Performance Based Training
PCF	Plant Control Facility
PFPE	polyfluoropolethers
PGA	peak ground acceleration
~~PGDP~~	~~Paducah Gaseous Diffusion Plant~~
~~PBT~~	~~Performance Based Training~~
PHA	Preliminary Hazard Analysis
PM	preventive maintenance
PMF	Probably Maximum Flood
PMT	post-maintenance testing
PORTS	Portsmouth Gaseous Diffusion Plant
PPE	personal protective equipment
PSD	prevention of significant deterioration
PSM	Process Safety Management
PSP	Protective Shipping Packages
PSRC	Plant Safety Review Committee
PSS	Plant Shift Superintendent
PT	performance testing
PTI	permits-to-install
PV	purge vacuum
QA	Quality Assurance
QAPD	Quality Assurance Program Description
QC	Quantity Control
QL	Quality Level
QRA	Quantitative Risk Analysis
R&D	research and development
R/A	Recycle/Assembly
RA	Radiation Areas
RAM	random access memory
RCRA	*Resource Conservation and Recovery Act* of 1976
RCW	recirculating cooling water
REIRS	Radiation Exposure Information Reporting System
RF	respirable fraction
RG	Regulatory Guide
~~RGA~~	~~Regional Gravel Aquifer~~
RHW	recirculating heating water
RM	river mile
RMA	Radioactive Material Area
RMC	Ridge Mast Crane
RMDC	Records Management and Document Control

RMP	Risk Management Program
RP	Radiation Protection
RPM	Radiation Protection Manager
RQ	Reportable Quantity
RWP	Radiation Work Permit
SAR	Safety Analysis Report
SARA	*Superfund Amendments and Reauthorization Act*
~~SCBA~~	~~self-contained breathing apparatus~~
SERC	Ohio State Emergency Response Commission
SHPO	Ohio State Preservation Officer
SIC	standard industrial classification
SME	Subject Matter Expert
SNM	special nuclear material
SPCC	Spill Protection Control and Countermeasures
SRD	System Requirements Document
SRP	Standard Review Plan
SSCs	structures, systems, and components
~~STP~~	~~Sewage Treatment Plant~~
SWPP	Storm Water Pollution Prevention
TDAG	Training Development and Administrative Guide
TEDE	Total Effective Dose Equivalent
TLDs	Thermoluminescence Dosimeters
TLV	Threshold Limiting Value
TPQ	threshold planning quanitity
TQs	Threshold Quantities
TRM	Training Requirement Matrices
~~TSD~~	~~Treatment, Storage, or Disposal~~
TWC	Tower Water Cooling
~~TWCR~~	~~Tower Water Cooling Return~~
~~TWCS~~	~~Tower Water Cooling Supply~~
~~UCNI~~	~~Unclassified Controlled Nuclear Information~~
~~UCRS~~	~~upper continental recharge system~~
UL	Underwriters Laboratories
UPS	uninterruptible power supply
USA	Upper Suspension Assembly
USACE	United States Army Corps of Engineers
USEC	USEC Inc.
USGS	U.S. Geological Survey
USL	upper safety limit
UST	underground storage tank
VHRA	Very High Radiation Area
WCA	workers in the controlled area
WI/CL	What-if/Checklist
WRA	workers in the restricted area

DEFINITIONS

Heeling – The process for removing the residual quantity of uranium material that remains in a cylinder after routine evacuation procedures.

Natural Uranium – Any uranium-bearing material whose uranium isotopic distribution has not been altered from its natural occurring state. Natural uranium is nominally 99.283 percent ^{238}U, 0.711 percent ^{235}U, and 0.006 percent ^{234}U (by weight relative to total uranium element).

Normal Uranium – Any uranium-bearing material having a uranium isotopic weight distribution that can be described as being (1) 0.700 to 0.724 percent in combined ^{233}U plus ^{235}U; and (2) at least 99.200 percent in ^{238}U.

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CHEMICALS AND UNITS OF MEASURE

CaF_2	calcium fluoride
cfs	cubic feet per second
Ci	curie
cm	centimeters
cm^2	square centimeter
dpm	disintegration per minute
DUF_6	depleted uranium hexafluoride
F	Fahrenheit
ft	feet
ft/d	feet per day
ft^2	square feet
g	grams
Gal	gallons
Gal/d	gallons per day
HF	hydrogen fluoride
in.	inches
k_{eff}	$k_{effective}$
km	kilometers
km^2	square kilometers
kV	kilovolts
L	liters

lb	pounds
L/d	liters per day
lfpm	linear feet per minute
m	meters
m^2	square meters
mCi	millicuries (one-thousandth of a curie)
mCi/mL	millicuries per milliliter
mg	milligram (one-thousandth of a gram)
mg/L	milligrams per liter
mph	miles per hour
mrem	millirem (one-thousandth of a rem)
MTU	metric tons uranium
pCi	picocurie (one-trillionth of a curie)
pCi/L	piocuries per liter
ppm	parts per million
psf	pounds per square foot
psi	pounds per square inch
REM~~rem~~	~~roentgen~~ Roentgen ~~equivalent~~ Equivalent ~~man~~Man
SWU	separative work units
U_3O_8	depleted uranium oxide
UO_2F_2	uranyl fluoride
UF_6	uranium hexafluoride
V	volt
wt.	weight
YA	Instrument Air
μCi	microcurie (one-millionth of a curie)
μCi/g	microcuries per gram
μg	microgram (one-millionth of a gram)
μg/kg	micrograms per kilogram
μg/L	micrograms per liter
μg/mL	micrograms per milliliter
μg/m^3	micrograms per cubic meter
μ	micron or micrometer (one-millionth of a meter)
^{235}U	uranium-235
^{99}Tc	technetium

EXECUTIVE SUMMARY

This license application was previously submitted by Centrus Energy Corp. (Centrus), formerly known as ~~prepared by~~ USEC Inc. ~~(USEC)~~ the applicant for a license to possess and use special nuclear, source and by-product material in the American Centrifuge Plant located in Piketon, Ohio, under the *Atomic Energy Act* of 1954, as amended, 10 *Code of Federal Regulations* (CFR) Parts 70, 40 and 30, and other applicable laws and regulations. A primary mission of the American Centrifuge technology is to provide the United States with a reliable and economical source of enriched uranium. ~~USEC~~ Centrus is the parent company of the ~~United States Enrichment Corporation~~American Centrifuge Operations, LLC (ACO), which is the current ~~holder~~ assignee of a sublease for portions of the Portsmouth Gaseous Diffusion Plant (GDP) reservation from the U.S. Department of Energy (DOE) through the *Lease Agreement between the U.S. Department of Energy and United States Enrichment Corporation for the Gas Centrifuge Enrichment Plant* (GCEP lease Agreement).~~U.S. Nuclear Regulatory Commission Certificate of Compliance for PORTS issued under 10 CFR Part 76. USEC is a global energy company and a leading supplier of enriched uranium fuel for commercial nuclear power plants. American Centrifuge Operating, LLC~~ACO (the Licensee) is a wholly owned indirect subsidiary of Centrus~~American Centrifuge Holdings, LLC, which~~ and is a limited liability company formed under the laws of Delaware. ~~American Centrifuge Holdings, LLC is a wholly owned subsidiary of USEC.~~

Deployment of the American Centrifuge Plant supports the national energy security goal of maintaining a reliable and secure domestic source of enriched uranium. Through amendments to the *Atomic Energy Act*, Congress created and privatized the Corporation with the intention that USEC would, among other things, conduct research and development as required, evaluate alternative technologies for uranium enrichment and help maintain a reliable and economical domestic source of enriched uranium. Centrus continues that fundamental mission through its indirect subsidiary ACO (the Licensee).

The Licensee is responsible for the design, fabrication, installation, operation, maintenance, modification and testing of the American Centrifuge Plant. The American Centrifuge Plant is a uranium enrichment facility designed to enrich, safely contain and handle uranium hexafluoride up to 10-weight percent uranium-235. ~~USEC requested~~ACO currently holds a license for a term of 30 years ~~from the start of operations~~. The initial modular design produces approximately 3.8 million separative work units annually. This submittal continues with modular deployment of the American Centrifuge Plant and the next phase of enrichment production, which involves deployment of a cascade of 16 centrifuges to demonstration production of high-assay, low-enrichment uranium fuel for advanced reactors. The design of the American Centrifuge Plant complies with the Baseline Design Criteria specified in 10 CFR 70.64(a) and the defense-in-depth requirements contained in 10 CFR 70.64(b).

The American Centrifuge Plant is located on U.S. Department of Energy (DOE) owned land in rural Pike County, a sparsely populated area in south central Ohio. Some of these facilities are leased to the Licensee. The DOE reservation has been studied and characterized extensively by both DOE and Centrus, formerly USEC. The facilities to be utilized for the American Centrifuge Plant, which are part of the former DOE Gas Centrifuge Enrichment Plant program, were built in the early 1980s. The existing facilities will be refurbished to accommodate the

American Centrifuge Plant. New facilities will be constructed to house withdrawal and product operations for the commercial American Centrifuge Plant. The commercial American Centrifuge Plant operation will also use other existing site-wide services such as laboratory analysis, fire protection, security, medical, waste management and environmental monitoring.

This license application follows the format and guidelines provided in NUREG-1520, *Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility*. The Application is written prospectively in the present tense, representing the licensed condition. The information provided reflects the design in sufficient detail to enable a reviewer to make a definitive evaluation that the American Centrifuge Plant can be constructed and operated without undue risk to the health and safety of the public, and with no significant impact to the environment.

1.0 GENERAL INFORMATION

This license application was previously submitted by ~~USEC Inc. (USEC)~~Centrus Energy Corp. (Centrus), formerly known as USEC Inc., for the American Centrifuge Plant (ACP). It encompasses the construction, manufacturing, start-up, operations, maintenance, and decommissioning of a uranium enrichment facility using American Centrifuge technology that will produce approximately 3.8 million separative work units (SWU) annually. ~~The ACP is located on the U.S. Department of Energy (DOE) reservation near Piketon, Ohio.~~

The United States Enrichment Corporation leases portions of the Portsmouth Gaseous Diffusion Plant (GDP) reservation from the U.S. Department of Energy (DOE) through the *Lease Agreement between the U.S. Department of Energy and United States Enrichment Corporation for the Gas Centrifuge Enrichment Plant* (GCEP Lease Agreement). Pursuant to a 2006 amendment to that lease agreement, Centrus subleased space for the American Centrifuge Lead Cascade Facility (Lead Cascade) and the ACP from the United States Enrichment Corporation. Centrus, with approval of the DOE, assigned the sublease for the space for the ACP to the Licensee, American Centrifuge Operating, LLC (ACO). The Licensee and its agents will conduct activities within the leased facilities and access and egress thereto, in accordance with this license application.

The ACP utilizes existing buildings located on the DOE reservation near Piketon, Ohio, that were built to support the gaseous centrifuge process beginning in the 1980s, in addition to several newly constructed buildings and facilities.

The ACP is the third step in the plan to deploy the American Centrifuge technology. The first step ~~is~~ was the centrifuge ~~machine~~ testing in Oak Ridge, Tennessee, ~~(which is underway)~~ to upgrade, and demonstrate an economically attractive gas centrifuge ~~machine~~ and enrichment process. The second step ~~is~~ was the deployment of the Lead Cascade ~~Demonstration Facility (Lead Cascade)~~ in Piketon, Ohio ~~(which is also underway)~~, which ~~will~~ provided reliability, performance, cost, and other vital data on the ACP enrichment process. ~~The~~ American Centrifuge ~~Plant~~ technology ~~design~~ is modular, with the basic building block of enrichment capacity being a cascade of centrifuges ~~machines~~. Information gained and work performed during the centrifuge testing and Lead Cascade projects included vital information ~~The demonstration phase (centrifuge testing and Lead Cascade) will provide information~~ on performance, reliability, and economics that will be used in the construction of the ACP. ~~This~~ A license application ~~is being submitted~~ was prepared pursuant to the *Atomic Energy Act* of 1954 as amended, 10 *Code of Federal Regulations* (CFR) Parts 70, 40, ~~and~~ 30, and other applicable laws and regulations. The commercial ACP operation is designed to enrich~~,~~ and safely contain and handle uranium hexafluoride (UF_6) up to 10-weight (wt.) percent uranium-235 (^{235}U). This license application includes the High Assay Low Enriched Uranium (HALEU) Demonstration Program which is designed to enrich and safely contain and handle UF_6 with an operational limit that is less than 20.0 wt. percent ^{235}U. ~~USEC requested a license for a term of 30 years from the start of operations.~~

This license application follows the format and content guidelines provided in NUREG-1520, *Standard Review Plan for ~~the Review of a License Application for a~~ Fuel Cycle Facilities~~y~~ License Applications*, Revision 2 (Reference 1). The information provided reflects the design in sufficient detail to enable a reviewer to make a definitive evaluation that the ACP can be constructed and operated without undue risk to the health and safety of the public and with no significant impact to the environment.

The ACP uses portions of the Portsmouth Gaseous Diffusion Plant (GDP) and the former DOE Gas Centrifuge Enrichment Plant (GCEP) along with ~~buildings/facilities constructed for the ACP~~eight new facilities. The ACP utilizes existing utilities and infrastructure that support the DOE reservation along with the utilities and infrastructure that ~~support the ACP alone~~were intended to support GCEP. ~~Agreements, including performance requirements, are established for those services not self-performed by the Licensee to help ensure they are available and reliable. Some n~~New ~~buildings/~~facilities are necessary ~~to efficiently operate the ACP~~for feed, withdrawal, sampling, and blending/transfer operations. ~~USEC~~Centrus has updated the ~~gas centrifuge~~ American Centrifuge technology from that used in the GCEP program, but the American Centrifuge components remain compatible with existing infrastructure and buildings/facilities.

The HALEU Demonstration Program is a program awarded by DOE's Nuclear Energy Oak Ridge Site Office for the demonstration of the HALEU production to support DOE research and development (R&D) activities and programs. The HALEU Demonstration Contract was awarded on May 31, 2019 and definitized on October 31, 2019 (Reference 17). The two primary objectives of the HALEU Demonstration Program is for American Centrifuge Operating, LLC (ACO), the licensee, to deploy a 16-machine AC-100M HALEU cascade in the Piketon facility to produce 19.75% ^{235}U enriched product and to demonstrate the capability to produce HALEU utilizing US-origin uranium enrichment technology. The HALEU Demonstration will be deployed in a subset of the larger ACP with deviations noted as appropriate in the sections that follow.

It is the intent of the licensee to deploy portions of the ACP in a modular fashion to accommodate market demand on a scalable, economical gradation. This modular deployment will encompass utilization of cascades of LEU production for customer product or feed material into HALEU cascades.

1.1 Plant and Process Description

This section describes the buildings and facilities that comprise the ACP located on the DOE reservation in Piketon, Ohio, and describes the process by which the plant will operate. Facilities are those buildings and systems identified in the lease agreement between the United States Enrichment Corporation and DOE. The ACP buildings and facilities are grouped in two categories, primary and secondary in the Integrated Safety Analysis (ISA) Summary. Figure 1.1-1 (located in Appendix B) depicts the entire DOE reservation and the area where the ACP resides in the southwest quadrant. Figure 1.1-2 (located in Appendix B) depicts a closer view of the ACP area and shows the Primary and Secondary buildings. Primary facilities are those buildings or areas that could contain licensed material in quantities that could potentially result in consequences that exceed the performance criteria defined in 10 CFR 70.61 resulting from credible accidents or that directly control a primary facility. All other ACP facilities are considered to be secondary. A further description of primary and secondary facilities and a list of these buildings/facilities are in Sections 1.1.3 and 1.1.4 of this license application.

The uranium element appears in nature in numerous isotopes; the three major isotopes of interest have atomic weights of 234, 235, and 238. The ^{235}U isotopes are fissionable and capable of sustaining a critical reaction. Natural uranium contains 0.711 percent ^{235}U isotope. Isotopic separation processes separate uranium into two fractions, one enriched in the ^{235}U isotope, and the other depleted.

Prior to the enrichment process, uranium is combined with fluorine to form UF_6 from the uranium feed suppliers. The UF_6 arrives at the plant in a solid state and this UF_6 is sublimed from a solid to a gas and fed into the system. In the gas centrifuge process, the isotopic separation is accomplished by centrifugal force, which uses the difference in weight of the uranium isotopes to achieve this isotopic separation. UF_6 can be enriched up to 10 wt. percent assay ^{235}U in the commercial ACP operation. The plant withdraws the enriched (product) stream and the depleted (tails) stream in the gaseous state. The product and tails streams are then sublimed back into a solid state for handling and movement. The plant minimizes the amount of UF_6 in the liquid state.

Two process buildings are included in the initial deployment of the ACP to support a 3.8 million SWU production capacity with centrifuges ~~machines~~ arranged in cascades.

UF_6 feed to the HALEU Demonstration will be LEU UF_6 product with an enrichment of less than 5.0 wt.% ^{235}U. The HALEU Demonstration will enrich this material to an enrichment less than 20.0 wt.% ^{235}U in its product stream and will deplete the feed to a target tails stream enrichment of approximately equal to or less than 1.0 wt.% ^{235}U.

1.1.1 Site Boundary

The ACP is located approximately one and one half miles east of U.S. Route 23 on the approximately 3,700 acre DOE reservation. The area around the reservation is sparsely populated, with the nearest residential center located approximately four miles to the north of the reservation. The ACP is located in the southwest quadrant of the reservation and is situated on approximately 200 acres. The site boundary is the DOE reservation boundary, which is depicted in Figure 1.1-1 (located in Appendix B). Proximity of the ACP to the nearest member of the public (i.e., permanent residence) is about 2,200 feet (ft) [670 meters (m)].

1.1.2 Plant Layout

The ACP layout is depicted in Figure 1.1-1 in relationship to the DOE reservation and in Figure 1.1-2 (both located in Appendix B) for the ACP specifically. The ACP is comprised of various buildings/facilities and areas that house systems and equipment necessary to support the American Centrifuge uranium enrichment process. The ACP utilizes buildings and facilities that were part of GCEP, built in the early 1980s, part of the GDP that was built in the early 1950s, and newly constructed buildings and facilities. Descriptions of the major primary and secondary facilities are contained in the following sections. A brief listing of the buildings and facilities utilized for the ACP is located in Table 1.1-1.

The design of the plant complies with the performance requirements of 10 CFR 70.61, the Baseline Design Criteria specified in 10 CFR 70.64(a) and the defense-in-depth requirements contained in 10 CFR 70.64(b).

1.1.3 Primary Facilities Description

Primary facilities are those buildings/facilities or areas that could potentially contain licensed material in quantities that result in consequences that exceed the performance criteria defined in 10 CFR 70.61 resulting from credible accidents or directly controls a primary facility. The primary facilities directly involved in the enrichment process are the X-2232C Interconnecting Process Piping (IPP), X-3001 Process Building; X-3002 Process Building; X-3012 Process Support Building; X-3344 Customer Services Building; X-3346 Feed and Withdrawal Building; and X-3346A Feed and Product Shipping and Receiving Building. Other buildings and areas that provide direct support functions to the enrichment process are the X-7725 Recycle/Assembly ~~Facility~~Building; X-7726 Centrifuge Training and Test Facility; X-7727H Interplant Transfer Corridor; X-745G-2 Cylinder Storage Yard; X-745H (future) Cylinder Storage Yard, and X-7746S, X-7746W Cylinder Storage Yards and Intraplant Roadways. These buildings and areas are where special nuclear material and hazardous material can be found and are considered to be the primary facilities in their functional support of the uranium enrichment process. A description of the primary facilities and their function is provided in the following sub-sections and are listed and briefly described in Table 1.1-1. An overall depiction of the enrichment processes is provided in Figure 1.1.3-1 located in Appendix E.

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 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. It is also noted that HALEU Demonstration does not involve or include the use of any liquid UF_6 handling operation or those facilities.

1.1.3.1 X-3001 and X-3002 Process Buildings

The initial deployment of the ACP includes two process buildings, which are located in the southwest quadrant of the DOE reservation: X-3001 and X-3002. The primary purpose of the process buildings is to house the centrifuges ~~machines~~ and support systems necessary to perform the actual enrichment process. Both buildings are similar in construction, layout, and design. Each building is approximately 416 feet (ft) by 730 ft (approximately 304,000 square feet [ft^2]) and has a large high bay process area and two utility areas. The height of each building is approximately

87 ft in the high bay area and 49 ft in the utility areas. The nearest reservation boundary is 2,606 ft to the west of the X-3001 building. Figure 1.1-3 (located in Appendix B) depicts the typical equipment and process flow for the X-3001 and X-3002 buildings. Figures 1.1.3.1-1, 1.1.3.1-2, 1.1.3.1-3, and 1.1.3.1-4 (located in Appendix E) also depict the equipment layout for the X-3001 and X-3002 buildings.

At the north and south ends of X-3001 and X-3002 buildings are equipment/utility bays and mezzanines where auxiliary equipment is housed. Items in these areas consist of heating and ventilation equipment, cooling water pumps, vacuum pumps, electrical switchgear, and standby electrical equipment (i.e., diesel generators, battery rooms, and uninterruptible power supply [UPS] systems). Building vents for the purge and evacuation vacuum systems are also located in the buildings. The vents are monitored and are permitted through the Ohio Environmental Protection Agency (OEPA).

The east side of the X-3001 building is connected to the X-3012 building, which is connected to the west side of the X-3002 building. The X-7727H corridor is connected to the west side of the X-3001 building. The X-2232C piping connects to the southwest corner of the X-3001 building at a valve house where it both enters and exits the building. The connection of the X-2232C piping exits the east side of the X-3001 building and enters and exits the X-3002 building on the west side through a valve house as well.

The centrifuges ~~machines~~ are installed in the high bay area in a cascade arrangement. The cascades are supplied UF_6 feed from a header from the Feed Area in the X-3346 building. The ~~machines~~ centrifuges in each cascade are grouped into stages that are connected in series. The feed, product, and tails lines to and from each centrifuge within a stage connect into stage headers that convey the UF_6 streams between stages. The depleted material from the bottom stage is piped through the X-2232C piping to the X-3346 building Withdrawal Area to be withdrawn as tails. The enriched material from the top stage is piped through the X-2232C piping to the X-3346 building Withdrawal Area to be withdrawn as product. For commercial ACP operations t~~T~~he cascade enrichment is normally less than 5.5 wt. percent ^{235}U, but enrichment levels up to 10 wt. percent ^{235}U are allowable.

The HALEU Demonstration cascade utilizes a similar centrifuge design to that used for the Lead Cascade. The equipment necessary to perform the enrichment process is in the X-3001 Process Building and consists of product and tails withdrawal system, uranium hexafluoride (UF_6) cylinders, centrifuges, and supporting units. The product and tails withdrawal systems use three cold boxes. NaF traps are used for additional withdrawal capacity during dumping. A 30B UF_6 cylinder is used for the feed material. Centrifuges and supporting units are placed in the Train 3 area of the X-3001. For further plant and process specifics related to the HALEU Demonstration Program, refer to LA-3605-0003A, *Addendum 1 of the Integrated Safety Analysis for the American Centrifuge Plant – HALEU Demonstration* (Reference 7).

1.1.3.2 X-3012 Process Support Building

The X-3012 houses the operational area, maintenance area, and the transfer aisleway that services the X-3002 building. The X-3012 building is located between the X-3001 and X-3002 buildings. The X-3012 building, which is approximately 201 ft by 240 ft at grade level, has a ground floor area of approximately 48,000 ft^2, and has a total covered floor space area of approximately 56,200 ft^2, which includes the ground floor and two mezzanine areas. The transfer aisle way between the X-3001 and X-3002 and through the X-3012 building measures 30 ft wide by approximately 59 ft high by 200 ft long and divides the building into north and south sections. The north section is approximately 17 ft high and contains the operational area. The south section of the building is approximately 26.5 ft high and contains the maintenance areas. The nearest reservation boundary is 3,024 ft to the west of the X-3012 building.

The X-3012 building is divided into three functional areas: an operational area, maintenance area, and a ~~machine~~ centrifuge transfer aisleway. The operational area is located in the north section of the building and includes the Area Control Room (ACR) for the X-3001 and X-3002 buildings; offices; lunchroom; restrooms; battery room; switchgear room; and heating, ventilation, and air conditioning (HVAC) rooms. A mezzanine above the north section contains the mechanical equipment room for the building. The ACR provides the central operating functions to monitor and control both the X-3001 and X-3002 building ~~machines~~ centrifuges and processes. The maintenance area is located in the south section of the building and includes: maintenance shops, storage areas, a battery charging room, offices, men's and women's locker rooms, restrooms, and a mezzanine area with additional office areas and HVAC rooms. The X-7727H corridor is used for the transport of centrifuges ~~machines~~ into and out of the X-3002 building.

Access between the X-3001 and X-3002 buildings is provided via the transfer aisleway, which also provides access between the operational and maintenance areas of the X-3012 building.

1.1.3.3 Feed, Withdrawal, and Product Operations

Figure 1.1-4 (located in Appendix B) depicts a process flow schematic of Feed, Withdrawal, and Product operations.

1.1.3.3.1 X-3346 Feed and Withdrawal Building

The X-3346 building is located in the southwest quadrant of the DOE reservation. The X-3346 building is located approximately 1,000 ft south-southwest of the X-3001 building. The nearest reservation boundary is 1,865 ft to the west of the X-3346 building. The X-3346 building is connected to the X-3001 and X-3002 buildings by the X-2232C piping to provide UF_6 feed to the enrichment process and for the withdrawal of product (enriched) and depleted (tails) UF_6 material.

The X-3346 building has a covered floor area of approximately 154,000 ft^2 with two distinct areas of operation to meet process feed, blending/transfer requirements and product and tails withdrawal. The X-3346 building has two distinct areas of operation. The first area, referred to as the Feed Area, supports the front end of the overall enrichment process by housing the equipment necessary to provide UF_6 feed. This area also houses the equipment necessary to blend/transfer UF_6 between cylinders, including filling customer cylinders. The second area, referred to as the Withdrawal Area, supports the back end of the enrichment process by housing the equipment necessary to withdraw enriched UF_6 into cylinders and to withdraw depleted UF_6 (tails) into tails cylinders. Figures 1.1-5a, 1.1-5b, 1.1-5c, 1.1-5d and 1.1-5e (located in Appendix B) depict the typical equipment and process flow for the X-3346 building. Figures 1.1.3.3.1-1, 1.1.3.3.1-2, and 1.1.3.3.1-3 (located in Appendix E) also depict the equipment layout for the X-3346 building.

The Feed Area of the X-3346 building houses electrically heated feed ovens. UF_6 feed is processed through freezer/sublimers to purify the feed material before being fed into the process manifolds/piping. There are separate manifolds that direct each stream to the X-3001 and X-3002 buildings through the X-2232C piping. The light gases removed during the feed purification process are evacuated to an evacuation system in the X-3346 Withdrawal Area. The Feed Area also houses the dedicated feed ovens and cold boxes required to perform blending/transfer operation between the cylinders. See Figure 1.1.3.3.1-4 (located in Appendix E) for a typical depiction of a cold box. This includes filling customer cylinders. A capability is provided to transfer UF_6 from the feed ovens to Withdrawal Area for blending of enriched UF_6 from the enrichment process. The Feed Area has accountability scales for weighing the feed and other cylinders. The location of the feed ovens and cold boxes provides the cylinder transporter sufficient room to transport the UF_6 cylinders between rows of ovens. The cylinder transporters move the cylinders into and out of the feed ovens and cold boxes.

The X-3346 building Withdrawal Area houses the equipment that functions to withdrawal enriched and depleted UF_6 from the process. Product (enriched UF_6) withdrawal is performed via the use of trains of vacuum pumps which directly transfer UF_6 at sub-atmospheric pressures and desublime the UF_6 into cylinders located in cold boxes. These cylinders may be customer cylinders. Different product assays can be withdrawn to the X-3346 building Withdrawal Area from the X-3001 and X-3002 buildings and blending of the material withdrawn may be blended with feed material. Tails withdrawal is performed via the use of multi-stage compressor trains which perform the withdrawal at sub-atmospheric pressures and then desublime the depleted UF_6 into tails cylinders located in cold boxes. A surge drum is in-line ahead of the tails compressor trains and a surge drum is in-line behind each of the two tails compressor trains. The Withdrawal Area has accountability scales for weighing the cylinders. The location of the cold boxes provides the cylinder transporter sufficient room to transport the UF_6 cylinders between rows of cold boxes. The cylinder transporters move the cylinders into and out of the cold boxes.

The primary specialized support systems for the Feed and Withdrawal Area are those associated with purge and evacuation; these systems are located in the X-3346 Withdrawal Area and support operations in the X-3344 building as well. These support systems service both process lines and equipment and local area UF_6 "wisp" management systems that control small UF_6 releases that might occur during operations (i.e., disconnecting pigtails from cylinders). Banks of cold traps are used to remove UF_6 from the gas streams before the gas is transferred though chemical traps and then to a vent through blowers. The purge and evacuation vents are monitored and permitted through the OEPA. Other major support equipment includes refrigeration units, precision scales, and bridge cranes. Other auxiliaries are those that are customary (e.g., electrical supply, instrument air, cooling water, etc.).

1.1.3.3.2 X-3346A Feed and Product Shipping and Receiving Building

The X-3346A building is located in the southwest quadrant of the DOE reservation approximately 300 ft south of the X-3346 building. The building measures approximately 100 ft in width, 40 ft in height, and 190 ft in length with a covered floor area of approximately 19,000 ft^2. This building serves as the focal point for the receipt and shipping of natural and enriched uranium in U.S. Department of Transportation (DOT) approved cylinders and Protective Shipping Packages (PSPs), as required. The nearest reservation boundary is 1,820 ft to the west of the X-3346A building. Figure 1.1-6 (located in Appendix B) depicts the typical equipment and process flow for the X-3346A building. Figure 1.1.3.3.2-1 (located in Appendix E) also depicts the equipment layout for the X-3346A building.

The X-3346A building is connected to the X-3346 building by a bridge crane rail system that serves both the X-3346 and X-3346A buildings. X-3346A has doors on the north and south sides of the building for either trucks (tractor trailer) or cylinder handling equipment or cranes utilized for movement of cylinders.

The X-3346A building contains the operations associated with receiving full UF_6 feed cylinders and returning empty feed cylinders to vendors and the receipt of empty product cylinders and shipment of full product cylinders to customers. The building includes a large shipping and receiving area, cylinder staging area, offices, and a trucker's rest area.

1.1.3.3.3 X-3344 Customer Services Building

The X-3344 building is located in the southwest quadrant of the DOE reservation to the southwest of the X-3001 building and to the north of the X-3346 building. The building is single story and has a covered floor area of approximately 35,200 ft^2 with one area of operation to meet the process sampling requirements. The nearest reservation boundary is 2,780 ft to the west of the X-3344 building. Figure 1.1-7 (located in Appendix B) depicts the typical equipment and process flow for the X-3344 building. Figure 1.1.3.3.3-1 (located in Appendix E) depicts the equipment layout for the X-3344 building. See Figure 1.1.3.3.3-2 (located in Appendix E) for a typical depiction of an autoclave.

The X-3344 Customer Services Building is the only building where liquid UF_6 may be present and a containment barrier (autoclave) is provided should an accident occur during sampling activities. The cylinders are enclosed in containment autoclaves when the UF_6 is in the liquid phase, to minimize the potential for a release of liquid UF_6. In the Customer Services Building, the basic approach to operations is to liquefy the UF_6 contained in cylinders within a closed autoclave, sample the liquid using a sample manifold and sample cylinders within the autoclave, then allow the cylinders to cool until the UF_6 has re-solidified. Cooling capability is supplied to expedite the cool-down process and shorten the cycle time on each individual autoclave. Any approved UF_6 container (2.5-ton, 10-ton or 14-ton) may be heated in an electrically heated containment autoclave for sampling purposes. There are no UF_6 process lines that are external to the autoclaves; the piping used for evacuation is disconnected from the cylinder and sample manifold prior to closure of the autoclave and contains only trace quantities of UF_6.

The primary specialized support systems are those associated with evacuation. These support systems service both evacuation piping lines and equipment and local area UF_6 "wisp" management systems that control small releases that might occur during operations (i.e., disconnecting pigtails from cylinders). The evacuation piping is connected to the evacuation system in the X-3346 Withdrawal Area. The vent(s) are monitored and permitted through the OEPA. Other major support equipment includes feed ovens (heating and refrigeration units), precision scales, and bridge cranes. Other auxiliaries are those that are customary (e.g., electrical supply, instrument air, cooling water, etc.).

1.1.3.4 X-7725 Recycle/Assembly ~~Facility~~Building

The X-7725 ~~facility~~ building is located in the southwest quadrant of the DOE reservation. The X-7725 ~~facility~~ building is connected to X-7726 facility and the X-7727H corridor and is located to the north of the X-3001 and X-3002 buildings. The X-7725 ~~facility~~ building is approximately 540 ft x 820 ft (approximately 442,800 ft^2 area), and it contains a total floor space of about 837,900 ft^2 on five floors. The nearest reservation boundary is 2,431 ft to the west of the X-7725 ~~facility~~building. Figure 1.1-8 (located in Appendix B) depicts the typical equipment and process flow for the X-7725 building and its relationship to X-7726 facility and the X-7727H transfer corridor~~buildings~~. Figures 1.1.3.4-1 and 1.1.3.4-2 (located in Appendix E) also depict the equipment layout for the X-7725 ~~facility~~building.

The purpose of the X-7725 ~~facility~~ building is to provide an area where centrifuges ~~machines~~ can be manufactured, assembled, tested, and maintained. The assembly of centrifuges ~~machines~~ begins with receipt of centrifuge ~~machine~~ components. Then these components are stored and staged for assembly. Centrifuge components and subassemblies are assembled into a complete centrifuge ~~machine~~ on one of the ~~machine~~ centrifuge assembly stands.

If some of the centrifuges are assembled faster than can be transported for installation, these centrifuges can be stored in the buffer storage area. Some completely assembled centrifuges ~~machines~~ are tested in the Gas Test stands using UF_6 to verify the correct placement of ~~machine~~ centrifuge components and the proper operation of the centrifuge ~~machine~~. The Gas Test is performed in the X-7725 ~~facility~~ building prior to moving the centrifuges ~~machines~~ to the process building for installation. Drawing X-7725-0003-ME (located in Appendix A) depicts the Gas Test process flow.

There are various support areas throughout the building on each level. These areas include cranes; mechanical equipment rooms; electrical equipment rooms; freight and personnel elevators; HVAC equipment rooms; maintenance areas; offices; restrooms; shower/locker rooms; shipping/receiving/materials storage areas; and other material handling equipment.

An overhead crane system traverses the buffer storage area and assembly area of the X-7725 building ~~facility~~ for movement of centrifuges ~~machines~~ or other large components.

1.1.3.5 X-7726 Centrifuge Training and Test Facility

The X-7726 facility is located in the southwest quadrant of the DOE reservation. The X-7726 facility is connected and adjacent to the northwest corner of the X-7725 building~~facility~~. The X-7726 facility has an overall height of approximately 80 ft, contains approximately 28,000 ft^2 of floor space at ground level and contains a total of 49,500 ft^2. The nearest reservation boundary is 2,431 ft to the west of the X-7726 facility. Figure 1.1-8 (located in Appendix B) depicts the typical equipment and process flow for the X-7726 facility and its relationship to X-7725 building ~~facility~~ and the X-7727H corridor.

The facility was originally built to support training of plant personnel for centrifuge assembly and testing. This facility will initially be used for centrifuge component manufacturing and centrifuge ~~machine~~ assembly, and then primarily used for a ~~machine~~ centrifuge assembly training and ~~machine~~ centrifuge component preparation area for the ACP.

The X-7726 facility is an area where material and components are received; components or subassemblies are inspected and tested; the components are assembled as centrifuges ~~machines~~; the final assembly is evacuated and leak checked; and repairs are performed to the ~~machine~~ centrifuge or subassemblies until the X-7725 building ~~facility~~ is available for use. Then these functions will be performed in the X-7725 building~~facility~~. The X-7726 facility will then be used as a backup manufacturing/assembly area and may also be used for select repair of failed centrifuges ~~machines~~ or for disassembly of failed ~~machines~~ centrifuges for failure analysis. The X-7726 facility will continue to be used as a training area for centrifuge subassembly preparation, column assembly, and ~~machine~~ centrifuge assembly.

An overhead crane system traverses the length of the X-7726 facility for movement of centrifuges ~~machines~~ or other large components.

There are various support areas throughout the building to provide the necessary ancillary support for the centrifuge assembly operations and personnel. These areas include mechanical equipment rooms; electrical equipment rooms; freight and personnel elevators; HVAC equipment rooms; maintenance areas; offices; restrooms; and shower/locker rooms.

1.1.3.6 X-7727H Interplant Transfer Corridor

The X-7727H corridor is located in the southwest quadrant of the DOE reservation. The nearest reservation boundary is 2,480 ft to the west of X-7727H corridor. The X-7727H corridor measures approximately 30 ft in width, 59 ft in height, and 750 ft in length. There are 55 ft by 25 ft doors located where the corridor meets the X-7725 building ~~facility~~ and X-3001 building. Figure 1.1-9 (located in Appendix B) depicts the typical equipment and process flow for the X-7727H building.

The X-7727H corridor is an elongated structure that connects the X-7725 building ~~facility~~ with the X-3001 building. It provides a protected pathway to transport centrifuges ~~machines~~ from the X-7725 building ~~facility~~ or X-7726 facility to the process buildings or back as necessary. The X-7727H corridor also serves as a shipping and receiving area for equipment and components during construction and operation activities. At the south end of the corridor is a smaller structure/service area, known as the service module unloading area.

1.1.3.7 Cylinder Storage Yards (X-745G-2, X-745H, X-7746S, and X-7746W)

The uranium enrichment process relies on the use of cylinders to allow movement and storage of UF_6 material outside of the process. This method of material handling requires storage areas for cylinders. The ACP cylinder yards provide this storage for natural feed uranium, depleted (tails) uranium, and enriched (product) uranium awaiting shipment. UF_6 cylinders may be stored in any storage yard regardless of use, although cylinders of a certain type may be routinely stored in a particular yard. Figure 1.1-2 (located in Appendix B) depicts the ACP layout and depicts the location of the various cylinder yards.

There are four cylinder storage yards that support the ACP. Two of the yards are located adjacent to the X-3346 building (X-7746S and X-7746W yards), and the other two yards are located just north of the reservation Perimeter Road to the north of the GDP X-344 UF_6 Sampling Facility (X-745G-2 and X-745H yards). The X-7746S, X-7746W, and X-745G-2 Cylinder Storage Yards provide approximately 47,000 ft^2, 132,000 ft^2, and 135,000 ft^2, respectively. The nearest reservation boundary is to the west approximately 1,982 ft from the X-7746S and W Cylinder Storage Yards, and 2,827 ft from the X-745G-2 Cylinder Storage Yard. The Cylinder Storage Yards are designed primarily for storage of 2.5-ton, 10-ton, and 14-ton UF_6 cylinders.

1.1.3.8 X-2232C Interconnecting Process Piping

The X-2232C piping is any process piping that is external to the primary facilities. The X-2232C piping is the piping that connects the X-3346 building to the X-3001 building and the X-3002 building to the X-3001 building to provide feed to the X-3001 and X-3002 buildings and return product and tails to the X-3346 building. The nearest reservation boundary is 2,225 ft to the west of the X-2232C piping. Figure 1.1-10 (located in Appendix B) depicts the typical equipment and process flow for the X-2232C piping.

The X-2232C piping is typically located in a series of elevated enclosures or modules that run from the X-3346 building Feed Area to the X-3001 building valve house (approximately 1,700 ft) and then to the X-3002 valve house (approximately 800 additional ft) to provide feed for enrichment. The X-2232 C piping also runs in the reverse direction from the X-3002 valve house then from the X-3001 valve house to the X-3346 Withdrawal Area for withdrawal of enriched and depleted UF_6. The standard X-2232C piping module is approximately 40 ft long. Some piping modules are of non-standard lengths or shapes to accommodate vertical loops to give extra clearance across roadways and to fit-up to buildings. The X-2232C piping enclosures are insulated to minimize heat loss and heated to prevent the freeze-out of UF_6.

1.1.3.9 X-2202 Roads

No highways enter the DOE reservation. There are access roads that intersect with the Perimeter Road from four directions.

The reservation where the ACP is located has an extensive roadway system. The buildings/facilities on the reservation are serviced with a system of roads, which as a rule generally follow a north-south grid. The volume of traffic on the reservation is low and traffic is limited. Most plant personnel are required to use parking adjacent to the portals. The roadways allow for easy and safe movement of people, equipment, and material.

1.1.4 Secondary Facilities Description

In addition to the primary facilities, there are a number of secondary buildings/facilities and areas that provide indirect support to the ACP enrichment process. No special nuclear material, natural uranium, depleted uranium, or other hazardous radiological materials are found in these buildings/facilities and areas. The support buildings include various electrical utilities, fire protection, sewage treatment, water treatment, hot water production, compressed air, and others. However, some of the utilities and support services are procured. Utilities procured by the ACP include high voltage electrical power, firewater, sanitary water, sanitary sewer, communications, and non-potable cooling water. Support services procured by the ACP include emergency response and administrative support. The procured utilities and services are provided through existing buildings and services.

The major secondary buildings/facilities are depicted in Figures 1.1-1 and 1.1-2 (both located in Appendix B) and include the ~~X-112 Data Processing Building; X-1020 Emergency Operations Center (EOC);~~ X-6000 Cooling Tower Pump House, Air Plant, and Air Plant Support Systems; X-6002 Boiler System; X-6002A Oil Storage Facility, X-7721 Maintenance, Stores and Training Building, X-7725A Waste Accountability Facility, and X-7745R Recycle/Assembly Storage area, respectively. A brief description of the major secondary facilities and their functions along with some major public warning and security systems are provided in the following sub-sections.

1.1.4.1 Section Reserved For Future Use~~X-112 Data Processing Building~~

~~The X-112 Data Processing Building provides secure housing for the data systems and personnel required to support ACP data processing.~~

1.1.4.2 X-220E1 and X-220E3 Evacuation Public Address System

The Evacuation Public Address (PA) System is in place to provide instructions or notification in the event of an incident requiring evacuation or sheltering of reservation/plant personnel. The X-300 Plant Control Facility (PCF)~~1020 EOC~~ PA system control console is continuously manned. During emergencies, the PA system is not used for routine traffic. The PA system serves most occupied plant buildings/facilities.

1.1.4.3 X-220R Public Warning Siren System

The Public Warning Siren System is used to provide notification to the public within a two-mile radius of the DOE reservation in the event of an incident requiring evacuation or sheltering of the public. The system is comprised of sirens on poles/towers around the two-mile radius and an electronic siren controller at the X-300 PCF, X-1020 Emergency Operations Center, and local sheriff's department.

1.1.4.4 Electrical Distribution Systems

Electrical power is supplied from the external 345 kilovolts (kV) power grid through the X-530A Switchyard to the X-5001 Substation via the X-5015, 345 kV Underground Cable. The X-5001B and X-530G oil pumping stations are the facilities that make up the high pressure oil system that provides the necessary dielectric medium for the underground cable. At the X-5001 Substation, the electrical power is stepped down in voltage to 13.8 kV, via the 345 kV to 13.8 kV power transformers. The power transformers are protected by the X-5001A Valve House that supplies water to the power transformer deluge system. Electrical power enters the X-5000 Switch House via the bus duct from the power transformers. Power is distributed throughout the ACP by the X-2215A Underground Electrical Distribution to Process Buildings and X-2215B Electrical Distribution to Areas Other Than Process Buildings. The distribution voltages are further stepped-down as necessary, depending on the building or facility requirements to power items (i.e., centrifuges ~~machines~~, pumps, compressors, cranes, elevators, lighting, HVAC, and offices). The X-2215C Exterior Lighting Fixtures provides exterior lighting for streets and fences throughout the ACP.

Most buildings and facilities are provided with double-ended service, wherein two substations supply power to switchgear separated by a tiebreaker. If one transformer fails or requires servicing, the entire building or facility load can be transferred to the remaining unit. Normally the transformers comprising a double-ended unit are fed from different switchyard busses.

Certain 480 V and 208 V substations are equipped with standby power in the form of diesel engine generators. The purpose of the diesel generators are to maintain power to essential systems in the event normal power is lost or interrupted to these systems momentarily or for long periods of time.

Standby power is provided by diesel engine driven generators in situations where a loss of normal power cannot be interrupted without causing damage to equipment or hazards to personnel. Single backup power is supplied by a standby generator to those systems for which power outages would result in potential damage to equipment, or substantial delays in restoring normal operations after an extended outage. Following a loss of normal power, standby generators will automatically start and pickup essential loads within a prescribed amount of time.

1.1.4.5 Section Reserved For Future Use~~X-1020 Emergency Operations Center~~

~~The X-1020 EOC serves as a central location to coordinate any emergencies that occur on the DOE reservation.~~

1.1.4.6 X-2220N Security Access Control and Alarm System

Due to the classified and proprietary nature of the ACP activities and equipment, access to areas classified as Security Areas and Vault-type Room(s) is controlled utilizing a Security Access Control and Alarm System. The system consists of two distinct subsystems: an Intrusion Detection System (IDS) and an Access Control System (ACS). The IDS provides interior protection and the ACS provides high-security entry controls. The two subsystems report to a single operator's workstation forming a single security system.

1.1.4.7 Security Fencing and Portals

The ACP is within a secured fenced area. This area consists of approximately three and a half miles of eight ft high chain-linked fence and barbed wire encompassing approximately 200 acres of the southwest quadrant of the Controlled Access Area (CAA). Various gates support normal operation and provide emergency egress. The fence is routinely patrolled and is well maintained.

Access to the ACP CAA consists of portals and gates at specific locations. When in use, portals are either staffed and gates (when open) are under surveillance by Protective ~~Force~~ Personnel with communications equipment or the portals are equipped with rotogates with an electronic badge reader. Portals are secured with high security locks when not in use. Signs are posted at the CAA access portals and gates identifying contraband items that are not permitted within the CAA without specific approval. Illumination is in place at the CAA access portals and gates to assist Protective ~~Force~~ Personnel and building or plant personnel in detecting unauthorized persons and to permit examination of badges and vehicles. In the event of extended power outages where necessary illumination is compromised, compensatory measures (e.g., standby lighting) are implemented.

CAA portal and gate operations are further defined and locations identified in the *Security Plan for the Protection of Classified Matter* ~~Security Program~~ ~~*for*~~ *at the American Centrifuge Plant*.

1.1.4.8 X-6000 Cooling Tower Pump House, Air Plant, and Air Plant Support Systems, and X-6001 Cooling Tower

The X-6000 Cooling Tower Pump House, Air Plant, and Air Plant Support Systems is located east of the X-3002 building and is approximately 223 ft long and 80 ft wide. The building contains two distinct sections: Cooling Tower Pump House and the Air Plant. The Air Plant is located at the north end section and the Cooling Tower pump equipment is located at the south end section of the X-6000 building. The X-6000 building contains the necessary equipment/systems to distribute dry compressed air to the ACP and to provide the requisite water to the X-6001 Cooling Towers for the removal of heat from the process buildings.

The X-6001 tower is located west of the X-1007 Fire Station and is approximately 100 ft east of the X-6000 building. The X-6001 tower measures approximately 282 ft long, 55 ft wide at the base, and is approximately 24 ft high from grade to upper deck, consisting of five cells. The X-6001 tower also contains the necessary equipment/systems, fans, piping, and hardware structures to satisfy the necessary cooling requirements for the process buildings.

1.1.4.9 X-6002 Boiler System

The X-6002 system is a gas-fired boiler system located between the X-6002A Oil Storage Facility and the X-7721 building just northeast of the X-3002 building. The boiler system provides hot water for heating.

The X-6002A facility is located east of the X-3002 building. The X-6002A facility supplies fuel oil to the X-6002 system when required. The boiler normally is operated on natural gas, but can use fuel oil as an alternate fuel.

1.1.4.10 X-7721 Maintenance, Stores, and Training Building

The X-7721 building is a multiple level building with approximately 138,000 ft^2 of total floor area. The purpose of the X-7721 building is to provide areas for maintenance shops; stores and receiving activities; and training.

1.1.4.11 X-7725A Waste Accountability Facility

The X-7725A facility is located in the southwest quadrant of the DOE reservation north of the X-7725 building ~~facility~~ and has approximately 29,400 ft^2 of floor space. This facility serves as a storage area for equipment and parts necessary for the maintenance and repair of the process and process support equipment.

1.1.4.12 X-7745R Recycle/Assembly Storage

The X-7745R storage area is a concrete pad immediately adjacent to and east of the X-7725 building ~~facility~~ providing approximately 215,200 ft^2 of space. This area is used mainly for clean, non-contaminated, outside, horizontal rack storage of centrifuge casings prior to being moved inside the building for ~~machine~~ centrifuge assembly. Other centrifuge components and miscellaneous storage may also be temporarily stored in this area.

1.1.4.13 X-2230B Sanitary Sewer

The X-2230B Sanitary Sewer system is an underground sewage collection system that through a series of piping and lift stations collects raw sewage from the ACP site and routes it to the DOE owned X-6619 Sewage Treatment facility. This facility is a NPDES permitted facility.

1.1.4.14 X-2230C Storm Sewer

The X-2230C Storm Sewer system is an underground drainage system to collect surface water from the ACP site. The water is routed through a series of piping to two holding ponds identified as X-2230N and X-2230M, both of which are NPDES permitted outfalls. This water is monitored for contaminants before being discharged into the nearby creeks.

1.1.5 Process Description

This process description is organized into eight sections that describe the gas centrifuge processes: 1) centrifuge program history; 2) separation fundamentals; 3) centrifuge fundamentals; 4) enrichment process theory; 5) total process configuration; 6) enrichment process support systems; 7) ~~machine~~ centrifuge assembly and movement systems; and 8) plant support systems. Additional details are provided in the ISA Summary.

1.1.5.1 Centrifuge Program History

For commercial production of uranium enriched in the ^{235}U isotope, a limited number of separation processes appear to be viable with technology currently available. In the United States, the electromagnetic process, gaseous diffusion process, and gas centrifuge process have been the primary methods employed since the inception of the uranium enrichment program during the Manhattan Project.

The gas centrifuge uranium enrichment program in the United States began in 1941. During World War II, the calutron and the gaseous diffusion processes were developed into viable techniques for producing enriched uranium more rapidly than the centrifuge process. As a result, work on the gas centrifuge technology was stopped. Development of centrifuge technology continued outside of the United States Government program until the Atomic Energy Commission resumed research and development work in 1960 at the Oak Ridge GDP under management of Union Carbide Corporation. Development progressed to the point that President Carter announced the switch from a GDP addition already under construction in Piketon, Ohio, to the more energy-efficient centrifuge process. The X-3001, X-3002, X-7726, and X-7725 buildings/facilities had been constructed by the time the GCEP program was cancelled in 1985. Six complete cascades were operating in parallel at the time of cancellation.

In 1993, the United States Enrichment Corporation took over uranium enrichment operations from the DOE at the GDP. It was recognized at that time that a newer more efficient separation technology ultimately would have to be deployed to replace the aging GDPs. After research on various separation technologies, USEC decided to deploy the American Centrifuge technology in 2002.

1.1.5.2 Separation Fundamentals

The processing of UF_6 into an isotopic content that enables commercial nuclear reactors to produce electricity through a controlled fission reaction is called enrichment. The enrichment process increases the concentration of the fissionable ^{235}U isotope from its naturally occurring assay of approximately 0.711 wt. percent up to 10 wt. percent assay in the commercial ACP operation. The enrichment process in the HALEU Demonstration will increase the enrichment from a feed enrichment of up to 5.0 wt.% ^{235}U up to a target enrichment of 19.75 wt.%. The balance of uranium consists primarily of the ^{238}U isotope.

There ~~are two~~is one methodolog~~ies~~y of enrichment commercially employed, ~~the gaseous diffusion process and~~ the gas centrifuge process. ~~Both~~ This process~~es~~ consists of the interconnection of multiple "separation elements" in configurations known as cascades. Figure 1.1-11 is a diagram of a separation element, consisting of a feed stream (F) that is separated into product (P) and tails (T) streams. The concentrations of ^{235}U in the feed, product, and tails streams are N_F, N_P, and N_T, respectively.

The amount of effort required to increase (enrich) a given quantity of uranium from concentration N_F to concentration N_P is described in terms of separative work. Separative work is a descriptive mathematical quantity that measures the amount of effort required to effect the separation and is measured in Separative Work Units (SWUs).

1.1.5.3 Centrifuge Fundamentals

Figure 1.1-12 shows a simplified schematic of a gas centrifuge ~~machine~~. A centrifuge ~~machine~~ consists of a large rotating cylinder and piping for the feeding of UF_6 gas, and the withdrawal of depleted and enriched UF_6 gas streams. The rotating cylinder, called the rotor, is contained within a stationary cylinder, called the casing, which maintains the rotor in a vacuum and provides physical containment of components in the unlikely event of a major ~~machine~~ centrifuge failure. Other major components of a centrifuge include upper and lower suspension systems, and a column.

Figure 1.1-12 depicts a modern centrifuge. The outer casing is at a high vacuum to minimize the drag on the high-speed rotor. Feed enters the ~~machine~~ centrifuge approximately mid-way down the column and mixes with the up flowing process gas layer near the rotor wall. The lighter component (enriched) stream flows upward where a scoop, positioned near the rotor wall, withdraws the enriched stream. The remaining portion of the gas stream flows down the wall, becoming the depleted stream where a scoop, positioned near the rotor wall, similarly withdraws the depleted stream.

The separation capacity of a centrifuge is a function of the difference in the assay at the top and bottom of the rotor. Radial separation (separation factor) is created by centrifugal force. Axial separation is created by the net transport of $^{235}UF_6$ to the top and $^{238}UF_6$ to the bottom of the centrifuge. The separation factor of the centrifuge separation unit (~~machine~~centrifuge) is higher than that of the gaseous diffusion separation element (converter). Due to the higher separation factor of the centrifuge separation unit, there are fewer stages required in a centrifuge cascade than in a gaseous diffusion cascade. However, the production rate for a single centrifuge separation unit is much less than a gaseous diffusion separation unit. Therefore, it is necessary to operate multiple centrifuge separation units in parallel in order to achieve production levels.

The high vacuum and partially armored casing serves two key functions: to minimize drag and confine the potential debris generated from a rotor failure while operating. The current ~~machine~~ centrifuge design relies on a diffusion pump on each ~~machine~~ centrifuge backed-up by a mechanical vacuum pump to maintain this high vacuum in the casing. The primary function of the vacuum system is to remove any traces of gases that escape from the rotor through the column gap or atmospheric leaks from the casing seals.

Centrifuges ~~machines~~ are arranged in parallel to make-up a stage. The ~~machines~~ centrifuges in a stage receive a common feed and discharge enriched material and depleted material into common headers. Stages are then arranged in series to make-up a cascade. The inter-stage flow arrangement is depicted schematically in Figure 1.1-13 for a typical cascade. Each stage is represented by a single ~~machine~~centrifuge, but the concept is that the enriched stream of the lower stage is set to closely match the assay of the external cascade feed and the depleted stream of the upper stage is also set to closely match that assay. The lower stage depleted stream header is the cascade tails header and the upper stage enriched stream header is the cascade product header.

1.1.5.4 Enrichment Process Theory

To produce enriched uranium at the desired ^{235}U assay, separation units are connected in series to form an enrichment cascade. Multiple cascades may be connected in parallel in order to produce enough product material of a given assay to meet customer orders.

1.1.5.5 Total Process Configuration

Total process configuration refers to how the enrichment process is carried out from the time natural uranium is received until finished product and process waste is shipped off-site. The process is divided into eight operations: 1) receipt of UF_6; 2) feeding of UF_6 into the enrichment process; 3) actual enrichment process, where the UF_6 assay is increased to its desired enrichment; 4) material withdrawal, where enriched and depleted UF_6 is removed from the enrichment process; a capability to withdraw feed material into product withdrawal to blend is also provided; 5) UF_6 sampling, where enriched UF_6 is sampled to ensure it meets customer specifications are met in either customer or source cylinders; feed, tails and dump cylinders are also sampled as required; 6) blending/transfer of enriched UF_6 between cylinders to fulfill customer specifications by sublimation and desublimation; 7) loading of UF_6 cylinders for shipment to customers; and 8) waste handling from waste generated from the entire process. See Figure 1.1-4 (located in Appendix B) and Figure 1.1.3-1 (located in Appendix E) for a functional depiction of the overall enrichment process.

1.1.5.5.1 Receiving Operations

The X-3346A building is the usual receiving point for cylinders. UF_6 feed cylinders, cylinders containing enriched product (such as Russian LEU material), customer shipping cylinders and overpacks, as well as, new and cleaned empty cylinders are received on-site via the X-3346A. Full feed cylinders (10- and 14-ton), customer cylinders (2.5-ton), and overpacks with customer cylinders are off-loaded, weighed, paperwork checked, and then the cylinders and overpacks are transferred to the appropriate storage areas until needed (see Figure 1.1-4 [located in Appendix B] for functional depiction of cylinder movements/transfers).

1.1.5.5.2 Feed Operations

Feed operations are performed in the Feed Area of the X-3346 building. See Figure 1.1.5.5.2-1 (located in Appendix E) for a function depiction of the feed process. The feed system is designed to supply UF_6 to the enrichment process located in the X-3001 and X-3002 buildings.

The feed system sublimes UF_6 from cylinders placed in electronically heated feed ovens. The feed system also is connected to equipment to increase the purity of the UF_6 fed to the enrichment process by removing non-UF_6 gases from the feed cylinder prior to feeding. UF_6 may be fed from any approved UF_6 cylinder. Once the UF_6 has been vaporized and purified, the UF_6 gas is transferred by desublimation into one of the six freezer/sublimers used for feed. When feed is needed for the Process Buildings, it is sublimed from the freezer/sublimer and is passed through the feed system pressure reducing station before it is fed to the enrichment process via the X-2232C Interconnecting Process Piping (IPP). The feed system can supply to two feed streams at two different feed rates to the enrichment process. Feed can also be provided to the IPP by bypassing the freezer/sublimers and feeding the pressure reducing station directly. The capability is also available to provide feed material to the Withdrawal Area so that it can be used to blend with product UF_6 from the freezer/sublimers. Feed from the feed manifold can be transferred to the dump cylinders in the Feed Area as can feed from four of the feed ovens.

Empty feed cylinders are staged on the X-7746S or X-7746W Cylinder Storage Yards prior to shipment from the X-3346A building. The source and customer cylinders are staged on the X-7746W or X-7746S Cylinder Storage Yards prior to sampling and shipment of the customer cylinders from the X-3346A building.

Feed ovens are the primary components in the feed process. Feed ovens are enclosures that restrict air-leakage to provide efficient heating of the cylinders, but are not designed as pressure vessels. The ovens heat the cylinders utilizing electrically heated air. UF_6 is sublimed from the solid phase into a vapor for enrichment in the process buildings. The feed process has several stages. The feed is vaporized, monitored for "lights," and fed to freezer sublimers to be purified (removal of lights) and desublimed. The feed is held in freezer/sublimers, vaporized (sublimed), and pressure controlled before entering the process buildings. "Lights" refer to light gases (e.g., N_2, O_2, HF, etc.) entrained in the feed material. There are two feed headers located in the Feed Area. The oven heating system is programmed to hold the air temperature constant such that the cylinder wall temperature is held at approximately 185° Fahrenheit (F). When the cylinder weight reaches a determined value, the temperature of the feed oven and the rate of feeding is decreased until the cylinder is nearly empty. Any solid UF_6 left in the feed cylinder after the feed rate declines to a predetermined level is "heeled" into the X-2232C feed piping downstream of the pressure reducing station until the cylinder pressure is equal to that of the X-2232C feed piping. "Heeling" is the process for removing residual UF_6 from a cylinder when it can no longer be used to feed material into the cascade. The emptied feed cylinder is then moved on to storage. See Figure 1.1.5.5.2-2 (located in Appendix E) for a typical depiction of a feed oven.

1.1.5.5.3 Enrichment Operations

The enrichment process is contained in the X-3001 and X-3002 buildings. See Figures 1.1.5.5.3-1, 1.1.5.5.3-2, 1.1.5.5.3-3, 1.1.5.5.3-5, 1.1.5.5.3-6, 1.1.5.5.3-7 (located in Appendix E) and 1.1.5.5.3-4 (located in Appendix A) for a functional depiction of the enrichment process. Each process building contains multiple cascades to optimize operating costs and production flexibility. Each cascade is capable of enriching UF_6 gas to the desired product assay. UF_6 feed material is supplied from the X-3346 building Feed Area to the process buildings via the X-2232C IPP. In the process buildings, feed is distributed to the feed control systems for each cascade. The feed flow rates to each cascade are automatically controlled to ensure the desired feed is added to the cascade to support the production rate. As the feed enters the cascade, it is mixed with material already in the cascade and is separated into enriched and depleted material streams. This process continues until the material exits the top of the cascade as enriched product or the bottom of the cascade as tails material. The proportion of feed that becomes enriched product is controlled by the stage control valves, which are adjusted to provide the desired product and tails assays. Product and tails material are withdrawn from each cascade and sent to the X-3346 building Withdrawal Area via the X-2232C piping for transfer to cylinders. The product is sublimed directly into product cylinders through vacuum pump transfer. The tails material is sublimed directly into tails cylinders through compressor transfer. The commercial ACP cascade is limited to a maximum assay of 10 wt. percent ^{235}U.

The major components that support the enrichment operations are: centrifuges ~~machines~~; centrifuge floor mount systems; service modules; inter-machine flow and control; X-2232C piping; and isolations valves.

1.1.5.5.3.1 Centrifuges ~~Machines~~

The gas centrifuge ~~machine~~ is comprised of a number of subassemblies (see Figure 1.1-12): Casing; Rotor; Column; Upper Suspension Assembly (USA); Lower Suspension and Drive Assembly (LSDA); and the Diffusion or Molecular Pump (not depicted in figure). A more extensive description of each of these components can be found in the ISA Summary.

1.1.5.5.3.2 Floor Mount

The ~~machine~~ centrifuge mount system is the primary structural interface between the soil subgrade of the process building floors and the centrifuges ~~machines~~. The ~~machine~~ centrifuge mount system is a hard-torsion, hard-shear, and soft-rocking system. It consists of recessed steel floor modules encased in a large isolated concrete foundation mat. A mount at the bottom of the floor module, known as the fifth point, is designed to carry the full vertical weight of the centrifuge ~~machine~~. Four specialty designed anchor pins with elastomeric isolators are arranged in a symmetrical pattern around the base of each ~~machine~~ centrifuge at the operating floor level. These pins attach the ~~machine~~ centrifuge to the encased steel frame and provide hard shear resistance in the event of horizontal thrust or torque lock-up, but allow vertical movement at the pin for the rocking motion.

The centrifuge mount system is designed so that each ~~machine~~ centrifuge responds to its operating environment independently of other ~~machines~~centrifuges. This is accomplished by having the massive concrete foundation mitigate the effects of torque and shear experienced during an operational upset such as a rotor failure. The overturning forces experienced during an operational upset or by external events such as an earthquake are attenuated by the ~~machine~~ centrifuge mount's soft rocking suspension.

1.1.5.5.3.3 Service Module

The piping configuration used to connect the centrifuges in the UF_6 enrichment process is designed to minimize the likelihood of a major interruption of operations, provide isolation of ~~machines~~ centrifuges and minimize construction costs. A primary purpose of isolation is to prevent or limit the transport of light gases to centrifuges that are operating satisfactorily. Light gases can be introduced from leaks, miss-operation of the UF_6 feed system, and centrifuges that are encountering operational problems. Figure 1.1-14 (located in Appendix B) depicts the Service Module and its general layout and systems interfaces.

Within the process building, utilities and process piping are routed to the centrifuges ~~machines~~ via service modules that consist of a frame structure with pipe headers and valves; control and instrument cabling; ventilation ductwork; and electrical distribution cables running the full length. Pipe headers for process gas, vacuum, and recycle are typically stainless steel, while those for air, cooling water, and fire suppression are steel. Smaller branch pipes connect the headers to each of the centrifuges ~~machines~~. The ~~machine~~ centrifuge isolation valves, ~~machine~~ centrifuge power controls, and ~~machine~~ centrifuge instrumentation are also mounted on the service modules. Each service module services multiple centrifuges ~~machines~~ and the service modules are connected in series to support an operating cascade.

1.1.5.5.3.4 Inter-Machine Flow and Control

The inter-machine flow and control system consists of process piping headers and valves for transporting the process gas to and from the centrifuges; feed control system for controlling the feed rate to the cascades in each train; inventory control system for each stage, which maintains the proper backpressure on each stage; instrumentation and controls for header pressures and centrifuge ~~machine~~ status; and sampling taps to provide sampling capability to determine product and tails assays and product contaminants.

1.1.5.5.4 Withdrawal Operations

Product withdrawal occurs in the Withdrawal Area of the X-3346 Feed and Withdrawal via desublimation directly into cylinders inside cold boxes. As many as four product assays can be fed to the X-3346 building from four separate dedicated half-building product lines from the process buildings. UF_6 can also be fed to the X-3346 Withdrawal Area from the X-3346 Feed Area for use as blend material to meet customer specifications. See Figure 1.1.3-1 (located in Appendix E) for a functional depiction of the product withdrawal process. Product material is first transferred through a series of vacuum pumps (vacuum pump trains) connected to the product line in the X-2232C piping and then desublimed directly into selected source or product cylinders which are located in cold boxes and does not involve UF_6 pressures above atmospheric pressure. Connection and disconnection of the couplings to the cylinders is supported by the Evacuation System in the Withdrawal Area of the X-3346 building which draws effluent through evacuation cold traps and chemical traps before venting through a permitted vent. The cold traps are heated and the UF_6 is desublimed into one of two dump cylinders located in cold boxes. The filled source or product cylinders are then moved to interim storage and can subsequently be moved to the X-3344 building for sampling and/or moved to the blending/transfer area in the X-3346 Feed Area.

Interim storage can be in the X-3346 building or the X-7746W or X-7746S Cylinder Storage Yards.

Tails withdrawal, also in the Withdrawal Area of the X-3346 Feed and Withdrawal Building, is accomplished through compression and direct desublimation of UF_6 material into tails cylinders inside a cold box and does not involve UF_6 pressures above atmospheric pressure. The tails withdrawal design incorporates the capability for simultaneously withdrawing two uranium assays. The compression train consists of centrifugal compressors arranged in series with coolers and with recycle capability. Tails withdrawal is used for emergency inventory removal. See Figure 1.1.5.5.4-1 (located in Appendix E) for a functional depiction of the tails withdrawal process. Effluent protection for cylinder connection and disconnection is the same as for product cylinders.

The major components that support the withdrawal operations are vacuum pump trains, tails, withdrawal trains, cold boxes, cold traps, chemical traps, assay spectrometers, and vents. See Figures 1.1.5.5.4-2 and 1.1.3.3.1-4 (located in Appendix E) for a typical depiction of a tails compressor and a cold box. See Figure 1.1.3-1 (located in Appendix E) for a depiction of the vent system.

1.1.5.5.5 Sampling Operations

UF_6 sampling operations for UF_6 product material is carried out in the X-3344 building, also known as the Customer Services Building. See Figure 1.1.5.5.5-1 (located in Appendix E) for a functional depiction of the sampling process. American Society for Testing and Materials (ASTM) sampling standards necessitate that sampling must be from homogenized UF_6; the design involves liquefaction of UF_6 during sampling operations (Reference 19 and 20). In addition, some sampling of feed and tails cylinders is done to support Nuclear Material Control and Accountability requirements.

Autoclaves with heating and cooling capability are used to liquefy UF_6 in the cylinders to facilitate sampling and then solidification of the UF_6 in the cylinders at the end of the sampling. A cylinder may be any approved UF_6 cylinder per ANSI N14.1 (Reference 24) that meets nuclear criticality safety (NCS) requirements. The autoclaves are pressure vessels and are designed to contain a UF_6 release. Electrically heated hot air is the heating medium and cold air is used for cooling.

The major components that comprise the sampling and transfer operations are autoclaves, cold traps, and vents. See Figure 1.1.3.3.3-2 (located in Appendix E) for a typical depiction of an autoclave. See Figure 1.1.5.5.5-2 (located in Appendix E) for a functional depiction of the vent system.

1.1.5.5.6 Blending/Transfer Operations

Blending/transfer operations may be performed in the Feed Area of the X-3346. Blending is performed if the assay of enriched UF_6 needs to be adjusted to meet customer specifications. Transfer between cylinders is performed if the assay of the UF_6 meets customer specifications. A capability is also available to provide feed material from the Feed Area to the Withdrawal Area so that it can be used to blend with product UF_6 as it is being withdrawn through four separated product pipes.

Localized blending of enriched UF_6 between cylinders and/or gaseous transfer of enriched UF_6 between cylinders is performed using a combination of up to three dedicated feed ovens and five dedicated cold boxes. Blending is performed by sublimation transfer of the UF_6 from parent cylinders (uranium feed cylinders and source cylinders) to a daughter cylinder by desublimation to meet customer specifications normally in a customer cylinder. The parent cylinders are heated in the feed ovens to sublime the UF_6 and the UF_6 is then desublimed directly into a daughter cylinder in a cold box. The transfer of enriched UF_6 from a parent source cylinder directly into customer cylinders may also be done using a dedicated feed oven and cold box in the same fashion. Transfer/blending does not involve UF_6 pressures above atmospheric pressure.

The major components that comprise the blending/transfer operations are feed ovens, cold boxes, cold traps, and vents. See Figure 1.1.3-1 (located in Appendix E) for a functional depiction of the vent system.

1.1.5.5.7 Shipping Operations

The X-3346A building is also the shipping point for emptied cylinders leaving the ACP as well as UF_6 cylinders shipped to fulfill customer product orders (including Russian LEU), and UF_6 cylinders containing feed or depleted material. Any approved UF_6 cylinder may be shipped from this facility. See Figure 1.1-4 (located in Appendix B) for a schematic of the Feed, Withdrawal, and Product Operations.

Filled customer product cylinders, emptied feed cylinders, and other UF_6 cylinders will be prepared for shipment and shipped in accordance with U.S. Nuclear Regulatory Commission (NRC) and DOT regulatory requirements from the X-3346A.

1.1.5.5.8 Waste Handling Operations

Depleted UF_6 tails material is considered a resource material with the ultimate disposition to be determined and is not considered a waste. The Licensee intends to evaluate possible commercial uses for depleted UF_6. Depleted UF_6 is stored in steel cylinders within cylinder storage yards until this material can be processed in accordance with the disposition strategy established by the Licensee. Depending upon technological developments and the existence of facilities available prior to the ACP shutdown, the depleted UF_6 may have commercial value and may be marketable for further enrichment or other processes.

Waste generated by the ACP is collected, handled, packaged, segregated, stored, and shipped for off-site treatment/disposal in a safe and environmentally acceptable manner in accordance with applicable state and federal regulations, and plant procedures. Waste accumulation areas are established throughout the ACP as necessary to meet these regulatory requirements.

The ACP obtains waste management services from a qualified provider licensed/certified by the NRC or an agreement state. Waste may be further sampled/measured to assist in determining the proper waste characterization and proper disposal/treatment method.

Potential waste streams generated include Low-Level Radioactive Waste, LLMW, RCRA Hazardous Waste, Sanitary/Industrial Waste, Recyclable Waste, and Classified/Sensitive Waste.

Waste generating activities are evaluated for waste minimization opportunities to reduce the volume and toxicity of waste generated to the degree determined to be economically practicable.

A further description of the transportation impacts can be found in Section 4.2 and the waste impacts can be found in Section 4.13 of the Environmental Report for the American Centrifuge Plant.

1.1.5.5.9 Liquid and Air Waste Discharge Points

Waste discharge points are categorized by either liquid (water) or air.

For liquid, wastewater discharges are handled by different means depending upon the originating source: process, sanitary, or storm water.

No process wastewater is intentionally discharged from the liquid effluent tanks. Accumulated water in these tanks are sampled and managed according to analytical results. Trained professionals using approved spill response protocols and spill response equipment will promptly contain liquid spills within the process buildings. Spill materials will be collected, sampled, analyzed, and managed in accordance with applicable federal and state laws. The only intentional process wastewater discharge resulting from plant operations is the blow down from the TWC (Tower Cooling Water) system. This cooling water system is not interconnected with the MCW (Machine Cooling Water) system located in the process buildings. The MCW system is a closed-loop system, which requires minimal makeup water, but does not have blow down discharges.

Sanitary wastewater (e.g., showers, toilets, etc.) located within the area discharge to the plant sanitary sewer system and ultimately to the X-6619 Sewage Treatment Plant. Treated sanitary wastewaters are discharged from X-6619 directly to the Scioto River via an underground pipeline via a permitted NPDES outfall.

Storm water runoff from the ACP area, along with some once-through cooling water (sanitary water), drain to a pair of holding ponds (X-2230N West Holding Pond and X-2230M Southwest Holding Pond). These ponds provide a quiescent zone for settling suspended solids, dissipation of chlorine, and oil diversion and containment. The ponds discharge to unnamed tributaries of the Scioto River. An automated sampler collects a weekly composite sample of the liquid effluent for radiological analysis as well as NPDES-mandated analyses.

For air, the process release of hazardous gases to the atmosphere is the area of concern. The projected concentration of Hydrofluoric acid (HF) gas release is six orders of magnitude, or a million times less than the Threshold Limiting Value (TLV) for HF. The conservative estimates of HF concentrations at the DOE reservation boundary indicate that its release during ACP operations will have an insignificant impact on air quality. On the other side, each process area vent systems in the X-3001, X-3002, X-3344, X-3346, and X-7725 buildings~~, and X-7725 facility~~ have gas flow monitoring instrumentation with local readouts as well as analytical instrumentation to continuously sample, monitor, and to alarm if UF_6 should breakthrough in the effluent gas stream.

1.1.5.6 Enrichment Process Support Systems

Support systems that support the enrichment process include the Area Control Room (ACR), vacuum systems (i.e., Evacuation Vacuum [EV] and Purge Vacuum [PV]), Machine Cooling Water, Criticality Accident Alarm System (CAAS), portable gulpers, and building HVAC systems.

1.1.5.6.1 Control Centers

There are two Area Control Rooms (ACRs) that support the ACP. One ACR is located in the X-3012 building and supports the enrichment process in the X-3001 and X-3002 buildings. X-3346 building has an ACR that supports the feed, blending/transfer and withdrawal operations performed in the X-3346 building and the sampling operations performed in the X-3344 building.

The Local Control Centers (LCC) are located in the process area and are designed to control a portion of a process building equipment. The LCCs are connected to the ACR that is designed to control an entire process building. The process may be controlled at the appropriate LCC or ACR. This will include monitoring of ~~machine~~ centrifuge parameters, service module header pressures, process gas pressures, building temperatures, and operation of the Intermediate Flow and Control System, as well as information about the EV and PV systems. The Intermediate Flow and Control System consist of four subsystems: 1) process piping headers; 2) feed control system; 3) inventory control system; and 4) controls.

The X-3012 building houses the ACR for the X-3001 and X-3002 buildings. The ACR is designed to control the centrifuges ~~machines~~ in both process buildings. The ACR, along with the LCCs, are used to monitor and control the ~~machines~~ centrifuges and cascade parameters. Each centrifuge ~~machine~~ has operating parameters that are monitored to measure the ~~machine~~ centrifuge condition and operating efficiency. Operations personnel investigate deviations from normal operating conditions and adjustments to the ~~machine~~ centrifuge are made to correct any problems.

The X-3346 building has an ACR for housing the monitoring, control, and alarm equipment associated with the feed, blending/transfer, withdrawal operations in the X-3346 and the sampling operations in the X-3344 building. This includes the assay spectrometers for monitoring feed, product and tails.

The ACR computer system displays an overview of the process equipment and utilities in process buildings. From the ACR, the operators can monitor utilities, and process variables in the cascade and ~~machine~~ centrifuge level. Also, operators can change setpoints (within certain parameters), isolate parts of the process, receive and identify alarm sources, and dispatch service personnel.

The status of each process controller can be displayed. A change in status activates an alarm. In the event of failure of a process controller, a standby controller automatically takes control of the system. The controllers interface directly with process equipment. Under normal circumstances, the LCCs are unmanned. However, in case of a failure, the LCCs can be used to provide the operators with the capability to control the appropriate equipment.

1.1.5.6.2 Vacuum Systems

To mitigate and prevent degradation or failure of key centrifuge components, the centrifuges operate in a vacuum environment. There are two major vacuum systems: EV and PV Systems (see Figure 1.1-15). Each centrifuge is connected to both systems via a manual interlock, so that the ~~machine~~ centrifuge can only be connected to one system at a time. Each EV system includes two mechanical vacuum pumps, valves, and controls to permit a vacuum pump to serve as a spare for the other. The EV system also includes piping required to connect the centrifuges from the diffusion pump through the service module piping to the mechanical vacuum pumps, and piping from the discharge of the mechanical headers. The EV system is used for roughing pump down of service module headers and newly installed centrifuges ~~machines~~. Each PV system includes two mechanical vacuum pumps, valves, and controls to permit a vacuum pump to serve as a spare for the other. The ~~purge vacuum~~PV pumps discharge to a set of alumina traps to remove any trace quantities of UF_6 prior to the gases being vented to atmosphere. The PV system also includes piping required to connect the centrifuges from the diffusion pump through the service module piping to the mechanical vacuum pumps, and piping from the discharge of the mechanical headers. The PV system is used as a final pump down of installed centrifuges ~~machines~~, and to maintain a continuous vacuum source on the ~~machine~~centrifuge, when it is in operation. See Figures 1.1.5.5.8-1 and 1.1.5.5.8-2 (located in Appendix E) for a functional depiction of the EV/PV system.

1.1.5.6.3 Machine Cooling Water System

The Machine Cooling Water (MCW) system is a closed-loop circulating water system designed to provide continuous cooling of the centrifuge diffusion pumps, LSDAs, and the PV, and EV pumps. The system contains circulating water pumps, filters, heat exchangers, expansion tanks, and piping tie-ins to the chemical feed, deionizer, and sanitary water systems.

Heated MCW leaves the centrifuge cascade through the service module header to an expansion tank, which provides enough suction head for the MCW circulating water pumps. The tank provides a convenient point for adding make-up water and water treatment chemicals. The discharge of the circulating pumps passes through a MCW filter and a heat exchanger where the MCW is cooled. The heat exchanger cooling water is supplied from a closed-loop Chilled Water (CW) system and the CW chiller (heat exchanger) cooling water is supplied from the cooling tower and Tower Water Cooling (TWC) pumps. The cooled MCW then returns to the centrifuges ~~machines~~ by way of the supply header in the service module.

The MCW system requires a chemical feed system where water treatment chemicals are added. The chemical feed system contains a chemical tank where chemicals are added via a chemical injection pump.

Sanitary water is provided for the MCW make-up water and the chilled water closed-loop. This water passes through a deionizer before entering either the MCW closed-loop or chilled water closed-loop. The make-up water is used for initial fill purposes and for maintaining the proper level of MCW and CW in the system. MCW system alarms are monitored in the ACR.

1.1.5.6.4 Building Heating, Ventilation, and Air Conditioning Systems

Process building heating, ventilation, and air conditioning (HVAC) systems are designed to maintain the building environment required for proper operation of process and associated equipment. The main subsystems affecting process buildings are the Process Area Ventilation System, and Process Area Heating and Pressurization System.

The Process Area Ventilation System provides air circulation and, when necessary, cooling using outside air. Each ventilation subsystem consists of a supply fan, return/exhaust fan, filters, and associated ductwork with automatic dampers and controls. The return/exhaust air fan draws heated air from the centrifuge ~~machine~~ area and, depending on the building temperature, exhausts it to the outside or recirculates it to the supply fan plenum. If it is necessary to cool the process area served by the subsystem, some percentage of outside air, up to 100 percent, is drawn through a damper into the supply fan plenum. This outside air mixes with any return air and passes through a filter to the supply fan inlet. The supply fan discharges through a damper into a large duct located along the length of the of the service module structure. Air is directed downward from the service module duct. No heating coils are utilized in this system.

The Process Area Heating and Pressurization System heats outside make-up air and supplies enough heat to offset exterior wall and roof heat losses. This system also serves to maintain a positive indoor pressure relative to the outdoor pressure. Individual heating and pressurization units are located on the mezzanine in the process buildings. Each unit consists of pneumatically operated outside air intake damper, a return air damper, a filter section, a heating coil (face and bypass) section, a supply fan, and distribution ducts that form a perimeter boundary around the centrifuge area. Outside air and return air dampers are modulated to maintain a positive building pressure. Recirculating Heating Water is supplied to the heating coils.

HVAC is provided to the X-3012, X-3344, X-3346, X-3346A, X-7725, and X-7726 buildings/facilities to provide proper operation of the equipment, as well as comfortable working conditions for personnel.

Other areas of the ACP are provided with HVAC or only heating and ventilation, depending on the location and function of the area or facility. Supplemental heat can be provided in any ACP facility using portable electric heaters should the RHW be out of service or outside weather conditions dictate the need.

1.1.5.6.5 Criticality Accident Alarm System

The primary radiation alarm system is the CAAS designed to detect a nuclear criticality and provide audible and visual alarms that will alert personnel to evacuate the immediate area. ACP primary facilities that handle ^{235}U in quantities exceeding 700g and enrichment levels ~~between~~ greater than or equal to 1 ~~and 10 wt~~ weight percent have CAAS coverage except the UF_6 cylinder storage yards. An exemption for the UF_6 cylinder storage yards has been requested in Section 1.2.5 of this License Application. Cylinders are moved between the various buildings with the material in a solid state on approved and defined routes using specifically designed equipment in accordance with approved procedures that are covered by CAAS.

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. Coverage is provided, unless it is determined that coverage is not required and the finding is documented in a NCS Evaluation. Per 10 CFR 70.24, CAAS is required in each area where threshold quantities (e.g., more than 700 grams of ^{235}U) of special nuclear material are handled, used, or stored.~~CAAS coverage is provided for the following ACP primary facilities: X-3001, X-3002, X-3012, X-3344, X-3346, X-3346A, X-7725, X-7727H, and the transportation routes for enriched UF_6 cylinders moving between the X-3344 and X-3346 and between the X-3346 and X-3346A.~~ The CAAS coverage areas are identified on plant drawings, and controls are established to preclude special nuclear material from areas where coverage is not provided.

1.1.5.6.6 Portable Gulpers

A portable gulper system is used for localized exhaust on applications like small-scale maintenance tasks. The gulper inlet duct or hose is placed near the work area. Any escaping airborne contamination is removed from the source and passes through the duct or hose and into the filter bank, where, depending on the operation, gases are neutralized and the particulates are removed. The resultant exhaust is clean air that is typically discharged into the work area.

1.1.5.7 ~~Machine~~ Centrifuge Assembly and Movement Systems

1.1.5.7.1 ~~Machine~~ Centrifuge Assembly

The centrifuges ~~machines~~ are assembled in the X-7725 building ~~facility~~ and/or the X-7726 facility assembly stands. Parts for the centrifuge ~~machine~~ assembly are received at these locations. Secure facilities are available to receive and store the classified parts, as well as other components of the centrifuges ~~machines~~. Overhead cranes, fork trucks, and parts elevators are available to handle parts delivery to the assembly stands.

Two centrifuge assembly positions and a column assembly stand is provided in the X-7726 facility and up to six centrifuge assembly positions and six-column assembly stands are available in X-7725 building ~~facility~~ for assembly of the various components into a completed

~~machine~~centrifuge. Overhead cranes are available for material handling needs including long parts insertion and lower and upper assembly installation. Lifting fixtures and other assembly tooling are required during the assembly of the centrifuges. Gross leak testing may be performed at these locations before the assembled ~~machine~~ centrifuge is moved from the assembly stands. No process gas (UF_6) testing of the ~~machines~~ centrifuges will take place in the assembly areas. Completed ~~machines~~ centrifuges may be moved via crane to an adjacent storage location until they can be moved again by crane or moved directly to a transporter for movement to the process buildings. Testing of the centrifuges~~machines~~ using UF_6 may be performed in the X-7725 building ~~facility~~ Gas Test Stands or in the process buildings after installation, prior to being placed into service.

1.1.5.7.2 Centrifuge ~~Machine~~ Transporter Cart

The centrifuge ~~machine~~ transport system, consisting of the centrifuge transporter cart and the various building crane systems, is used to move centrifuges. Centrifuges are transported between the X-7725 building ~~facility~~ and X-7726 facility assembly facilities and the X-3001 and X-3002 buildings within the X-7727H corridor using a centrifuge transporter cart. Within a building, centrifuges ~~machines~~ are moved using overhead cranes from assembly locations to storage locations, or between the storage locations and the centrifuge transporter cart.

The centrifuge transporter cart is a battery-operated, mobile vehicle specially designed to transport centrifuges in an upright position, while protecting them from damage due to excessive motion. The centrifuge transporter cart includes a tugger vehicle and can accommodate a maximum of two centrifuges. ~~may consist of an intra-plant transporter and a separate trailer intra-plant tow tractor with a capacity of up to ten centrifuges, or it may be a combined, self-propelled unit with an equal or lesser capacity. In either case, t~~The centrifuge transporter cart is equipped with ~~clamping~~ mechanisms to secure each centrifuge in a vertical position during the different modes of operation. The design assures that the centrifuge transporter cart remains stable and level during loading and unloading operations.

1.1.5.7.3 Cranes

There are a variety of cranes that will be used. Depending on the operation they support, they will vary in configuration, span length, and capacity. Some cranes will be for general use, whereas others are designed for specific tasks and applications. Crane designs are in accordance with recognized national standards such as the American Society of Mechanical Engineering (ASME)/American National Standards Institute (ANSI) B30 series, the National Electric Code, and the Crane Manufacturing Association of America. There are numerous specialty cranes and monorails located throughout the ACP that support specific operations.

There are specialty cranes in the process buildings for installing and removing centrifuges ~~machines~~. Crane features include variable speed controls, strict deflection criteria, clamping devices for ~~machine~~ centrifuge movement, and automated positioning controls.

The crane systems in X-7725 building and X-7726 facilities were specifically designed for receiving, assembly and disassembly of the ~~machines~~centrifuges. The X-7725 building ~~facility~~ features a sophisticated under hung crane system on the main and upper assembly levels. Operator controlled cabs are able to transfer between adjoining remote controlled bridges providing mobility throughout the assembly area.

The feed, withdrawal and sampling operations feature cranes for movement of cylinders to and from exterior storage lots. Except for the X-3346 Feed Area, the cranes do not enter the buildings. The cranes are operated from the ground by pendant or by remote control and are specifically designed for handling cylinders.

1.1.5.7.4 Cylinder Transporter

The cylinder transporters used in the X-3346 Feed Area is a rail mounted transporter that is loaded by a bridge crane internal to the X-3346 building. The cylinder transporter is designed to support weighing the cylinder and cylinder cradle. The transporter is designed to move the cylinder and cradle to the designated feed oven and onto the cylinder carriage system. The cylinder transporter is also designed to remove the cylinder from the feed oven cylinder carriage system and to place the cylinder and cradle on accountability scales for measurements required by the NMC&A Program. The cylinder and cradle are removed from the cylinder transporter by a bridge crane internal to the X-3346 building. The cylinder transporters used for the X-3346 Withdrawal Area and in the X-3344 Customer Services Building function in the same fashion as described above in loading and unloading the cylinder and cradle into the cold boxes and autoclaves respectively. Cranes place the cylinders and cradles on the cylinder transporters externally to these two areas.

The cylinder transporter is electrically powered from rechargeable batteries on the transporter. The cylinder transporter is designed to be locally controlled.

1.1.5.8 Plant Support Systems

Plant support systems consist of the following: electrical distribution system (345 kV, 13.8 kV, 4,160 volt [V], 2,400V, 480V, 277V, 208V, and 120V); instrument air; TWC; fire and sanitary water storage and distribution systems; and sewage treatment system.

1.1.6 Hazardous Material Storage

Large quantities of highly hazardous material, defined as a Threshold Quantity (TQ) in the Occupational Safety and Health Administration (OSHA) Process Safety Management Standard (29 CFR 1910.119) and the EPA Risk Management Program Standard (40 CFR Part 68), are not present in the ACP.

Other chemicals and typical industrial materials (e.g., acetone, solvents, acids and oils) are used in the X-7725 building, X-7726 facilityies, and X-3012 building for assembly and maintenance activities. These substances are stored in approved containers and are listed in the Hazardous Material Inventory Control System. Quantities are appropriately reported annually to the Federal and State EPA as required by the *Superfund Amendments Reauthorization Act* (SARA Sections 312 and 313).

The Licensee complies with requirements for generators of hazardous and mixed waste. The State of Ohio has adopted a federal conditional exemption from the hazardous waste rules that is available under 40 CFR Part 266, Subpart N (OAC 3745-266).

1.1.7 Roadways

Two major four-lane highways service the DOE reservation: U.S. Route 23, traversing north-south, and ~~U.S.~~ State Route 32/124, traversing east-west. The reservation is situated approximately three and one half miles from the intersection of U.S. Route 23 and ~~U.S.~~ State Route 32/124. Ingress and egress from the reservation to these major roadways is by the Main Access Road, which connects to U.S. Route 23. The Main Access Road connects to the Perimeter Road, which encircles the fenced portion of the DOE reservation. Alternative ingress and egress from the reservation can be established from the north access road in the event of significant Main Access Road repairs. Service roads throughout the reservation connect to the Perimeter Road with access to the ACP controlled through security portals. The reservation roadways are depicted in Figures 1.1-1 and 1.1-2 (located in Appendix B).

1.1.8 ~~Transition from Lead Cascade Demonstration Facility Activities to American Centrifuge Plant Activities~~ Phased Modular Expansion Plan for the American Centrifuge Plant

It is the intent of ACO to deploy portions of the ACP in a modular fashion to accommodate market demand on a scalable, economical gradation. This modular deployment may encompass utilization of cascades of Low Enriched Uranium (LEU) production for LEU customer product or feed material into HALEU cascades. The ratio of LEU cascades to HALEU cascades would be approximately 6 to 1. ~~On February 24, 2004, the NRC granted USEC a license to possess and use source and special nuclear material at the American Centrifuge Lead Cascade Demonstration Facility (Lead Cascade) located on the DOE reservation in Piketon, Ohio. USEC has operated the Lead Cascade since June 6, 2007. Materials License SNM-7003 provides the expiration date for the license.~~

~~Depending on a number of factors, including cost and schedule, one of the following four options would be utilized to transition activities from the Lead Cascade possession and use license to the construction and operation license of the ACP.~~

1.1.8.1 ~~Option 1: Subsume Lead Cascade Operations under the ACP~~ High Assay Low Enriched Uranium Demonstration

The HALEU Demonstration cascade utilizes a similar centrifuge design to that used for the Lead Cascade. The equipment necessary to perform the enrichment process is in the X-3001 Process Building and consists of product and tails withdrawal system, UF_6 cylinders, centrifuges, and supporting systems. The product and tails withdrawal systems use three cold boxes. NaF traps are used for additional withdrawal capacity during dumping. A 30B UF_6 cylinder is used for the feed material. Centrifuges and supporting units are placed in the Train 3 area of the X-3001 building. For further plant and process specifics related to the HALEU Demonstration Program, refer to LA-3605-0003A, *Addendum 1 of the Integrated Safety Analysis for the American Centrifuge Plant – HALEU Demonstration* (Reference 7).

In support of this HALEU Demonstration Program and NRC Materials License (SNM-2011) Condition 23, 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) (Reference 71). The amended GCEP Lease Agreement renewed and extended the term of the lease through May 31, 2022. The ACO sublease incorporates the terms of the GCEP Lease Agreement.

At the conclusion of the three-year HALEU Demonstration Program, the facilities will be either returned to the DOE in accordance with the requirements of the GCEP Lease Agreement or the parties will amend the GCEP Lease Agreement to allow the performance of other work on the leased premises. ~~This option presumes that the Licensee would operate the centrifuge machines that comprise the Lead Cascade after the Lead Cascade license expiration date. The Licensee would terminate its possession and use license and transfer any remaining demonstration activities of the Lead Cascade to an authorized use within the ACP License. This would occur prior to the Lead Cascade license expiration date. The Lead Cascade facility descriptions would be reviewed to identify any potential changes to ACP facility descriptions and the changes would be evaluated in accordance with 10 CFR 70.72 and 70.32. The Licensee would notify the NRC well in advance of the transition of the Lead Cascade to the ACP. At that time, the Licensee would request a License Amendment and submit a more detailed Lead Cascade transition plan to NRC in accordance with the requirements of 10 CFR 70.38 and 10 CFR 40.42 for NRC review and approval.~~

~~The Lead Cascade UF_6 inventory would be transferred to the ACP prior to the license expiration date. The Licensee expects that most of the Lead Cascade centrifuge machines and equipment/components (i.e., piping, valves, other support system/components, etc.) will be used in the ACP. The re-use, refurbishment, or other disposition of the machines and system components will be based upon engineering evaluations and ACP design requirements. To the extent Lead Cascade equipment is used as part of the ACP, decommissioning of that equipment will not be necessary. Equipment not utilized in the ACP will be handled in accordance with the requirements of 10 CFR 70.38 and 10 CFR 40.42.~~

1.1.8.2 High Assay Low Enriched Uranium Demonstration Continuation

As the second phase of deployment, the Licensee plans to continue operation of the 16 centrifuge HALEU cascade as previously described for an additional 10-year period. The Licensee would amend the License Application and applicable Supporting Documents to allow continued operation of this HALEU cascade with increased possession limits for the requested extended period of operation. ACO's financial assurance and decommissioning liability would be established in accordance with the requirements of 10 CFR 70.38, 40.42, and 30.36 and submitted as part of the License Amendment Request.

This phase would only occur if parties agree to extend the GCEP Lease Agreement in support of ongoing planned Licensee activities. In accordance with Materials License Condition

23, the Licensee would provide a copy of the amended agreement to the NRC. Additionally, the Licensee would notify the NRC if/when a decision is made to transition to this phase seeking approval prior to the implementation of any changes.

To ensure proper transition between phases, the Licensee proposed that the license be conditioned as follows:

- The Licensee will obtain prior NRC review and approval before transitioning to subsequent future phase of operation as discussed in Section 1.1.8 of the License Application.

1.1.8.3 ~~Option 2: Renewal of Lead Cascade Demonstration Facility Possession and Use~~ High Assay Low Enriched Uranium Production

A subsequent proposed deployment will be the installation of one or more 120 centrifuge HALEU cascade(s) in Train 3 with HALEU Feed and Withdrawal stations located in Train 4.

~~This option presumes that the Licensee would renew the Lead Cascade license in accordance with 10 CFR 70.73 and continue to operate the Lead Cascade concurrently with the activities being conducted under the ACP license. When NRC grants permission to operate the ACP, the Licensee would either terminate its possession and use license and transfer any remaining demonstration activities of the Lead Cascade to an authorized use within the ACP License as described in Option 1, continue to operate the Lead Cascade under its license for a period of time, or terminate its license in accordance with Option 3.~~

1.1.8.~~3~~4 ~~Option 3: Termination of Lead Cascade Operations~~Expanded Low Enriched Uranium and High Assay Low Enriched Uranium Production

The proposed follow on phase to High Assay Low Enriched Uranium production discussed in 1.1.8.3 above will be the addition of one or more 120 centrifuge HALEU cascades and/or LEU cascades and associated Feed and Withdrawal stations in a modular fashion all within the X-3001 building. The HALEU cascades could be fed directly from associated LEU cascades or directly with LEU cylinders.

~~This option presumes that the Licensee would allow the Lead Cascade license to expire. The Lead Cascade UF_6 inventory would be transferred to an entity authorized to possess the material prior to the license expiration date. The Licensee expects that most of the Lead Cascade centrifuge machines and equipment/components (i.e., piping, valves, other support system/components, etc.) will be used in the ACP. The re-use, refurbishment, or other disposition of the machines and system components will be based upon engineering evaluations and ACP design requirements. To the extent Lead Cascade equipment is used as part of the ACP, decommissioning of that equipment will not be necessary. The Lead Cascade facility descriptions would be reviewed to identify any potential changes to ACP facility descriptions and the changes would be evaluated in accordance with 10 CFR 70.72 and 70.32. Equipment not utilized in the ACP will be handled in accordance with the requirements of 10 CFR 70.38 and 10 CFR 40.42.~~

~~The Licensee would notify the NRC well in advance of the license expiration date of its plans to execute this option. At that time the Licensee would submit a more detailed Lead Cascade~~

~~license termination plan to NRC in accordance with the requirements of 10 CFR 70.38 and 10 CFR 40.42 for NRC review and approval.~~

1.1.8.~~4~~5 ~~Option 4: Phased~~ Full ACP Deployment

~~This option presumes that upon receipt of a license for the ACP, the Licensee would implement the initial phase of its commercial operations as described in Appendix C. A more detailed description may be found in document LA-3605-0003A, *Addendum 1 of the ISA Summary*. Thereafter, the Licensee would construct and install machines in phases until it reaches a capacity of 3.8 million SWU approximately four years after receipt of a license~~.

The Licensee ~~would~~ will notify the NRC ~~well~~ in advance of the transition of the ~~Lead Cascade to the~~full ACP as previously approved with the initial issuance of Materials License SNM-2011. At that time, the Licensee ~~would~~ will request a License Amendment and submit a ~~more~~ detailed decommissioning cost estimate and required financial assurance documentation ~~Lead Cascade transition plan~~ to NRC in accordance with the requirements of 10 CFR 70.38, ~~and~~ 10 CFR 40.42, and 10 CFR 30.36 for NRC review and approval. Additionally, the Licensee will provide the necessary financial qualification documentation as detailed in Materials License Condition 15.

1.1.9 Material of Construction

The ACP facilities are designed and built in a manner to ensure an operating life of at least 30 years. Materials of construction are chosen in accordance with the guidance provided in GAT-901 and GAT-T-3000 (References 25 and 26) to ensure piping and other equipment can maintain a minimum wall thickness during the operating life of the ACP. Corrosion and erosion rates are not anticipated to exceed 0.0025 millimeter per year depending upon material of construction, equipment configurations and flow rates.

This portion of the text has been determined to contain Export Controlled Information and is located in Appendix B of this license application.

An example of the use of steel in this fashion is UF_6 cylinders. While steel will corrode and not produce a protective fluoride film, the design compensates for the corrosion by increasing the thickness of the cylinder wall. Operational requirements for periodic retesting of the cylinders every five years ensures that the residual wall thickness is still adequate even under high temperature conditions experienced during cylinder heating. Corrosion of steel is greatly increased if moisture is introduced into the UF_6 cylinders; however, controls are in place to minimize the presence of moisture to address criticality and chemical reaction concerns.

Soldering and brazing alloys must be considered for the effects of operational conditions, material compatibility, and corrosion over the expected life of the associated equipment to ensure the integrity of the equipment is maintained. These metals are also exposed to UF_6 and elevated temperature conditions which affect their corrosion rates. KY/L-1990 (Reference 27) is used as guidance in selecting soldering and brazing materials for process equipment. Experience from GDP operations with these materials of construction supports the expectation there should be no corrosion and erosion related breaches during the lifetime of the ACP because the design effort has considered the compatibility of materials, equipment, and process gas and its constituents.

1.1.10 Use of Lubricants

The ACP is designed and constructed to use oilless pumps and compressors as much as possible in the processing of UF_6. Where lubrication is required and the associated equipment can potentially see process gas, the preferred lubricants are compatible with UF_6 and HF. Compatible lubricants are polyfluoropolyethers (PFPE), known by shelf names such as Fomblin or Krytox. These lubricants are fluorinated which minimizes their ability to react with the fluorine associated with UF_6 and HF. The chemical components are carbon, fluorine, and oxygen. Also, PFPEs have minimal flammability and toxicity concerns.

When the process equipment cannot achieve the desired performance parameters utilizing fluorinated lubricants, hydrocarbon based lubricants can be used. Performance parameters include, but are not limited to, pressure, mass flow, and availability. Where hydrocarbon-based lubrication is required, the amounts in use are small enough such that criticality and combustible loading concerns are minimal.

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

Figure 1.1-1 U.S. Department of Energy Reservation in Piketon, Ohio

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

Figure 1.1-2 American Centrifuge Plant Layout

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

Figure 1.1-3 X-3001 (X-3002) Typical General Equipment and Process Flow Layout

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

Figure 1.1-4 Feed, Withdrawal, and Product Operations

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

Figure 1.1-5a X-3346 Feed Equipment and Process Flow Layout

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

Figure 1.1-5b X-3346 Blending/Transfer Equipment and Process Flow

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

Figure 1.1-5c X-3346 Product Withdrawal Equipment and Process Flow

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

Figure 1.1-5d X-3346 Tails Withdrawal Equipment and Process Flow

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

Figure 1.1-5e X-3346 Typical General Equipment and Process Flow Layout

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Figure 1.1-6 X-3346A Typical General Equipment and Process Flow Layout

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

Figure 1.1-7 X-3344 Typical General Equipment and Process Flow Layout

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

Figure 1.1-8 X-7725 Typical General Equipment and Process Flow Layout

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

Figure 1.1-9 X-7727H Typical General Equipment and Process Flow Layout

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

Figure 1.1-10 X-2232C Typical General Equipment and Process Flow Layout

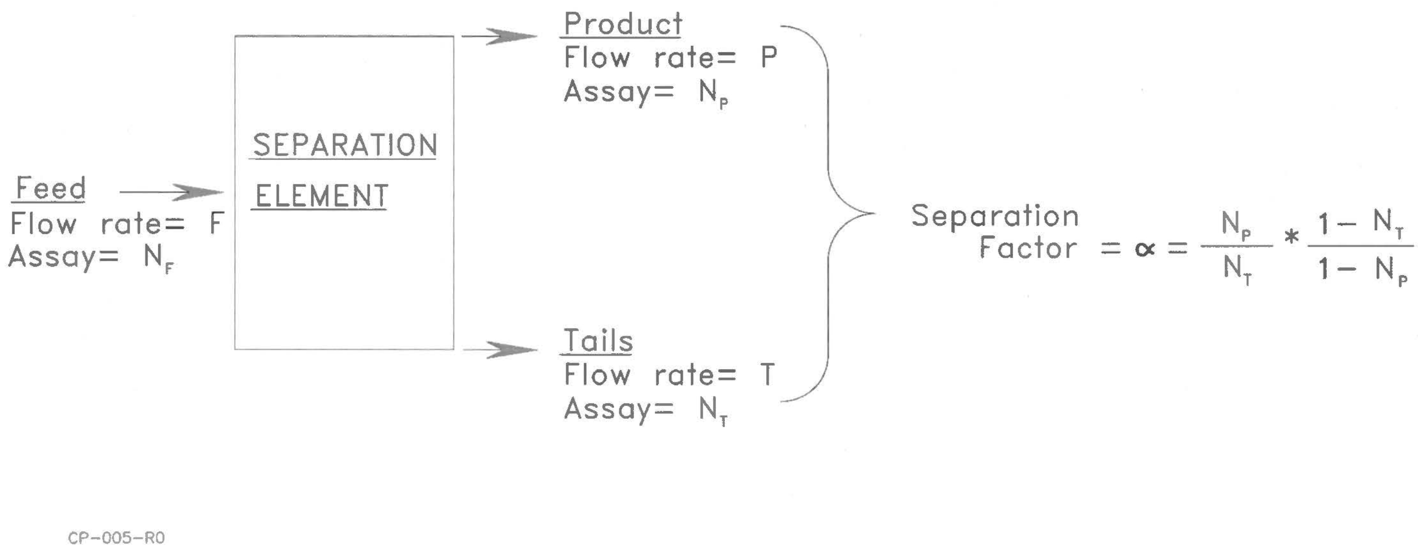


Figure 1.1-11 Separation Element

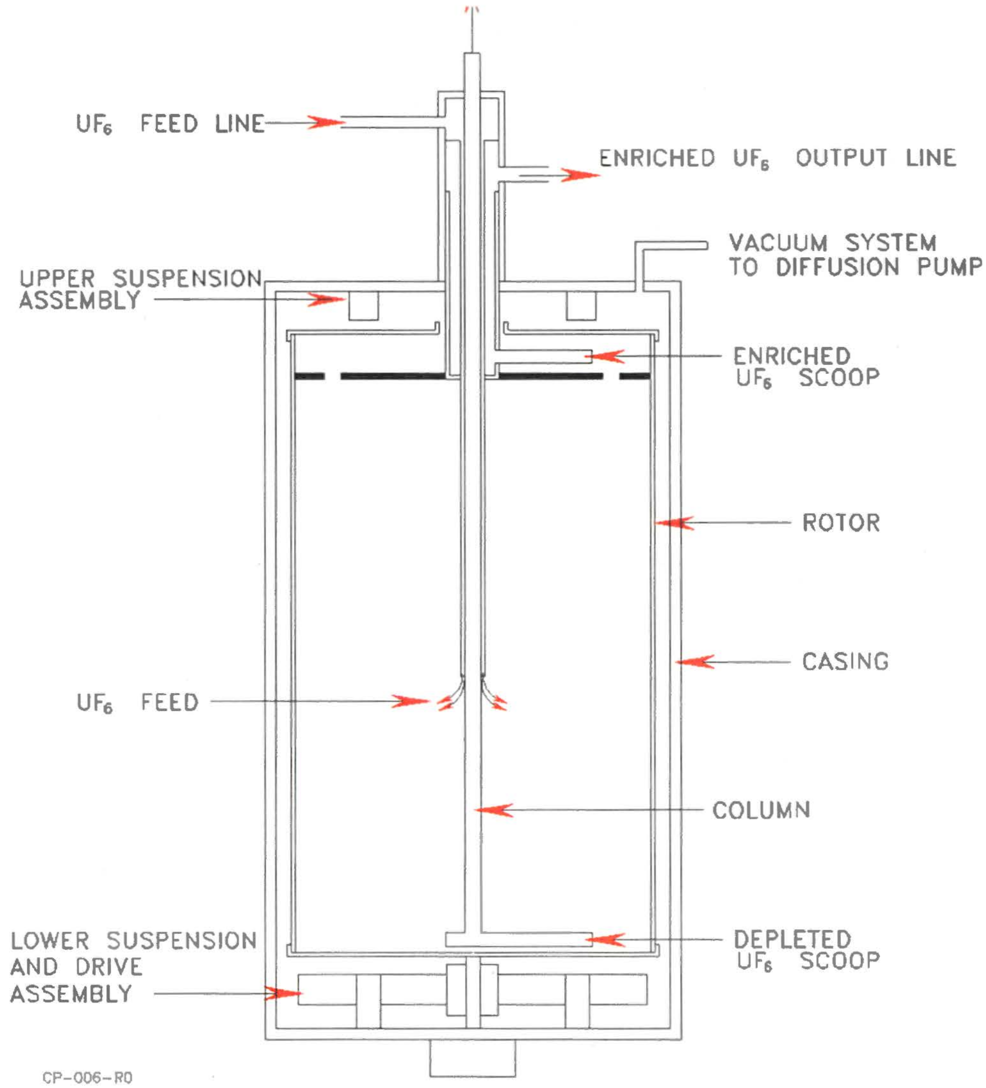


Figure 1.1-12 Centrifuge Schematic
(For HALEU Demonstration, a molecular pump will be used in place of the diffusion pump)

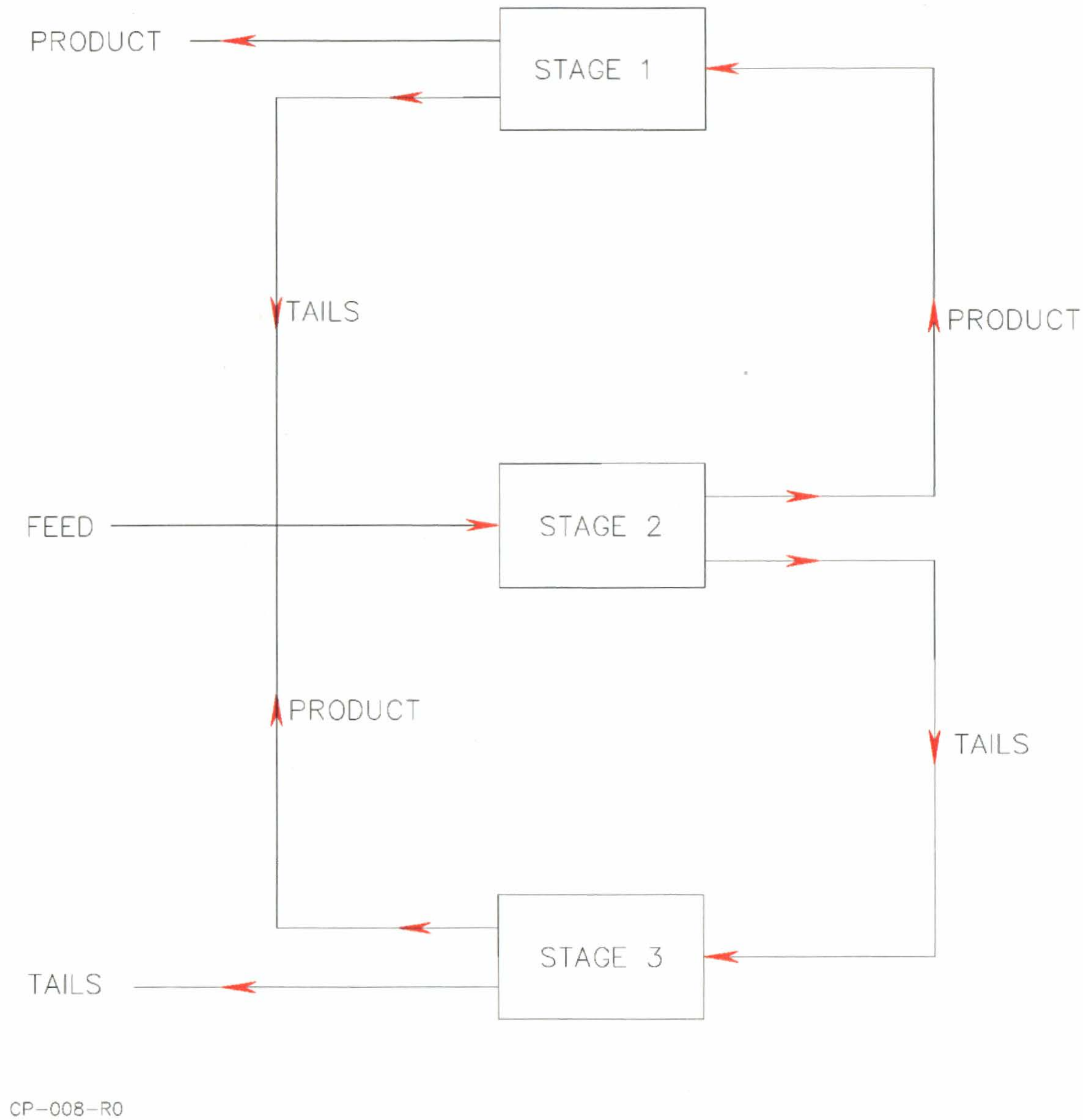


Figure 1.1-13 Example Cascade and Stage Flow Schematic

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

Figure 1.1-14 Systems Interfaces

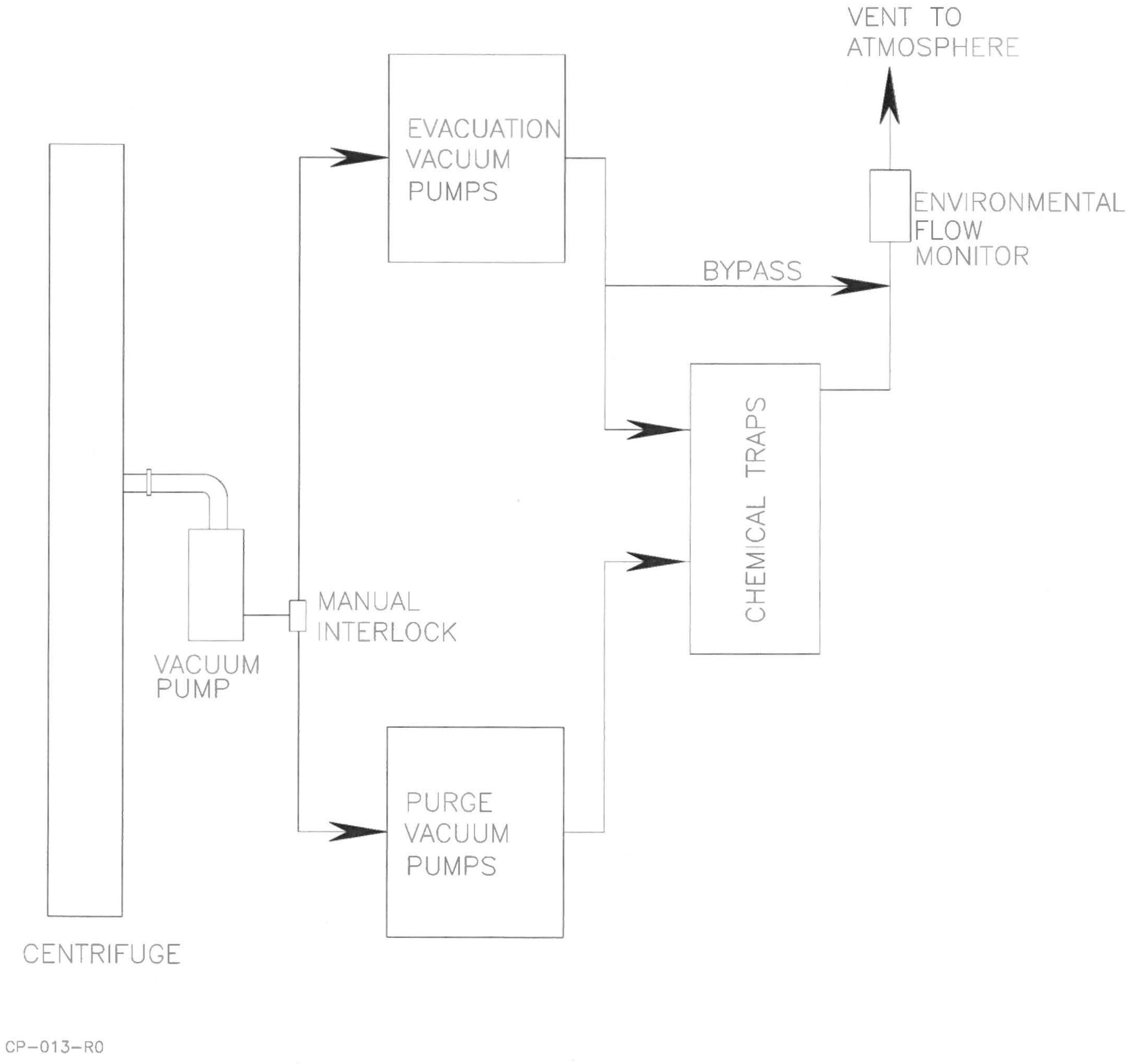


Figure 1.1-15 Purge and Evacuation Vacuum System Schematic

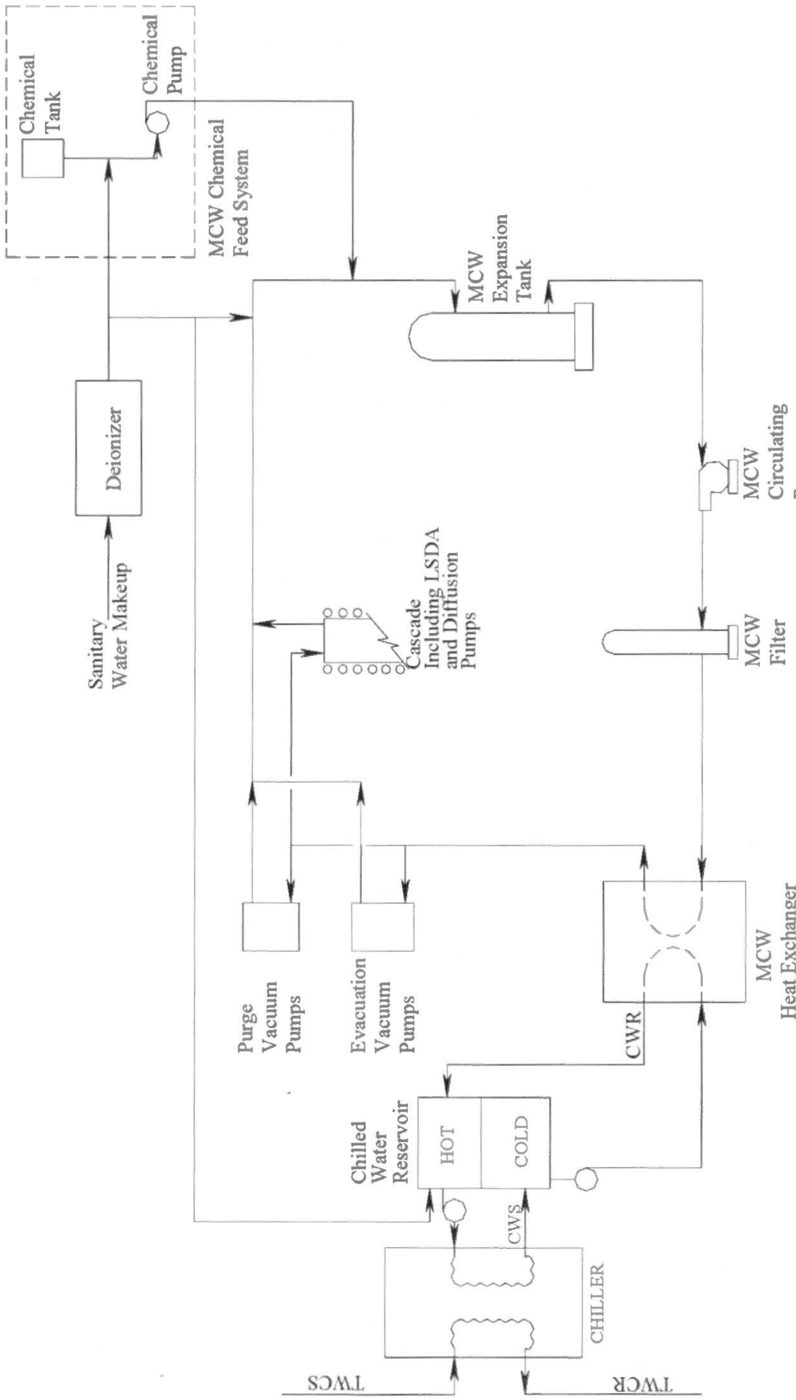


Figure 1.1-16 Machine Cooling Water System Flow Schematic

(For HALEU Demonstration, a molecular pump will be used in place of the diffusion pump and does not require MCW)

Table 1.1-1 American Centrifuge Plant Major Facilities

Facility No.	Facility Description	Facility Function
~~X-112~~	~~Data Processing Building~~	~~Provides secure housing for the data systems and necessary personnel.~~
X-220E1	Evacuation Public Address System	Provides the ability to provide evacuation instructions or notification in the event of an incident requiring evacuation or sheltering of reservation/plant personnel.
X-220E3	Power Public Address System	Provides the ability to provide evacuation instructions or notification in the event of an incident requiring evacuation or sheltering of reservation/plant personnel.
X-220R	Public Warning Siren System	Provides notification to the public within a two-mile radius of the DOE reservation in the event of an incident requiring evacuation or sheltering of the public.
X-745G-2	Cylinder Storage Yard	Allows for movement and storage of UF_6 material outside of the process. (typically Tails).
X-745H	Cylinder Storage Yard	Future cylinder storage yard area reserved.
~~X-1020~~	~~Emergency Operations Center~~	~~Serves as a central location to coordinate any emergencies that occur on the DOE reservation.~~
X-2202	Roads	Allow for easy and safe movement of people, equipment, and material.
X-2215A	Underground Electrical Distribution to Process Buildings	This facility provides 13.8 kV electrical power distribution to the process buildings.
X-2215B	Electrical Distribution to Areas Other Than Process Buildings	This facility provides 13.8 kV electrical power distribution to the process support facilities.
X-2220N	Security Access Control and Alarm System	Provides interior protection and high-security entry controls.
X-2230B	Sanitary Sewer	Provides underground sewage collection system.
X-2230C	Storm Sewer	Provides underground drainage system to collect surface water.
X-2230M	Southwest Holding Pond	Provide a quiescent zone for settling suspended solids, dissipation of chlorine, and oil diversion and containment prior to being discharged to an unnamed tributary of the Scioto River. Holding Pond #1
X-2230N	West Central Holding Pond	Provide a quiescent zone for settling suspended solids, dissipation of chlorine, and oil diversion and containment prior to being discharged to an unnamed tributary of the Scioto River. Holding Pond #2

Table 1.1-1 American Centrifuge Plant Major Facilities

Facility No.	Facility Description	Facility Function
X-2232C	Interconnecting Process Piping	Process piping that is external to the primary facilities that connects the X-3346 building to the X-3001 building and connects the X-3001 and X-3002 buildings (includes feed, product and tails UF_6).
~~X-3000~~	~~Office Building~~	~~Houses personnel necessary for plant administration.~~
X-3001	Process Building	Houses the centrifuges ~~machines~~ and their support systems.
X-3002	Process Building	Houses the centrifuges ~~machines~~ and their support systems.
X-3012	Process Support Building	Houses the operational and maintenance areas and the transfer aisleway that services the X-3002 building.
X-3344	Customer Services Building	Houses the equipment to sample cylinders for customer specifications as well as meeting NMC&A cylinder sampling requirements.
X-3346	Feed and Withdrawal Building	Houses four distinct areas of operation: one to meet the UF_6 feed material needs of the enrichment process operation, one to blend/transfer UF_6 between cylinders and two to meet the process withdrawal requirements: one for product withdrawal and the other for tails withdrawal.
X-3346A	Feed and Product Shipping and Receiving Building	Houses equipment necessary to receive and ship the UF_6 cylinders necessary to support the ACP operations as well as providing NMC&A scale capability.
X-5000	Switch House	This facility contains equipment necessary to distribute electrical power throughout ACP.
X-5001	Substation	This facility contains power transformers and other equipment necessary to transform 345 kV power to 13.8 kV for electrical power distribution throughout ACP.
X-5015	345 kV Underground Cable	This facility provides 345 kV electrical power from the X-530A to the X-5001.
X-6000	Cooling Tower Pump House, Air Plant, and Air Plant Support Systems	Contains the necessary equipment/systems to distribute dry compressed air to the ACP and to provide the requisite water to the X-6001 Cooling Tower for the removal of heat from the process buildings.

Table 1.1-1 American Centrifuge Plant Major Facilities

Facility No.	Facility Description	Facility Function
X-6001	Cooling Tower	Provides the necessary cooling requirements for the process buildings.
X-6002	Boiler System	Provides hot water for heating.
X-7721	Maintenance, Stores and Training Building	Provide areas for maintenance shops; stores and receiving activities; and training.
X-7725	Recycle/Assembly Building~~Facility~~	An area where the centrifuges ~~machines~~ can be manufactured, assembled, tested, and maintained. Used as a shipping, receiving, and materials storage area.
X-7725A	Waste Accountability Facility	Serves as a storage area for equipment and parts necessary for the maintenance and repair of the process and process support equipment.
X-7725C	Chemical Storage Building	Provides clean, non-contaminated, protected, storage area of manufacturing chemicals.
X-7726	Centrifuge Training and Test Facility	Initially used for centrifuge component manufacturing and centrifuge ~~machine~~ assembly, then used for ~~machine~~ centrifuge assembly training and centrifuge~~machine~~ component preparation.
X-7727H	Interplant Transfer Corridor	Provides a protected pathway to transport centrifuges ~~machines~~ from the X-7725 building or X-7726 ~~buildings~~ facility to the process buildings or back, as necessary. This area also serves as a shipping and receiving area for equipment and components during construction.
X-7745R	Recycle/Assembly Storage Yard	Provides clean, non-contaminated, outside, horizontal rack storage of centrifuge casings prior to being moved inside the building for centrifuge~~machine~~ assembly.
X-7746S	Cylinder Storage Yard	Allows for movement and storage of UF_6 material outside of the process.
X-7746W	Cylinder Storage Yard	Allows for movement and storage of UF_6 material outside of the process.

1.2 Institutional Information

~~American Centrifuge Operating, LLC~~ ACO is the ~~applicant~~ licensee for the ACP license to receive, acquire, possess, and transfer byproduct, source, and special nuclear material. ~~American Centrifuge Operating, LLC~~ACO is a wholly owned indirect subsidiary of ~~American Centrifuge Holdings, LLC, which is a limited liability company formed under the laws of Delaware. American Centrifuge Holdings, LLC is a wholly owned subsidiary of USEC Inc~~Centrus Energy Corp. (Centrus).

1.2.1 Corporate Identity

~~USEC Inc. is a global energy company and a leading supplier of enriched uranium fuel for commercial nuclear power plants.~~ Centrus is a supplier of various components of nuclear fuel to utilities and advanced engineering, design, and manufacturing services to government and private sector customers. USEC Inc., the predecessor to Centrus, was organized in 1998 under Delaware law in connection with the privatization of the United States Enrichment Corporation. Centrus' direct and indirect ~~USEC Inc.'s~~ subsidiaries ~~United States Enrichment Corporation and American Centrifuge Holdings, LLC~~ are also registered companies in the State of Delaware.

Centrus' ~~USEC Inc.'s~~ principal office is located at 690~~3~~1 Rockledge Drive, Bethesda, MD 20817. ~~USEC Inc.~~Centrus is listed on the NYSE American~~ew York Stock Exchange~~ under the ~~ticker~~ symbol ~~US~~LEU. Private and institutional investors own the outstanding shares of ~~USEC Inc~~Centrus. The principal officers of ~~USEC Inc.~~Centrus are listed below and are citizens of the United States.

~~John K. Welch~~Daniel B. Poneman, President and Chief Executive Officer
Larry B. Cutlip, Sr. Vice President, Field Operations
~~Philip G. Sewell, Senior Vice President and Chief Development Officer~~
~~Robert Van Namen, Senior Vice President and Chief Operating Officer~~
~~John C. Barpoulis, Senior Vice President and Chief Financial Officer~~
~~Peter B. Saba, Senior Vice President, General Counsel, Corporate Secretary, and Chief Compliance Officer~~

The NRC has determined that Centrus~~USEC Inc.~~ is not owned, controlled, or dominated by an alien, a foreign corporation, or a foreign government.

~~With the exception of a sublease of the ACP and the Lead Cascade facilities in Piketon, Ohio, the operation and control of United States Enrichment Corporation is separate from that of American Centrifuge Holdings, LLC.~~

In September 2008, USEC Inc., the predecessor to Centrus, formed five wholly owned subsidiaries in the State of Delaware to carry out future commercial activities related to the American Centrifuge project. These subsidiaries were intended to own the American Centrifuge Plant (ACP) and equipment, provide operations and maintenance services, manufacture centrifuge machines and conduct ongoing centrifuge research and development. These subsidiaries are American Centrifuge Holdings, LLC (ACH), a direct subsidiary to Centrus, and ACO; American

Centrifuge Technology, LLC (ACT); American Centrifuge Manufacturing, LLC (ACM); and American Centrifuge Enrichment, LLC (ACE), direct subsidiaries to ACH. ACO is the licensee and operating organization for the ACP. ACO will operate the HALEU Demonstration Program under the NRC ACP license.

Due to the current oversupply in the enrichment market, Centrus does not plan for near term deployment of a commercial scale uranium enrichment facility. As a result, Centrus has consolidated the ACP operations in Piketon, Ohio, and the technical, engineering and manufacturing capabilities in Oak Ridge, Tennessee, into ACO. Currently ACH, ACT, ACM and ACE are inactive companies.~~USEC Inc. established five limited liability companies: American Centrifuge Holdings, LLC (AC Holdings); American Centrifuge Operating, LLC (AC Operating or the Licensee); American Centrifuge Technology, LLC (AC Tech); American Centrifuge Manufacturing, LLC (AC Mfg); and American Centrifuge Enrichment, LLC (ACE). The Certificates of Formation for each of the limited liability companies are filed in the State of Delaware.~~

~~AC Holdings is a subsidiary of USEC Inc. and AC Operating, ACE, and AC Tech are wholly owned subsidiaries of AC Holdings. AC Holdings will own a majority of AC Mfg (a joint venture with Babcock & Wilcox Technical Services Group, Inc. [B&W]). Together, these five companies will hold all assets, rights, and obligations connected with the centrifuge technology. This structure will accommodate any third party financing or investment in the American Centrifuge Project and future expansion of the project using funds from other sources. The principal place of business for AC Holdings and its subsidiaries is 6903 Rockledge Drive, Bethesda, MD 20817.~~

~~AC Tech will hold the intellectual property rights to the American Centrifuge technology and conducts the technology development activities in Oak Ridge, Tennessee. AC Mfg is a joint venture formed by USEC Inc. and B&W to manufacture and assemble the centrifuge machines for the ACP. AC Mfg will have manufacturing facilities in Oak Ridge, Tennessee and will hold the contracts for manufacturing and assembling centrifuge machines. Final assembly of the machines will occur at ACP leased facilities following the Licensee's procedures. Workers necessary for technology development and manufacturing of centrifuge machines will work for AC Tech, AC Mfg, or their contractors.~~

~~ACE is a subsidiary of AC Holdings and will be the borrower under any financing arrangement. ACE will own the centrifuges and other equipment and materials related to the American Centrifuge Project, and will have the customer contracts and the contracts for the construction of the ACP and with other vendors needed to complete deployment of the American Centrifuge Project. Title to uranium will be held by ACE, its customers, and other contracting parties. ACE purchases the centrifuges from AC Mfg. ACE will also be party to agreements with the Licensee pursuant to which the Licensee will operate and maintain the Lead Cascade and ACP (including decontamination and decommissioning activities). AC Operating, not ACE, will control the centrifuges machines, uranium, the Lead Cascade, the ACP, and any other licensed facilities and materials.~~

~~AC Operating, the Licensee, is a wholly owned subsidiary of AC Holdings and it is not anticipated to have third party investors. The Licensee is contracted by ACE to manage, operate, and maintain the Lead Cascade and ACP (including decontamination and decommissioning activities) and ACEs' contracts with third parties. The officers of the Licensee are citizens of the United States.~~

~~The Licensee's~~ACO's principal officers are ~~expected to be~~ the same as ~~USEC Inc.~~Centrus' principal officers. The officers of ACO are citizens of the United States.

The Licensee ~~will~~ holds the regulatory licenses and permits, including the NRC license, required to construct and operate the ~~Lead Cascade and ACP~~centrifuge facilities in Piketon, Ohio. The workers necessary to operate the centrifuge facilities in Piketon will be employed by~~, or loaned to,~~ the Licensee or its qualified contractors. Contracted resources are utilized in a number of these programmatic areas to provide day-to-day functional support. Inter-company arrangements (i.e., through reverse work authorizations) are in place to provide the necessary support.

The mailing address for the Licensee at the ACP is:

> American Centrifuge Operating, LLC
> American Centrifuge Plant
> P. O. Box 628
> Piketon, Ohio 45661-0628

1.2.1.1 Site Location

~~The ACP is located on the DOE Portsmouth GDP. The reservation is located at latitude 39°00'30" north and longitude 83°00'00" west, measured at the center of the reservation, on approximately 3,700-acres of federally owned land near Piketon, in Pike County, Ohio. The largest cities within an approximate 50-mile radius are Portsmouth, Ohio, located approximately 27 miles to the south, and Chillicothe, Ohio, located approximately 27 miles to the north. The reservation occupies approximately 750 security-fenced acres and is located about one and one half miles east of U.S. Route 23 and two miles south of U.S. Route 32, and two miles east of the Scioto River.~~

The ACP is located on DOE-owned land in rural Pike County, a sparsely populated area in south-central Ohio. Specifically, the ACP is located on the DOE reservation in the former GCEP facilities. The buildings/facilities and grounds are leased by Centrus from the DOE. The Licensee in turn subleases the buildings and grounds from Centrus. The DOE reservation has been studied and characterized extensively by both the DOE and Centrus.

The United States Enrichment Corporation, leases portions of the Portsmouth GDP reservation from the DOE. Pursuant to a 2006 amendment to that lease agreement, Centrus, formerly known as USEC Inc., subleased space for the Lead Cascade and the ACP from the United States Enrichment Corporation. ~~USEC Inc.,~~Centrus, with approval of the DOE, assigned the sublease for the space for the ACP to the Licensee. The Licensee and its agents will conduct activities within the leased facilities and access and egress thereto, in accordance with this license application.

1.2.1.2 Other Reservation Activities

~~The United States Enrichment Corporation operates the GDP in accordance with a NRC Certificate of Compliance issued pursuant to 10 CFR Part 76 requirements. These operations include:~~

- ~~Performing uranium deposit removal activities in the cascade facilities and~~
- ~~Activities necessary to support DOE decontamination and demolition of the GDP facilities.~~

In addition to the ~~United States Enrichment Corporation's~~Licensee's operations, the DOE ~~has constructed and plans to~~ operates a depleted uranium hexafluoride (DUF_6) Conversion Facility on the reservation adjacent to the ACP. ~~and is~~The DOE is also engaged in activities related to the decontamination and ~~demolition~~ decommissioning (D&D) of the GDP and environmental restoration activities in a number of locations on the reservation. DOE utilizes contractors and sub-contractors to perform this work. DOE self-regulates DOE activities conducted in non-leased areas in accordance with applicable DOE requirements. ~~Additionally, the Ohio National Guard maintains an area on the reservation for the maintenance, reconditioning, and storage of equipment. No ordnance is permitted. The activities are accomplished in and around the X-751 facility, located on the south end of the reservation.~~

~~The DUF_6 Conversion Facility on the reservation will convert DUF_6 inventories into depleted uranium oxides (UO_2, UO_3, and U_3O_8); transport the depleted uranium conversion products and waste materials to a disposal facility; transport and sell the hydrogen fluoride (HF) produced as a conversion co-product; and neutralize the excess HF to calcium fluoride (CaF_2) or either sell or dispose of it appropriately in the event that the HF product is not sold (References 2 and 28).~~

Mid-America Conversion Services, LLC (MCS) currently manages the DUF_6 Conversion Facility at the DOE reservation. The DUF_6 Conversion Facility was designed and constructed to convert DOE's inventory of DUF_6 produced by the former Portsmouth GDP to a more stable uranium oxide form for reuse, storage, and/or transportation and disposition. The process also produces hydrogen fluoride (HF) as a conversion co-product. Excess HF is neutralized to calcium fluoride (CaF_2) (References 2 and 28). The DUF_6 area consists of cylinder storage yards, a process building, support buildings, a warehouse and an administration building.

Fluor-BWXT Portsmouth, LLC (FBP) is the DOE contractor for D&D of the GDP. FBP is responsible for the D&D of 415 facilities and structures that supported the uranium enrichment operations conducted at the site. During D&D, Fluor-BWXT prepares contaminated facilities for demolition by deactivating utilities and removing stored waste, materials, process equipment such as converters and compressors, and piping.

The plant also includes various support structures that provide feed and transfer operations and site services such as maintenance; steam generation; cleaning; process heat removal; electrical power distribution; and water supply storage and distribution.

Pixelle Specialty Solutions™, formerly Glatfelter Specialty Papers, operates a lumberyard on the north edge of the DOE reservation. This facility is utilized as a sorting and transfer area for commercial and paper grade lumber.

~~Considering that the location of the DUF_6 Conversion Facility is within approximately 600 ft of the closest ACP facility (X-1107D), some of the DUF_6 Conversion Facility accidents could affect the health and safety of the ACP workers if they happened to be outside. ACP workers are trained to be aware of and understand the hazards associated with UF_6 and those hazards are similar for the DUF_6 Conversion Facility. There are DUF_6 Conversion Facility accidents determined to have high consequences, but sufficient controls are credited to minimize their probability of occurrence according to the Environmental Impact Statement, Engineering Analysis Report, and Documented Safety Analysis (References 2, 23, and 28). None of the DUF_6 Conversion Facility accident scenarios create new accident scenarios or initiators for the ACP. The field Emergency Response Organization is prepared to address the hazards associated with the DUF_6 Conversion Facility and how to respond to mitigate their effects.~~

1.2.2 Financial Qualifications

Under the HALEU Contract (Reference 17), DOE agreed to reimburse the Company for 80 percent of its costs incurred in performing the contract. The Company's cost share is the corresponding 20 percent and any costs incurred above these amounts. Costs under the HALEU Contract include *program costs*, including direct labor and materials and associated indirect costs that are classified as *Cost of Sales*, and an allocation of corporate costs supporting the program that are classified as *Selling, General, and Administrative Expenses*. Services to be provided over the three-year contract include constructing and assembling centrifuges and related infrastructure in a cascade formation. When estimates of remaining program costs to be incurred for such an integrated construction-type contract exceed estimates of total revenue to be earned, a provision for the remaining loss on the contract is recorded to *Cost of Sales* in the period the loss is determined. Our corporate costs supporting the program are recognized as expense as incurred over the duration of the contract term. The accrued loss on the contract will be adjusted over the remaining contract term based on actual results and remaining program cost projections (Reference 22).

In support of this HALEU Demonstration Program, DOE amended the GCEP Lease Agreement, in which the parties agree that all work performed under the HALEU Demonstration Contract on leased premises shall be considered a permitted use; any alterations or changes to the premises pursuant to the Demonstration Contract with the DOE shall be a permitted change to the premises; and that 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. Both the GCEP Lease and the Demonstration Contract afford indemnification pursuant to the Price Anderson Act.

The Company has long-term nuclear fuel sales and supply contracts in place that extend to 2030; these contracts will provide a stream of revenue for many years and provide a foundation for growth (Reference 22).

At the time of initial licensing and remains as the basis for the initial Materials License approval, ~~T~~the Licensee estimated~~s~~ the total cost to construct the initial 3.8 million SWU capacity for the ACP to be up to $3.1 billion (2008 dollars) (Reference 3) (see Appendix C of this license application), excluding capitalized interest, tails disposition, decommissioning, and any replacement equipment required during the life of the plant outside of normal spare equipment. The commercial ACP design is modular and can be constructed and installed incrementally over time. ~~Upon receipt of a license, the Licensee plans to implement the initial phase of its commercial operations as described in Appendix C of this license application. In parallel,~~ As the final commercial ACP phase, the Licensee plans to construct the plant and install ~~machines~~ centrifuges in ~~phases~~ increments until the ACP reaches a capacity of up to 3.8 million SWU production annually. ~~Phase I construction activities are those construction activities that occur during the 12 month period immediately following receipt of the license.~~ As groups of ~~machines~~ centrifuges are installed, operations will be initiated and will result in enrichment production that will generate revenue. The Licensee may construct and install additional capacity thereafter as operations and market conditions permit subject to additional NRC licensing approval. Financing for each phase of incremental capacity may be raised using different financial instruments, and the ratio of equity to debt may vary over time for each increment.

Funding for various future phases of construction may come from a variety of sources including, but not limited to, funds from operations, capital raised by ~~USEC Inc.~~ the Licensee, ~~ACE~~ other American Centrifuge limited liability companies, lending and/or lease arrangements and that the mix of funding sources may vary depending upon the phase of the project. ~~For example, initial construction activity has been funded entirely from USEC Inc. funds from operations, whereas later phases will be funded by ACE.~~ Prior to initiating each phase, the Licensee will make available for inspection on a confidential basis, its budget estimate for such phase and documentation of the source of funds available or committed to fund that increment.

In general, the Licensee's financial qualifications to construct and operate the ~~ACP~~ HALEU 16-centrifuge cascade under the Demonstration Contract is ~~are~~ demonstrated by the contract with DOE and the Selected Financial Data and detailed Consolidated Financial Statements within the latest ~~Annual Report~~ information filed with the U.S. Securities Exchange Commission by its parent Centrus.

In order to meet the financial qualifications requirements for construction and operation of future expansion of the facility beyond the cascade funded under the HALEU Demonstration Contract, the Licensee proposes that the license be conditioned as follows:

- Construction of each additional incremental future expansion ~~phase~~ of the ACP shall not commence before funding for that increment is available or committed. Of this funding, the Licensee or affiliates must demonstrate ~~have in place~~ before constructing such increment, ~~commitments for one or more of the following: equity contributions from the Licensee, affiliates and/or partners, along with lending and/or lease~~ arrangements that solely or cumulatively are sufficient to ensure funding for the particular increment's construction costs. The Licensee will make available for NRC inspection, documentation of both the budgeted costs for such phase and the source of funds available or committed to pay those costs.

- Operation of additional expansion of the ACP shall not commence until the Licensee or affiliates has in place, either: (1) long term contracts lasting five years or more that provide sufficient funding for the estimated cost of operating the facility for the five year period; (2) documentation of the availability of one or more alternative sources of funds that provide sufficient funding for the estimated cost of operating the facility for five years; or (3) some combination of (1) and (2).

~~The DOE-USEC Agreement required that the ACP be constructed on the DOE reservation located at either the Portsmouth Gaseous Diffusion Plant or the Paducah Gaseous Diffusion Plant.~~ Pursuant to Section 3107 of the USEC *Privatization Act*, the United States Enrichment Corporation leases the portions of the DOE reservation from DOE on which the ACP is located. The Licensee subleases those portions of the DOE reservations from the United States Enrichment Corporation. Under its lease with DOE and the sublease, and in accordance with Section 3107, the United States Enrichment Corporation and the Licensee are~~is~~ indemnified under Section 170d of the *Atomic Energy Act* for liability claims arising out of any occurrence within the United States, causing, within or outside the United States, bodily injury, sickness, disease, or death, or loss of or damage to property, or loss of use of property, arising out of or resulting from the radioactive, toxic, explosive, or other hazardous properties of chemical compounds containing source or special nuclear material arising out of activities under the lease. This indemnification is sufficient to meet the requirements of Section 193(d) of the *Atomic Energy Act* of 1954, as amended, and 10 CFR 140.13b, because the DOE indemnity provides greater financial protection than commercially available liability insurance. Therefore, the appropriate amount of separate liability insurance that should be required by the NRC is zero and an exemption from the requirements of 10 CFR 140.13b crediting DOE indemnity in lieu of nuclear liability insurance as discussed in this section is provided in Section 1.2.5 of this license application.

By letter dated May 14, 2007 (AET 07-0030) the Licensee provided status of its efforts to obtain nuclear liability insurance in accordance with NRC License Condition #14. The NRC agreed on July 16, 2007 that the Licensee had satisfied the requirements of this license condition and no further action is required concerning this license condition.~~USEC proposed that the license be conditioned as follows: the Licensee will provide to the Commission, at least 120-days prior to receiving licensed material in the ACP, a signed agreement between DOE and USEC regarding the indemnification.~~

Information indicating how reasonable assurance will be provided that funds will be available to decommission the facility as required by 10 CFR 70.22(a)(9), 10 CFR 70.25, and 10 CFR 40.36 is described in Chapter 10.0 of this license application.

1.2.3 Type, Quantity, and Form of Licensed Material

The type, quantity, and form of NRC-regulated special nuclear, source, and by-product material are shown in Table 1.2-1 for the proposed commercial plant and Table 1.2-2 for the HALEU Demonstration Program (see Appendix D of this license application).

1.2.4 Authorized Uses

The commercial ACP operation enriches UF_6 up to 10 wt. percent ^{235}U. The specific authorized uses for each class of NRC-regulated material are shown in Table 1.2-3~~2~~.

The HALEU Demonstration cascade enriches UF_6 up to a target enrichment of 19.75 wt. percent ^{235}U, but less than 20 wt. percent ^{235}U. Enrichment levels up to 25 wt. percent ^{235}U are authorized to permit for process fluctuations which can create small amounts of higher weight percent material. The specific authorized uses for each class of NRC-regulated material for the HALEU Demonstration Program are shown in Table 1.2-4.

Within the ACP Operations, ~~T~~the Licensee will provide a minimum 60-day notice to the NRC prior to initial customer product withdrawal of licensed material exceeding 5 wt. percent ^{235}U enrichment. This notice will identify the necessary equipment and operational changes to support customer product withdrawal, storage, processing, and shipment for these assays.

1.2.5 Special Exemptions or Special Authorizations

The following exemption to the applicable 10 CFR Part 20 requirements are identified in Section 4.8 of this license application:

- UF_6 feed, product, and depleted uranium cylinders, which are routinely transported inside the DOE reservation boundary between ACP locations and/or storage areas at the ACP, 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 a radiation reading greater than 0.1 ~~r~~Roentgen ~~e~~Equivalent ~~m~~Man per hour (~~rem~~REM/hour) at 30-centimeters (cm) but less than 1 REM~~rem~~/hour at 30 cm is posted Caution, High Radiation Area and entrance into the area shall be controlled by an RWP. Physical and administrative controls to prevent inadvertent or unauthorized access to High and Very High Radiation Areas are maintained. The on-site radiological impacts from the proposed exemptions to the requirements of 10 CFR 20.1904 and 20.1601 would be minimal and are consistent with previously approved exemptions found in the GDP certification. Moreover, pursuant to the regulations in 10 CFR 20.2301, the requested exemption is authorized by law and would not result in undue hazard to life or property.

The following exemption from the applicable 10 CFR 70.50 reporting requirement is identified in Section 11.6.3 of this license application:

- 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.

  10 CFR 70.17 allows the Commission, upon application of any interested person or upon its own initiative, to grant such exemptions from the requirements of the regulations in this part as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest. The requested exemption is authorized by law because there is no statutory prohibition on extending the reporting period to 60 days.

  Furthermore, granting this exemption request will not endanger life or property or the common defense and security, in that the exemption request does not relieve the ACP from other requirements contained in 10 CFR 70.50 (a) or (b) or by 10 CFR 70.74 and Appendix A of Part 70, such as 1-hour, 4-hour, and 24-hour reporting requirements for defined events.

  The proposed exemption would result only in written reports being submitted within the time limit currently allowed under 10 CFR 50.73 for commercial nuclear power plants. It would be consistent with the exemption granted to the gaseous diffusion plants for reporting of events pursuant to 10 CFR 76.120(d)(2) (67 Federal Register 68699, November 12, 2002) and the exemption granted to the Lead Cascade during licensing.

  This proposal allows for completion of required root cause analyses after event discovery and fewer supplemental reports, thereby reducing regulatory burden and confusion. Thus, it is clearly consistent with the public interest.

  ~~USEC~~ The Licensee notes that the requirements of 10 CFR 20.2201 and 20.2203 require written reports of certain events within 30 days after their occurrence. The Licensee~~USEC~~ is not requesting an exemption from these reporting requirements.

The following exemption from the requirements of 10 CFR 70.25(e) and 10 CFR 40.36(d) addressing the decommissioning funding requirements is identified in Section 10.1 of this license application:

- 10 CFR 70.25(e) and 10 CFR 40.36(d) require, in part, that "The decommissioning funding plan must also contain a certification by the licensee that financial assurance for decommissioning has been provided in the amount of the cost estimate for decommissioning…".

  In support of HALEU Demonstration Program, as noted in Section 10.1 of this license application, 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). In the amended GCEP Lease Agreement, DOE 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, exempting ACO from any financial assurance for any liability or lease turnover conditions shall be required from the Corporation (Licensee). Additionally, as stated within the amended GCEP Lease Agreement, the parties agree that should any liabilities of the Corporation (Licensee) arise 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.

The following exemption from the requirements of 10 CFR 70.25(e) and 10 CFR 40.36(d) addressing the decommissioning funding requirements is identified in Section 10.2.10.4 and the ~~Decommissioning Funding Plan (~~DFP~~)~~ of this license application:

- 10 CFR 70.25(e) and 10 CFR 40.36(d) require, in part, that "The decommissioning funding plan must also contain a certification by the licensee that financial assurance for decommissioning has been provided in the amount of the cost estimate for decommissioning…".

  In support of future expansion of the ACP, ~~A~~as noted in Section 10.2.10.4 of this license application, the financial assurance for a portion of the decommissioning costs, to include the disposition of centrifuges ~~machines~~ and UF_6 tails, which constitutes a major portion of the decommissioning liability, will be provided incrementally as centrifuges are built/installed and UF_6 tails generated. Full funding for decommissioning of the facilities will be provided in the initial executed financial assurance instrument.

  This exemption is justified for the following reasons: 1) It is authorized by law because there is no statutory prohibition on incremental funding of decommissioning costs. 2) The requested exemption will not endanger life or property or the common defense and security for the following reasons: the unique modular aspects of the American Centrifuge technology allow 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~~ are added to the process, until full capacity of the facility is reached; at which point the UF_6 tails are generated at a relatively constant rate throughout the life of the plant. As such, requiring full funding for decommissioning liability, to include centrifuges ~~machines~~ and UF_6 tails disposition, incurred over the lifetime of the plant, at the time of initial license issuance, produces an unnecessary financial burden on the licensee.

  Furthermore, incremental funding of decommissioning costs, to include centrifuges ~~machines~~ and UF_6 tails disposition, is justified based upon the Licensee~~USEC~~'s commitments to update the cost estimates and provide a revised funding instrument for decommissioning annually, to cover the upcoming period of operation, prior to operation at full capacity, and after full capacity has been reached to annually adjust the cost estimate for UF_6 tails disposition and to adjust all other decommissioning costs periodically, and no less frequently than every three years. In addition, the relative stability of the factors, which are utilized to generate the UF_6 tails volumes, allows actual inventory values to be provided for prior periods of operation and reliable estimates for the upcoming periods of operation. The NRC has previously accepted an incremental approach to decommissioning funding costs for the United States Enrichment Corporation's operation of the GDPs. 3) Finally, granting this exemption is in the public interest for the same reasons as stated above and will facilitate deployment of gas centrifuge enrichment technology by eliminating an unnecessary financial burden on the licensee.

The following exemption from the requirements of 10 CFR 70.24 addressing criticality monitoring is identified in Section 3.10.6 of the ISA Summary and discussed in Section 5.4.4 of this License Application. Exemption is required for criticality monitoring of the UF_6 cylinder storage yards.

- 10 CFR 70.24, *Criticality Accident Requirements*, requires that licensees authorized to possess special nuclear material in a quantity exceeding 700 g of contained ^{235}U shall maintain in each area in which such licensed special nuclear material is handled, used, or stored, a monitoring system capable of detecting a criticality that produces an absorbed dose in soft tissue of 20 rads of combined neutron and gamma radiation at an unshielded distance of two meters from the reacting material within one minute.

  10 CFR 70.17 allows the Commission, upon application of any interested person or upon its own initiative, to grant such exemptions from the requirements of the regulations in this part as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest. The requested exemption is authorized by law because there is no statutory provision prohibiting the grant of the exemption. The requested exemption will not endanger life or property or the common defense and security and is otherwise in the public interest for the reasons discussed below.

  Transportation, handling and storage of solid UF_6 filled cylinders are doubly contingent. Double contingency is established by multiple controls that limit the likelihood for a solid product cylinder to be breached during transportation, handling or storage, and the likelihood for a breach to not be identified and repaired before sufficient moderation results in a criticality. Moderation control of UF_6 filled cylinders is maintained by ensuring cylinder integrity through periodic cylinder inspections. If a UF_6 filled cylinder is found to be breached, the cylinder is covered within 24-hours after discovery to reduce the potential accumulation of moderating material, i.e., rainwater. This time limit ensures a corresponding heavy rainfall will not result in accumulation of sufficient amounts of water to cause a criticality. Damaged cylinders are repaired as necessary and emptied. UF_6 cylinders are uniquely identified and their design requirements are controlled to further ensure cylinder integrity and reliability (i.e., UF_6 cylinders are QL-1 components and are controlled in accordance with the Quality Assurance Program Description), and the Licensee~~USEC~~ implements onsite cylinder handling practices (i.e., requiring the use of approved equipment in accordance with approved procedures), which reduces the likelihood that a solid UF_6 cylinder would be breached. These requirements are established as items relied on for safety to ensure the health and safety of the public and workers.

The UF_6 cylinders stored in storage yards are not covered by a criticality monitoring system unless those cylinders contain licensed material greater than 5.0 weight percent ^{235}U. NCS evaluation of product cylinders of any size, configured in infinite planar arrays, containing material enriched up to 5.25 weight percent ^{235}U, has concluded that subcritical conditions are maintained. The ACP ISA has concluded that cylinders containing licensed material less than or equal to 5.0 weight percent ^{235}U cannot be involved in a criticality accident sequence that has a probability of occurrence that exceeds 5 x 10^{-6}/year.

The frequencies of criticality events in the cylinder yards have been decreased to the Highly Unlikely range ($<10^{-5}$/year) through the establishment of preventive controls established by the ISA in accordance 10 CFR 70.62. Considering the conservatism of the ISA methodology in developing the unmitigated frequency and actual historical data related to cylinder operations, the frequency values could be reduced further. This additional reduction considers the fact that during 50 years of GDP operations, only one cylinder breach has occurred due to mishandling or equipment failure. Since that occurrence, cylinder handling equipment has been redesigned and cylinder handling methods have been revised to minimize the potential for breaches to occur. Another fact not considered in the ISA is that holes with a dimension of less than one inch will self-seal such that moderating material cannot infiltrate the breach. A third factor not considered in the ISA is that enriched cylinder operations require constant use and monitoring of cylinders such that corrosion breaches in enriched cylinders are highly unlikely. Allowing for this additional reduction in frequency, the probability for a criticality event becomes incredible, therefore CAAS coverage is not necessary.

The increased vehicular and pedestrian traffic in support of CAAS maintenance and calibration requirements would cause a subsequent increased likelihood for impact events involving cylinders and there would be an increased safety risk for workers from radiation exposure due to the ongoing CAAS maintenance and calibration requirements. To meet the CAAS coverage requirements in ANSI 8.3 and the operating requirements for the ACP, enriched cylinder storage yards would require a minimum of 60 clusters. Clusters would need to be at a height of approximately 40 feet, which would require maintenance equipment and pedestrian traffic to perform testing and preventative maintenance tasks to ensure their reliability and operability. This equipment and traffic would increase the likelihood for fire and impact events in the cylinder storage yards such that workers would be at a higher risk for injury and exposure relative to the minimal mitigative value produced by the presence of CAAS.

The following exemption from the requirements of 10 CFR 140.13b crediting DOE indemnity in lieu of nuclear liability insurance as discussed in Section 1.2.2 of this license application.

- 10 CFR 140.13b requires, that "Each holder of a license issued under Parts 40 or 70 of this chapter for a uranium enrichment facility that involves the use of source material or special nuclear material is required to have and maintain liability insurance. The liability insurance must be the type and in the amounts the Commission considers appropriate to cover liability claims arising out of any occurrence within the United States that causes, within or outside the United States, bodily injury, sickness, disease, death, loss of or damage to property, or loss of use of property arising out of or resulting from the radioactive, toxic, explosive, or other hazardous properties of chemical compounds containing source material or special nuclear material. Proof of liability insurance must be filed with the Commission as required by § 140.15 before issuance of a license for a uranium enrichment facility under parts 40 and 70 of this chapter."

In support of this HALEU Demonstration Program, DOE amended the GCEP Lease Agreement, in which the parties agree that all work performed under the HALEU Demonstration Contract on leased premises shall be considered a permitted use; any alterations or changes to the premises pursuant to the Demonstration Contract with the DOE shall be a permitted change to the premises; and that 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. Therefore, the Demonstration Contract exempts ACO from any financial assurance for any liability insurance during the three-year contract period.

In support of future expansion of the ACP, in accordance with Section 3107 of the USEC *Privatization Act*, the Lease with DOE for the DOE owned facilities that will be used for the ACP includes an indemnity agreement from DOE under Section 170d of the *Atomic Energy Act* (AEA) for liability claims.

The Commission may, pursuant to 10 CFR 140.8, upon application of any interested person or upon its own initiative, grant such exemptions from the requirements of the regulations in this part as it determines are authorized by law and are otherwise in the public interest. This exemption is authorized by law because there is no statutory prohibition on crediting the DOE indemnity agreement in lieu of nuclear liability insurance. The DOE indemnity agreement contained in the Lease pursuant to DOE's authority in Section 170d of the AEA is sufficient to meet the requirements of Section 193(d) of the *Atomic Energy Act* of 1954, as amended. Section 193(d) states that "the Commission shall require, as a condition of the issuance of a license ... for a uranium enrichment facility, that the licensee have and maintain liability insurance of such type and in such amounts as the Commission judges appropriate to cover liability claims ..."

The Lease requires that the Licensee~~USEC~~ obtain "financial protection to cover public liability, [as defined in the AEA] in such amount and of such type as is commercially available at commercially reasonable rates, terms and conditions" (Lease at Section 10.1(c)). To the extent required by the Lease, the Licensee~~USEC~~ will obtain such financial protection and will provide proof of such financial protection to the NRC prior to commencing operations.

The indemnity agreement contained in the Lease will "cover liability claims arising out of any occurrence within the United States that causes, within or outside the United States, bodily injury, sickness, disease, death, loss of or damage to property, or loss of use of property arising out of or resulting from the radioactive, toxic, explosive, or other hazardous properties of chemical compounds containing source material or special nuclear material." Section 193(d) affords the Commission the discretion to determine the type and amount of liability insurance that is required to cover liability claims. The Commission has the discretion to conclude that no liability insurance is required in light of the DOE indemnity agreement. Therefore, the requested exemption is authorized by law.

Moreover, the requested exemption is in the public interest since it will facilitate deployment of the ACP, thereby maintaining domestic enrichment capacity using more efficient centrifuge technology. Requiring separate nuclear liability insurance would at best impose an unnecessary financial burden on the licensee and at worst preclude the construction of the ACP if commercial insurance ultimately is unavailable for facilities, such as the ACP, which are located on a DOE owned site. ANI, the only company providing commercial nuclear liability insurance in the U.S., has informed us that it has never insured a facility located on a DOE owned site. Furthermore, the separate liability insurance would not provide a commensurate benefit to the public since the DOE indemnity covers any public liability under Section 170 of the AEA up to the statutory limit of liability. The DOE indemnity agreement in the Lease adequately provides financial protection for the public for public liability as defined in the AEA. Therefore, the requested exemption is in the public interest.

The following exemption from NRC's Materials License Condition 15 related to financial funding as discussed in Section 1.2.2 of this license application.

- In order to meet the financial qualifications requirements for construction and operation of the facility, the Licensee proposes that the license be conditioned as follows:

  Construction of each additional incremental future expansion of the ACP shall not commence before funding for that increment is available or committed. Of this funding, the Licensee or affiliates must demonstrate before constructing such increment, arrangements that solely or cumulatively are sufficient to ensure funding for the particular increment's construction costs. The Licensee will make available for NRC inspection, documentation of both the budgeted costs for such phase and the source of funds available or committed to pay those costs.

  Operation of additional expansion of the ACP shall not commence until the Licensee or affiliates has in place, either: (1) long term contracts lasting five years or more that provide sufficient funding for the estimated cost of operating the facility for the five year period; (2) documentation of the availability of one or more alternative sources of funds that provide sufficient funding for the estimated cost of operating the facility for five years; or (3) some combination of (1) and (2).

In general, the Licensee's financial qualifications to construct and operate the HALEU 16-centrifuge cascade under the Demonstrations' Contract is demonstrated by the contract with DOE and the Selected Financial Data and detailed Consolidated Financial Statements within the latest information filed with the U.S. Securities Exchange Commission by its parent Centrus.

Under the HALEU Contract, DOE agreed to reimburse the Company for up to 80 percent of its costs incurred in performing the contract. The Company's cost share is the corresponding 20 percent and any costs incurred above these amounts. Costs under the HALEU Contract include *program costs*, including direct labor and materials and associated indirect costs that are classified as *Cost of Sales*, and an allocation of corporate costs supporting the program that are classified as *Selling, General, and Administrative Expenses*. Services to be provided over the three-year contract include constructing and assembling centrifuges and related infrastructure in a cascade formation and production of up to 600 kgU HALEU. When estimates of remaining program costs to be incurred for such an integrated construction-type contract exceed estimates of total revenue to be earned, a provision for the remaining loss on the contract is recorded to *Cost of Sales* in the period the loss is determined. Our corporate costs supporting the program are recognized as expense as incurred over the duration of the contract term. The accrued loss on the contract will be adjusted over the remaining contract term based on actual results and remaining program cost projections. The Licensee requests an exemption to this condition during the three-year HALEU Contract period.

The following Special Authorization has been identified in this license application:

- Surface Contamination Release Levels for Unrestricted Use – Items may be released for unrestricted use if the surface contamination is less than the levels listed in Table 4.6-1.

The following exemption from the requirements in 10 CFR 95.57(c) is identified in Section ~~2~~1.17.c) of the *Security Plan for the Protection of Classified Matter at the American Centrifuge Plant*~~Security Program~~:

- NRC regulations in 10 CFR 95.57(c) require that all classification actions (documents classified, declassified, or downgraded) to be submitted to the NRC Division of Security Operations. These may be submitted either on an "as completed" basis or monthly. The information may be submitted either electronically by an on-line system or by paper copy using NRC Form 790. Historically, the Licensee~~USEC~~ has utilized NRC Form 790 for each classification action, has compiled them monthly, and submitted them to the NRC. The Licensee~~USEC~~ must also submit a quarterly classification summary document to the DOE for all derivative classification decisions made during the previous quarter. This dual reporting is burdensome to the Derivative

Classifiers and the Centrifuge Classification Officer and creates a situation where the classification actions may be double counted. Accordingly, in lieu of filing its classification actions with NRC, the Licensee~~USEC~~ will continue to submit the quarterly classification summary documents to DOE and will make them available for NRC inspection at the facility.

1.2.6 Security of Classified Information

The Licensee~~USEC~~ is required by 10 CFR 70.22(m) to submit, as part of its application for a license for the ACP, a plan describing the plant's proposed security procedures and controls, as set forth in 10 CFR Part 95, for the protection of classified matter. The Licensee~~USEC~~ satisfies the 10 CFR 70.22(m) requirements by submittal of the *Security Plan for the Protection of Classified Matter at the American Centrifuge Plant*~~Security Plan for the Protection of Classified Matter as Chapter 2 of the Security Program for the American Centrifuge Plant~~. The Security Plan~~rogram~~ ~~is being~~was submitted for NRC review along with this license application. In accordance with 10 CFR Part 95.15(b), the Licensee~~USEC~~ will submit, at least 60 days prior to operation of the ACP, a~~n~~ request ~~application~~ for ~~the transfer of~~ a revision to the Facility Clearance from ~~DOE to the NRC~~ non-possessing facility to a possessing facility.

~~The specific design of the intrusion detection and alarm system is not yet complete. Upon completion of the design,~~ The Licensee~~USEC~~ shall provide the Commission with at least 120 days advance notice of its plan to introduce classified matter in the American Centrifuge Plant~~, the final design for the intrusion detection and alarm system,~~ and the updated Security Plan~~rogram~~ for review and approval, consistent with ~~Section 8.1 of~~ 10 CFR Part 95 *Format and Content Guide*.

1.2.7 Security of Special Nuclear Material of Low Strategic Significance and Moderate Strategic Significance

Pursuant to 10 CFR 70.22(k) the Licensee~~USEC~~ is submitting, as part of its application for a license for the ACP, a plan describing the measures used to protect Special Nuclear Material of ~~Low~~ Strategic Significance that the Licensee~~USEC~~ uses, possesses, or has access to at the plant. The Licensee~~USEC~~ satisfies the 10 CFR 70.22(k) requirement by submittal of the *Security Plan for the Physical ~~Security Plan for the~~ Protection of Special Nuclear Material ~~of Low Strategic Significance as Chapter 1 of the Security Program for~~ at the American Centrifuge Plant*. The Security Plan~~rogram~~ is being submitted for NRC review along with this license application.

The specific design of the intrusion detection and alarm system is not yet complete. Upon completion of the design, the Licensee~~USEC~~ shall provide the Commission with at least 120 days advance notice of its plan to introduce special nuclear material in the American Centrifuge Plant, the final design for the intrusion detection and alarm system, and the ~~updated~~ Security Plan~~rogram~~ for review and approval, consistent with ~~Section 8.1 of~~ 10 CFR Part 95 *Format and Content Guide*.

Table 1.2-3~~2—~~ Commercial ACP Authorized uses of NRC-regulated materials

Material Class	Authorized Use
A. Source Material, Element 92[a, b]	1. Enrichment of uranium up to 10 percent enrichment by weight ^{235}U
	2. Receipt, storage, inspection, acceptance, and sampling of cylinders containing uranium
	3. Filling and storage of cylinders of normal uranium and uranium depleted in ^{235}U
	4. Cleaning and inspection of cylinders used for the storage and transport of process product and tails containing source or Special Nuclear Material
	5. Storage of process wastes containing uranium, transuranic elements, and other contaminants and decay products
	6. Process, characterize, package, ship, or store low-level radioactive and mixed wastes
	7. Radiation protection, process control and environmental sample collection, analysis, instrument calibration, and operation checks
	8. Maintenance, repair, and replacement of process equipment
	9. Laboratory analysis and testing
	10. Heating cylinders and feeding contents into the enrichment process
	11. Transfer between cylinders
B. Source Material, Element 90	1. Calibration and use of portable radiation protection and fixed laboratory equipment
	2. Laboratory analysis and testing
	3. Process, characterize, package, ship, or store low-level radioactive and mixed wastes
C. Special Nuclear Material[a,b]	1. Filling, assay, storage, and shipment of cylinders and other Nuclear Criticality Safety approved containers containing uranium enriched up to 10 percent by weight ^{235}U
	2. Nondestructive testing and analyses of product and process streams

Table 1.2-3~~2~~ Commercial ACP Authorized uses of NRC-regulated materials

Material Class	Authorized Use
	3. Receipt, storage, inspection, and acceptance sampling of cylinders containing uranium enriched up to 10 percent by weight ^{235}U
	4. Cleaning and inspection of cylinders used for the storage and transport of process feed, product, and tails containing source or Special Nuclear Material
	5. Storage of process wastes containing uranium, transuranic elements, and other contaminants and decay products
	6. Process, characterize, package, ship, or store low-level radioactive and mixed wastes
	7. Radiation protection, process control and environmental sample collection, analysis, instrument calibration, and operation checks
	8. Maintenance, repair, and replacement of process equipment
	9. Laboratory analysis and testing
	10. Heating cylinders and feeding contents into the enrichment process
	11. Transfer between cylinders
	12. Material remaining in cylinders and facilities as a result of previous operations
D. By-product Material, Elements 3-89, 91	1. Radiation protection, process control, and environmental sample collection, analysis, instrument calibration, and operation checks
	2. Laboratory analysis and testing
	3. Nondestructive testing of product and product streams
	4. Storage of process wastes containing uranium, transuranics, process contaminants, and decay products
	5. Material remaining in equipment and facilities as a result of feeding reprocessed uranium
	6. Process, characterize, package, ship, or store low-level radioactive and mixed wastes [C]

Table 1.2-3~~2~~ Commercial ACP Authorized uses of NRC-regulated materials	
Material Class	**Authorized Use**
Elements 93, 95 to 100	1. Calibration and use of portable radiation protection and fixed laboratory equipment
	2. Laboratory analysis and testing
	3. Nondestructive testing of product and product streams
	4. Storage of process wastes containing uranium, transuranics, process contaminants, and decay products
	5. Material remaining in cylinders and facilities as a result of feeding reprocessed uranium
	6. Process, characterize, package, ship, or store low-level radioactive and mixed wastes[c]
$^{43}_{99}$Tc	1. Material remaining in cylinders and facilities as a result of feeding reprocessed uranium
	2. Storage of process wastes as a result of feeding reprocessed uranium

[a] Uranium to be fed to the enrichment plant will meet the requirements of ASTM Standard C996, "Standard Specification for Uranium Hexafluoride Enriched to Less Than 5% ^{235}U or ASTM standard C787, "Standard Specification for Uranium Hexafluoride for Enrichment" for reprocessed UF_6. Other uranium that does not meet the requirements of ASTM C996 or C787 for reprocessed UF_6 may be accepted for storage and subsequent disposition but will not be introduced to the enrichment process, with the exception of small amounts (e.g., 50 pounds UF_6) associated with sampling, subsampling, and analyses required to establish receiver's values.

[b] Includes the feed and processing of Paducah Product and any "stockpile" UF_6 transferred from DOE to the Licensee~~USEC~~ for enrichment.

[c] Includes the potential return of material (waste) generated at the ACP, sent off-site, and subsequently returned.

Table 1.2-4 HALEU Demonstration Program Authorized uses of NRC-regulated materials

Material Class	Authorized Use
A. Uranium (non-fissile) and daughter products 92[a, b]	1. Activities involving uranium enriched to less than 1.0 wt.% ^{235}U
	2. Receipt, storage, inspection, acceptance, and sampling of cylinders containing uranium
	3. Filling and storage of cylinders of normal uranium, depleted, and uranium enriched to less than 1.0 wt.% ^{235}U
	4. Storage of process wastes containing uranium, transuranic elements, and other contaminants and decay products
	5. Process, characterize, package, ship, or store low-level radioactive and mixed wastes
	6. Radiation protection, process control, environmental sample collection, instrument calibration, and operation checks
	7. Maintenance, repair, and replacement of process equipment
B. Source Material, Isotopes and Other Contamination Element 90	1. Calibration and use of portable radiation protection and fixed laboratory equipment
	2. Activities required to obtain samples for analysis whether on-site or off-site, and the potential subsequent return of this material for disposition (waste, utilization).
	3. Process, characterize, package, or store low-level radioactive and mixed wastes
C. Special Nuclear Material [a,b]	1. Feeding cylinders enriched to up to 5 percent by weight ^{235}U, and filling cylinders containing enriched material less than 20 percent by weight ^{235}U.
	2. The HALEU cascade is operated at less than 20 weight percent ^{235}U. Enrichment levels up to 25 weight percent ^{235}U are authorized to permit for process fluctuations which can create small amounts of higher weight percent material.
	3. Receipt, storage, inspection, acceptance, and sampling of cylinders and other Nuclear Criticality Safety approved containers containing uranium enriched up to 20 percent by weight ^{235}U
	4. Nondestructive testing and analyses of product and process streams

Table 1.2-4 HALEU Demonstration Program Authorized uses of NRC-regulated materials	
Material Class	**Authorized Use**
	5. Storage of process wastes containing uranium, transuranic elements, and other contaminants and decay products 6. Process, characterize, package, ship, or store low-level radioactive and mixed wastes 7. Radiation protection, process control, environmental sample collection, instrument calibration, and operation checks 8. Maintenance, repair, and replacement of process equipment 9. Activities required to obtain samples for analysis whether on-site or off-site, and the potential subsequent return of this material for disposition (waste, utilization). 10. Feeding contents into the enrichment process 11. Filling and storage of cylinders as enriched up to, but less than, 20 percent by weight ^{235}U.
D. By-product Material, Elements 3-89, 91	1. Radiation protection, process control, environmental sample collection, instrument calibration, and operation checks 2. Activities required to obtain samples for analysis whether on-site or off-site, and the potential subsequent return of this material for disposition (waste, utilization). 3. Nondestructive testing of product and product streams 4. Storage of process wastes containing uranium, transuranics, process contaminants, and decay products 5. Material remaining in equipment and facilities as a result of feeding reprocessed uranium 6. Process, characterize, package, or store low-level radioactive and mixed wastes[c]

Table 1.2-4 HALEU Demonstration Program Authorized uses of NRC-regulated materials	
Material Class	**Authorized Use**
Elements 93, 95, to 100	1. Calibration and use of portable radiation protection and fixed laboratory equipment
	2. Activities required to obtain samples for analysis whether on-site or off-site, and the potential subsequent return of this material for disposition (waste, utilization).
	3. Nondestructive testing of product and product streams
	4. Storage of process wastes containing uranium, transuranics, process contaminants, and decay products
	5. Process, characterize, package, or store low-level radioactive and mixed wastes[c]
${}^{43}_{99}Tc$	1. Material remaining in cylinders and facilities as a result of feeding operations
	2. Storage of process wastes as a result of feeding operations.

[a] Uranium to be fed to the enrichment plant will meet the requirements of ASTM Standard C996, "Standard Specification for Uranium Hexafluoride Enriched to Less Than 5% ^{235}U or ASTM standard C787, "Standard Specification for Uranium Hexafluoride for Enrichment."

[b] Includes the feed and processing of Paducah Product.

[c] Includes the potential return of material (waste) generated at the HALEU Demonstration Program, sent off-site, and subsequently returned.

1.3 Site Description

This section presents information on the ACP's location, geography, demographics, meteorology, surface hydrology, subsurface hydrology, geology, and seismology.

The ACP is located on DOE-owned land in rural Pike County, a sparsely populated area in south-central Ohio. Specifically, the ACP is located on the DOE reservation in the former GCEP facilities (Figure 1.1-1, located in Appendix B). The buildings and grounds are leased by ~~the United States Enrichment Corporation~~Centrus Energy Corp. from the DOE. The Licensee in turn sub-leases the buildings and grounds from ~~the United States Enrichment Corporation~~Centrus. The reservation has been studied and characterized extensively by both DOE and ~~the United States Enrichment Corporation~~Centrus.

1.3.1 Geography

The DOE reservation is approximately 3,700 acres located on the east side of the Scioto River, near Piketon, Ohio, and approximately equidistant between Portsmouth and Chillicothe, Ohio. A topographic map of the reservation is provided in Figure 1.3-1.

The Scioto River Valley is one mile west of the reservation. The Scioto River, approximately two miles west of the reservation, is a tributary of the Ohio River, and their confluence is approximately 25 miles south of the reservation. With the exception of the Scioto River floodplain, which is farmed extensively, the area around the reservation consists of marginal farmland and forested hills. The only other body of water located near the reservation is Lake White, which is located approximately six miles north of the reservation.

The primary roadways near the DOE reservation are U.S. Route 23 and State Route 335, which traverse a roughly north-south course, and State Route 124 (same as State Route 32), which traverses an east-west course just north of the reservation.

The Pike County Airport is located approximately 11 miles north-northeast of the DOE reservation. No commercial flights or cargo shipping occurs there. The 4,900-ft runway supports single and twin-engine planes and small jets. The Greater Portsmouth Regional Airport, located approximately 15 miles southeast of the DOE reservation, provides only light plane service (Class 1 airport). The Chillicothe-Ross County Airport is located approximately 35 miles north-northeast of the DOE reservation. The nearest commercial airports are John Glenn Columbus International Airport in Columbus, Ohio, approximately 75 miles north, Rickenbacker Airport near Columbus, Ohio approximately 60 miles away, the Tri-State Airport in Huntington, West Virginia approximately 65 miles southeast, and the Cincinnati/Northern Kentucky International Airport, approximately 100 miles west.

~~Two major four lane highways: U.S. Route 23, traversing north-south, and U.S. Route 32/124, traversing east-west, service the reservation. Commercial air transportation is provided through the Greater Cincinnati International Airport (approximately 100 miles west), the Port Columbus International Airport (approximately 75 miles north), or the Tri-State Airport (approximately 55 miles south-east). The Greater Portsmouth Regional Airport, serving private~~

~~and charter aircraft, is located approximately 15 miles southeast near Minford, Ohio, and the Pike County Airport, located just north of Waverly, is a small facility for private planes.~~

1.3.2 Demographics

The DOE reservation is located in Pike County, which is primarily rural in nature. With the exception of the Scioto River floodplain, which is farmed extensively, the area around the reservation consists of marginal farmland and forested hills. The remaining counties in the vicinity are also largely rural in character, except near the towns of Portsmouth in Scioto County and Chillicothe in Ross County.

1.3.2.1 Area Population

The DOE reservation worker population was ~~2,842~~2,336 as of ~~October~~ January ~~2010~~2020, but these workers are unequally distributed and reside in the surrounding counties. The nearest residential center and the closest town to the reservation is Piketon, located in Pike County about four miles north of the reservation on U.S. Route 23 with a population of ~~1,907~~2,181 in 2010~~00~~. The largest town in Pike County is Waverly, about eight miles north of the reservation, with a population of ~~4,433~~ 4,408 in ~~2000~~2010. Chillicothe, in Ross County about 27 miles north, is the largest population center in the Region of Influence with a population of ~~21,796~~21,698 in ~~2000~~2010. Other population centers include Portsmouth, about 27 miles south in Scioto County, and Jackson, about 26 miles east in Jackson County, with populations of ~~20,909~~ 20,340 and ~~6,184~~6,242 in ~~2000~~2010, respectively. Table 1.3-1 presents historic and projected population in the Region of Influence and the state. (References 4 and 34). The total population within the five-mile radius of the reservation was 5,~~836~~ 805(Figure 1.3-2) in ~~2000~~2010. (Population information was obtained from census data - Reference ~~4~~35).

1.3.2.2 Significant Transient and Special Populations

In addition to the residential population, there are institutional, transient, and seasonal populations in the area.

1.3.2.2.1 Schools

There are a number of educational institutions inside a five-mile radius of the DOE reservation. All of the Scioto Valley Local School District's (SVLSD) schools are within the five-mile radius. As of January 2020, ~~They~~ these schools are the Piketon High School and Junior High School, located in the same building with ~~635~~ 492 students and ~~66~~ 27 ~~staff~~teachers, Zahn's Corner Middle School with ~~366~~ 303 students and ~~44 staff~~18 teachers (relocated to Piketon High School and Jasper Elementary for the 2019-2020 school year); and Jasper Elementary School with ~~517~~ 385 students and ~~49 staff~~18 teachers (Reference 36). In addition to the SVLSD there is the Pike County Career Technology Center with ~~439~~ 400 vocational high school students~~, 100~~ and adult education students, and ~~79~~ 70 staff. There are also two public preschools with daycare:~~;~~ the Early Childhood Family Center with 35 students and 32 staff, and the Pike County Community Action Committee with ~~96~~ 267students and ~~148~~ 63 staff. ~~, and~~ In addition, there is a private pre and elementary school, Miracle City Academy, with ~~13~~ 32 students and ~~4~~ 5 staff (Reference 37). The locations and student-occupancies of these facilities are shown in Figure 1.3-3 (Reference 5).

1.3.2.2.2 Hospitals and Nursing Homes

Adena Pike Medical Center is the hospital closest to the site, located approximately 7.5 miles north of the facility off of State Route 104 south of Waverly. The hospital facility has 25 licensed beds, ~~270~~ approximately 147 total staff, and operates at full capacity. Adena Health ~~System~~ Center operates an urgent care facility located in Waverly approximately 1 mile north of the hospital. The Southern Ohio Medical Center Family Health Center also operates an urgent care center in Waverly. The ~~Waverly Family~~Valley View Health Center is located next to the Adena Pike Medical Center. The Adena Family Medicine – Piketon and~~, and~~, another ~~the Piketon Family Health and Dental Center is~~Valley View Health Center are both located in Piketon.

There are two licensed nursing homes in the Piketon area, ~~the~~ Piketon Nursing Center, and Pavilion at Piketon. As of January 2020, the Piketon Nursing Center had ~~with~~ 46 patients and 46 staff, and the Pavilion at Piketon ~~Pleasant Hill Manor with~~ had 193 patients and 220 staff.~~, and~~ Additionally, a home for ~~the mentally retarded~~people with intellectual and developmental disabilities in Wakefield, ~~Friends of Good Shepherd Manor~~Scioto Trails Group Home, with ~~51 residents~~32 beds and 100 staff. Figure 1.3-3 depicts these medical and nursing facilities and shows the number of beds per facility (Reference 5).

1.3.2.2.3 Recreational Areas and Recreational Events

No significant recreational areas are located on the DOE reservation; recreational activities for employees are held off-site.

Off-site recreational areas include the Brush Creek State Forest, a 0.5 square mile portion of which is within five miles southwest of the reservation. Usage of this area is extremely light and is estimated to be 20 persons/year, primarily hunters and mushroom pickers. The location of Brush Creek State Forest is identified in Figure 1.3-3 (Reference 38~~5~~).

Usage of Lake White State Park (Figure 1.3-3), located approximately six miles north of the reservation, is occasionally heavy and concentrated on the 92 acres of land closest to the lake. Most of the land surrounding the lake is privately owned. The ~~337~~333-acre Lake White offers recreation, such as, boating, fishing, water skiing, and swimming. ~~There are 10 non-electric campsites for primitive overnight camping~~ (Reference 10~~6~~).

Rock Water Campground is a private, secured campground with 68 campsites within five miles west of the site. The site is approximately 20 acres that includes a 12 acre lake for swimming and fishing (Reference 39).

1.3.2.3 Uses of Nearby Lands and Waters

Land within five miles of the DOE reservation is used primarily for farms, forests, and rural residences. About 25,430 acres of farmland, including cropland, wooded lot, and pasture, lie within five miles of the reservation. The cropland is located mostly on or adjacent to the Scioto River flood plain and is farmed extensively, particularly with grain crops. The hillsides and terraces are used for cattle pasture. Both beef and dairy cattle are raised in the area.

The only significant industry in the vicinity is located in an industrial park south of Waverly. The industries include a ~~cabinet manufacturer~~a farm supply store and distribution center, a plastic recycling and processing center, and an automotive parts manufacturer. These industries do not present any potential hazards to ACP operations.

Approximately 24,400 acres of forest lie within five miles of the reservation. This includes some commercial woodlands and a very small portion of Brush Creek State Forest.

No known public or private water is withdrawn from the Scioto River downstream of the ACP (Reference ~~7~~40).

1.3.3 Meteorology

This section provides a meteorological description of the DOE reservation and its surrounding area. The purpose is to provide meteorological information necessary to understand the regional weather phenomena of concern for the ACP operations and to understand the basis for the dispersion analyses performed (Reference ~~7~~41).

1.3.3.1 Regional Climatology

Located west of the Appalachian Mountains, the region around the site has a climate essentially continental in nature, characterized by moderate extremes of heat and cold and wetness and dryness. ~~(Reference 7).~~ July is the hottest month, with an average monthly temperature of ~~74.2~~75.0°F, and January is the coldest month with an average temperature of ~~30°F~~29.9°F. The highest and lowest daily temperatures from 1951 to ~~2002~~ 2019 were 103°F and –31°F on July 14, 1954, and January 19, 1994, respectively (References ~~7, and~~ 8, 13, 32 and 33).

Moisture in the area is predominantly supplied by air moving northward from the Gulf of Mexico. ~~(Reference 7).~~ Precipitation is abundant from March through August and sparse in October and February. The average annual precipitation at Waverly, Ohio, for the period from 1951 to ~~2002~~ 2019 was 40 inches (in.). The greatest daily rainfall during this period was 4.9 in., occurring on March 2, 1997 (Reference 13).

Occasionally, heavy amounts of rain associated with thunderstorms or low-pressure systems ~~will~~ falls in a short period of time. The Midwestern Climate Center, Climate Analysis Center, the National Weather Service, the National Oceanic and Atmospheric Administration, and the Illinois State Water Survey Division of the Illinois Department of Energy and Natural Resources have published values of the total precipitation for durations from 30 minutes to 24 hours and return periods from 1 to 100 years. The results for the geographic locale including the reservation are summarized in Table 1.3-2 (Reference ~~9~~13). A local drainage analysis for extreme storms at the site has also been performed (Reference ~~7~~42).

Snowfall occurrence varies from year to year, but is common from November through March. The average annual snowfall for the area is about 21.1 in., based on 1951-~~2002~~ 2019 data. During that time period, the maximum monthly snowfall was 25.4 in., occurring in January 1978 (References ~~7, 8, and 13~~13 and 32). The design basis snowfall for building construction is the historical maximum snowfall, which equates to approximately 20 pounds per square foot (psf) and complies with standard ASCE-7-2002, *Minimum Design Loads for Buildings and Other Structures* (Reference 73).

1.3.3.2 On-Site Meteorological Measurements Program

A 60-m meteorological tower is used on the DOE reservation. The tower is equipped with instrument packages at the 10-, 30-, and 60-m (33-, 98-, and 197-ft) levels to measure the air temperature, wind speed, and wind direction. Other instrumentation measures the solar radiation, barometric pressure, precipitation, and soil temperatures.

1.3.3.3 Local Meteorology

Since January 1995, a 60-m (197-ft) tower has been in use. It is equipped with instrument packages at the 10-, 30-, and 60-m (33-, 98-, and 197-ft) levels. In addition, ground-level instrumentation measures solar radiation, barometric pressure, precipitation, and soil temperatures at 1 and 2-ft depths.

Hourly temperatures at the 10- and 30-m (33- and 98-ft) levels above the ground ~~were~~ have been recorded at the site meteorological tower from since at least 1995 ~~to 2002~~. Data from the 1995 to 2002 period show that ~~At~~ at the 10-m (33-ft), 69,734 of the possible 70,080 data points are available. At the 10-m level the average annual hourly temperature was 50.6°F, the minimum average hourly temperature was –1.4°F, and the maximum average hourly temperature was 94.1°F (Reference 6).

Of the 70,080 possible hourly wind speed and wind direction data for 1995 through 2002, approximately 70,000 are available points. Wind roses for the 10-, 30-, and 60-m (33-, 98-, and 197-ft) levels at the reservation constructed from the 1998 through 2002 data are compared in Figures 1.3-4, 1.3-5, and 1.3-6, respectively (Reference 6). The prevailing wind directions are from the south-southwest to southwest at the 10-m (33-ft) level.

Additional data from calendar year 2016 was also obtained. The average wind speeds were 3.6, 5.0, and 6.5 mph at the 10-, 30- and 60-meter levels, respectively. At the 10-meter level, the minimum average hourly temperature was 4.0 °F, and the maximum average hourly temperature was 96.4 °F.

Tornadoes do occur in Southern Ohio; however, specific analyses of the frequency of tornadoes in the region show that they are rare. On the average, from 1950 to ~~2002~~2010, ~~18~~ 19 tornadoes per year were reported in Ohio, but the total varies widely from year to year (e.g., 63 in 1992 and ~~0~~ 4 in ~~1988~~2005). Pike County has experienced ~~three~~ eleven tornadoes since 1950. When considering the surrounding counties (Adams, Jackson, Highland, Ross, and Scioto), the total number of tornadoes experienced is ~~46~~ 54 since 1950. Of those tornadoes, ~~15~~ 12 were rated F2 or greater on the Fujita Tornado Scale (Reference ~~13~~43). The reservation had an average of three days per year between ~~1950~~ 1990 and ~~2002~~ 2019 with severe storms with winds exceeding 58 mph (Reference 4~~1~~3). Because the reservation is not a coastal location, the effects of hurricanes are not considered other than increased rainfalls as remnants of the storm affected weather patterns in the upper Ohio River Valley. For new construction complying with standard ASCE-7-2002, *Minimum Design Loads for Buildings and Other Structures*, 7 psf/sec is the minimum design wind load.

Severe storms can and are likely to produce lightning strikes, which can interrupt and cause a partial power failure. However, the buildings are heavily grounded and some have installed lightning protection. The DOE reservation had an average of three days per year between 1990 and 2019 with severe storms with winds exceeding 58 mph, defined as severe thunderstorm winds. (Reference 43) ~~The reservation is in an area that had an average of 36 thunderstorms between the years 1989 and 1998~~. The reservation is at a "moderate" risk value of loss due to lightning strikes. Lightning has not been a problem for these structures, since initial construction in the mid-1980s.

1.3.4 Surface Hydrology

This section describes the surface hydrology on and around the DOE reservation.

1.3.4.1 Hydrologic Description

The significant surface streams and waterways affecting the DOE reservation are discussed in this section.

1.3.4.1.1 Scioto River Basin

The DOE reservation is located near the southern end of the Scioto River basin, which has a drainage area of 6,517 square miles. The headwaters of the Scioto River form in Auglaize County in north central Ohio. The Scioto River flows 235 miles through nine counties in Ohio, and through the cities of Columbus, Circleville, Chillicothe, and Portsmouth. At Portsmouth, in Scioto County, the river empties into the Ohio River at river mile (RM) 356.5. The slope of the Scioto River channel averages about 1.7 ft/mile between Columbus and Portsmouth (Reference 44~~7~~).

Upstream retarding basins are located on tributaries throughout the Scioto River basin. The upstream retarding basin nearest the reservation forms Lake White along Pee Pee Creek, about six miles north of the reservation (Figure1.3-7). The spillway of the reservoir is located at an elevation of 567 ft above mean sea level (amsl), while the roadway along the top of the dam is at an elevation of 577 ft amsl (Reference ~~7)~~45). Pee Pee Creek empties into the Scioto River south of Waverly at RM 40.

The U.S. Geological Survey (USGS) has collected stream-flow data for the Scioto River at Higby, Ohio, since 1930. The gauging station is located approximately 13 miles north of the reservation at RM 55.5. The drainage area of the Scioto River basin above Higby is 5,130 square miles. The river flows measured at Higby from 1930 to ~~2001~~2018 range from 177,000 cubic feet per second (cfs) on January 23, 1937, to 244 cfs on October 23, 1930~~, and average 4,721 cfs~~. The annual mean flow has ranged from 1,364 cfs in 1954 to 8,178 cfs in 1996. The 1937 flood had a peak water elevation of 593.7 ft amsl. The consecutive seven-day minimum discharge of record is 255 cfs, which occurred during October 19-25, 1930 (References ~~7~~46 and 47).

Water in the vicinity of the reservation is available from Lake White, the Scioto River, and groundwater supplies (Reference 48~~7~~). Most of the water used is taken from groundwater. Three municipal water supply facilities are located in the segment of the Scioto River between Higby and the confluence with the Ohio River (and three water suppliers use groundwater wells). Both Waverly and Piketon, located at RM 40 and 34, respectively, use groundwater wells. The city of Portsmouth uses water from the Ohio River through an intake at the Ohio River at RM ~~362.2~~350.8, which is 5.7 miles upstream from the mouth of the Scioto River (Reference 49~~7~~).

Water used at the reservation normally comes from groundwater. Currently, water is supplied by wells in the Scioto River alluvium. These wells are located near the east bank of the Scioto River, downstream from Piketon. Four well fields (X-605G, X-608A, X-608B, and X-6609) have the capacity to supply reliably between 36.4 and 40.2 cfs.

1.3.4.1.2 DOE Reservation Area

The DOE reservation is located about 2 miles east of the confluence of the Scioto River and Big Beaver Creek near RM 27.5 (Figure 1.3-7). The reservation occupies an upland area bounded on the east and west by ridges of low-lying hills that have been deeply dissected by present and past drainage features. The plant nominal elevation is 670 ft amsl, which is about ~~113~~ 130 ft above the normal stage of the Scioto River. Both groundwater and surface water at the reservation are drained from the plant by a network of tributaries of the Scioto River.

Both Big Beaver and Little Beaver Creeks receive runoff from the northeastern and northern portions of the reservation. Little Beaver Creek, the largest stream on the property, flows northwesterly through the northern portion of the main plant area (Figure 1.3-7). It drains the northern and northeastern parts of the main plant before discharging into Big Beaver. About two miles from the confluence of the two creeks, Big Beaver Creek empties into the Scioto River at RM 27.5 (Figure 1.3-7). Upstream from the plant, Little Beaver Creek has intermittent flow throughout the year.

In the southeast portion of the reservation, the southerly flowing Big Run Creek (Figure 1.3-7) is situated in a relatively broad, gently sloping valley where significant deposits of recent alluvium have been laid down by the stream (Reference 50~~7~~). This intermittent stream receives overflow from the X-230K South Holding Pond, which collects discharge of storm sewers on the south end of the plant. Big Run Creek empties into the Scioto River about five miles downstream from the mouth of Big Beaver Creek (Figure 1.3-7).

Two streams drain the western portion of the reservation (Figure 1.3-7). The stream in the plant's southwest portion flows southerly and westerly in a narrow, steep-walled valley with little recent alluvium. It drains the southwest corner of the ACP via the southwest holding pond. The stream near the west central portion of the reservation flows northwesterly and receives runoff from the central and western part of the reservation via the west drainage ditch. Both streams flow directly to the Scioto River and carry predominately storm water runoff, with lesser contributions from such sources as groundwater infiltration, steam condensate, and firewater (Reference 50~~7~~).

Little Beaver Creek receives 39 percent of the total reservation effluents, Big Run Creek, 9 percent, and the two unnamed tributaries, 25 percent. The remaining 27 percent is discharged directly to the Scioto River through two pipelines. Treated effluents from a sanitary sewage plant are conveyed about two miles to the Scioto River via a 15-in. vitreous clay sewer line at Outfall 003; blowdown from the recirculating cooling water system enters the Scioto via Outfall 004 (Reference 51~~7~~).

1.3.4.1.3 Site and Facilities

The DOE reservation nominal elevation is 670 ft amsl, which is about ~~113~~ 130 ft above the normal stage of the Scioto River. The top-of-slab floor elevations for the ACP facilities are at approximately 671 ft amsl. Storm water that falls at the reservation is drained to local Scioto River tributaries by storm sewers. The flow of storm water is further controlled by a series of holding ponds downstream from the storm sewers.

The Perimeter Road, as shown in Figure 1.3-8, serves as a hydrologic boundary that prevents storm water runoff from backing up into the ACP. Once storm water has been discharged onto the outer side of the Perimeter Road to the north, west, and south, the water flows downhill to local creeks and runs. To the east and southeast, the Perimeter Road acts as a diversion dam that directs storm water runoff to Big Run Creek. The northeastern corner of the Perimeter Road protects the ACP from flooding that could occur if the X-611B sludge lagoon dam failed. The relationship of storm water holding ponds, located along the outside of Perimeter Road shown in Figure 1.3-8, to the topographic elevations, indicated in Figure 1.3-9, emphasizes the overall function of the reservation surface water drainage system that has been described here (Reference ~~7~~42).

Water used at the reservation is supplied by wells sunk into the Scioto River alluvium. The raw water is pumped from wells at three locations along the Scioto River along with a backup system that can draw directly from the Scioto River when the wells are unable to produce sufficient water to meet the reservation demand. The well fields and pump house are located where flooding is anticipated, so the equipment is designed and installed to operate without adverse effect (Reference 48~~7~~). The equipment in the pump house is located above the 571 ft amsl level and the well pumps can operate under water.

1.3.4.2 Flood History

The average annual discharge at the Higby station for the period of record (1930-~~2001~~2018) is 4,721 cfs, while the maximum discharge of record is 177,000 cfs observed on January 23, 1937. The stage of the 1937 flood was 593.7 ft amsl. The historical flood stage of the Scioto River next to the DOE reservation was estimated to be 556.7 ft amsl by using the estimate that the Scioto River drops approximately 37 ft between the Higby gauging station (RM 55.5) and the mouth of Big Beaver Creek (RM 27.5). Elevations for floods (with three recurrence intervals) at the confluence of the Scioto River and Big Beaver Creek (RM 27.5), estimated by the U. S. Army Corps of Engineers, are compared with the reservation nominal grade elevation in Table 1.3-~~9~~3 (References 38, 46, 52, and 53 ~~7~~).

Since the reservation has a nominal elevation of about 670 ft amsl (Figure 1.3-9) and about 113 ft above the historical flood level for the Scioto River in the area, the reservation has not been affected by flooding of the Scioto River.

1.3.4.3 Probable Maximum Flood

The plant elevation is greater than the maximum historic levels recorded for the Scioto River in the area and the 500-year flood predicted by the U.S. Army Corps of Engineers. However, a calculation of the Probable Maximum Flood (PMF) was also performed. The details of a method of calculating the PMF are discussed in NRC Regulatory Guide 1.59, *Design Basis Floods for Nuclear Power Plants*. It is based on the drainage area and the location of the watershed involved. The drainage area of the Scioto River basin above Higby is 5,131 square miles and the whole basin is 6,517 square miles (Reference ~~7~~52). The drainage area of the Scioto River above the DOE reservation (RM 27.5) is between those two values. A conservative estimate for the PMF discharge of the Scioto River at either Higby or the reservation is approximately 1,000,000 cfs. This value is used as the PMF discharge of the Scioto River at the reservation, which including the wind/wave activity contribution, would correspond to a flood level of 571 ft amsl, well below the nominal 670 ft amsl elevation of the reservation.

Two widely accepted probabilistic methods, the log Pearson III distribution and the Gumbel method, have been considered. The 10,000-year flood discharges of the Scioto River at Higby determined with these two methods are 526,000 and 280,000 cfs, respectively. Both of these discharge rates are smaller than that of the PMF. The PMF is, therefore, the bounding event in determining the evaluation basis loads from flooding for the reservation.

Conservative estimates indicate that the failure of upstream dams would not threaten the safety of the reservation because of the high nominal plant grade elevation (Reference 54~~7~~). In addition, the limited storage capacities of the reservoirs, the large stream distances of these dams from the reservation, and friction and form losses would make the actual wave heights even smaller than the estimated values. Discharges were considered for dam failures at full pool combined with that of either a 25-year flood or one-half of the PMF of the Scioto River. The result involving one-half of the PMF would result in a higher value, which is also somewhat greater than that of the PMF. However, this combined extreme flood would not threaten the safe operation of the reservation because of the high nominal plant grade elevation, similar to the case of the PMF.

1.3.4.3.1 Effects of Local Intense Precipitation

Storm Intensities and 10,000-Year Storms

The Midwestern Climate Center, National Weather Service, National Oceanic and Atmospheric Administration, and Illinois State Water Survey Division of the Illinois Department of Energy and Natural Resources have published values of the total precipitation reaching the ground for durations from 30 minutes to 24 hours and return periods from 1 to 100 years for the midwestern states, including Ohio (Reference 9). The results for the geographic locale including the DOE reservation are summarized in Table 1.3-2. Values for 10,000-year storms are extrapolated from smaller duration values using a least-squares method. The rainfall intensity for a given storm listed in Table 1.3-2 can be obtained by dividing the total precipitation by the duration.

To determine whether the influx of rainwater from a 10,000-year storm can be conveyed away from plant structures, the intensity versus duration relation for 10,000-year storms at the reservation is first established. This was done by adopting an established empirical intensity versus duration relation and using values listed in the last row of Table 1.3-2 and a nonlinear least-squares methodology. The resultant graph is shown in Figure 1.3-10. At small durations, although the intensities are high, the total precipitations are small. At large durations, the reverse is true ~~(Reference 7)~~.

Results for Creeks

The stage-discharge relationships for the five streams draining the reservation facilities were evaluated using the estimated cross sections and Manning's formula with $n = 0.15$, a value typical for flood plains and very poor natural channels. The peak runoffs of these streams can be calculated using the natural runoff model and the intensity vs. duration relation shown in Figure 1.3-10. Local flooding for different streams is caused by 10,000-year storms with differing duration values because each watershed drains a basin of a different size (Reference ~~7~~42). The relatively large differences between nominal plant grade elevation and the calculated flood stage elevations for the five streams clearly indicate that the ACP would not be inundated by these streams during a 10,000-year storm.

Results for Storm Sewers

In addition to the Manning's formula and the natural runoff model, the urban runoff model and an inflow-outflow balance method (Reference ~~7~~42) were also used to assess the storm sewers. In each case, the duration that gives maximum peak discharge is determined and used as the 10,000-year storm.

The results indicate that the reservation would experience local ponding during a 10,000-year storm because the storm sewer system has insufficient capacity to convey the rainwater to the outfalls. The average depth of water around the base of the buildings would range from 3.91 to 5.08 in. The existing storm sewer system would require from approximately 1.8 to 9.9 hours to drain the excess storm water to the outfalls (Reference ~~7~~55).

The effect of a clogged storm sewer system on the ponding depth has been considered (Reference ~~7~~42). Because the storm sewer flow is approximately one-fourth of the total 10,000-year storm flow, the overland drainage system is the dominant factor in determining the water depth at the base of the buildings. Thus local ponding levels can be controlled by keeping natural surfaces within the security fence grassed, mowed, and free of high weeds, and by keeping debris from blocking urbanized surfaces. This would prevent water from backing up to higher levels. Ponding on the reservation is not expected to impact the ACP safe operations.

Results for Ponds and Lagoons

To assess whether failures of the local dams could conceivably jeopardize the safety of ACP operations, holding ponds, lagoons, and retention basins formed by these dams were considered in the local drainage analysis. They include the west drainage ditch: X-2230N West-Central Holding Pond, X-2230M Southwest Holding Pond, X-230K South Holding Pond, Storm Sewer L, and X-230L North Holding Pond (Reference ~~7~~42). The surface elevations of the reservation facilities are well below the 670-ft amsl minimum grade elevation of the ACP facilities.

Results for Ditches and Culverts

The reservation storm sewer system discharges through each of the outfalls into a series of ditches, culverts, and holding ponds, with eventual discharge to nearby creeks or to the Scioto River directly.

Outfalls at the reservation have been analyzed to predict their response during a 10,000-year storm (Reference ~~7~~42). Although some of the culverts would be incapable of carrying the influx of rainwater and some over-banking would happen during a 10,000-year storm, water surface elevations computed for flows in the related culverts are below grade elevation at the ACP and would not cause local flooding at these buildings during a 10,000-year storm.

Effects of Ice and Snow

The reservation has a generally moderate climate. Winters in the area are moderately cold. On the average, there are 123 days per year below 32°F, but only approximately four days per year at or below 0°F. The average annual snowfall is 22 in. To estimate the extreme snowfall at the reservation, values for three surrounding cities are used. The maximum monthly snowfalls of record for Columbus (Ohio), Charleston (West Virginia), and Louisville (Kentucky) are 34.4, 39.5, and 28.4 in., respectively, measured in January 1978. If the largest value among the three is used for the reservation, and if an average density of 0.1 for freshly fallen snow is assumed (References ~~7 and~~ 8 and 56), this snowfall corresponds to 3.95 in. of rainfall.

1.3.4.3.2 Probable Maximum Flood on Rivers

The maps and the procedure outlined in Section B.3.2.2 of NRC Regulatory Guide 1.59, *Design Basis Floods for Nuclear Power Plants,* were used as guidance to estimate the PMF discharge (Reference 14). The log-log plot of the data approximates a straight line. The drainage area of the Scioto River basin above Higby is 5,131 square miles, above Piketon is 5,824 square miles, and above the mouth of the Scioto River is 6,517 square miles. The drainage area of the Scioto River above the DOE reservation (RM 27.5) is estimated from these values to be 6,000 square miles. PMF discharge of the Scioto River at the reservation as taken from the log-log plot is approximately 1,000,000 cfs. This value is adopted as the PMF discharge near the reservation (Reference ~~7~~55).

Coincident Wind Wave Activity

A conservatively high wind velocity of 40 mph blowing over land from the most adverse direction was adopted to associate with the PMF elevation at the reservation in accordance with Alternatives I and II in Appendix A of NRC Regulatory Guide 1.59, *Design Basis Floods for*

Nuclear Power Plants (Reference 14). The fetch length near the DOE reservation during the PMF of the Scioto River was estimated from USGS topographic quadrangle maps having a 1:24,000 scale to be one mile. The increase of flood elevations of the Scioto River near the reservation due to this wind wave activity was estimated to be 1.8 ft (Reference 57). The PMF plus this coincident wind wave activity would have a flood stage of 571 ft amsl.

Comparison of Flood Levels with DOE Reservation Elevations

The nominal, top-of-grade elevation at the reservation is 670 ft amsl, about 99 ft above the PMF plus wind wave activity flood stage of 571 ft amsl. The top-of-slab floor elevation for the ACP is at approximately 671 ft amsl. The Scioto River during a PMF superimposed with wind wave activity; therefore, would not inundate these buildings.

The reservation water supply facilities are located near the Scioto River. The X-608 Raw Water Pump House equipment is located just above the 571 ft amsl flood stage. The X-605G, X-608A, X-608B, and X-6609 Raw Water Wells are located below the 571 ft amsl flood stage, but are designed to operate during flood conditions (Reference 48~~7~~).

1.3.4.4 Potential Seismically Induced Dam Failures

The domino-type failure of dams upstream on the Scioto River, failures of individual dams on the tributaries of the Scioto River, and individual dam failures combined with either a 25-year flood or one-half of the PMF of the Scioto River may result in flood elevations that are comparable or even greater than that of the PMF 569 ft amsl. However, even when a conservative wave height of 41.3 ft is used, this cascade of dam failures clearly would not threaten the DOE reservation because the nominal plant grade elevation is 670 ft amsl, which is ~~113~~ 130 ft higher than the normal Scioto River level.

1.3.4.5 Channel Diversions and Ice Formation on the Scioto River

The ancient Newark River was a major channel for alluvium-bearing meltwater from the continental glaciations (Reference ~~7~~58). This river system ended when its deep valley and those of other major south-draining streams were partially filled with silt, sand, and gravel outwash. The present Scioto River was developed on top of this glacial outwash during the final retreat of glaciers from the area (Reference ~~7~~59). The Scioto River apparently has a smaller flow and hence a more restricted channel. Therefore, channel diversions of the lower stem of the Scioto River out of the ancient Newark River Valley are unlikely.

Ice occurs on streams in the Ohio River basin, including its tributary, the Scioto River. Ice on the Scioto River should not affect the water supply to the DOE reservation because the plant uses groundwater taken near the river. Additionally, ice formation would not pose a threat of flooding to the reservation, given the high elevation of the plant relative to the river.

1.3.4.6 Low Water Considerations

Water used at the DOE reservation can be supplied from wells in the Scioto River alluvium and pumped via existing waterlines to the X-611 Water Treatment Plant. The X-608 Pump House near the well fields can also pump water from the Scioto River and is a backup system that is used only when the well systems are unable to produce sufficient water to meet the plant demand (Reference ~~7~~48).

At the Higby gauging station, which is approximately 13 miles north of the reservation, the minimum river flow measured from 1930 to ~~2001~~ 2019 was 244 cfs on October 23, 1930 ~~(Reference 7)~~. The consecutive seven-day minimum discharge record of 255 cfs occurred during October 19-25, 1930 ~~(Reference 7). The consecutive seven-day minimum discharge record of 255 cfs occurred during October 19-25, 1930~~ (Reference ~~7~~46). The volumetric river flow is much greater than the reservation's water use.

1.3.4.7 Dilution of Effluents

The average discharge of the Scioto River near the DOE reservation is 4,721 cfs. Potentially, this discharge rate has a large capacity for reducing the concentration of received contaminants. For example, the uranium discharged from the reservation from the GDP through the local drainage system to the Scioto River was estimated to be 45 kg during 1990 (Reference ~~7~~60). In 1990, the bulk of the uranium (76 percent) was discharged through Outfall 001 to Little Beaver Creek (Reference ~~7~~60). Assuming a full dilution, this would result in an average uranium concentration of 1.1 x 10^{-5} milligrams per liter in the Scioto River well below the maximum concentration. ~~The United States Enrichment Corporation is responsible for 11 NPDES outfalls at the DOE reservation. DOE and the United States Enrichment Corporation NPDES outfalls remained in compliance with contaminant concentration discharge limits in 2002 (Reference 22). Further description of Surface Water contaminants can be found in Section 3.4.2 of the Environmental Report.~~

In support of ACP operations, the GDP NPDES permits have been modified to transfer ownership of certain discharge points. The Licensee now has two outfalls that discharge directly to surface water and one outfall that discharges to the FBP X-6619 Sewage Treatment Plant before leaving site through FBP Outfall 003 to the Scioto River. The Tower Water Cooling system discharges its blowdown to GDP Recirculating Cooling Water system under a service agreement, which in turn discharges its blowdown directly to the Scioto River via an underground pipeline (NPDES Outfall 004). FBP has eight outfalls and nine internal outfalls. MCS has one outfall and one internal outfall. In 2017, the overall Licensee's NPDES compliance rate was 100 percent and the overall FBP's NPDES compliance rate was 99 percent, with further details being provided in FBP-ER-RCRA-WD-RPT-0288 (Reference 70). Further description of Surface Water contaminants can be found in Section 3.4.2 of the Environmental Report.

1.3.5 Subsurface Hydrology

This section describes the subsurface hydrogeologic system in the Interior Low Plateaus region of southern Ohio in the vicinity of the DOE reservation.

1.3.5.1.1 Regional and Area Characteristics

In the region surrounding the DOE reservation in southeastern Ohio, groundwater is used for domestic and municipal drinking water supplies, irrigation, and industrial purposes. Larger demands are usually met by a combination of groundwater and surface water. A system of reservoirs is used for flood control in the Scioto River Basin, which also maintains surface water supplies during periods of low flow.

Aquifers in near-surface sand and gravel deposits adjacent to ancient or present surface drainage courses provide abundant quantities of water. Reliable quantities of groundwater from shallow bedrock aquifers are localized. While abundant quantities of satisfactory groundwater are available from deeper bedrock aquifers, depths as great as 1,000 ft make exploitation of those aquifers impractical except in the western part of the region. The quality of water from sand and gravel aquifers in the Scioto River Basin is usually classified as fair-to-excellent, while bedrock aquifers are classified as fair because of elevated iron content.

1.3.5.1.1 Aquifers

The subsurface hydrologic system near the DOE reservation is composed of unconsolidated Pleistocene clastic sediments of glacial and alluvial origin in river valleys and of underlying Paleozoic bedrock units. Figures 1.3-11 and 1.3-12 show the general configuration of these valleys and bedrock units near the reservation.

The unconsolidated sediments aquifer consists of two distinct aquifers in the immediate vicinity of the reservation: the Scioto River glacial outwash aquifer and "other" alluvial aquifers, of Quaternary Age. The Scioto River glacial outwash aquifer consists of permeable deposits of sand and gravel beneath the area adjacent to the river and occupies the ancient Newark River Valley. The other alluvial aquifers consist of deposits of clay and silt interbedded with lenses of sand and gravel, and they partially fill the pre-glacial drainage channels and major tributaries of the Scioto River. These latter aquifers, referred to as the Gallia aquifer of the Teays Formation, are of relatively lesser importance. Because of compositional differences related to their geologic history, the Scioto and Gallia aquifers are treated separately. Table 1.3-4 relates the Scioto River outwash, Gallia hydrogeologic units, and bedrock units to the regional stratigraphic setting.

The bedrock aquifer consists of Silurian through Mississippian limestones, sandstones, and shales. The distribution and use for most of the Silurian and Devonian aquifers is limited to the western portions of the state. For example, groundwater in the Greenfield limestone is used in the area about 50 miles west of the reservation. The bedrock aquifer near the reservation consists of the Mississippian-age Bedford Shale, Berea Sandstone, Sunbury Shale, and Cuyahoga Shale in ascending order (Reference ~~7~~61).

Scioto River Glacial Outwash Aquifer

Glacial outwash sediments and riverbed alluvium that were deposited during the Quaternary Period underlie the Scioto River Valley. It is one of the principal aquifers in Ohio. The unit extends from the confluence of the Scioto and Ohio rivers to the headwaters of the Scioto in north-central Ohio (Reference ~~7~~61).

The glacial outwash deposits consist primarily of fine gravel and coarse sand that sometimes is interbedded with fine sand and silt and locally may contain small bodies of clay. These deposits are thickest, 70 to 80 ft, in a comparatively narrow incised bedrock channel, which in the Piketon area, generally underlies the west side of the river valley. The highly porous and permeable glacial outwash deposits are overlain by about 10 to 20 ft of fine-grained, poorly permeable river alluvium laid down by the modern Scioto River. The water table ranges generally from 10 to 15 ft below the ground surface, and the saturated thickness of the unit is about 40 to 65 ft. For the most part, the aquifer is unconfined (Reference ~~7~~62).

The Scioto River outwash aquifer supplies municipal, commercial, and domestic water for the area west of the reservation (Reference ~~7~~63). The Scioto River outwash aquifer is probably responsive to the stage of the present Scioto River.

Gallia Alluvial Aquifer

The Gallia alluvial aquifer, although similar to the Scioto River outwash aquifer by being Quaternary in age, differs in its geologic history and composition. The Gallia, consisting of silty sand and gravel, is the lower member of the Teays Formation. The overlying Minford Member consists of silt and clay. Where the Sunbury Shale is absent, the Gallia Sand overlies the Berea Sandstone. Because the Gallia represents localized infilling of an ancient streambed, its areal distribution is limited. The Gallia Sand is used locally as a source of water for municipal, commercial, and domestic purposes.

Bedrock Aquifer

Data describing the bedrock aquifer in the region surrounding the reservation are generally limited to published maps and hydrograph data from the Ohio Department of Natural Resources, Division of Water. Such maps for Pike County and Jackson and Vinton Counties (Reference ~~7~~64) indicate that the bedrock aquifer serves only domestic needs.

1.3.5.1.2 Regional Groundwater Use

The Scioto glacial outwash aquifer serves as the principal aquifer in the region. Water from this aquifer supplies domestic, agricultural, industrial, and municipal needs. Several municipalities use the aquifer for reserve capacity. Minor alluvial aquifers (including the Gallia) supply domestic needs locally.

1.3.5.1.3 Flow in the Regional Aquifers

With respect to aquifer contamination, the two most important aquifers are the Berea Sandstone and the Gallia (References ~~7~~ 61, 65, 66, and 67). The ability for environmental contaminants from ACP operations and waste disposal activities to enter these aquifers and migrate off-site is the most important characteristic of the subsurface hydrologic system.

The potential for off-site contamination of regional aquifers is a function of the distribution of geologic units that might enhance cross-formational flow. The vertical head profile between the Berea and the Gallia is determined by the distribution of the Sunbury Shale. Where the Sunbury is absent or very thin, an upward vertical-head profile exists from the Berea to the Gallia. Where the Sunbury is present, a vertically downward head profile exists from the Gallia to the Berea. Thus, the proximity of on-site environmental contaminants to locations exhibiting downward vertical-head profiles poses the greatest potential for off-site contamination of the Berea. This flow from the Sunbury to the Berea would occur through fractures or deeply weathered zones in the Sunbury.

Groundwater flow at the DOE reservation is controlled by the complex interactions between the Gallia and Berea units. The flow patterns are also affected by the presence and elevation of storm sewer drainpipes and their bedding and by the reduction in recharge caused by building and paved areas. Three principal discharge areas exist for ground water: (1) Little Beaver Creek to the north and east; (2) Big Run Creek to the south; and (3) two unnamed drainages to the west. An east-west trending groundwater divide that passes through the reservation characterizes groundwater flow patterns in both the Berea and Gallia. Other groundwater divides are also present, dividing the flow system of each unit into four sub-basins in the Gallia and three in the Berea.

While contamination of the Berea aquifer from on-site activities is possible, due to the downward vertical-head profile from the Gallia, off-site monitoring has not detected contaminant concentrations above background levels (Reference ~~7~~60). Additionally, dissolved solids exceeding 10,000 ppm within about five miles down gradient from the reservation make it unlikely that significant portions of the Berea drinking water resource would be adversely affected.

Precipitation is the primary source of recharge of these aquifers. Recharge at the reservation is estimated at between 2.3 and 11.7 in. per year (Reference ~~7~~66). Infiltration reaches the water table and moves laterally to areas of discharge or vertically to adjacent aquifers. The Gallia aquifer near or adjacent to surface drainage ways is likely in active communication with the surface water.

1.3.5.2 Site Characteristics

The DOE reservation sits in a mile-wide former river valley (Portsmouth River Valley) surrounded by farmland and wooded hills with generally less than 100 ft of relief. The main plant area has a nominal elevation of 670 ft amsl about 113 ft above the stage of the Scioto River, which lies about 2 miles to the west of the reservation. The Scioto River and its tributaries receive surface water and groundwater discharge from the reservation.

Geologic units controlling groundwater flow beneath the reservation are, in descending order, the Minford and Gallia unconsolidated units of the Quaternary age, and the Sunbury, Berea, and Bedford bedrock units of the Mississippian age (Table 1.3-4). The Mississippian Cuyahoga shale, the youngest bedrock unit in the area, forms the hills east and west of the reservation. Also present in some places is up to 20 ft of artificial fill, which is predominantly Minford silt and clay.

The main groundwater flow system beneath the reservation is the Gallia sand and the lower unit of the Minford, the Minford silt. The Gallia sand and the lower Minford silt form the uppermost, unconfined aquifer (the Gallia aquifer) with a combined thickness of about 11 ft (Figure 1.3-13). The bottom of the Gallia aquifer has an elevation ranging from 630 to 640 ft amsl in the plant area.

The Gallia aquifer is partly surrounded by the Cuyahoga shale, which lies in the wooded hills around the reservation. The Sunbury shale underlies both the Gallia aquifer and the Cuyahoga shale. The Sunbury separates the Gallia aquifer from the underlying confined aquifer, the Berea sandstone. Where the Sunbury is absent or thin, the Berea aquifer and the overlying Gallia aquifer act essentially as one unit. About 100 ft of Bedford shale underlies the Berea aquifer over the entire reservation. The lower 10 ft of the Berea is very similar to the underlying Bedford shale (Reference ~~7~~65).

1.3.5.2.1 Aquifers Beneath the Site

The Gallia exhibits the highest hydraulic conductivity of the aquifers on the DOE reservation. Hydraulic conductivity values range from 0.11 to 150 feet per day (ft/d), with a mean of 3.4 ft/d (Reference ~~7~~65). Groundwater flow directions in the Gallia are roughly from the center of the reservation toward the surrounding low-lying surface water drainage system. The ultimate discharge area for most groundwater is Little Beaver Creek to the north and east, Big Run Creek to the south, and two unnamed drainages to the west.

1.3.5.2.2 Aquifer Properties

The Berea Sandstone exhibits little spatial variation in hydraulic properties. The DOE reservation means hydraulic conductivity for the Berea is 0.16 ft/d (Reference ~~7~~65). The highest hydraulic conductivity in the Berea was measured as 0.35 ft/d at the X-616 area, where the unit has been slightly eroded and may be slightly weathered; the lowest hydraulic conductivity was measured is 0.1 ft/d at both X-231B and X-701B.

Groundwater elevations in the Berea Sandstone are determined by local geologic conditions. Measurements between August 1988 and September 1989 indicate a mean water elevation of 646.15 ft amsl with a standard deviation of 0.92 ft (Reference ~~7~~66). A generally downward vertical gradient occurs between the Berea and overlying aquifer when overlain by the Sunbury Shale, which acts as an effective confining unit. Where the Sunbury is absent or very thin, an upward vertical gradient exists between the Berea and overlying aquifer. Groundwater flow in the Berea is expected to be similar to those of the Gallia except in the eastern part of the reservation, where the directions are generally toward the east and southeast.

Recharge from precipitation has been estimated to be 8.9 in. per year using the 1985 data and the Thornthwaite method (Reference ~~7~~65). This corresponds to about 25 percent of the total precipitation of 35.78 in. that year. In general, the estimated annual recharge rates vary from 3.3 to 11.7 in. per year.

Little Beaver Creek to the north and east, Big Run Creek to the southeast, and the two unnamed tributaries to the west control groundwater flow in the Gallia and Berea aquifers by acting as local recharge or discharge areas. In some places, the large-diameter storm drain segments are partially below the elevation of the Gallia water table (Reference ~~7~~65). These drains and surrounding gravel beddings may act as groundwater interceptors in the Gallia flow system.

1.3.5.2.3 Groundwater Flow

The main groundwater flow unit beneath the DOE reservation is the Gallia aquifer formed by the Gallia sand and the Minford silt, with a combined average thickness of about 11 ft. The hydraulic conductivity of this aquifer is not considered as high, but the surrounding Cuyahoga shale and underlying Sunbury shale and Berea sandstone have even lower conductivities and form less important groundwater flow units (Reference ~~7~~65). In general, the Gallia aquifer beneath the main plant area receives recharge through infiltration of rainfall and discharges water to surrounding low-lying areas through openings formed by missing Cuyahoga shale. One narrow opening is between the X-701B area and Little Beaver Creek to the east. Two wide openings exist, one near the northern perimeter road toward Little Beaver Creek and the other near the southern perimeter road. Discharges, in the form of groundwater, are likely to occur from the DOE reservation through these openings. Other openings that are not easily seen from the bedrock surface plot are associated with Big Run Creek to the south and the two unnamed tributaries to the west. Discharges through these openings are likely first in the form of groundwater and then as surface water in the creeks. These discharge routes can be potential pathways for the reservation contaminants to reach areas outside the plant and ultimately the Scioto River.

Regional flow in the Berea is generally to the southeast, in the direction of structural dip. Locally, the flow direction is affected by Big Run Creek, Little Beaver Creek, and the west and southwest drainages (Reference 68~~7~~). For example, flow in the northern part of the reservation turns somewhat northward due to the influence of Little Beaver Creek. In areas where the Sunbury is absent, the Berea and the overlying Gallia become hydraulically connected.

Groundwater flow directions in both aquifers are influenced by the presence of Little Beaver Creek, Big Run Creek, and the two unnamed tributaries. At many places, the two separate groundwater flow systems are roughly parallel, but at some places, for example near the northern perimeter road, they are quite different. In general, large head differences exist between the Gallia and the Berea because the Sunbury shale presents an effective barrier that restricts the vertical communication between the two aquifers (Reference 67).

1.3.6 Geology and Seismology

This section describes the geology and seismology for the Interior Low Plateaus region of southern Ohio in the vicinity of the DOE reservation. Discussions of the site and regional physiography, reservation and engineering geography, seismology, surface faulting, and liquefaction potential are provided.

1.3.6.1 Regional and Site Physiography

The DOE reservation is located within the Interior Low Plateaus physiographic province, about 20 miles south of its northwestern edge. It is bordered on the north and west by the Central Lowlands province and on the south and east by the Appalachian Plateaus province. The Interior Low province is underlain by relatively flat-lying Paleozoic Age limestone and shale.

Portions of the Interior Low Plateaus province have been glaciated, but the reservation is south of the region covered by Pleistocene glaciations. However, alluvium and transported glacial sediments form a surface veneer in the mile-wide, broad valley where the reservation is located. Erosion, exposing the underlying, nearly flat-lying shale and sandstone of Mississippian and Pennsylvanian Age have maturely dissected the surrounding hills.

The reservation is located within a broad, flat valley that was (1) primarily developed by long-term erosion of the shale and sandstone that underlies the Interior Low Plateaus physiographic province; (2) subsequently modified by partial filling by glacial and alluvial sediments; and (3) later subjected to erosion. The prolonged erosion since the Permian Period has produced the dominant topography. Ground elevations within the reservation generally range from about 660 ft to 680 ft amsl, although the ground rises to about 700 ft amsl at the base of hills that border the Perimeter Road; the surrounding hills extend up to about 1,200 ft amsl. The nearby Scioto River (at about elevation 510 ft amsl) is the lowest elevation within five miles.

Prior to construction of the GDP, the area was farmland that formed a portion of the watershed for the nearby Scioto River. A drainage divide (about elevation 675 ft amsl) was at approximately midpoint of the plant, which separated gullies and streams flowing to the north from those flowing west and south. Generally, site preparation and grading performed approximately 50 years ago involved only minor surface modification. With the exception of a few drainage features (swales) that required as much as 20 ft of fill, most of the area developed was cut less than 10 ft and filled less than 12 ft.

1.3.6.2 Site Geology

Aside from roadways and other ancillary structures outside the Perimeter Road, the DOE reservation is located within the valley eroded into the bedrock by the ancient Portsmouth River and later filled in by glacial lake sediments. Except for a few low hills that extend into the reservation, the Perimeter Road on the west and east generally follows the lateral limits of the ancient Portsmouth River Valley. The valley is bounded on the west by a series of low hills extending up to elevation 840 ft amsl that have been maturely dissected; these hills expose nearly flat-lying Mississippian Age shales of the Sunbury and Cuyahoga Formations. The Sunbury and Cuyahoga Formations are also exposed in the maturely dissected low hills east of the reservation. These consolidated Mississippian formations dip downward to the east about 27 ft/mile (i.e., less than ½ a degree).

Drainage that developed at the reservation prior to glaciations consisted of a northward and westward flowing master stream (the ancient Teays River) and tributaries such as the ancient Portsmouth River. The Portsmouth River deposited a thin discontinuous veneer of alluvium in the reservation valley that has subsequently been covered by lacustrine deposits of glacial origin. Only the small streams that flow through the reservation contain recent alluvium.

Unconsolidated deposits at the reservation consist of Quaternary stream alluvium (Holocene and Pleistocene), Pleistocene lacustrine deposits of glacial origin, and older alluvium of the ancient Portsmouth River. Consolidated deposits within 500 ft of the ground surface consist of Devonian, Mississippian, and Pennsylvania shale and sandstone.

Unconsolidated material

Fill – Fill was placed during the 1950s to develop the reservation. Most of the fill ranges from 1 ft to 3 ft in thickness, but up to 20 ft of fill was placed in former stream valleys or draws to develop a plateau for building construction for the GDP facilities. Then in the early 1980s, additional fill was placed to create plateaus for the GCEP building construction. The fill is composed mostly of clean, silty clay. Verification data regarding fill density and its moisture content indicate that the fill under the plant buildings was compacted to at least 95 percent of its maximum dry density according to ASTM D 698 (standard Proctor).

Lacustrine deposits – Lacustrine deposits averaging 23 ft in thickness are exposed at the ground surface over much of the reservation and underlie fill at the remainder of the reservation; these deposits have been termed the Minford clays, Minford silts, or the Minford Clay Member of the Teays Formation. The general soil profile is composed of about 16 ft of clay underlain by about 7 ft of silt. Both these soil types are firm to very stiff, over consolidated, and classified as silty clay and silt, but some highly plastic clay occurs near the ground surface.

Older alluvium – The lacustrine deposits are underlain by a discontinuous interval of clayey sand and gravel (Gallia sand) deposited by the ancient Portsmouth River. The alluvium is commonly referred to as the Gallia Sand Member of the Teays Foundation in the nearby Teays Valley. The average thickness is about 3 ft; the maximum thickness of the alluvium is 12 ft. It is firm to dense.

Consolidated material

Cuyahoga Formation – This Mississippian formation crops out in hills adjacent to the reservation, with the base of the formation at elevation 639 ft amsl. When unweathered, the Cuyahoga consists of about 339 ft thickness of hard grey to grey-green shale with lenses of sandstone.

Sunbury Formation – Underlying the Cuyahoga is a 19 to 20 ft thick interval of hard, black, carbonaceous shale. It underlies the unconsolidated sediments beneath most of the reservation.

Berea Formation – The Berea Formation underlies the Sunbury shale and extends downward. It is composed of about 30 to 35 ft of grey thick-bedded, fine-grained sandstone with shale laminations.

Bedford Formation – The Bedford is composed of about 98 ft of varicolored shale with interbeds of sandstone and siltstone.

Ohio Formation – The Ohio Shale is the uppermost Devonian Formation under the reservation. It is composed of 300 to 600 ft of dark brown, dark grey, and black fissile shale.

1.3.6.3 Site Structural Setting

Lacustrine deposits cover the DOE reservation bedrock; some streambeds contain recent alluvium. Little bedrock is exposed on the reservation except in the hills surrounding the plant. Neither the U. S. Army Corps of Engineers studies nor the Law Engineering Study in 1978 discovered evidence of bedrock faulting (Reference 18). The available data indicates that the underlying bedrock is not faulted; it has a strike of north 28° east and a homoclinical dip to the southeast of about 1/2 a degree.

1.3.6.4 Engineering Geology

The available evidence indicates the favorable performance of the DOE reservation facilities since their construction in the 1950s and the more recent GCEP facilities constructed in the early 1980s with respect to bearing capacity, settlement, and modest seismic events.

No shears, folds, or other structural weaknesses are known to be in the bedrock. Measurements of joint sets in bedrock exposed around reservation exhibit jointing typical of undeformed bedrock. These joints have no effect on the performance of foundations since they are covered by an interval of lacustrine glacial deposits. No evidence from the borings indicates zones of deep weathering that might indicate faulting or shearing.

No published data exist on unrelieved stresses in the bedrock, but the geologic history suggests that the bedrock may still be undergoing a very slow isostatic rebound. This rebound is due to a combination of the past loading and subsequent unloading of the bedrock by the Pleistocene glaciers and/or stress relief from erosion of the unconsolidated lacustrine sediments.

The consolidated bedrock within 500 ft of the ground surface is predominately clastic in origin (shale and sandstone).

Most of the unconsolidated soils are cohesive and over consolidated and relatively uniform in thickness and extent. The soils exhibit a low potential for liquefaction and differential settlement. Cohesive soils exposed at the surface may exhibit minor shrinkage cracks resulting from moisture loss.

The geologic literature and records of mineral production in the reservation area indicate no mineral extraction has been done beneath the reservation. The potential exists for minor oil and gas accumulations in the underlying consolidated strata, but there are no records of significant gas or oil production within five miles of the reservation.

The soil at the reservation is primarily low plasticity clay and silty clay. The bedrock is composed of hard shale and sandstone.

The regional geologic history and extensive amount of exploratory data indicate no evidence of tectonic depressions, shears, faults, or folds.

The plant uses process water from the aquifer below the Scioto River, and no groundwater is withdrawn from the subsurface at the reservation for sanitary or process uses.

The exploratory and laboratory test data indicate that the glacial and alluvial soils are over consolidated and have moisture contents well below their liquid limit. Engineering studies have shown the soils are only moderately compressible under applied foundation loads, and the satisfactory performance of the various foundations attests to that. The potential is low for surface fissuring of soils resulting from a period of extreme drought.

The studies by the U. S. Army Corps of Engineers and Law Engineering in the 1970s in the GCEP area (Reference 18), south-southeast and southwest of the GDP, found groundwater between 650 ft amsl and 665 ft amsl. The basal older alluvium exhibits no evidence of artesian conditions. Limited data on groundwater fluctuations indicate variations of between 3 ft and 5 ft over a period of six months. The groundwater level responds to annual precipitation.

No problems were encountered with groundwater during construction of the GCEP facilities. Most foundations bear upon the stiff lacustrine soils at depths of 5 ft or less below the finished floor elevation of the buildings.

No slopes within the Perimeter Road have inclination of 3 horizontal: 1 vertical or greater except for one slope; this slope is not adjacent to any structures (Reference 69~~7~~). Low inclination slopes less than 20 ft in height that have soil parameters of $\phi = 10°$, $c = 1{,}000$ will have a static safety factor of at least 2.0 and a dynamic safety factor of at least 1.5 under a peak ground acceleration (PGA) of 0.21 gravity. The natural ground and engineered fill upon which the structures are founded have been analyzed for shear failure and settlement. Design documents show the factor of safety against shear failure under static conditions is more than 2.0, and predicted total settlements of foundations are less than 2 in. Because of the stiff nature of the foundation soils, negligible settlement ~~will~~ occurs as a result of the design basis earthquake, as discussed in the next section.

1.3.6.5 Seismology

There are no major geologic fault structures in the vicinity of the DOE reservation and there have been no historical earthquake epicenters within less than 25 miles from the reservation except for two small recent events. On December 21, 2014, a magnitude 2.0 event occurred in Union Township of Pike County, approximately four miles southeast of the DOE reservation. On March 20, 2019, a magnitude 2.1 event occurred in Minford, Scioto County, approximately 12 miles southeast of the DOE reservation (Reference 70). ~~However, t~~There have been eight other earthquake epicenters within 50 miles. The maximum event had an epicenter intensity of over IV on the Modified Mercalli (MM) scale. But these events were at the reservation with intensities between I and IV. The maximum PGA of a MM level IV event roughly corresponds to 0.02 gravity. Historically, the maximum earthquake-induced PGA experienced at the reservation was in 1955 and had a value of only 0.005 gravity.

In the Preliminary Safety Analysis Report (Reference 15) developed for GCEP and issued in July 1980, the documented results of the studies of the historic seismicity of the area surrounding the reservation were presented. Data was developed on probable seismic activity and the intensity levels were converted into acceleration values. The maximum earthquake was defined as one with a mean recurrence interval of 1,000 years. This corresponds to an earthquake with a horizontal PGA of 0.15 gravity. Thus, the DOE considered that it was sufficient to design the structures, systems, and components necessary for safety to withstand this level earthquake without leading to undue risk to the health and safety of workers, the public or the environment. That is, the 1,000-year return earthquake was the design basis earthquake (DBE) for GCEP.

The seismic design criteria for the GCEP site was published in a DOE document, ORO-EP-120, ~~*Preliminary Safety Analysis Report for the Gas Centrifuge Enrichment Plant*~~*Seismic Design Criteria for the Gas Centrifuge Enrichment Plant* - GCEP (Reference 16) in 1980 and contained recommended design and maximum earthquake PGA values. The PGA values corresponding to these two earthquake levels were 0.04 gravity for the design earthquake and 0.15 gravity for the maximum earthquake corresponding to 72- and 1,000-year return periods, respectively. These PGA levels were selected based on judgment considering: 1) much of the information discussed in the other former studies of the GDP site; 2) the GCEP was to be a newly constructed facility, 3) the GCEP might be subjected to licensing requirements, and 4) the return periods of 1,000 years for events concerning safety were discussed for new enrichment plants. Although recommended, it was the opinion of the authors of ORO-EP-120 that the PGA value of 0.15 gravity for a return period of 1,000-years was conservative.

The DBE for the primary facilities in the ACP is a 1,000-year return period earthquake, except for the X-3344 Customer Services Building which has a 10,000-year return period earthquake DBE or 0.48 gravity PGA value. Updated seismic criterion were developed specifically for the ACP and referenced in the *Summary of ACP Seismic Design Values* (Reference 29). The document summarizes the DBEs for the current site-specific return periods of 1,000 and 10,000-years. Additionally, the document includes the 100,000-year response spectra which is used to show there is adequate reserve in the connections for the X-3344 which is designed for a 10,000-year DBE. This criterion was based on earlier geotechnical investigations performed by Engineering Consulting Services (ECS) and Fugro, Williams, Lettis and Associates (FWLA) and presented in these reports: ECS, *Final Report of Site-Specific Seismic Study* dated January 2006 (Reference 21), ECS, *Final Report of Subsurface Exploration and Geotechnical Engineering Evaluation* dated March 2006 (Reference 30), and FWLA, *Geotechnical Investigation – American Centrifuge Plant* dated June 2010 (Reference 31). Further description of seismic acceleration justification can be found in Sections 2.5.1.1 and 6.1.1.7 in the ISA Summary.

1.3.6.6 Surface Faulting

The geologic setting of the DOE reservation suggests there is a low probability of faulting within five miles of the reservation. No data from earlier geotechnical studies at the reservation (rock shearing, sharp changes in strata dip, and flexures) are characteristic of faulted rocks. The available data indicates the reservation bedrock is not faulted.

1.3.6.7 Liquefaction Potential

Extensive exploration and laboratory testing programs (data sets) have been completed at the DOE reservation. The associated borings and accompanying laboratory test results were used at the reservation to analyze the response of soil to ground shaking caused by earthquakes.

The laboratory classification tests, shear strength tests, and consolidation test data were used to define the general engineering characteristics of the soil. Analysis of the data indicates that there is a low potential for soil liquefaction at the reservation, even in the unlikely event of the occurrence of an earthquake of magnitude 5.25 with a maximum PGA of 0.15 gravity. Consequently, settlement in the reservation area due to liquefaction is unlikely.

Table 1.3-1 Historic and Projected Population in the Vicinity of the DOE Reservation

	1980	1990	2000	2010	2020
Jackson County	30,592	30,230	32,641	~~34,724~~33,225	31,600
Pike County	22,802	24,249	27,695	~~29,981~~28,709	29,000
Ross County	65,004	69,330	73,345	~~80,111~~78,064	76,000
Scioto County	84,545	80,327	79,195	~~81,307~~79,499	73,730
Region of Influence	202,943	204,136	212,876	~~226,123~~219,497	210,330
Ohio	10,797,630	10,847,115	11,353,140	~~11,805,877~~11,536,504	11,574,870

Year ~~2010~~ 2020 projections based on established rates applied to ~~2000~~ 2010 census counts. ~~(Reference 4)~~

Table 1.3-2 Precipitation as a Function of Recurrence Interval And Storm Duration for the DOE Reservation

Recurrence Interval (Years[b])	Storm duration (hours) 0.5	1	2	3	6	12	24
	Precipitation (in.[a])						
1	0.85	1.08	1.33	1.47	1.72	1.99	2.29
2	1.03	1.31	1.62	1.79	2.09	2.43	2.79
5	1.27	1.61	1.98	2.19	2.57	2.98	3.42
10	1.48	1.88	2.33	2.57	3.01	3.49	4.01
25	1.8	2.29	2.82	3.12	3.65	4.24	4.87
50	2.09	2.66	3.28	3.62	4.24	4.92	5.66
100	2.4	3.06	3.77	4.16	4.88	5.66	6.5
10,000	3.85	4.91	6.05	6.67	7.83	9.09	10.44

[a] Values calculated based on a least-squares fit to data for 1 to 100 year recurrence interval (Reference ~~13~~4)
~~b. (Reference 9)~~

Table 1.3-3 Comparison of Flood Elevations of the Scioto River near the DOE Reservation With the Nominal Grade Elevation

	Elevation	
Recurrence interval	Meters	Feet
50-year flood[a]	170.1	558.0
100-year flood[a]	170.8	560.3
500-year flood[a]	172.4	565.7
Historical written record[b]	169.7	556.7
Probable Maximum Flood[c]	174.0	571.0
Nominal grade	204.2	670.0

[a] Estimates by U.S. Army Corps of Engineers ~~(Reference 7)~~.

[b] Estimated from records at Higby, 181.0 m (593.7 ft) ~~(Reference 7)~~, assuming the flood level at the mouth of Big Beaver Creek is 11.3 m (37 ft) lower.

[c] Probable Maximum Flood calculated flow is greater than that of the estimated 10,000-year flood discharge. ~~(Reference 7)~~

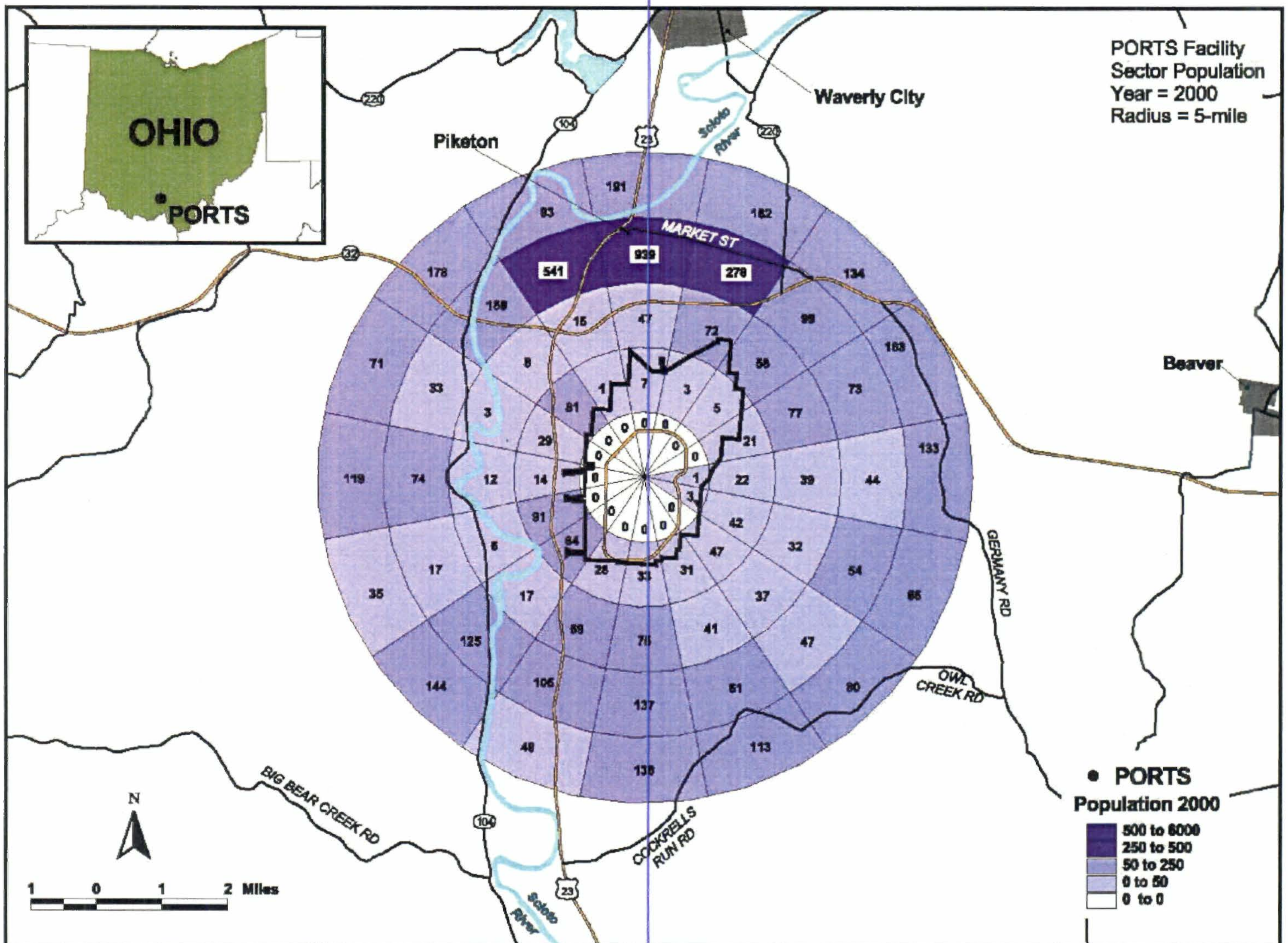
Table 1.3-4 Regional Stratigraphic and Hydrogeologic Subdivisions

ERA	System	Series	Formation or Unit	Hydrogeologic Unit
Cenozoic	Quaternary	Pleistocene	Teays Scioto River Outwash Minford Member Gallia Member	Scioto River
	Mississippian		Cuyahoga Sunbury Shale Berea Sandstone Bedford Shale	Gallia
Paleozoic	Devonian	Upper	Ohio Shale	Bedrock

~~(Reference 7)~~


Piketon
Piketon
SCIOTO
NEWTON
PORTSMOUTH GASEOUS
DIFFUSION PLANT
Long Ridge
NEWTON
U.S. RESERVATION
ATOMIC ENERGY COMMISSION
SCIOTO
Wakefield
PIKE CO
SCIOTO CO
PIKE CO
SCIOTO CO
Cockrell Run

Figure 1.3-1 Topographic Map of the Department of Energy Reservation
~~(Reference 11)~~


PORTS Facility
Sector Population
Year = 2000
Radius = 5-mile
OHIO
PORTS
Piketon
Waverly City
Beaver
Scioto River
MARKET ST
GERMANY RD
OWL CREEK RD
BIG BEAR CREEK RD
COCKRELLS RUN RD
N
1 0 1 2 Miles
• PORTS
Population 2000
500 to 8000
250 to 500
50 to 250
0 to 50
0 to 0

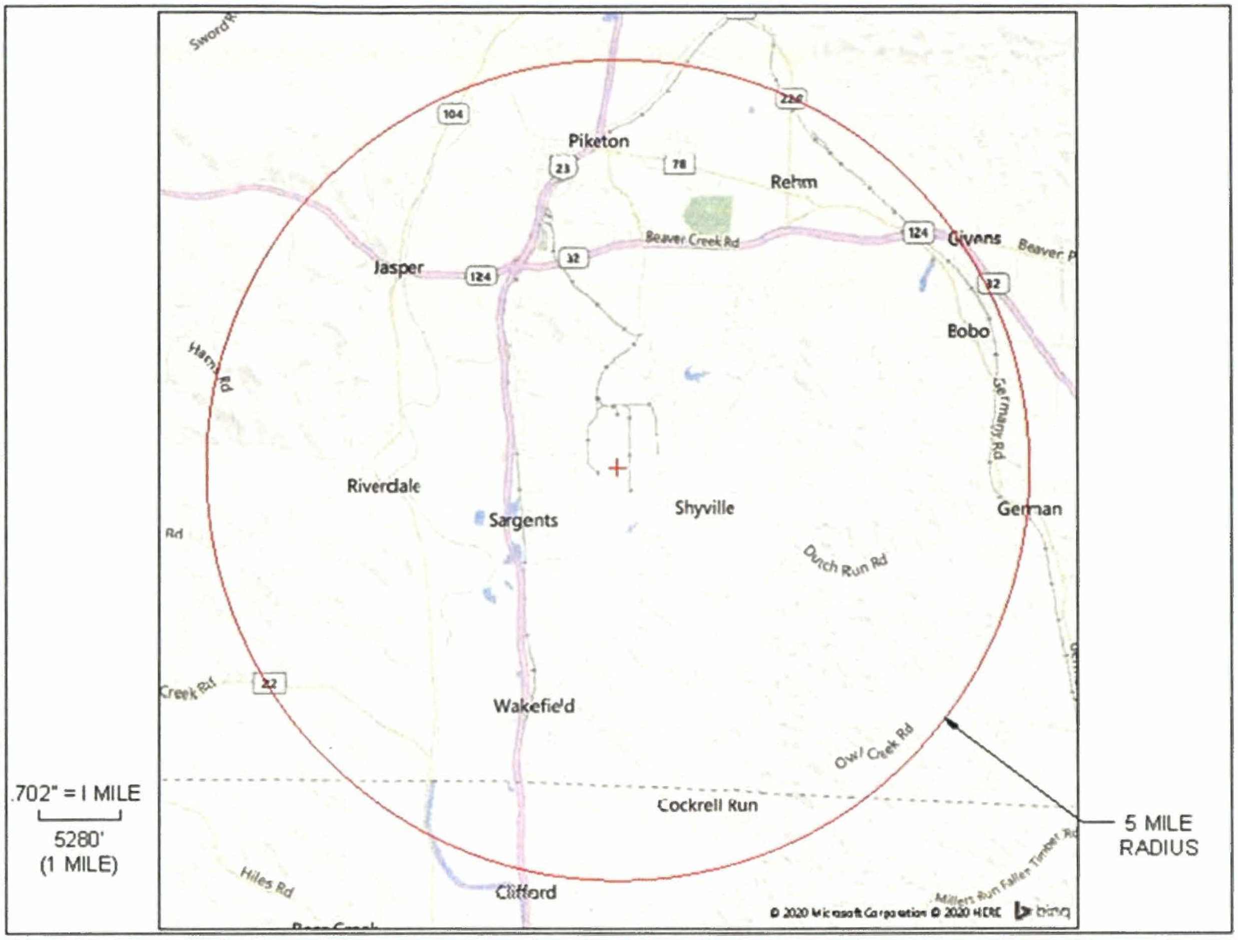
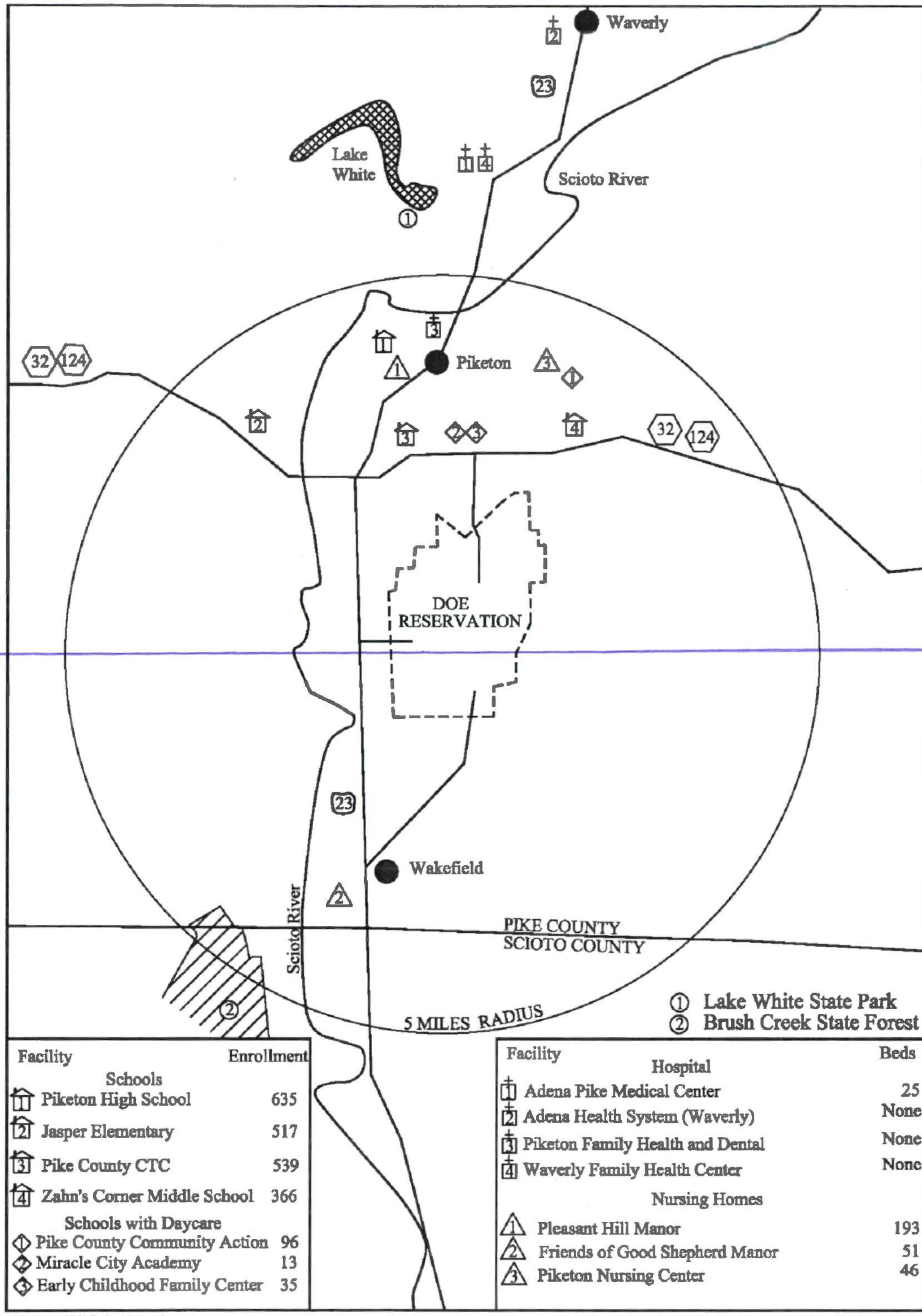


Figure 1.3-2 ~~Population~~Area Within Five Mile Radius of the U.S. Department of Energy Reservation

~~(Reference 12)~~



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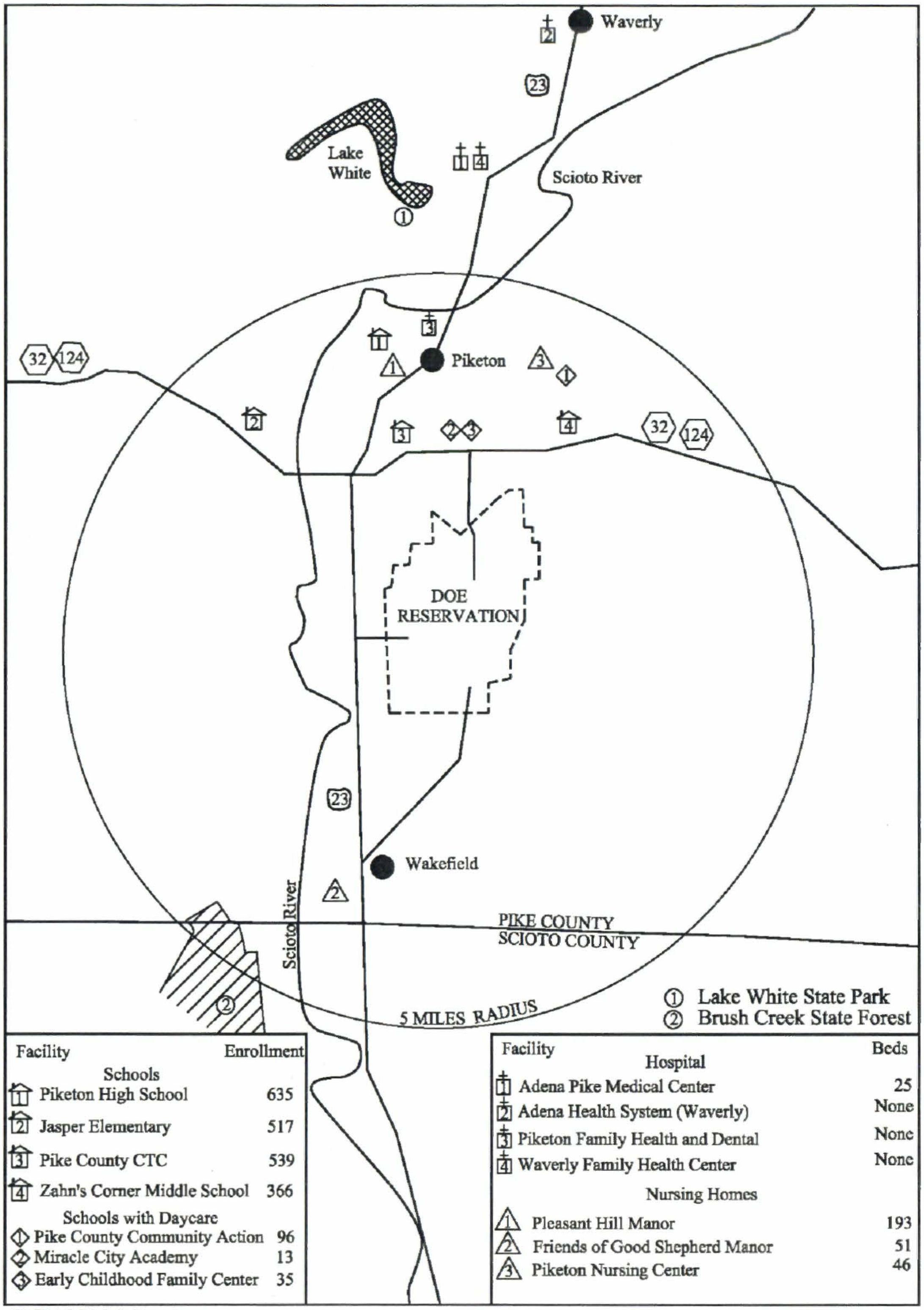
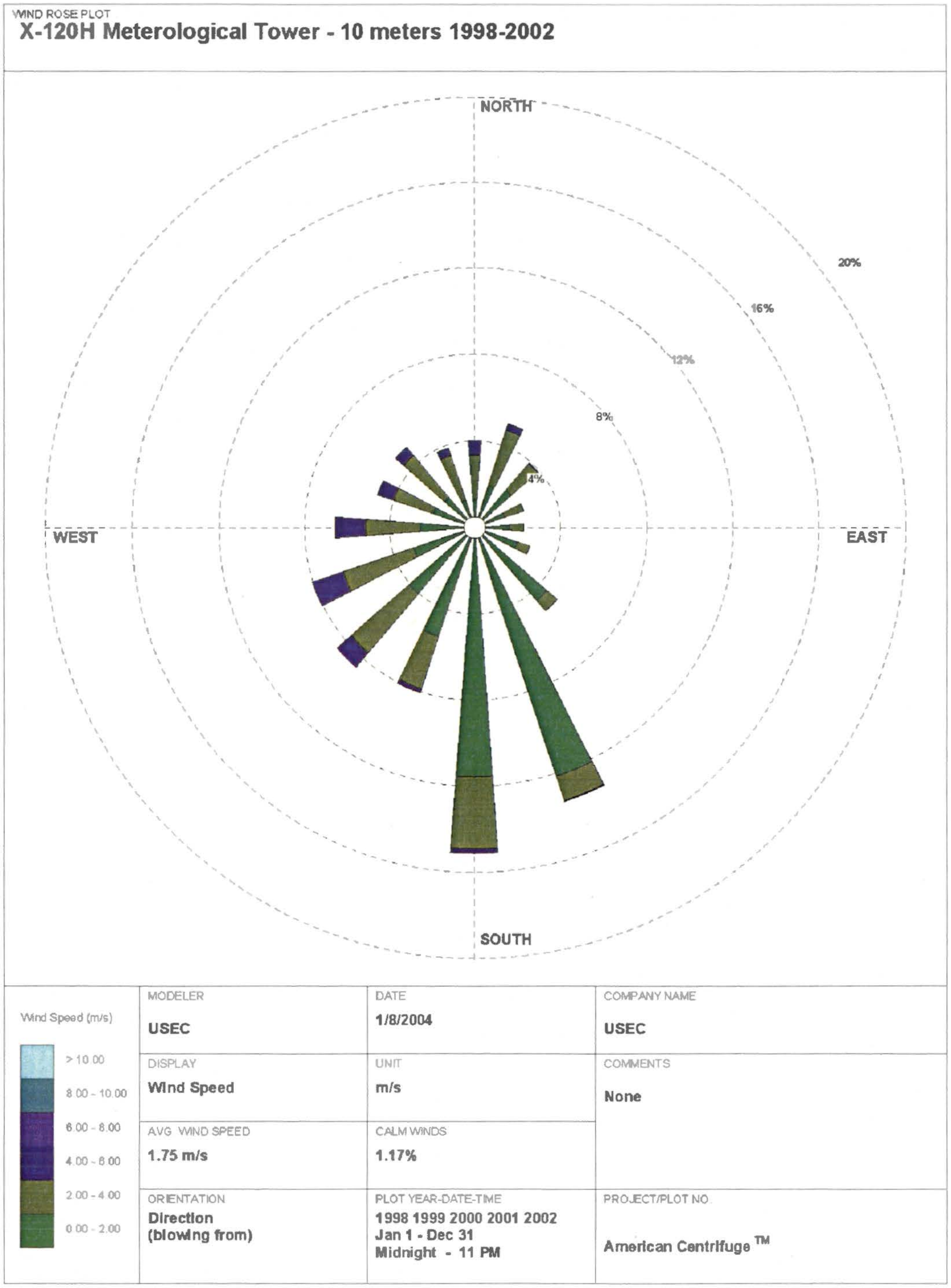


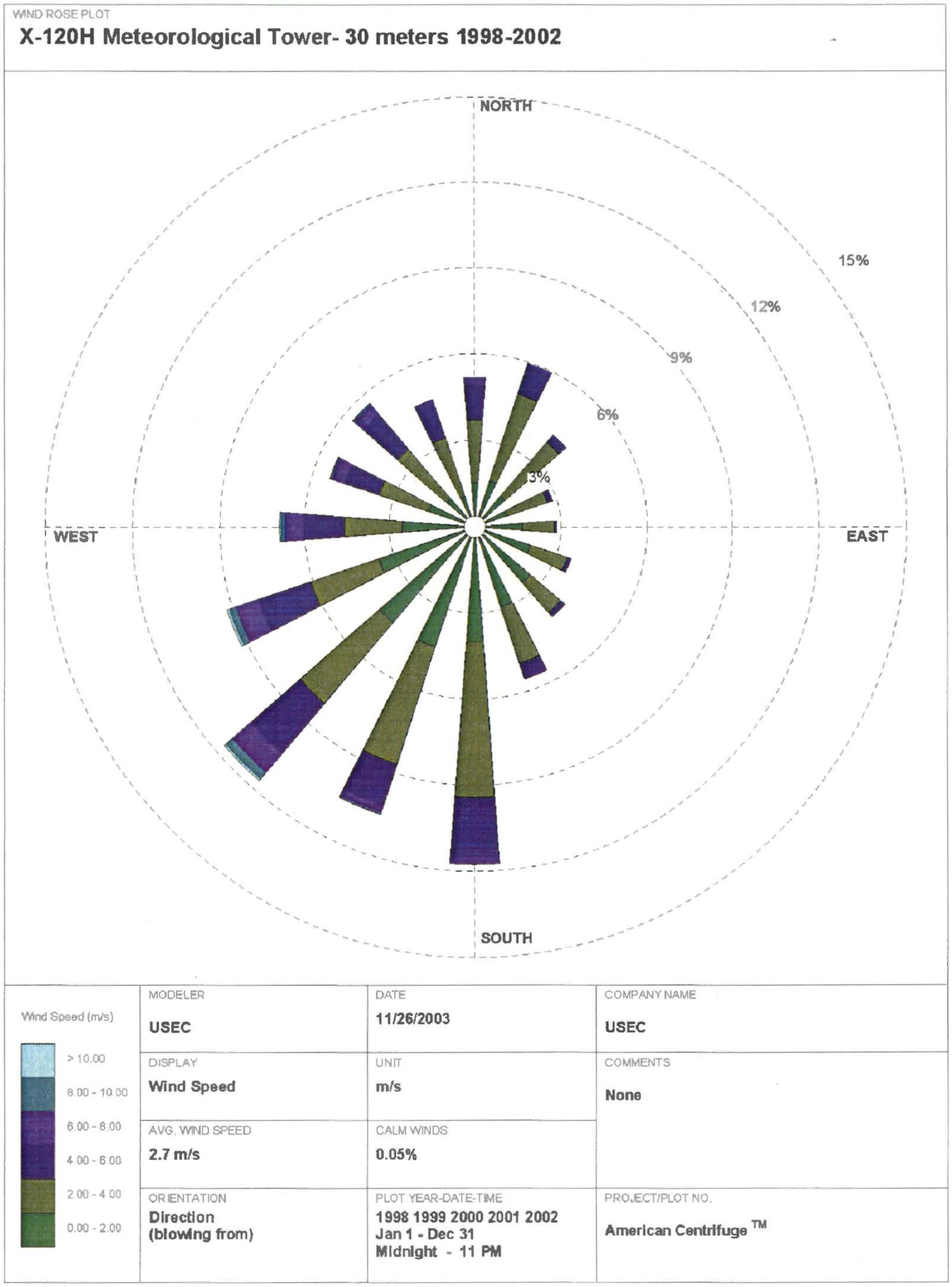
CP-ISAS F1.2-2, Rev. 1

Figure 1.3-3 Special Population Centers Within Five Miles of the U.S. Department of Energy Reservation



CP-057-R0

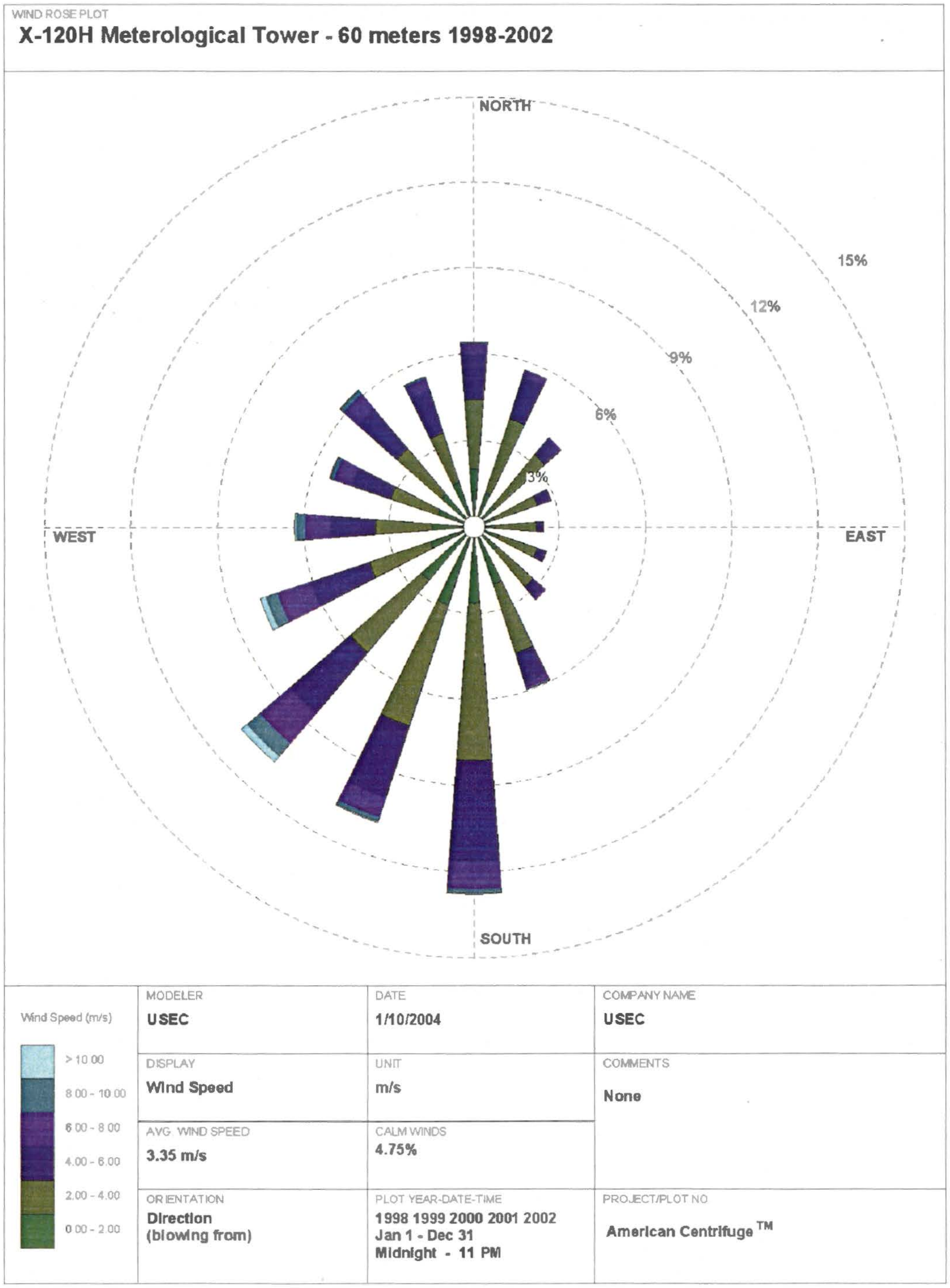
Figure 1.3-4 Comparison of Wind Roses at 10-m Level at the U.S. Department of Energy Reservation from 1998 - 2002
~~(Reference 6)~~



CP-058-R0

Figure 1.3-5 Comparison of Wind Roses at 30-m Level at the U.S. Department of Energy Reservation from 1998 - 2002

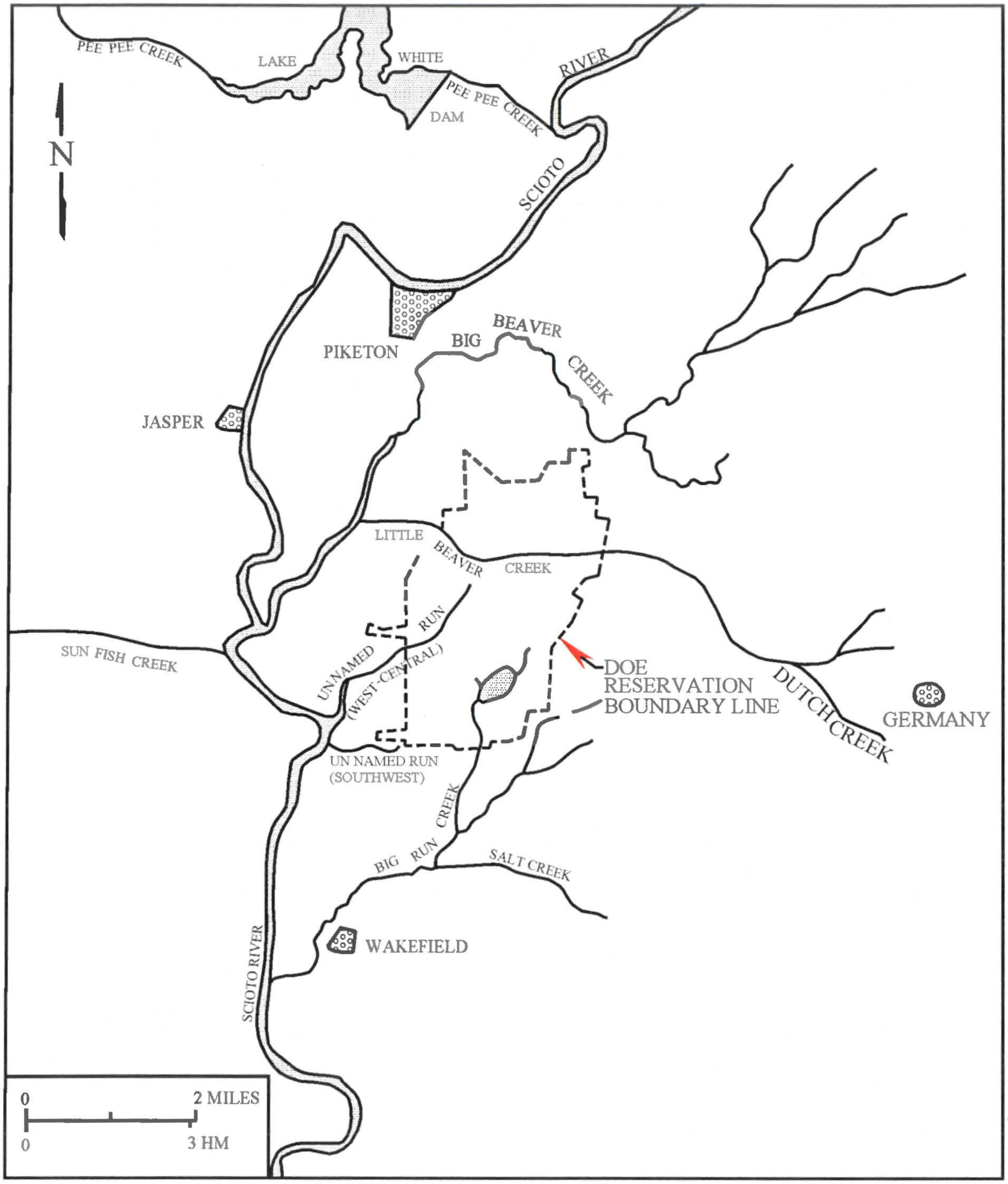
~~(Reference 6)~~



CP-059-R0

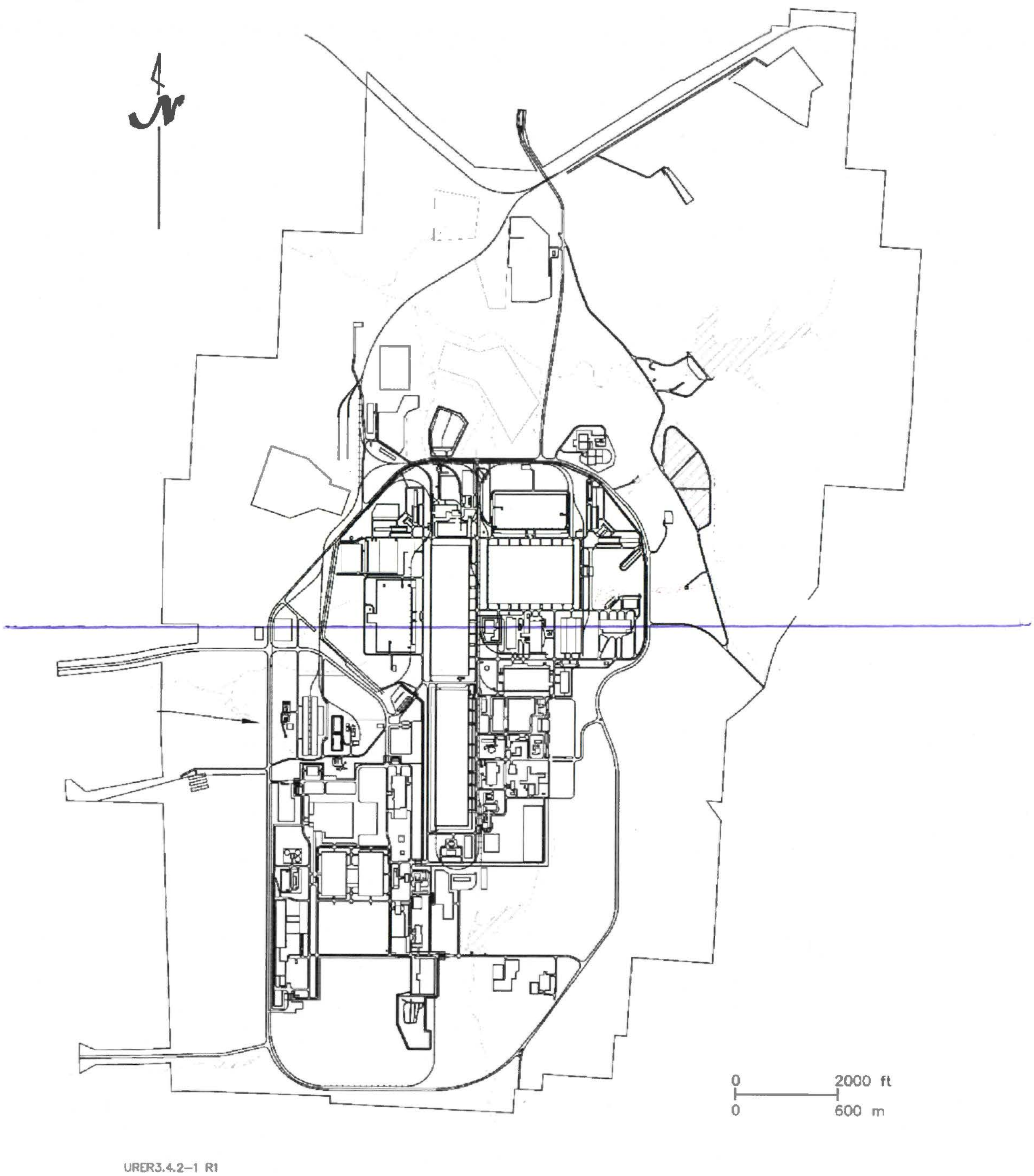
Figure 1.3-6 Comparison of Wind Roses at 60-m Level at the U.S. Department of Energy Reservation from 1998 - 2002

~~(Reference 6)~~



CP-038-R0

Figure 1.3-7 Location of Rivers and Creeks in the Vicinity of the U.S. Department of Energy Reservation


N
0
2000 ft
0
600 m
URER3.4.2–1 R1

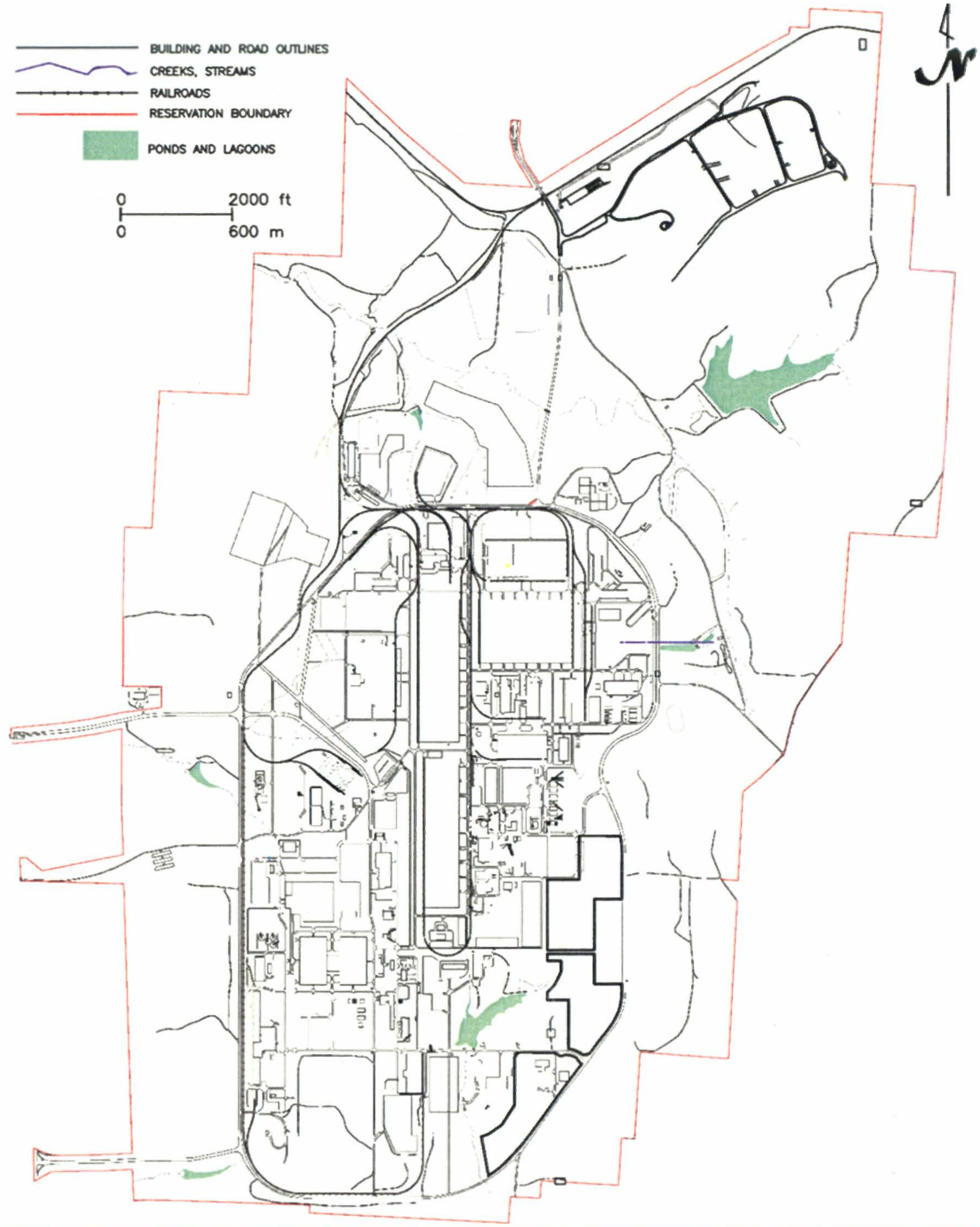
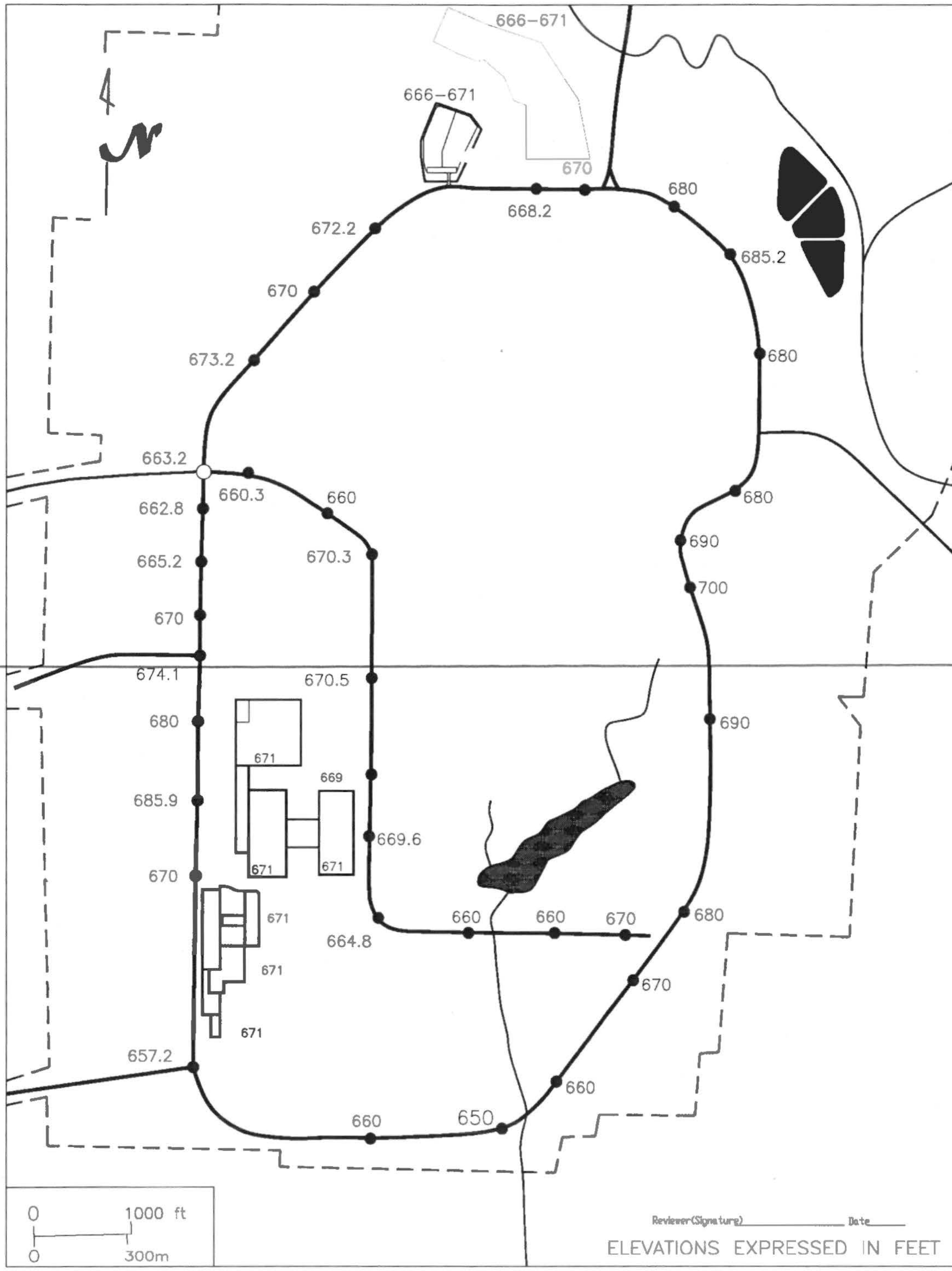


Figure 1.3-8 Ponds and Lagoons on the U.S. Department of Energy Reservation


666-671
666-671
670
680
668.2
672.2
685.2
670
680
673.2
663.2
660.3
660
680
662.8
690
665.2
670.3
700
670
674.1
670.5
680
690
671
669
685.9
669.6
671
671
670
671
660
660
670
680
664.8
671
670
671
657.2
660
660
650
0
1000 ft
0
300m
Reviewer(Signature)
Date
ELEVATIONS EXPRESSED IN FEET

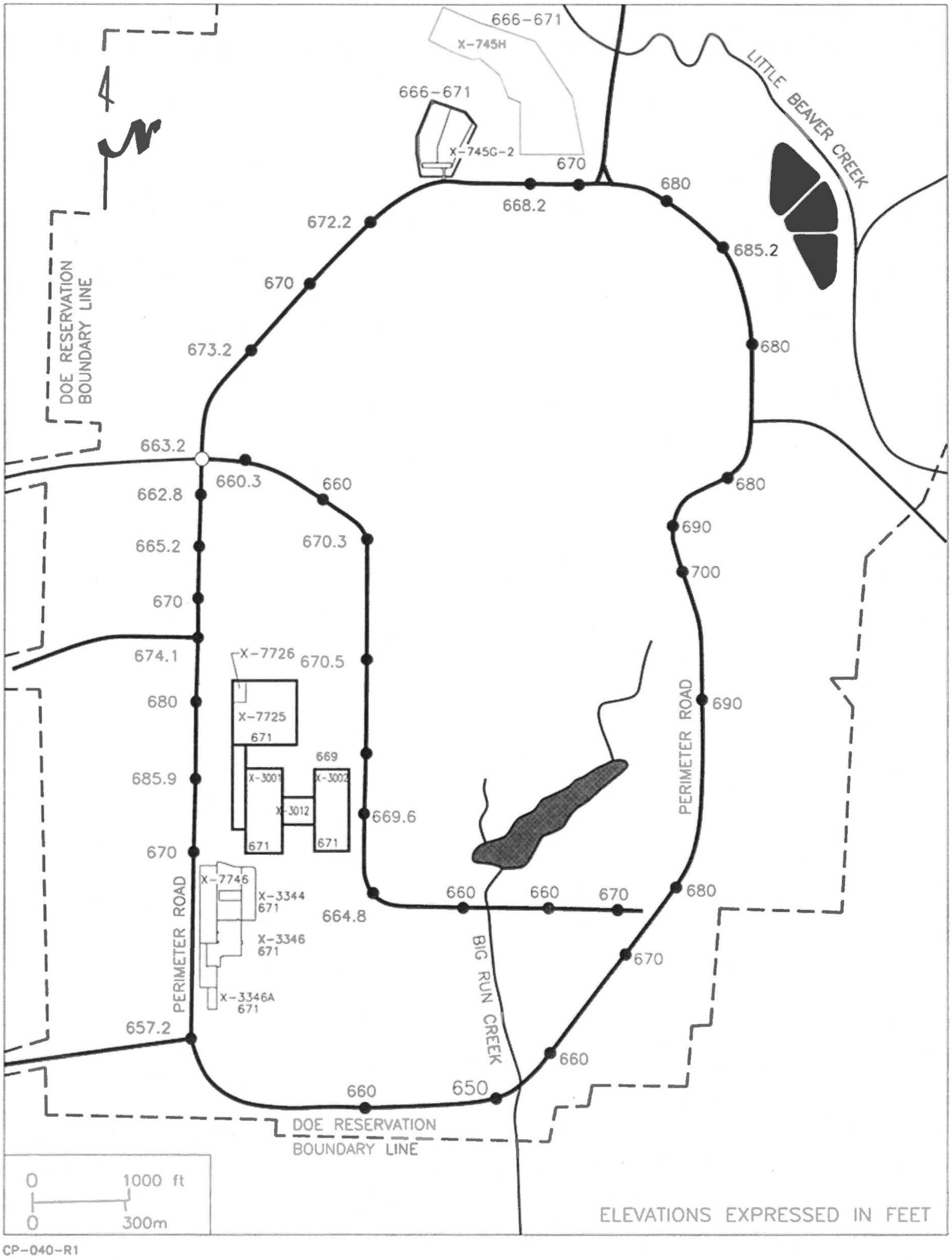


Figure 1.3-9 Elevations of Roadways and of the Surrounding Areas of Main Process Buildings

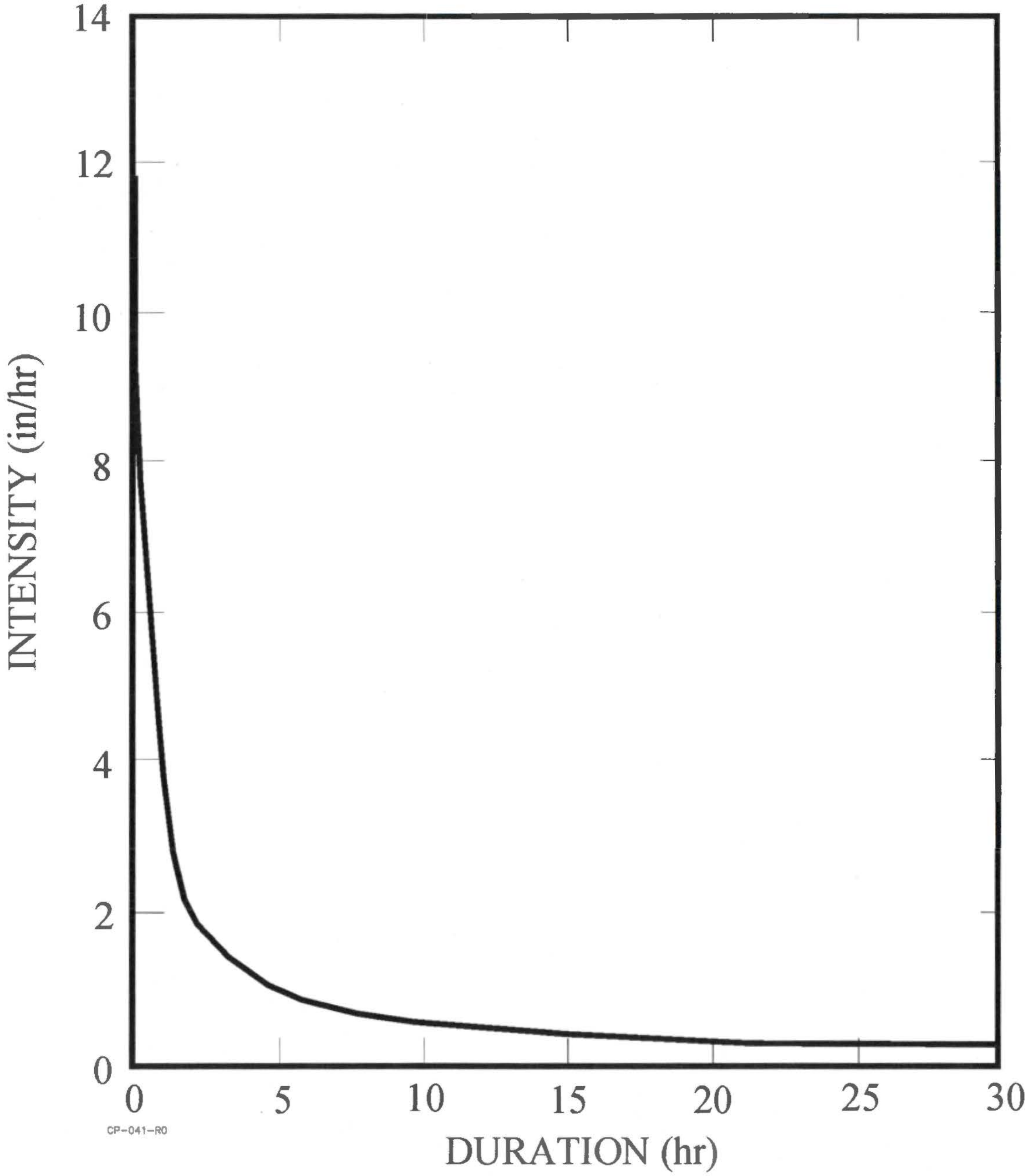


Figure 1.3-10 The 10,000-year Intensity Versus Duration Graph for Storms at U.S. Department of Energy Reservation

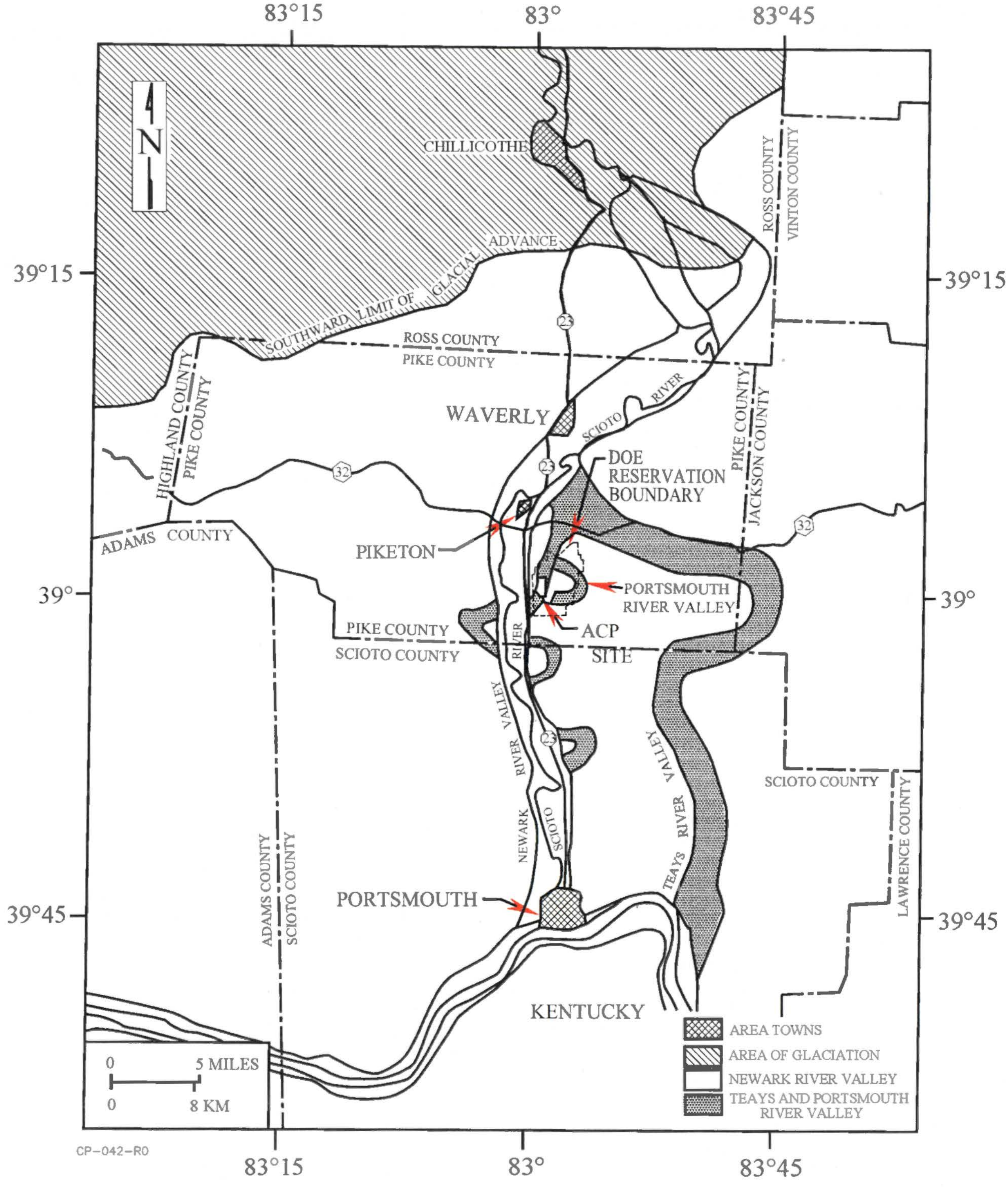


Figure 1.3-11 Location of the Ancient Newark (Modern Scioto) and Teays Valleys in the U.S. Department of Energy Reservation Vicinity

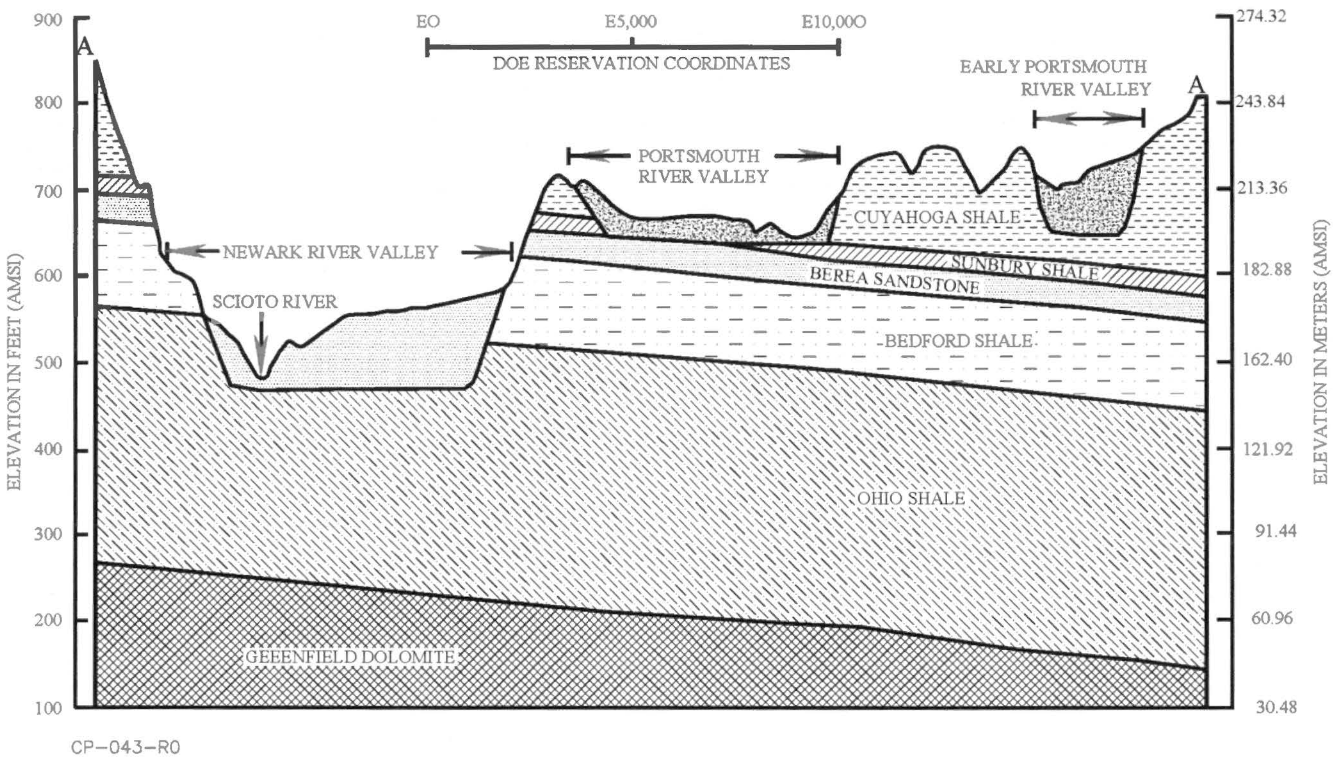


Figure 1.3-12 Geologic Cross Section in the U.S. Department of Energy Reservation Vicinity

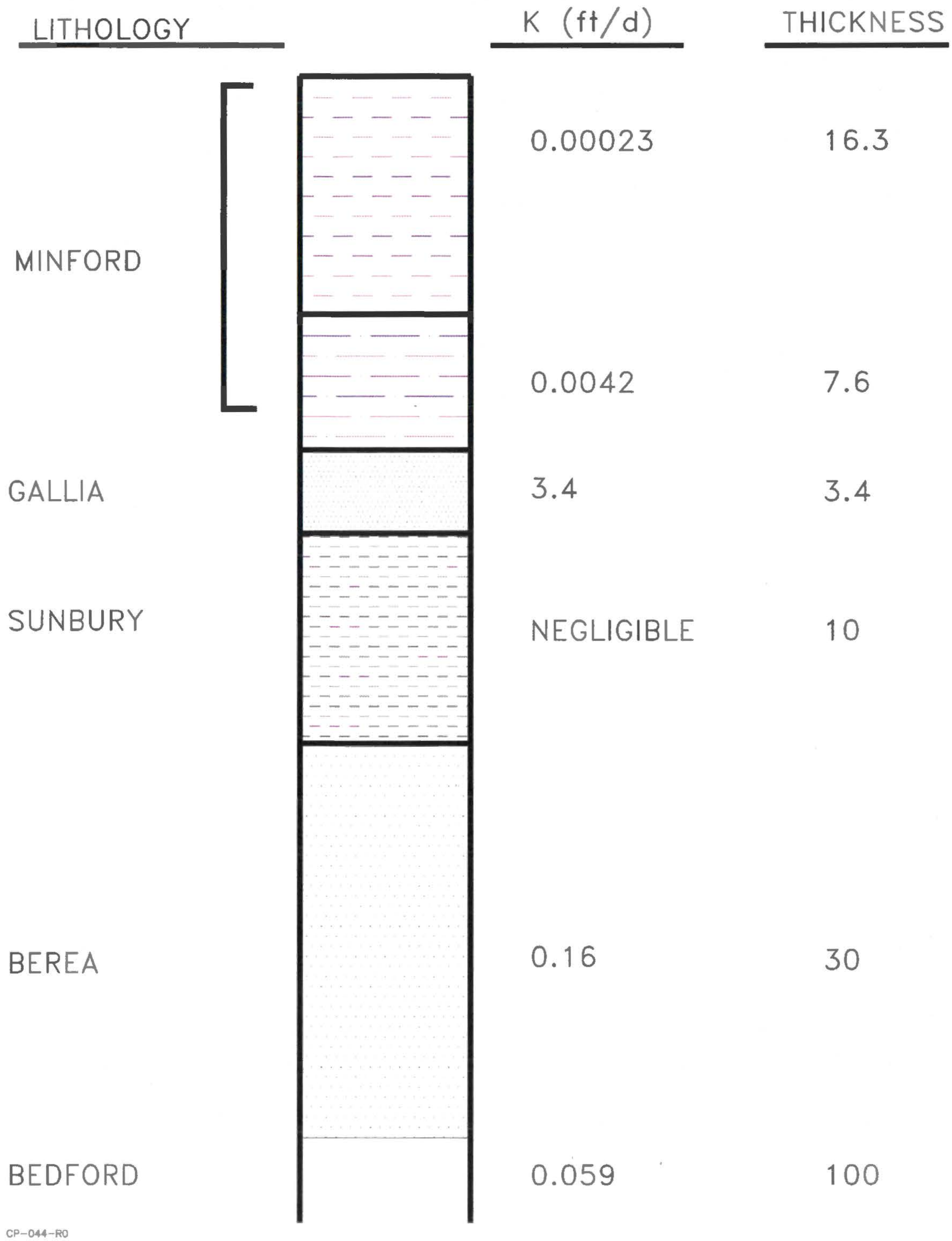


Figure 1.3-13 Geologic Column at the U.S. Department of Energy Reservation

1.4 Application Codes and~~,~~ Standards~~, and Regulatory Guidance~~

The ACP utilizes a number of the facilities that were originally constructed to support the GCEP and the GDP. The buildings/facilities were designed and constructed according to DOE requirements and/or nationally accepted codes and standards applicable at the time. Many of those codes and standards were earlier versions of current codes and standards that are utilized today for new construction. The codes and standards of record will be verified and documented during the ACP design verification process discussed in Section 11.1.6 of this license application. Any deviations from the codes and standards of record will be evaluated and documented in accordance with the Configuration Management Program as described in Section 11.1 of this license application. New buildings/facilities/processes will meet the codes and standards applicable at the time the facility is designed and constructed as stated in plant design criteria. Modifications to existing buildings and/or facilities will be evaluated to determine if there is a safety benefit from applying current codes and standards and justification will be documented if current codes and standards are not applied.

The following sub-sections list the various industry codes~~,~~ and standards~~, and regulatory guidance documents~~ that have been referenced in this license application. The extent to which the Licensee satisfies the requirements of each code or ~~,~~ standard~~, and guidance document~~ is identified individually in the sub-sections. In the context of this section, the terms provisions and guidance are intended to refer only to the explicit requirements of each code or standard.

To establish definitive guidance for the design of the ~~American Centrifuge Plant~~ACP, the Licensee~~USEC~~ proposed that the license be conditioned as follows:

> The Licensee will obtain prior NRC review and approval before deleting or modifying the commitment to any code or standard contained in Section 1.4 of the License Application.

The current design of the ~~American Centrifuge Plant~~ACP does not include any items relied on for safety (IROFS) that use software, firmware, microcode, Programmable Logic Controllers, and/or any digital device, including hardware devices that implement data communication protocols. ~~Should this design change, the Licensee will obtain prior NRC approval for the applicable guidance and standards.~~

1.4.1 American National Standards Institute/American Nuclear Society

- ANSI/ANS 3.1-1987, *Selection, Qualification, and Training of Personnel for Nuclear Power Plants*

  The Licensee utilizes the provisions contained in 4.3.3, 4.4.5, and 4.5.3.2 of this standard to develop qualifications of radiation protection personnel.

  For the reference to this standard, see Section 4.5.4 of this license application.

- ANSI/ANS 3.2-1994, *Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants*

  The Licensee utilizes the provisions contained in Appendix A.6, paragraph (a) of this standard.

  For the reference to this standard, see Section 11.4.2.1 of this license application.

- ~~ANSI/ANS-8~~.1-~~1998~~2014, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*

  The Licensee satisfies the guidance of this standard with the following exceptions/clarification:

  Section 4.1.6 - Operations are reviewed annually; however, personnel in the operating group who are knowledgeable of the NCS requirements for their operations perform this review. Personnel who are knowledgeable in NCS and are independent of operations (e.g., Engineering) provide assistance in these annual reviews. Personnel who are knowledgeable in NCS and are independent of operations (e.g., Engineering) review operations annually.

  For references to this standard, see Sections 5.4.1, 5.4.2, 5.4.5.1, and 5.4.5.2 of this license application.

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

  The Licensee satisfies the provision of this standard as modified by Regulatory Guide 3.71 with the following exceptions/clarifications:

  Section 1.2.5 – The primary radiation alarm system is the Criticality Accident Alarm System designed to detect a nuclear criticality and provide annunciation using audible alarms that are supplemented by ~~and~~ visual alarms in some locations (e.g., in high-noise areas) that will alert personnel to evacuate the immediate area. ACP primary facilities that handle ^{235}U in quantities greater than 700g have Criticality Accident Alarm System coverage except the UF_6 cylinder storage yards.

  For reference to this standard, see Sections 5.4.1, 5.4.4, and 8.1.1 of this license application; Section 2.2.4 of the Emergency Plan for the American Centrifuge Plant; and Section 3.10.6 of the ISA Summary for the ACP.

- ANSI/ANS-8.19-~~1996~~2014, *Administrative Practices for Nuclear Criticality Safety*

  The Licensee satisfies the provisions of this standard with the following exceptions/clarification:

  Section ~~7.8~~8.6 - Operations are reviewed annually; however, personnel in the operating group who are knowledgeable of the NCS requirements for their operations perform this review. Personnel who are knowledgeable in NCS and are independent of operations (e.g., Engineering) provide assistance in these annual reviews. Personnel who are knowledgeable in NCS and are independent of operations (e.g., Engineering) review operations ~~biannually~~ biennially (every two years).

For references to this standard, see Sections 5.4.1 and 11.3.1.8 of this license application.

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

  The Licensee satisfies the provisions of this standard.

  For references to this standard, see Sections 5.4.1, 11.3.1.1.2, 11.3.1.4, and 11.3.1.8 of this license application.

- ANSI/ANS-8.21-1995, *American National Standard for Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors*

  The Licensee satisfies the provisions of this standard.

  For references to this standard, see Section 5.4.1 and 5.4.5 of this license application.

- ANSI/ANS-8.23-~~1997~~2007, *Nuclear Criticality Accident Emergency Planning and Response*

  The Licensee satisfies the provisions of this standard as modified by Regulatory Guide 3.71. Section 4.1(9) of the standard requires provision for nuclear accident dosimeters meeting ANSI N13.3-1969 (Reaffirmed 1981), "Dosimetry for Criticality Accidents." A clarification is that nuclear accident dosimeters may be used that do not necessarily comply with ANSI N13.3-1969 (R1981).

  For references to this standard, see Section 5.4.1, 5.4.4, and 8.1.1 of this license application and Section 2.2.4 of the Emergency Plan for the American Centrifuge Plant.

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

  The Licensee satisfies of this standard as modified by Regulatory Guide 3.71.

  For references to this standard, see Sections 5.4.1 and 5.4.5.2 of this license application.

1.4.2 American National Standards Institute

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

  The Licensee utilizes the provisions contained in Sections 4, 5, 6, and 7 of this standard for determining radiation protection exposure records.

For the reference to this standard, see Section 4.8.5 of this license application.

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

  The Licensee satisfies the provisions of this standard, except for Sections 4.6 and 5.1(3).3.

  For the reference to this standard, see Section 4.8.4 of this license application.

- ANSI N14.1-20~~01~~12, *Nuclear Materials - Uranium Hexafluoride - Packaging for Transport*

  The Licensee satisfies the provisions of this standard, except for portions superseded by Federal Regulations with the following exceptions/clarifications:

  A. Cylinders, ~~/~~Valves, and Plugs: Cylinders, ~~and~~ valves, and plugs ~~that are already owned and operated by the United States Enrichment Corporation GDP's and were not~~ are manufactured or purchased to ~~this~~ ANSI N14.1-2012.~~01 specifications, but were manufactured to~~Previously procured and manufactured cylinders, valves, and plugs that meet previous ~~committed~~ versions of the ANSI standards or specifications in effect at the time of manufacture may be used. ~~only satisfy ANSI N14. 1-2001 Sections 4, 5, 6.2.2 to 6.3.5, 7 and 8.~~ Alternatively, existing cylinders, valves, and plugs manufactured to previous version of the ANSI standards or specifications may be modified to meet ANSI N14.1-2012 at some point in the lifecycle due to potential issues or constraints that prohibit continued compliance with standard or specification in effect at the time of manufacture. Only cylinders, valves, and plugs of models still authorized by ANSI N14.1-2012 for manufacture may be accepted for this modification. Cylinders of this type may be subsequently transferred to the ACP.

  ~~B. Tinning: ANSI N14.1-2001 requires that cylinder valve and plug threads be tinned with solder alloys meeting the requirements of ASTM B32 with a minimum tin content of 45% such as alloy SN50. ANSI N14.1-1995 and prior editions required the use of ASTM B32 50A, a 50/50 tin/lead solder alloy described in the1976 and previous editions of the ASTM standard. Some cylinder valve and plug threads that were purchased to meet the 1990 or the 1995 edition of the standards were tinned using a method that is conservative with respect to the 2001 edition of the ANSI standard (minimum tin content of 46% versus 45%) rather than meeting the 1990 or 1995 editions of the standard. Cylinders with these type of plugs may be subsequently transferred to the ACP.~~

  ~~C. Cylinder Valve Protectors (CVPs): For 48X, 48Y, and 48G cylinders; ANSI N14.1-2001 requires the CVPs to be fabricated from weldable carbon steel with a minimum tensile strength of 45,000 lbs/in^2 and a maximum carbon content of 0.26%, such as ASTM A-36 steel. The 1990 standard required these devices to be fabricated from ASTM A285 Grade C or A516 steel. Likewise, set screws were~~

~~manufactured to specific requirements for each CVP. ANSI N14.1-2001 Addendum 1 allows an alternate cylinder valve protector design. Cylinders in use at the GDP's and subsequently transferred to the ACP may meet the CVP design allowed by ANSI N14.1-1990 or either of the CVP designs allowed by ANSI N14.1-2001. Alternately, the CVPs for any of these cylinders in use at the GDP's may be steel, similar in design to those specified in ANSI N14.1-1990 and 2001, and meets the intent of this standard. Set screws that are employed in these CVPs are also steel and were manufactured in accordance with the ANSI N14.1-1990 or 2001 designs, a derivative of this design, or a grade 5 bolt. Cylinders with these types of CVPs may be subsequently transferred to the ACP.~~

~~D~~B. Cylinder Plugs: Use of steel or aluminum-bronze plugs in UF_6 cylinders was~~is~~ acceptable at the United States Enrichment Corporation GDP's for the following operations: heating, feeding, sampling, filling, transferring between cylinders, and onsite transport and storage. Therefore, these cylinders with these types of plugs may be subsequently transferred to the ACP.

~~E.~~C.~~48HX Cylinders: None of the model 48HX cylinders in use by the United States Enrichment Corporation GDP's were manufactured to ANSI N14.1-2001 standard and this model of cylinder is no longer in production. However, the 2001 edition of this standard mistakenly lists the minimum volume for this cylinder as 139 ft3 and the maximum fill limit at 26,840 pounds. Previous editions of the standard list the minimum volume for this cylinder type as 140 ft3 and the maximum fill weight as 27,030 pounds. Model 48HX cylinders in use at the GDP's comply with the volume requirements and fill limits listed in the 1990/1995 editions of ANSI N14.1 standard and may be subsequently transferred to the ACP.~~

For the reference to this standard, see ~~the~~ Section~~s~~ 1.1.5.5.5 of this license application; ~~2.2.3.5.1, 2.2.4.5, 2.2.5.5.1, 2.2.10.5, and 2.2.12.5~~ Sections 2.2.3 (including subsections), 3.5.5, 3.6.4.1, and 3.7.4 (including subsections) of the ISA Summary for the ACP; and Sections 7.3.4.4, 7.3.6.4.3.1, 7.3.6.7.1.1, and 7.3.6.7.3.1, Appendix E of Addendum 1 of the ISA Summary.

1.4.3 American National Standards Institute/American Society of Mechanical Engineers

- ANSI/ASME NQA-1-2008~~1994~~ and NQA-1a-2009 Addenda, *Quality Assurance Requirements for Nuclear Facility Applications*

  The Licensee satisfies the provisions of this standard as stated below, with clarification stated in the QAPD:

  A. The Licensee satisfies the definitions, as stated in ~~the Introduction of Part I of~~ ASME NQA-1-2008~~1994~~ with NQA-1a-2009 addenda, Part I, Introduction, Section 400 *Terms and Definitions*.

  B. Indoctrination and training satisfies the provisions of ASME NQA-1-2008, Part I, Requirement 2, Section 200 *Indoctrination and Training* and Section 500 *Records*.

~~Supplement 2S-4, "Supplementary Requirements for Personnel Indoctrination and Training" of Part 1 of ASME NQA-1-1994.~~

C. ~~Quality Control p~~Personnel performing inspection and testing, as well as QA audit personnel, meet the requirements of ASME ~~satisfies the provisions of~~ NQA-1-2008, Part I, Requirement 2, Section 300 *Qualification Requirements* and Section 400 *Records of Qualification.* ~~Supplement 2S-1, "Supplementary Requirements for the Qualification of Inspection and Test Personnel" of Part 1 of ASME NQA-1-1994.~~

D. ~~QA audit personnel satisfy the provisions of Supplement 2S-3, "Supplementary Requirements for the Qualification of Quality Assurance Program Audit Personnel" of Part 1 of ASME NQA-1-1994.~~

~~E.~~ Design outputs that consist of computer programs are developed, validated, and managed in accordance with ASME NQA-1-2008~~1994~~ with the NQA-1a-2009 addenda, Part I, ~~Part II, Subpart 2.7,~~ Basic Requirement 11 *Test Control* and Part II, Subpart 2.7 *Quality Assurance Requirements for Company Software for Nuclear Facility Applications*.

E~~F~~. Methods of design verification satisfy the provisions of ~~Supplement 3S-1 of~~ ASME NQA-1-2008~~1994~~, Part I, Requirement 3, Section 501 *Methods*.

~~G~~F. Computer Program Testing is performed in accordance with ASME NQA-1-2008 with the NQA-1a-2009 addenda, Part I, ~~-1994, Basic~~ Requirement 11, ~~"~~*Test Control*~~,"~~ ~~and Supplement 11S-2, "Supplementary Requirements for Computer Program Testing."~~

G. Lifetime records are defined in accordance with ASME NQA-1-2008, Part I, Requirement 17, Section 401 *Lifetime Records.* ~~1994, Supplement 17S-1, "Supplementary Requirements for Quality Assurance Records," Section 2.7.1.~~

~~I~~H. Hard copy or microfilm storage facilities satisfies the guidance of ASME NQA-1-2008~~1994~~, Part I, Requirement 17, Section 600 *Storage.* ~~Supplement 17S-1, "Supplementary Requirements for Quality Assurance Records," Section 4.4.~~

For the references to this standard, see Section 11.5.1 of this license application and Sections 2.0, 3.0, and 11.0 of the QAPD for the ACP.

1.4.4 American Society of Mechanical Engineers

- ASME Boiler and Pressure Vessel Code Section VIII, *Pressure Vessels*, 2004

  Autoclaves providing containment to minimize the potential for release of licensed material are designed, constructed, and installed in accordance with this standard.

For the references to this standard, see Sections 3.6.4.1 and 7.3.4.16 of the ISA Summary.

- ASME B31.3, *Process Piping*, 2018~~2004~~

  Piping providing containment to minimize the potential for release of licensed material is designed, constructed, and installed in accordance with this standard.

  For the references to this standard, see Sections 3.6.2.3, 3.6.2.4.1, and 3.6.2.5~~, and 7.3.4.13~~ of the ISA Summary.

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

  New and existing fixed HEPA filter systems needed to ensure compliance with release limits or to control worker radiation exposure satisfy the provisions of this standard with the following exceptions/clarifications:

  Section 5.2 - Do not satisfy; No credit is taken for absorbers

  Section 5.5 - Do not satisfy requirements for air heaters

  Section 8.0 - Quality assurance requirements for applicable systems are identified in the QAPD

  Appendix A - Do not sample adsorbents

  Appendix B - Do not use allowable leakage guidance

  Appendix C – This appendix is used as guidance only

  Appendix D - The manifold qualification program uses this appendix as guidance only

For the reference to this standard, see Section 4.6.1 of this license application and Section 3.8.2.2 and 3.16 of the ISA Summary for the ACP.

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

  New and existing fixed HEPA filter systems that satisfy the requirements of ASME N509 and are needed to ensure compliance with release limits or to control worker radiation exposure satisfy the provisions of this standard with the following exceptions/clarifications:

  Section 6.0 - Only satisfy this section for new seal-welded duct systems or for connections to a system where this section has been previously applied

  Section 7.0 - Do not use guidance for monitoring frame pressure leak tests

Existing fixed HEPA filter systems that do not satisfy the requirements of ASME N509 are tested using the requirements of this standard or another industry accepted standard as guidance only

For the reference to this standard, see Section 4.6.1 of this license application.

1.4.5 American Society for Testing and Materials

- ASTM C787, *Standard Specification for Uranium Hexafluoride for Enrichment*, 2015~~2003~~

  The Licensee will satisfy the provisions of this standard. All other uranium that does not meet the requirements of ASTM - C787 for reprocessed UF_6 may be accepted for storage and subsequent dispositioning, but will not be introduced to the enrichment process, with the exception of small amounts (e.g., 50 pounds UF_6) associated with sampling, sub-sampling, and analyses required to establish receiver's values.

  For the reference to this standard, see Tables 1.2-1 and 1.2-2 of this license application.

- ASTM C996, *Standard Specification for Uranium Hexafluoride Enriched to Less than 5 Percent U-235*, 2015~~2004~~

  The Licensee will satisfy the provisions of this standard. All other uranium that does not meet the requirements of ASTM – C996 for reprocessed UF_6 may be accepted for storage and subsequent dispositioning, but will not be introduced to the enrichment process, with the exception of small amounts (e.g., 50 pounds UF_6) associated with sampling, sub-sampling, and analyses required to establish receiver's values.

  For the reference to this standard, see Tables 1.2-1 and 1.2-2 of this license application.

- ASTM C1052, *Standard Practice for Bulk Sampling of Liquid Uranium Hexafluoride*, ~~2001~~2014

  The Licensee will satisfy the provisions of this standard.

  For the reference to this standard, see Section 1.1.5.5.5 of this license application and Section 3.5.5 of the ISA Summary.

1.4.6 National Fire Protection Association

- NFPA 10-2018~~2002~~, *Standard for Portable Fire Extinguishers*

  The Licensee satisfies the provisions of this standard with the following exceptions/clarification:

> The provisions of this standard were used as guidance in determining the size, selection, and distribution of portable fire extinguishers. The Licensee will satisfy the provisions of this standard for modifications to the facility except as documented and justified by the Authority Having Jurisdiction (AHJ).

For references to this standard, see Section 7.4.3 and Table 7.1-1 of this license application.

- NFPA 13-~~2002~~2019, *Standard for the Installation of Sprinkler Systems*

  The Licensee satisfies the provisions of this standard with the following exceptions/clarification:

  > Existing suppression systems are maintained in accordance with the applicable codes and standards enforced at the time of construction and installation. The provisions of the~~is~~ standard in place at the time of construction and installation were used as guidance for the design and installation of wet and dry pipe automatic sprinkler systems. In addition, ACP facilities meet the definition of Ordinary Hazard Occupancies (Group 1) as stated in this standard and the fire protection systems meet or exceed the sprinkler discharge requirements for this type of occupancy. The Licensee will satisfy the provisions of this standard for modifications to the facility except as documented and justified by the AHJ.

  For the reference to this standard, see Section 7.3.1 and Table 7.1-1 of this license application and Section 3.10.3 of the ISAS for the ACP.

- NFPA 15-~~2001~~2017, *Standard for Water Spray Fixed Systems for Fire Protection*

  The Licensee will satisfy the provisions of this standard for modifications to the facility except as documented and justified by the AHJ.

  For the reference to this standard, see Section 7.3.1 and Table 7.1-1 of this license application.

- NFPA 25-2002~~2004~~, *Standard for Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*

  The Licensee will satisfy the provisions of this standard except as documented and justified by the AHJ.

  For the reference to this standard, see Section 7.1.2 and Table 7.1-1 of this license application and Sections 2.2.6 and 3.8.1.1 of the ISA Summary for the ACP.

- NFPA 30-2018~~2003~~, *Flammable and Combustible Liquids Code*

The Licensee satisfies the requirements of this standard with the following exceptions/clarification:

Above ground storage tanks were installed using the provisions of this standard for guidance only. The Licensee will satisfy the provisions of this standard for modifications to the facility except as documented and justified by the AHJ.

For references to this standard, see Section 7.3 and Table 7.1-1 of this license application.

- NFPA 51B-2019~~2003~~, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*

  The Licensee uses the provisions of this standard as guidance for the review of hot work permitting.

  For the reference to this standard, see Section 7.1.1, 7.1.2, and Table 7.1-1 of this license application.

- NFPA 55-2020~~2005~~, *Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks*

  The Licensee uses the provisions of this standard as guidance for the use of compressed gases.

  For the reference to this standard, see Section 7.1.1, 7.3, and Table 7.1-1 of this license application.

- NFPA 70-2005, *National Electrical Code*

  This NFPA standard was used as guidance for the installation of the electrical systems.

  For the reference to this standard, see Section 7.3 and Table 7.1-1 of this license application and Section 2.6.7 of the ISA Summary for the ACP.

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

  This NFPA standard was used as guidance for the installation of the fire alarm systems.

  For the reference to this standard, see Section 7.3.2 and Table 7.1-1 of this license application.

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

This NFPA standard was used as guidance for the protection of the computer systems.

For the reference to this standard, see ~~Section 7.0, Table 7.1-1~~Chapter 7 of this license application.

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

  The Licensee will satisfy the provisions of this standard except as documented and justified by the AHJ.

  For the reference to this standard, see ~~Section 7.0, Table 7.1-1~~ Chapter 7 of this license application.

- NFPA 101-2018~~2003~~, *Life Safety Code*

  The Licensee uses the provisions of this standard as guidance for the review of emergency egress paths.

  For the reference to this standard, see ~~Section 7.3~~Chapter 7 of this license application.

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

  The Licensee uses the provisions of this standard as guidance for the review of building construction.

  For the reference to this standard, see ~~Section 7.0~~ Table 7.1-1 of this license application.

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

  ~~The Licensee satisfies the provisions of this standard with the following exceptions/clarification:~~

  ~~As described in Section 11.7.1.8 of the licensing application, there are several acceptable methods for the storage of permanent records. 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 AHJ.~~

  ~~For the reference to this standard, see Section 11.7.1.8 of this license application.~~

- NFPA 241-2019~~2000~~, *Standard Safeguarding Construction, Alteration, and Demolition Operations*

  The Licensee uses the provisions of this standard as guidance for the review of construction activities.

  For the reference to this standard, see Section 7.1.1 and Table 7.1-1 of this license application.

- NFPA 801-2020~~2003~~, *Standard for Fire Protection for Facilities Handling Radioactive Materials*

The Licensee will utilize this standard for any future modifications to the fire protection program as stated in Section 7.1.1 of this license application.

For the reference to this standard, see Section ~~7.1.1~~7.0 and Table 7.1-1 of this license application.

1.4.7 Section Reserved For Future Use
~~**Nuclear Regulatory Commission Guidance**~~

~~Regulatory Guide 1.59, Revision 2, *Design Basis Floods for Nuclear Power Plants*~~

~~The Licensee satisfies the provisions of this Regulatory Guide (RG) to the extent applicable to a Part 70 licensee.~~

~~For references to this standard, see Sections 1.3.4.3 and 1.3.4.3.2 of this license application.~~

~~Regulatory Guide 3.67, Revision 0, *Standard Format and Content for Emergency Plans for Fuel Cycle and Materials Facilities*~~

~~The Licensee utilized the provisions of this RG as guidance for DOE reservation Emergency Plan.~~

~~For references to this RG, see Sections 8.1 and 8.2 of this license application~~

~~Regulatory Guide 3.71, Revision 0, *Nuclear Criticality Safety Standards for Fuels and Material Facilities*~~

~~This RG endorses ANSI/ANS-8 standards. The Licensee commits to ANSI/ANS-8.1-1983, ANSI/ANS-8.3-1997, ANSI/ANS-8.19-1996, and ANSI/ANS-8.20-1991 as described above.~~

~~For the reference to this RG, see Section 5.5 of this license application.~~

~~Regulatory Guide 5.15, Revision 1, *Tamper-Indicating Seals for the Protection and Control of Special Nuclear Material.*~~
~~The Licensee satisfies the provisions of this RG.~~

~~For the reference to this RG, see Section 3.3.4 of Security Program for the American Centrifuge Plant.~~

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

~~The Licensee satisfies the provisions of this RG.~~

~~For the reference to this RG, see Section 4.1.1 of this license application.~~

~~Regulatory Guide 8.25, Revision 1, *Air Sampling in the Workplace*~~

The Licensee satisfies the provisions contained in Sections 1, 2, 5, and 6 of this RG.

For the reference to this RG, see Section 4.7.5 of this license application.

Regulatory Guide 8.34, *Monitoring Criteria and Methods to Calculate Occupational Radiation Doses*

The Licensee satisfies the provisions contained in Section 7 of this RG.

For the reference to this RG, see Section 4.7.3 of this license application.

Regulatory Guide 1.109, Revision 1, *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50, Appendix I*

The Licensee satisfies the provisions of this RG to the extent applicable to Part 70 licensee.

For references to this RG, see Sections 9.2.2.1.2 and 9.2.2.2.2 of this license application.

- NUREG-1065, *Acceptable Standard Format and Content for the Fundamental Nuclear Material Control Plan Required for Low Enriched Uranium Facilities*

This NUREG was used for general reference purposes in structuring the FNMCP for the ACP.

For references to this NUREG, see Section 15.0 of the FNMCP for the ACP.

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

This NUREG was used as a general reference and guidance document during the development of the ISA and ISA Summary.

For references to this NUREG, see Sections 3.1.2, 3.2, 3.3, 5.5, 6.4, 7.2.2, 7.6, 8.2, 9.2.3, and 9.4 of this license application.

- NUREG-1520, *Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility*, March 2002

This NUREG was used as a general reference and guidance document during the development of the license application. This license application follows the format and guidelines of the NUREG.

For references to this NUREG, see Sections 1.0, 1.4, 3.2, 5.5, 6.4, 7.6, 8.2, 9.2.3, 9.4, 10.11, and 11.9 of this license application.

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

~~This NUREG was used as a general reference and guidance document during the development of the license application.~~

~~For the references to this NUREG, see Section 6.14 of this license application.~~

- ~~NUREG-1748, *Environmental Review Guidance for Licensing Actions Associated with NMSS Programs*~~

~~This NUREG was used as a general reference and guidance document during the development of the license application.~~

~~For the references to this NUREG, see the Environmental Report for the ACP.~~

- ~~NUREG-1757, *Consolidated NMSS Decommissioning Guidance, Volumes 1, 2, and 3, Final Report, September 2003*~~

~~This NUREG was used as a general reference and guidance document during the development of the decommissioning section of the license application.~~
~~For the references to this NUREG, see Section 10.10.1 of this license application.~~

- ~~NUREG/BR-0006, *Instructions for Completing Nuclear Material Transaction Reports*~~

~~This NUREG describes the requirements for reporting nuclear material transactions to the national database. 10 CFR 74.15 requires that instructions in this NUREG be followed.~~

~~The Licensee satisfies the provision of this NUREG.~~

~~For the reference to completion of Nuclear Material Transaction Reports, see Section 10 of the FNMCP for the ACP.~~

- ~~NUREG/BR-0007, *Instructions for the Preparation and Distribution of Material Status Reports*~~

~~This NUREG describes the requirements for submitting material status reports to the national database. 10 CFR 74.13 requires that instructions in this NUREG be followed.~~

~~The Licensee satisfies the provisions of this NUREG to the extent possible for uranium enrichment facilities.~~

~~For the reference to this NUREG, see Section 8.7 of the FNMCP for the ACP.~~

- ~~NUREG/BR-0096, *Instruction and Guidance for Completing Physical Inventory Summary Reports, NRC Form 327*~~

~~This NUREG provides line-by-line instructions for preparing NRC Form 327, Special Nuclear Material and Source Material Physical Inventory Summary Reports.~~

~~The Licensee satisfies the provisions of this NUREG.~~

~~For the reference to this NUREG, see Section 12.4 of the FNMCP for the ACP.~~

- ~~NUREG/CR-4604, *Statistical Methods for Nuclear Material Management*~~

~~This NUREG contains techniques and formulas used to estimate random and systematic error variances associated with nuclear material measurement methods.~~

~~For the reference to this NUREG, see Section 9.1.1 of the FNMCP for the ACP.~~

- ~~NUREG/CR-5734, *Standard Format and Content for the Fundamental Nuclear Material Control Plan Required for Low Enriched Uranium Enrichment Facilities*~~

~~This NUREG is used to establish the Detection Quantity for evaluation of nuclear material inventory differences.~~

~~For the reference to this NUREG, see Section 9.4 of the FNMCP for the ACP.~~

- ~~NUREG/CR-6410, *Nuclear Fuel Cycle Facility Accident Analysis Handbook*~~

~~Portions of this NUREG were used as a general reference and guidance document in the development of the accident analyses in the ISA.~~

~~For the reference to this NUREG, see Section 3.3 of the ISA Summary for the ACP.~~

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

~~This NUREG was used as a general reference and guidance document in the development of the validation report supporting Nuclear Criticality Safety evaluations performed to support the accident analyses in the ISA and will be used as such for future validations.~~

~~For the reference to this NUREG, see Section 5.4.5.2 of this license application and Section 3.3 of the ISA Summary.~~

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

~~The Licensee has reviewed the information contained in this Information Notice.~~

~~For the reference to this IN, see Section 6.4 of this license application.~~

1.4.8 Institute of Electrical and Electronics Engineers

Several of the Institute of Electrical and Electronics Engineers (IEEE) standards identified in this section include the term "Class 1E." The Licensee is taking exception to utilizing the term "Class 1E." The term utilized by the Licensee for items relied on for safety, per 10 CFR Part 70, is "IROFS." IROFS quality levels (i.e., QL-1 or QL-2) are established and defined in Section 2.0 of the QAPD. The IROFS, including their quality class, are based on the analyzed, credible conditions identified in the ISA. IROFS (and non-IROFS that may directly affect the safety function of an IROFS) will be designed, procured, maintained and documented in accordance with the requirements of the "Configuration Management Program" included in Chapter 11.0 of this license application.

- ANSI/IEEE 336-2010~~1985~~, *ANSI/IEEE Standard Installation, Inspection, and Testing Requirements for Power, Instrumentation, and Control Equipment at Nuclear Facilities*

  The Licensee commits to periodic inspections and testing of items relied on for safety will be in accordance with Clause 7.

  For the reference to this standard see Sections 2.6.4 and 2.6.8 of the ISA Summary for the ACP.

- IEEE 338-1987 *Standard Criteria for the Periodic Surveillance Testing of Nuclear Power Generating Station Safety Systems*

  The Licensee commits to utilizing IEEE 338 Sections 1 (Scope), 2 (Definitions), 4 (Basis), and 5 (Design Requirements); and portions of Sections 3 (References) and 6 (Testing Program Requirements).

  The Licensee takes exception to portions of the contents of IEEE 338 Sections 3 and 6 and Annex A for the following reasons:

  Section 3 — The ACP operations procedures will govern plant operations in lieu of ANSI/ANS 3.2-1982.

  Section 3 — In Section 3 (References) the Licensee commits to only the applicable portions of the IEEE Standards 7-4.3.2 and IEEE 603.

  Section 6.1 (11) The ACP operations procedures will govern plant operations in lieu of ANSI/ANS 3.2-1982.

  Note - Annex A provides only "informative" references.

  For the reference to this standard see Sections 2.6.4 and 2.6.7 of the ISA Summary for the ACP.

- IEEE 7-4.3.2-2003~~1993~~, *Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations*

  The Licensee commits to utilizing IEEE 7-4.3.2 Clauses 1 (Scope), 3 (Definitions) and 7 (Execute Features) and portions of Clauses 5 (Safety System Criteria), 6 (Sense and Command Features), and 8 (Power Source Requirements).

  The Licensee takes exception to IEEE 7-4.3.2 Clauses 2 (References), 4 (Safety System Design Basis), and Annexes A through H. These areas are not considered to be applicable or necessary due to their nuclear reactor content and redundancy with other IEEE standards and the Licensee's ISA. Annexes A through H provide only "informative" details and references. The Licensee also takes exception to the contents of IEEE 7-4.3.2 Clause 5 for the following reasons:

  Sections 5.3 and 5.3.1 — The Licensee commits to ASME NQA-1-2008~~1994~~ with NQA-1a-2009 addenda Part I~~I~~, ~~Subpart 2.7, Basic~~ Requirement 11 and Part II, Subpart 2.7 as defined in Section 1.4.3 of this license application.

  Section 5.3.2 — The Licensee does not intend to qualify existing commercial computers.

  Section 5.15 — Reliability analysis methods and calculations are as specified in the ISA for the ACP.

  For the reference to this standard see Section 2.6.4 of the ISA Summary for the ACP.

- IEEE 308-2001, *Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations*

  The Licensee commits to utilizing IEEE 308 Section 3 (Definitions) and portions of Sections 1 (Overview), 4 (Principle Design Criteria), 5 (Supplemental Design Criteria), 6 (Surveillance and Test Requirements), and 8 (Documentation).

  The Licensee takes exception to IEEE 308 Sections 2 (References), and portions of Sections 1 (Overview), 4 (Principle Design Criteria), 5 (Supplemental Design Criteria), 6 (Surveillance and Test Requirements), and 8 (Documentation) for the following reasons:

  Section 1 — Figure 1 is not applicable to the ACP. The Licensee will provide reliable electrical power to all IROFS that require electrical power to function during postulated events analyzed in the ISA. Back-up power is required only as needed to provide the reliability of the IROFS as credited in the ISA. Note that IROFS that fail safe on loss of power do not require back-up power systems.

  Section 2 — The ACP does not commit to all of the standards listed in this section.

Section 4.2 Figure 3 is not applicable to the ACP. The Licensee will provide reliable electrical power to all IROFS that require electrical power to function during postulated events analyzed in the ISA. Back-up power is required only as needed to provide the reliability of the IROFS as credited in the ISA. Note that IROFS that fail safe on loss of power do not require back-up power systems.

Section 4.7 Documents will be identified and controlled in accordance with Sections 6.0 and 17.0 of the QAPD and plant procedures.

Sections 4.10 and 5.2.1 These Sections are not applicable to the ACP as written and are modified as follows: A back-up power supply may be utilized to provide reliable power to an IROFS that requires electrical power to function during postulated events analyzed in the ISA. The power circuits from the back-up power supply to the IROFS will be independent and redundant if necessary to provide the reliability of the IROFS as credited in the ISA. The control circuits from the control room to the IROFS will also be independent and redundant if necessary to provide the reliability of the IROFS as credited in the ISA.

Section 4.11 A non-IROFS load that needs reliable standby power may be connected to an IROFS power system in accordance with portions of Figure 3 and IEEE 384.

Sections 5.2.4 and 5.3.1 These Sections are not applicable to the ACP. The ACP will follow applicable portions of IEEE 446 for guidance related to standby power supplies and DC power systems.

Section 5.3.3.6Battery systems for IROFS that are not failsafe will be tested in accordance with approved ACP maintenance procedures.

Section 6.1 The "illustrative" continuous monitoring surveillance methods listed in Table 3 are optional (i.e., surveillance monitoring by a computer is not mandatory).

Section 7 This section does not apply to a uranium enrichment facility.

Section 8.1 The ACP does not commit to performing the studies listed as Items a through g; applicable studies will be conducted and documented to demonstrate the adequacy of IROFS and associated support systems.

The ACP electrical IROFS systems will utilize commercial-grade equipment approved or rated by nationally-recognized industry standards and reputable organizations such as IEEE, Underwriters Laboratory Inc. (UL), Factory Mutual (FM), NFPA, and

National Electrical Manufacturers Association (NEMA). Procurement and installation will be in accordance with the QAPD.

For the reference to this standard see Sections 2.6.4 and 2.6.7 of the ISA Summary for the ACP.

- IEEE 323-2003, *Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations*

  The Licensee commits to IEEE 323 Clauses 1 (Scope), 3 (Definitions), 4 (Principles), and 7 (Documentation).

  The Licensee takes exception to IEEE 323 Clause 2 (References), 5 (Methods), 6 (Program), and Annex A. Annex A provides only "informative" references (37), whereas, only certain portions of two IEEE standards (7-4.3.2 and 603) listed in Clause 2 (References) are applicable to the ACP.

  For the reference to this standard see Sections 2.6.4 and 2.6.7 of the ISA Summary for the ACP.

  Per Section 4.1, "For equipment located in a mild environment for meeting its functional requirements during normal environmental conditions and anticipated operational occurrences, the requirements shall be specified in the design/purchase specifications. A qualified life is not required for equipment located in a mild environment and which has no significant aging mechanisms." For purposes of the ACP, the equipment will be located in a mild environment in which no significant radiation exposure or aging mechanisms are identified or expected. The accident conditions anticipated at the ACP are mild in nature. The worst conditions are due to fire scenarios which can produce high temperature, subsequent water spray exposure from the fire suppression system, and exposure to UF_6 due to a release.

  Therefore, the Licensee will not classify any equipment as Class 1E in accordance with Sections 5 and 6, but will include the other applicable requirements identified in the IEEE standards, i.e., design control (additional design package rigor, equipment specifications, critical design characteristics, QC inspection criteria, vendor testing requirements, special equipment storage and handling requirements), quality control, post maintenance testing, preventive maintenance/testing, surveillances and documentation control/retention.

  The primary equipment that is required to fulfill the IROFS function, including necessary support system components back to the point of redundancy, is considered to be part of the IROFS boundary. All IROFS boundary components will be designed, installed and maintained to the applicable IEEE requirements identified and committed to above and in accordance with the QAPD. In addition to meeting the above requirements, the ACP electrical IROFS systems will utilize commercial-grade equipment approved or rated by nationally recognized industry standards and reputable organizations such as IEEE, UL, FM, NFPA, and NEMA.

- IEEE 379-2000, *Standard Application of the Single-Failure Criterion to Nuclear Power Generating Station Safety Systems*

  The Licensee commits to utilizing IEEE 379 Sections 1 (Overview), 3 (Definitions), 5 (Requirements), and 6 (Design Analysis), and portions of Section 4 (Single-Failure Criterion). Applicable portions of IEEE 379 will be used as a guideline for the design of IROFS systems since this standard supplements IEEE 603 by providing guidance in the application of the single-failure criterion for safety systems in nuclear power stations.

  The Licensee takes exception to the contents of IEEE 379 Sections 2 and 4 and Annex A. The exceptions that the Licensee takes to the contents of IEEE 379 are:

  Section 2 — The ACP does not commit to all of the standards listed in this section.

  Section 4 — These Sections are not applicable to the ACP as written and are modified as follows: a back-up power system may be utilized to provide reliable power to an IROFS that requires electrical power to function during postulated events analyzed in the ISA. The power circuits from the back-up power system to the IROFS will be independent and redundant if necessary to provide the reliability of the IROFS as credited in the ISA. The control circuits from the control room to the IROFS will also be independent and redundant if necessary to provide the reliability of the IROFS as credited in the ISA.

  Annex A provides only "informative" references.

  For the reference to this standard see Sections 2.6.4 and 2.6.7 of the ISA Summary for the ACP.

- IEEE 384-1992, *Standard Criteria for Independence of Class 1E Equipment and Circuits*

  The Licensee commits to utilizing IEEE 384 Clauses 1 (Scope), 2 (Purpose), 4 (Definitions), 5 (Independence Criteria), 6 (Separation Criteria), and 7 (Specific Isolation Criteria). Applicable portions of IEEE 384 will be used as a guideline for the design of IROFS systems since this standard supplements IEEE 603 by providing guidance criteria for implementation of the independence requirements for Class 1E systems.

  The Licensee takes exception to the contents of IEEE 384 Clause 3 and Annex A. The Licensee does not commit to all the standards listed in Clause 3. Annex A provides only "informative" references.

  The ACP electrical IROFS systems will utilize commercial-grade equipment approved or rated by nationally recognized industry standards and reputable organizations such as IEEE, UL, FM, NFPA, and NEMA. Procurement and installation will be in accordance with the QAPD.

For the reference to this standard see Sections 2.6.4 and 2.6.7 of the ISA Summary for the ACP.

- IEEE 446-1995, *Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications*

  The Licensee commits to utilizing IEEE 446 Clauses 1 (Scope) and 2 (Definitions) and portions of Clauses 6 (Protection), 7 (Grounding), 8 (Maintenance), and 10 (Reliability).

  The Licensee takes exception to the contents of IEEE 446 Clauses 3, 4, 5, and 9. These clauses are not considered to be applicable or necessary due to their content and/or redundancy with other IEEE standards and NFPA 70 *National Electrical Code*. In addition, the Licensee takes exception to portions of IEEE 446 Clauses 6, 7, 8, and 10 for the following reasons:

  Section 6.11 The Licensee does not commit to all of the standards listed in this section.

  Section 7.14 The Licensee does not commit to all of the standards listed in this section.

  Section 8.1.3 Maintenance personnel will receive training on-site, not at the manufacturer's location. It is anticipated that ACP supervisory personnel will receive factory training and then develop an on-site training program to be utilized for on-site training of ACP maintenance personnel; additional on-site training provided by the manufacturer may be an option if deemed appropriate.

  Section 8.4.3.a) 1) Battery charging system inspections are anticipated to be monthly in accordance with Table 8-1, not weekly.

  Section 8.4.3.a) 2) The diesel-generator (D-G) system testing will not consist of full-load, weekly testing. A plant procedure for periodic testing of the D-G set will be developed in accordance with existing plant D-G testing practices based upon nearly 50 years operating experience and the D-G manufacturer's recommendations.

  Section 8.5.2 Daily inspections of uninterruptible power supply (UPS) systems will not be required; inspections are anticipated to be monthly in accordance with Section 8.5.2.b.

Section 8.5.2.a) The listed UPS "weekly inspection" items are anticipated to be monthly and included in the routine inspections listed in Section 8.5.2.b).

Section 8.6.1 A battery system maintenance procedure will be developed in accordance with existing plant battery system practices based upon nearly 50 years operating experience and the battery system manufacturer's recommendations. It is anticipated that general battery system inspections will be performed monthly in accordance with Table 8-1.

Section 8.9 The Licensee does not commit to all of the standards listed in this section.

Sections 10.4 a.) thru c.) The UPS final factory testing steps will be based upon the capacity (size) of the system, the precise type of batteries, the system configuration, and the intended function of the installed system.

Section 10.9 The Licensee does not commit to all of the standards listed in this section.

For the reference to this standard see Sections 2.6.4 and 2.6.7 of the ISA Summary for the ACP.

- *IEEE* 484-2002, *IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications*

  The Licensee will satisfy the provisions of this standard.

  For the reference to this standard see Section 3.8.9 of the ISA Summary for the ACP.

- IEEE 603-1998, *Standard Criteria for Safety Systems for Nuclear Power Generating Stations*

  The Licensee commits to utilizing IEEE 603 Clauses 1 (Scope), 3 (Definitions) and 7 (Execute Features) and portions of Clauses 5 (Safety System Criteria), 6 (Sense and Command Features), and 8 (Power Source Requirements).

  The Licensee takes exception to the contents of IEEE 603 Clauses 2 (References), 4 (Safety System Design Basis), and Annexes A, B, and C. These clauses are not considered to be applicable or necessary due to their nuclear reactor content and redundancy with other IEEE standards and the Licensee's ISA. Annexes A, B, and C provide only "informative" details and references. In addition, the Licensee takes exception to portions of contents in IEEE 603 Clauses 5, 6, and 8 for the following reasons:

Sections 5 and 5.1: Single-failure criterion will be applied only where needed to provide the reliability of the IROFS credited in the ISA.

Sections 5.3 and 5.3.1: The Licensee commits to ASME NQA-1-2008~~1994~~ with addenda Part II, ~~Subpart 2.7, Basic~~ Requirement 11 and Part II, Subpart 2.7 as defined in Section 1.4.3 of this license application.

Section 5.4: Qualification - Use and qualification of equipment is specified in the Licensee's IEEE 323 commitment above.

Sections 5.6.1 and 5.6.2: The Licensee's goal is to design any safety system that might not survive all design basis events such that it is electrically failsafe (i.e., does not require electrical power to perform its intended safety function).

Section 5.15: Reliability analysis methods and calculations are as specified in the ACP ISA. The ACP condition notice system will be monitored and evaluated.

Section 6.2: Manual control requirements may not be applicable to all IROFS; the need will be evaluated during the final design phase.

Section 8.1: Safety systems that are failsafe upon loss of electrical power will not require redundant power sources.

For the reference to this standard see Sections 2.6.4 and 2.6.10 of the ISA Summary for the ACP.

- IEEE 1023-2004, *IEEE Recommended Practice for the Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations and Other Nuclear Facilities*

  The Licensee will satisfy the provisions of this standard.

  For the reference to this standard see Section 2.6 of the ISA Summary for the ACP.

- IEEE 1050-1996, *Guide for Instrumentation and Control Equipment Grounding in Generating Stations*

  The Licensee commits to utilizing IEEE 1050 Clauses 1 (Overview), 3 (Definitions), 4 (Design), 5 (System Grounding), 6 (Shield Grounding), and 7 (Testing).

  The Licensee takes exception to the contents of IEEE 1050 Clause 2 and Annexes A and B. The Licensee does not commit to all of the standards listed in Clause 2. Annexes A and B provide only "informative" references.

For the reference to this standard see Section 2.6.4 of the ISA Summary for the ACP.

1.4.9 Other Various Codes and~~,~~ Standards~~, and Guidance~~

- ASCE 7-2002, *Minimum Design Loads for Buildings and Other Structures*

  The Licensee will satisfy the provisions of this standard.

  For the reference to this standard, see Sections 1.3.3.1 and 1.3.3.3 of this License Application.

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

  ~~The data contained in Tables 2-1 and 2-2 of this document used to calculate dose conversion factors for radionuclides of concern. This data is also used to calculate the Derived Air Concentrations (DACs) listed in Table 4.7-4.~~

  ~~For the reference to this guidance document, see Section 4.7.4 of this license application.~~

- ~~American Society for Nondestructive Testing Recommended Practice No. SNT-TC-1A, June 1980 Edition~~

  ~~The Licensee satisfies the provisions of this recommended practice.~~

  ~~For the reference to this recommended practice, see Section 2.0 of the QAPD for the ACP.~~

- ~~IAEA Safeguards Technical Manual, Part F, Volume 3~~

  ~~The method used to establish sample sizes for item monitoring activities was obtained from this manual.~~

  ~~For the reference to this recommended practice, see Section 7.4 of the FNMCP for the ACP.~~

- ANSI/ISA 67.04.01-2018~~2000~~ *Setpoints for Nuclear Safety-Related Instrumentation*

  The IROFS related setpoints are determined utilizing methodologies in accordance with this standard. The Licensee commits to utilizing ISA 67.04.01 Clause 1 (Purpose), 2 (Scope), 3 (Definitions), 4 (Establishment of Setpoints), 5 (Documentation), and 6 Maintenance of Safety-Related Setpoints).

The Licensee takes exceptions to the contents of ISA 67.04.01 Clauses 7 (References) and 8 (Informative References). The Licensee does not commit to all the standards listed in Clauses 7 and 8.

For the reference to this standard see Section 2.6.10 of the ISA Summary for the ACP.

1.5 License Application Regulatory Guidance Documents

The following sub-sections lists the various regulatory guidance documents that have been referenced in this license application. The extent to which the Licensee satisfies each guidance document is identified individually in the sub-sections.

1.5.1 U.S. Nuclear Regulatory Commission Guidance

- Regulatory Guide 1.59, Revision 2, *Design Basis Floods for Nuclear Power Plants*

  The Licensee satisfies the provisions of this Regulatory Guide (RG) to the extent applicable to a Part 70 licensee.

  For references to this RG, see Sections 1.3.4.3 and 1.3.4.3.2 of this license application.

- Regulatory Guide 3.67, Revision 0, *Standard Format and Content for Emergency Plans for Fuel Cycle and Materials Facilities*

  The Licensee utilized the provisions of this RG as guidance for DOE reservation Emergency Plan.

  For references to this RG, see Section 8.0 of this license application. This RG currently does not apply under the HALEU Demonstration Program.

- Regulatory Guide 3.71, Revision 3, *Nuclear Criticality Safety Standards for Nuclear Materials Outside Reactor Core*

  This RG endorses ANSI/ANS-8 standards. The Licensee commits to ANSI/ANS-8.1-2014, ANSI/ANS-8.3-1997, ANSI/ANS-8.19-2014, and ANSI/ANS-8.20-1991 as described above.

  For the reference to this RG, see Section 5.5 of this license application and Section 3.10.6 of the ISA Summary for the ACP.

- Regulatory Guide 5.80, Revision 0, *Pressure-Sensitive and Tamper-Indicating Device Seals for Material Control and Accounting of Special Nuclear Material.*

  The Licensee satisfies the provisions of this RG.

For the reference to this RG, see Section 3.3.4 of Security Program for the American Centrifuge Plant.

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

  The Licensee satisfies the provisions of this RG.

  For the reference to this RG, see Section 4.7.3 of this license application.

- Regulatory Guide 8.25, Revision 1, *Air Sampling in the Workplace*

  The Licensee satisfies the provisions contained in Sections 1, 2, 5, and 6 of this RG.

  For the reference to this RG, see Section 4.7.5 of this license application.

- Regulatory Guide 8.34, Revision 0, *Monitoring Criteria and Methods to Calculate Occupational Radiation Doses*

  The Licensee satisfies the provisions contained in Section 7 of this RG.

  For the reference to this RG, see Section 4.7.3 of this license application.

- Regulatory Guide 1.109, Revision 1, *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50, Appendix I*

  The Licensee satisfies the provisions of this RG to the extent applicable to Part 70 licensee.

  For references to this RG, see Sections 9.2.2.1.2 and 9.2.2.2.2 of this license application.

- NUREG-1065, *Acceptable Standard Format and Content for the Fundamental Nuclear Material Control Plan Required for Low Enriched Uranium Facilities*

  This NUREG was used for general reference purposes in structuring the FNMCP for the ACP. This NUREG currently does not apply under the HALEU Demonstration Program.

  For references to this NUREG, see Section 15.0 of the FNMCP for the ACP.

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

  This NUREG was used as a general reference and guidance document during the development of the ISA and ISA Summary.

For references to this NUREG, see Sections 3.1.2, 3.2, 3.3, 5.5, 6.4, 7.2.2, 7.6, 8.2, 9.2.3, and 9.4 of this license application.

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

  This NUREG was used as a general reference and guidance document during the development of the license application. This license application follows the format and structure of the NUREG.

  For references to this NUREG, see Sections 1.0, 1.4, 3.2, 5.5, 6.4, 7.6, 8.2, 9.2.3, 9.4, 10.11, and 11.9 of this license application.

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

  This NUREG was used as a general reference and guidance document during the development of the license application.

  For the references to this NUREG, see Section 6.14 of this license application.

- NUREG-1748, *Environmental Review Guidance for Licensing Actions Associated with NMSS Programs*

  This NUREG was used as a general reference and guidance document during the development of the license application.

  For the references to this NUREG, see the Environmental Report for the ACP.

- NUREG-1757, *Consolidated NMSS Decommissioning Guidance, Volumes 1, 2, and 3, Final Report~~, September 2003~~.*

  This NUREG was used as a general reference and guidance document during the development of the decommissioning section of the license application.

  For the references to this NUREG, see Section 10.10.1 of this license application.

- NUREG/BR-0006, *Instructions for Completing Nuclear Material Transaction Reports*

  This NUREG describes the requirements for reporting nuclear material transactions to the national database. 10 CFR 74.15 requires that instructions in this NUREG be followed.

  The Licensee satisfies the provision of this NUREG.

  For the reference to completion of Nuclear Material Transaction Reports, see Section 10 of the FNMCP for the ACP.

- NUREG/BR-0007, *Instructions for the Preparation and Distribution of Material Status Reports*

  This NUREG describes the requirements for submitting material status reports to the national database. 10 CFR 74.13 requires that instructions in this NUREG be followed.

  The Licensee satisfies the provisions of this NUREG to the extent possible for uranium enrichment facilities.

  For the reference to this NUREG, see Section 8.7 of the FNMCP for the ACP.

- NUREG/BR-0096, *Instruction and Guidance for Completing Physical Inventory Summary Reports, NRC Form 327*

  This NUREG provides line-by-line instructions for preparing NRC Form 327, Special Nuclear Material and Source Material Physical Inventory Summary Reports.

  The Licensee satisfies the provisions of this NUREG.

  For the reference to this NUREG, see Section 12.4 of the FNMCP for the ACP.

- NUREG/CR-4604, *Statistical Methods for Nuclear Material Management*

  This NUREG contains techniques and formulas used to estimate random and systematic error variances associated with nuclear material measurement methods.

  For the reference to this NUREG, see Section 9.1.1 of the FNMCP for the ACP.

- NUREG/CR-5734, *Standard Format and Content for the Fundamental Nuclear Material Control Plan Required for Low Enriched Uranium Enrichment Facilities*

  This NUREG is used to establish the Detection Quantity for evaluation of nuclear material inventory differences.

  For the reference to this NUREG, see Section 9.4 of the FNMCP for the ACP.

- NUREG/CR-6410, *Nuclear Fuel Cycle Facility Accident Analysis Handbook*

  Portions of this NUREG were used as a general reference and guidance document in the development of the accident analyses in the ISA.

  For the reference to this NUREG, see Section 3.1.2.3.2.2.5.1 of this license application and Section 3.3 of the ISA Summary for the ACP.

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

  The Licensee has reviewed the information contained in this Information Notice.

  For the reference to this IN, see Section 6.4 of this license application.

1.5.2 Other Various Guidance Documents

- American Society for Nondestructive Testing Recommended Practice No. SNT-TC-1A, June 1980 Edition

  The Licensee satisfies the provisions of this recommended practice.

  For the reference to this recommended practice, see Section 2.0 of the QAPD for the ACP.

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

  The data contained in Tables 2-1 and 2-2 of this document used to calculate dose conversion factors for radionuclides of concern. This data is also used to calculate the Derived Air Concentrations (DACs) listed in Table 4.7-4.

  For the reference to this guidance document, see Section 4.7.4 of this license application.

- IAEA Safeguards Technical Manual, Part F, Volume 3

  The method used to establish sample sizes for item monitoring activities was obtained from this manual.

  For the reference to this recommended practice, see Section 7.4 of the FNMCP for the ACP.

1.~~6~~5 References

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2.0 ORGANIZATION AND ADMINISTRATION

The Licensee is committed to conducting operations at the American Centrifuge Plant (ACP) in a manner that protects the health and safety of workers and the public; protects the environment; and provides for the common defense and security. In order to meet these objectives, as well as others required for operation of the ACP, the Licensee maintains the following operations policy with respect to environmental, health, nuclear safety, safeguards, security, and quality to guide the day-to-day business activities of, and provide direction to, ACP personnel.

> The Licensee is responsible for safe operation of the ACP and is committed to conducting operations in a manner that protects the health and safety of workers and the public; protects the environment; provides for the common defense and security; and is in compliance with applicable local, state, and federal laws and regulations.

The Licensee has provided the management structure to ensure that this policy is effectively implemented and is responsible for the safe operation of the ACP. Programs are established for the environmental, health, safety, safeguards, security, and quality areas and are provided with sufficient resources to support safe operation of the ACP. Contracted resources are utilized in a number of these programmatic areas to provide day-to-day functional support. Arrangements (i.e., through reverse work authorizations) are in place to provide the necessary support.

The Licensee is responsible for the design, quality assurance (QA), refurbishment/construction, manufacturing, testing, start-up, operation, maintenance, and future decommissioning of the ACP. Preparation of some refurbishment/construction documents and portions of the refurbishment/construction activities are contracted to qualified contractors. The Licensee staffs the ACP with qualified individuals to ensure a smooth transition from refurbishment/construction activities to plant operations.

Managerial positions that have the principal responsibilities important to environmental, health, safety, safeguards, security, and quality for the ACP are described in this chapter. Their qualifications, responsibilities, and authorities are clearly defined in position descriptions that are accessible to affected personnel and the U.S. Nuclear Regulatory Commission (NRC) upon request.

Section 2.1 describes the organizational commitments, relationships, responsibilities, and authorities for the overall management system to assure the protection of the health and safety of the workers and the public; protection of the environment; and provide for the common defense and security from design through refurbishment/construction, start-up, operation, and future decommissioning. Each manager has stop work authority for activities under their area of responsibility and if such authority is exercised, they must also concur with restart of those shutdown operations. If QA personnel exercises stop work authority, the Senior Vice President, Field Operations must concur with restart.

Section 2.2 describes the management controls for maintaining the environmental, health, safety, safeguards, and quality programs and the administrative systems to control relationships and interfaces between the programs.

Section 2.3 describes the plans and management controls for pre-operational testing and initial start-up of the ACP.

2.1 Organizational Commitments, Relationships, Responsibilities, and Authorities

The American Centrifuge management structure provides for line responsibility for safe operations with sufficient staff support to develop, communicate, and implement technical programs for various environmental, health, safety, safeguards, security, and quality areas. Figure 2.1-1 depicts the American Centrifuge organization.

Various day-to-day functional support for carrying out the requirements of the environmental, safety, health, and safeguards programs, and security ~~programs~~ plans may be provided by contractors (i.e., through reverse work authorizations), along with administrative services required to support overall facility operations. American Centrifuge management maintain overall decision-making authority and responsibility for oversight of the major functional support areas that may be provided by contractors. Contractors may also provide the necessary utilities (e.g., electricity, cooling water, potable water, and sanitary sewage) to support operations.

Minimum qualifications, functions, and responsibilities for key staff positions are described below. The personnel responsible for managing the design, refurbishment/construction, manufacturing, operation, and future decommissioning of the plant have the substantive breadth and level of experience to successfully execute their responsibilities. These key staff positions are available as necessary to provide timely support in their respective functional area. Alternates are designated in writing and in accordance with procedural requirements to fulfill the responsibilities and authorities of these personnel during their absence. Alternates will meet the minimum qualification for the corresponding position.

Throughout this section, equivalent technical experience means the substitution of two years of nuclear industry experience for each year of college up to a total of three years. Additionally, 30-semester hours or 45-quarter hours from an accredited college or university may be substituted for the remaining one year of baccalaureate education. Individuals who do not meet the formal educational requirements specified in this section or do not meet the equivalent technical experience defined above are not automatically eliminated where other factors provide sufficient demonstration of their abilities to fulfill the duties of a specific position. These other factors must clearly demonstrate proficiency in the technical area for which the position will be responsible (e.g., a license or certification, documented completion of relevant training, or previous experience in the same position at another plant). These factors are evaluated on a case-by-case basis, documented, and approved by the appropriate Director or General Manager.

2.1.1 Senior Vice President, Field Operations

The Senior Vice President, Field Operations reports to the President and Chief Executive Officer and has overall responsibility for the safe operation and the deployment of American Centrifuge Project(s), including facility design; process equipment procurement; machine design; testing, and manufacturing; enrichment plant refurbishment/construction; testing of facilities; and turn-over to operations. The Senior Vice President provides strategic leadership and direction for the enrichment operations organization, including the functions of operations; maintenance; project support; engineering; system(s) testing; transportation; procurement; materials handling and storage; industrial, radiological, and nuclear safety; and future decommissioning. The individual also has overall responsibility for the development and implementation of conduct of operations for the ACP and associated plans, programs, and management measures as defined by the regulatory requirements. The Senior Vice President is responsible for the QA program and for determining the status, adequacy, and effectiveness of the Quality Assurance Program Description (QAPD).

The General Manager; Director, Quality Assurance; Director, Engineering, Procurement, and Construction (EPC); Director, Nuclear Safety; and Director, Engineering report to the Senior Vice President and manage the activities in their areas of responsibility.

The Senior Vice President has, as a minimum, a bachelor's degree in engineering or the physical sciences or equivalent technical experience, six years nuclear experience, and ten years of management experience, which may be concurrent with the nuclear experience.

2.1.2 General Manager

The General Manager reports to the Senior Vice President, Field Operations. The General Manager is responsible for the day-to-day safe operation of the plant, including direction of operation and maintenance of the ACP; overall responsibility for the Plant Safety Review Committee (PSRC), Nuclear Safety, and Radiological Protection program for keeping exposures and contamination below regulatory limits and as low as reasonably achievable; compliance with applicable NRC regulatory requirements; and adherence to applicable policies and procedures. The General Manager also oversees activities of line management organizations that support ACP operations, as applicable. The General Manager is the primary interface with NRC inspection personnel on matters of regulatory compliance within his/her scope of responsibility and may delegate responsibility for this day-to-day interface to the Regulatory Manager.

The Regulatory Manager, Business Services Manager, Operations Manager, and Production Support Manager report directly to the General Manager and manage the activities in their area of responsibility. Additionally, the Piketon Quality Assurance Manager; Industrial Safety Manager; Director, EPC; Director, Nuclear Safety; Piketon Engineering Manager have matrixed responsibilities directly to the General Manager in support of ~~Piketon~~ safe operations at Piketon ACP facilities.

The General Manager has, as a minimum, a bachelor's degree in engineering or the physical sciences or equivalent technical experience, six years of nuclear experience, and six years of management experience, which may be concurrent with the nuclear experience.

2.1.2.1 Regulatory Manager

The Regulatory Manager reports to the General Manager and is responsible for regulatory oversight functions and commitment management. The Regulatory Manager, as delegated by the Senior Vice President and General Manager, maintains the day-to-day interface with NRC representatives on matters of regulatory compliance. This manager has responsibility for maintaining the ~~plant change~~change evaluation process and ensuring the ~~plant change~~change evaluation reporting requirements are met. The Regulatory Manager is also responsible for implementing the Corrective Action Program; ensuring incident investigations are performed and providing management with data to assure that corrective actions and commitments are properly addressed and managed to facilitate compliance with the implementing policies and procedures.

The Regulatory Manager is also responsible for the Nuclear Materials Control and Accountability (NMC&A) program that is independent from operations.

The Regulatory Manager has, as a minimum, a bachelor's degree in engineering or the physical sciences or equivalent technical experience, and four years of nuclear experience.

2.1.2.1.1 Nuclear Materials Control and Accountability Manager ~~[commercial operations only]~~

The NMC&A Manager reports to the Regulatory Manager and has programmatic responsibility ~~is responsible~~ for ~~ensuring that an effective~~the NMC&A program, ~~is implemented.~~ ensuring regulatory requirements are met on a day-to-day basis. This manager is independent from production, plant operating cost, and production schedule concerns. This manager has direct access to the General Manager for resolution of concerns dealing with the NMC&A Program.

The NMC&A Manager has, as a minimum, a bachelor's degree in engineering or a technical field or equivalent technical experience, and ~~four years~~ experience in nuclear materials safeguards.

2.1.2.2 Business Services Manager

The Business Services Manager reports to the General Manager and has matrixed responsibilities for procurement; packaging, transportation, and materials management; finance; and information technology in support of the American Centrifuge Project(s).

The Business Services Manager has, as a minimum, a bachelor's degree in business or the physical sciences or equivalent technical experience, and four years of nuclear experience.

2.1.2.2.1 Procurement Manager

The Procurement Manager reports to the Director, Engineering, Procurement and ~~Contracts~~ Construction and is responsible for providing support services to the Business Services Manager for procurement and providing procurement material control services (including supplier qualification coordination, purchasing, contracting). This manager is also responsible for supply strategy and development of qualified long-lead-time and complex-system suppliers.

The Procurement Manager has, as a minimum, a bachelor's degree in business or physical sciences or equivalent technical experience, and four years of nuclear experience.

2.1.2.2.2 Packaging, Transportation, and Materials Management Manager

The Packaging, Transportation, and Materials Management Manager reports to the Director, Engineering, Procurement and ~~Contracts~~ Construction and is responsible for providing support services to the Business Services Manager for packaging and transportation of classified matter and radioactive material.

The Packaging, Transportation, and Materials Management has, as a minimum, a bachelor's degree in business or physical sciences or equivalent technical experience, and four years of nuclear experience.

2.1.2.3 Operations Manager

The Operations Manager reports to the General Manager and is responsible for fissile material operations, centrifuge operations, and shift operations. This manager is responsible for directing activities of the Cascade / Recycle and Assembly Operations Shift Supervisors in operation of the cascade, feed and withdrawal, and gas test, as well as the Maintenance Work Center Supervisor for maintenance and operations of the plant equipment, utilities processes, and facilities. This includes centrifuge assembly, drying, transportation, and installation in the cascade; safe operation of the uranium hexafluoride (UF_6) processes in accordance with approved procedures; proper receipt, storage, handling, and onsite transportation of UF_6; execution of the Integrated Systems and Test Plans (ISTPs), initial start-up, and operation of the centrifuges ~~machines~~, equipment, and support systems. Other activities include select repair of centrifuges ~~machines~~; maintenance; classified equipment control; accountable property inventory, segregation, and disposition; contractor support; integrated planning and scheduling; caretaker activities; materials management support; and future decommissioning and disposal activities, ensuring ~~all~~ activities are performed in accordance with approved programs, processes, and procedures.

The Operations Manager has, as a minimum, a bachelor's degree in engineering or the physical sciences or equivalent technical experience, and four years of nuclear experience~~, including six months at a uranium processing plant~~.

2.1.2.3.1 Integrated Systems Test and Start-up Manager

The Integrated Systems Test/Start-up Manager reports to the Operations Manager and is responsible for assisting 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. This manager is also responsible for the acceptance of turnover from the EPC or from contractors/vendors to the Licensee; initial acceptance testing; and initial start-up of equipment and support systems.

The Integrated Systems Test/Start-up Manager has, as a minimum, a bachelor's degree in engineering or the physical sciences or equivalent technical experience, and four years of nuclear experience.

2.1.2.3.2 Process Area Managers [commercial operations only]

Process Area Managers report to the Operations Manager and are responsible for directing activities of the Cascade, Recycle and Assembly, and Balance of Plant (BOP) Operations Shift Supervisors in operation of the cascade, feed and withdrawal, gas test, and plant utilities processes and facilities. This includes, activities such as ensuring the safe operation of the UF_6 processes, proper receipt, storage, handling, and on-site transportation of UF_6; machine installation and pump down; integrated system testing; provide oversight in the areas of BOP Operations and Facility Surveillances; and future Construction Work In Process (CWIP)~~/Legacy~~ Waste Disposition; and Classified Equipment Control and Centrifuge Disposition.

These Process Area Managers are responsible for the plant utilities operations, process and facility surveillances; CWIP and ~~legacy~~ waste disposition, classified equipment control, centrifuge

~~machine~~ storage, transport, disassembly, and disposition; UF_6 cylinder storage, handling, transportation, and disposition; shift operations; accountable property assessment, inventory, and segregation; and caretaker operations. The Process Area Managers are also responsible for directing the activities of the Cascade / Recycle and Assembly Operations Shift Supervisors to accomplish these objectives and includes activities such as ensuring the safe operation of the plant utilities operations and the future disassembly, decommissioning, and disposition of materials.

The Process Area Managers have, as a minimum, a high school diploma or satisfactory completion of the General Educational Development test, and three years of industrial/chemical/nuclear plant operations, maintenance, engineering, or support experience.

2.1.2.3.3 Cascade / Recycle and Assembly Operations Shift Supervisors

Cascade / Recycle and Assembly Operations Shift Supervisors report to the Operations Manager and are responsible for directing the operation of systems within the facilities necessary to support facility operation within approved programs, processes, and procedures. The Cascade / Recycle and Assembly Operations Shift Supervisors authorize the restart of equipment that has been shut down in a routine fashion when the prerequisites and limitations of the associated operating procedure are met. The Cascade / Recycle and Assembly Operations Shift Supervisors are responsible for providing operational support of centrifuge ~~machine~~ assembly, transport, installation, pump down, integrated system testing, start-up, operation, disassembly, and select repair. The Cascade / Recycle and Assembly Operations Shift Supervisors also direct the operation of systems with the facilities, necessary to support the operation and future decommissioning activities.

As the senior manager on shift (one per shift), the Cascade / Recycle and Assembly Operations Shift Supervisor represents the General Manager and has the authority and responsibility to make decisions, as necessary, to ensure safe operations. These supervisors are responsible for accumulation and dissemination of information regarding American Centrifuge activities to the Incident Commander during emergencies.

Cascade / Recycle and Assembly Operations Shift Supervisors have, as a minimum, a high school diploma or satisfactory completion of the General Educational Development test, and three years of industrial/chemical/nuclear plant operations, maintenance, or engineering experience. Operations Shift Supervisors must have one year of supervisory experience or completion of a supervisory training course.

2.1.2.3.4 Senior Shift Supervisors [commercial operations only]

Senior Shift Supervisors report to the Operations Manager. As the senior manager on shift (one per shift), the Senior Shift Supervisor represents the General Manager and has the authority and responsibility to make decisions, as necessary, to ensure safe operations. The Senior Shift Supervisors are responsible for accumulation and dissemination of information regarding American Centrifuge activities to the Incident Commander during emergencies and making notification of events to regulatory agencies. The Senior Shift Supervisors are also responsible for directing the operation of systems within the facilities necessary to support enrichment operation and future disassembly, decommissioning, and disposal activities and caretaker operations. The Senior Shift

Supervisors authorize the restart of equipment that has been shut down in a routine fashion when the prerequisites and limitations of the associated operating procedure are met.

Senior Shift Supervisors have, as a minimum, a high school diploma or satisfactory completion of the General Educational Development test, and six years of industrial/chemical/nuclear plant operations, maintenance, or engineering experience. Senior Shift Supervisors must have two years of supervisory experience or completion of a supervisory training course.

2.1.2.3.5 Maintenance Work Center Supervisor

Maintenance Work Center Supervisor reports to the Operations Manager. The Maintenance Work Center Supervisor is responsible for directing activities of the BOP Operations Shift Supervisors and of the Maintenance Shift Supervisors in the performance of preventive, predictive, and corrective maintenance and to provide support ~~services~~ on facilities and equipment, ~~with the exception of centrifuge 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.

The Maintenance Work Center Supervisor is also responsible for integrated planning, scheduling, and materials management. This includes maintenance of logs and records; managing daily work control activities; maintenance of an integrated work schedule to initiate, screen, evaluate, and prioritize maintenance work; coordinating shop maintenance activities; and coordinating development of work control guidelines.

Maintenance Work Center Supervisor has, as a minimum, a high school diploma or satisfactory completion of the General Educational Development test, and three years of industrial/chemical/nuclear plant operations, maintenance, engineering or support experience. Maintenance Work Center Supervisors must have one year of supervisory experience or completion of a supervisory training course.

2.1.2.3.5.1 Balance of Plant Operations Shift Supervisors

BOP Operations Shift Supervisors report to the Maintenance Work Center Supervisor and are responsible for directing the activities for plant utilities processes and facilities within approved programs, processes, and procedures.

BOP Operations Shift Supervisors have, as a minimum, a high school diploma or satisfactory completion of the General Educational Development test, and three years of industrial/chemical/nuclear plant operations, maintenance, or engineering experience. BOP Operations Shift Supervisors must have one year of supervisory experience or completion of a supervisory training course.

2.1.2.4 Production Support Manager

The Production Support Manager reports to the General Manager. This manager is responsible for fire safety; emergency management; radiation protection (RP), which includes chemical process safety, health physics, industrial hygiene, and environmental/waste management; security; and training and procedures, which includes records management and document control. During commercial operations, this manager will also be responsible for the Customer Order Management program.

The Production Support Manager has, as a minimum, a bachelor's degree in engineering or the physical sciences or equivalent technical experience, and four years of nuclear experience.

2.1.2.4.1 Fire Safety / Emergency Management Manager

The Fire Safety/Emergency Management Manager reports to the Production Support Manager. This manager is responsible for the Fire Safety program; fire protection systems and services (i.e., including emergency and fire response, fire inspection, fire testing services, interpretation and application of applicable fire codes and standards); and emergency management.

The Fire Safety/Emergency Management Manager has, as a minimum, a bachelor's degree or equivalent technical experience, four years of fire protection experience, and six months of nuclear experience.

2.1.2.4.2 Radiation Protection Manager / Supervisor

The Radiation Protection Manager (RPM)/Supervisor reports to the Production Support Manager. The RPM/Supervisor is responsible for the RP Program and administration on a day-to-day basis, including providing guidance and direction for establishment and implementation of the RP Program and has the authority to deny access to radiological areas by personnel who do not adhere to radiological protection requirements. The RPM/Supervisor also has oversight of radiological protection procedures in order to maintain the integrity of the RP Program. The RPM/Supervisor has direct access to the General Manager and the Senior Vice President for RP matters.

This position also has programmatic responsibilities for chemical process safety, health physics, industrial hygiene, and environmental/waste management activities.

The RPM/Supervisor has, as a minimum, a bachelor's degree in engineering, health physics, RP, or the physical sciences or equivalent technical experience, and four years experience in RP, ~~including six months at a uranium processing plant~~.

2.1.2.4.3 Security Manager

The Security Manager reports to the Production Support Manager. This manager is responsible for the strategic direction of the site security operations and programs for safeguards and security services. The Security Manager has direct access to the General Manager and Senior Vice President for security matters.

The Security Manager has, as a minimum, a bachelor's degree or equivalent technical experience, and four years security experience.

2.1.2.4.4 Training and Procedures Manager

The Training and Procedures Manager reports to the Production Support Manager. This manager is responsible for preparation, presentation, and documentation of employee orientations; and for technical and qualification training program development and implementation. This manager is also responsible for the development and implementation of the Procedures program and the programmatic oversight of the Records Management and Document Control (RMDC) programs.

The Training and Procedures Manager has, as a minimum, a bachelor's degree in engineering or the physical sciences or equivalent technical experience, and four years of nuclear experience.

2.1.2.4.4.1 Records Management and Document Control Manager

The RMDC Manager reports to the Training and Procedures Manager. This manager is responsible for the RMDC programs.

The RMDC Manager has, as a minimum, a bachelor's degree in engineering or the physical sciences or equivalent technical experience, and four years of nuclear experience.

2.1.3 Director, Quality Assurance

The Director, QA reports to the Senior Vice President. This Director is a member of the senior management team of the American Centrifuge Project and has been designated the responsibility for ensuring that the project achieves its quality targets and meets its regulatory driven quality commitments in a safe manner. This Director is responsible for QA for the operations, including future decommissioning as applicable, at the Piketon, Ohio and Oak Ridge, Tennessee facilities; for vendors and suppliers; and for construction and manufacturing activities, both for internal and external customers.

This Director advises and provides guidance to the Senior Vice President on matters of safety and QA. The Piketon QA Manager and Industrial Safety Manager report to the Director, QA and are independent from production, plant operating cost, and production schedule concerns to ensure appropriate independent oversight of project activities.

The Director, QA has, as a minimum, a bachelor's degree in engineering or the physical sciences or equivalent technical experience, and six years of nuclear experience, and six years of management experience which may be concurrent with the nuclear experience.

2.1.3.1 Piketon Quality Assurance Manager

The Piketon QA Manager reports to and receives technical direction for QA matters from the Director, QA and is matrixed directly to the General Manager. The Piketon QA Manager has the responsibility to exercise oversight of design, procurement, refurbishment/construction, manufacturing, testing, start-up, plant operations, maintenance, and future decommissioning to ensure that the health and safety of the public and workers are adequately protected; to ensure compliance with safety, safeguards, and quality requirements; and to ensure implementation of the

QAPD, policies, and procedures. The Piketon QA Manager provides independent assessment and audit of ACP activities.

Although the Piketon QA Manager has direct access to the General Manager and Senior Vice President and interacts directly with line management for QA matters, the Piketon QA Manager is independent from production, plant operating cost, and production schedule concerns. The Piketon QA Manager has access to information and participates (as desired) in any evaluations or discussions related to safety, safeguards, and quality.

The Piketon QA Manager has, as a minimum, a bachelor's degree in engineering or the physical sciences or equivalent technical experience, and four years nuclear experience, and four years of management experience in quality assurance; nuclear safety oversight; engineering and technical support; or regulatory affairs, which may be concurrent with the nuclear experience.

2.1.4 Director, Engineering, Procurement, and Construction

The Director, EPC reports to the Senior Vice President and is matrixed directly to the General Manager. During the refurbishment/construction of the ACP, this director is responsible for providing technical administration and direction to the engineering, procurement, and construction contractor(s); and providing the primary interface with the refurbishment/construction contractor(s). ~~; and managing the execution for the Balance of Plant work which the Licensee self-performs for the deployment of the ACP.~~

The Director, EPC has, as a minimum, a bachelor's degree in engineering or the physical sciences or equivalent technical experience, six years of nuclear experience, and six years of management experience, which may be concurrent with the nuclear experience.

2.1.5 Director, Nuclear Safety

The Director, Nuclear Safety reports to the Senior Vice President and is matrixed directly to the General Manager. This director is responsible for developing and implementing the nuclear safety program, including technical oversight of nuclear safety, including nuclear criticality safety (NCS) and maintenance of the Integrated Safety Analysis (ISA), safety analysis training, review of procedures involving fissile material operations, and assessments of program implementation. This director is also responsible for direct management of the NCS functions and administration of the NCS program on a day-to-day basis. These activities may include conducting assessments of nuclear safety program implementation; ensuring adherence to NCS evaluation requirements; review and approval of fissile material operations; review and approval of design changes that could affect or establish new fissile material operations; developing posting and labeling requirements; and NCS training requirements.

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.

2.1.6 Director, Engineering

The Director, Engineering reports to the Senior Vice President and has the overall responsibility for successful deployment of the centrifuge technology in an operational plant environment. This director is the overall design authority for Piketon operations. This director provides strategic leadership and direction to the engineering organization and manages the utilization of engineering resources across the enterprise to support field operations. This director has design authority for the American Centrifuge operations. Design authority is then delegated to the Piketon Engineering Manager to provide day-to-day engineering support.

The Director, Engineering has, as a minimum, a bachelor's degree in engineering or the physical sciences or equivalent technical experience, and six years nuclear experience.

2.1.6.1 Piketon Engineering Manager

The Piketon Engineering Manager reports to the Director, Engineering. This manager is the delegated design authority for Piketon operations and is matrixed directly to the General Manager. This manager is responsible for Piketon engineering activities in support of operations and future decommissioning, which includes maintaining the configuration management program; systems and design engineering; review of design and modifications of items relied on for safety (IROFS); and supporting procurement services. This manager is also responsible for the development of the ISTPs.

The Piketon Engineering Manager has, as a minimum, a bachelor's degree in engineering or the physical sciences, and four years of nuclear experience.

2.1.6.1.1 Configuration Management Manager

The Configuration Management Manager reports to the Piketon Engineering Manager. This manager has the responsibility for maintaining the configuration management program plan and overseeing the implementation of the program to ensure that the physical equipment and facilities; the drawings, specifications, and procedures; and the design/licensing basis for the plant are maintained.

The Configuration Management Manager has, as a minimum, a bachelor's degree in engineering or the physical sciences or equivalent technical experience, and four years of nuclear experience.

2.1.6.1.2 Piketon System Engineering Manager [commercial operations only]

The Piketon System Engineering Manager reports to the Piketon Engineering Manager. This manager has responsibility for the system engineering activities in support of plant operations.

The Piketon System Engineering Manager has, as a minimum, a bachelor's degree in engineering or the physical sciences or equivalent technical experience, and four years of nuclear experience.

2.1.6.1.3 Piketon Design Engineering Manager [commercial operations only]

The Piketon Design Engineering Manager reports to the Piketon Engineering Manager. This manager has responsibility for the design engineering activities in support of plant operations, which includes providing engineering support and review of the design and modifications of IROFS.

The Piketon Design Engineering Manager has, as a minimum, a bachelor's degree in engineering or the physical sciences or equivalent technical experience, and four years of nuclear experience.

2.1.7 Plant Shift Superintendent (Contractor)

The Plant Shift Superintendent (PSS) reports to the U.S. Department of Energy (DOE) reservation contractor management and provides support through approved reverse-work authorizations with the DOE. The PSS is responsible for accumulation and dissemination of information regarding site activities, serving as or designating an Incident Commander during emergencies, and making notification of events. The PSS has the authority and responsibility to make decisions as necessary to ensure safe site operations, including stopping work. The PSS provides a centralized point for incident identification, screening, and reporting. The PSS's responsibilities are consistent with those exercised at the gaseous diffusion plant for emergency response.

The PSS has, as a minimum, a bachelor's degree in engineering or the physical sciences or equivalent technical experience and four years experience at a gaseous diffusion plant, or a high school diploma plus 12 years experience at a gaseous diffusion plant.

2.1.8 Shift Crew Composition [only during operational phases with licensed material]

The minimum operating shift crew consists of an Operations Shift Supervisor, a Radiation Protection/Industrial Hygiene technician, and one operations technician per process building. Other personnel, such as NCS, will be available on an as needed basis.

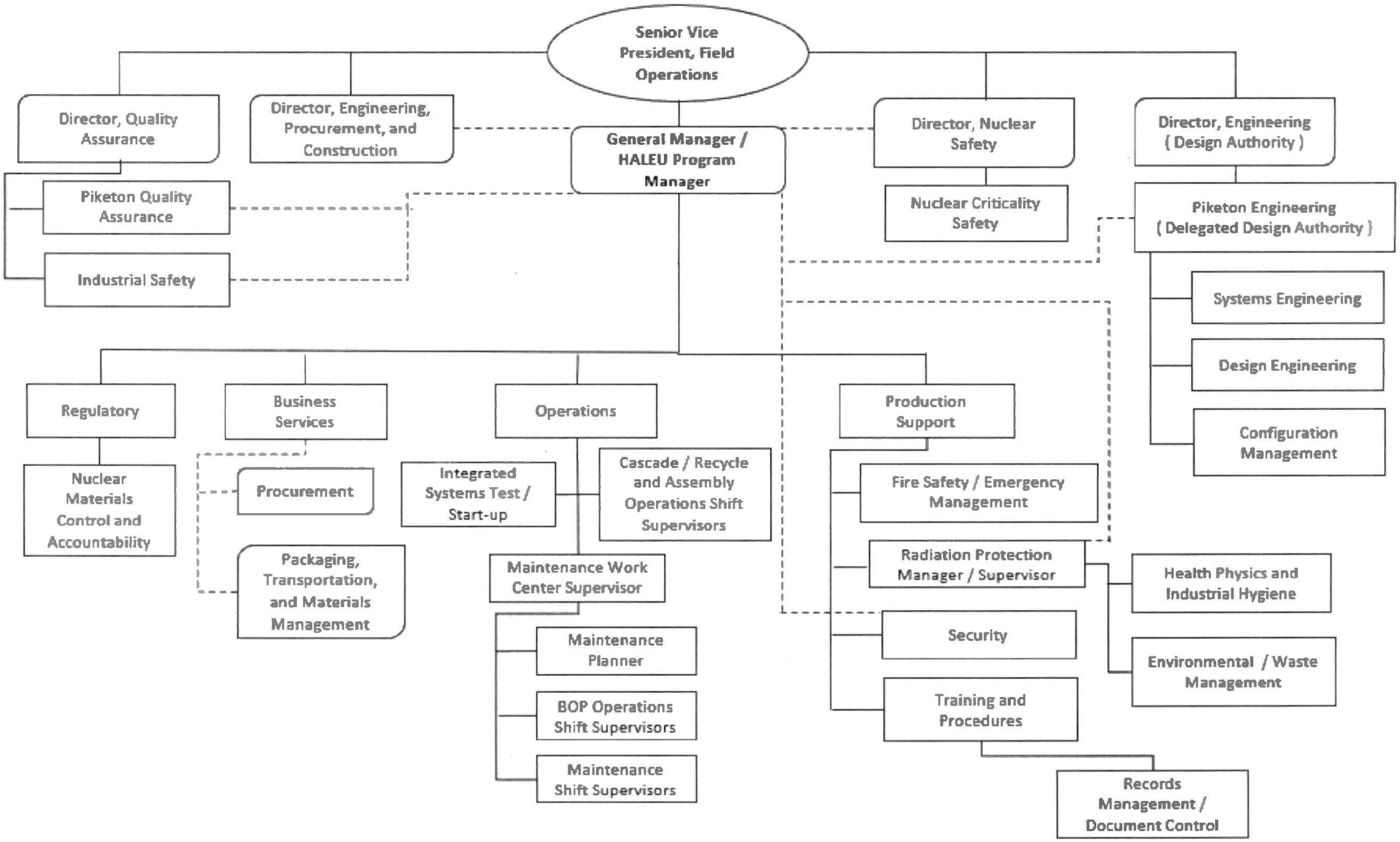

Figure 2.1-1
American Centrifuge Organization Chart

2.2 Management Controls

The Licensee has established management measures with associated policies, administrative procedures, and management controls to ensure the ACP equipment, facilities and procedures; the staff (including training and qualifications); and the programs provide for the protection of the health and safety of workers and the public, protection of the environment, and for the common defense and security. Management controls have been established to maintain configuration management of the plant. These controls are described in Section 11.1 of this license application. Organizations with environmental, health, nuclear safety, safeguards, security, and quality responsibilities have been established with a reporting chain, independent from the operations organization. Effective lines of communication and authority among the organizations involved in the engineering, environmental, safety, and health, and operations functions of the plant are clearly defined.

The management controls established for the ACP include policies, management systems, and administrative procedures that are communicated to plant personnel. Policies related to the protection of health and safety of workers and the public, protection of the environment, and providing for the common defense and security are discussed in pertinent sections of this license application. Activities that are essential for effective implementation of the environmental, safety, and health functions are documented in approved, written procedures, prepared in compliance with a document control program. Procedure development and document control are described in Section 11.4 of this license application and Sections 5.0 and 6.0 of the QAPD.

Management measures required to ensure the availability and reliability of IROFS are described in Chapter 11.0 of this license application. Controls specific to plant programs are identified in the QAPD, Fundamental Nuclear Material Control Plan, and Security ~~Program~~Plans.

The commitment tracking and Corrective Action Programs are integrated to prioritize ACP actions consistent with their safety and safeguards significance. Any person working in the plant may report potentially unsafe conditions or activities by submitting a condition notification. Reported concerns are investigated, assessed, and resolved as described in Section 11.6 of this license application.

Where safety, security, or safeguards might be adversely impacted by cost or schedule considerations, it is the policy of the Licensee to subordinate cost and schedule considerations to ensure adequate treatment of safety and safeguards in full compliance with applicable regulatory requirements.

The integration of ACP operations and the various programs and requirements is accomplished through a variety of management practices, including:

- Staff meetings to discuss issues and policy implementation;
- Review of performance indicators;
- Review of identified events or conditions;
- Multi-discipline reviews by the PSRC; and

- Work permit systems that provide the integration in the field of various health, safety, and environmental program requirements and hazard evaluations.

Additionally, oversight of the integration of various program elements is provided by the QA organization.

Letters of agreement exist with off-site emergency resources (i.e., fire, police, ambulance/rescue units, and medical services).

2.2.1 Plant Safety Review Committee

The PSRC performs multi-discipline reviews of day-to-day and proposed activities to ensure that these activities are and/or will be conducted in a safe manner. The PSRC advises the General Manager on matters related to RP, Nuclear Safety, Chemical Safety, Fire Safety, and Environmental Protection. The specific membership, qualifications, meeting frequency, quorum, functions, responsibilities, and required records are provided in a plant procedure. Auditing and oversight of PSRC activities is the responsibility of the Piketon QA Manager.

Subcommittees may be established by the PSRC chairperson to provide assistance in conducting reviews and assessments as described in the PSRC procedure. The PSRC chairperson approves the subcommittee procedures, membership, and member qualifications. The PSRC maintains the overall responsibility for any required reviews.

2.3 Pre-operational Testing and Initial Start-up

Specific plans have been established to ensure the safe and efficient turnover, testing, and start-up of centrifuges ~~machines~~, equipment, and support systems. These plans cover the transition from the refurbishment/construction phase to the operations phase.

The Integrated Systems Test/Start-up Manager is responsible for development and implementation of plans to provide for the turnover and testing of equipment and systems from contractors/vendors to the Licensee.

The Piketon Engineering Manager is responsible for the development of ISTPs with the assistance of the Integrated Systems Test/Start-up Manager. The Integrated Systems Test/Start-up Manager is responsible for the execution of the ISTPs. The ISTPs demonstrate the proper operation of completed systems to ensure the systems meet their intended design functions. The Integrated Systems Test/Start-up Manager is also responsible for the acceptance of turnover from the EPC, initial acceptance testing, and initial start-up of equipment and support systems. The Operations Manager is responsible for the acceptance of turnover, initial acceptance testing, initial start-up, and operation of the centrifuges ~~machines~~. Documentation of testing is maintained in accordance with RMDC requirements and is available for NRC review.

2.3.1 Pre-operational Testing Objectives

The overall objectives of the pre-operational test program are to ensure that the facilities and systems, including the IROFS:

- Have been adequately designed and constructed;
- Meet contractual, regulatory, and licensing requirements;
- Do not adversely affect worker or public health and safety; and
- Can be operated in a dependable manner so as to perform their intended functions.

2.3.2 Turnover, Functional, and Initial Start-up Test Program

The refurbishment/construction contractor(s) is responsible for completion of as-built drawing verification; purging/flushing; cleaning; hydrostatic or pneumatic testing; system turnover; and initial calibration of instrumentation in accordance with procedures, design documents, and installation specifications. As systems or portions of systems are turned over to the Licensee, initial acceptance testing is performed in accordance with established schedules. The Integrated Systems Test/Start-up Manager is responsible for coordination of initial turnover and initial acceptance testing.

Integrated systems testing, as a minimum, includes system or component tests required by the pertinent design codes or QAPD that were not performed by the refurbishment/construction contractor(s) prior to initial turnover to the Licensee. The testing that is performed is commensurate with the system or component's quality level and is principally associated with IROFS, but may also include other tests on systems or components that the Licensee deems appropriate for financial, reliability, or other reasons. Integrated systems tests include the testing that is necessary to demonstrate that the facility, system, or component is capable of performing its intended function in a safe and controlled manner. The Integrated Systems Test/Start-up Manager is responsible for the execution of the ISTPs for the ACP. The integrated systems tests are performed following completion of construction; flushing; hydrostatic or pneumatic testing; system turnover; and initial calibration of required instrumentation. Scheduling of the testing is such that it generally occurs prior to UF_6 introduction.

Other pre-operational tests, not required prior to UF_6 introduction, may be performed following introduction of UF_6 to the process system during the operations phase and are the responsibility of the Operations Manager. Testing and turnover in conjunction with modifications identified by the Operations Manager following transition to the operations phase are the responsibility of the Piketon Engineering Manager.

2.4 References

None

3.0 INTEGRATED SAFETY ANALYSIS AND INTEGRATED SAFETY ANALYSIS SUMMARY

The requirements in 10 *Code of Federal Regulations* (CFR) 70.62(c) specify that an Integrated Safety Analysis (ISA) of the appropriate level of detail for the complexity of the process involved be conducted and maintained. An ISA Summary is required by 10 CFR 70.65(b). Accordingly, the Licensee has conducted an ISA of adequate complexity to support preparation of an ISA Summary for the American Centrifuge Plant (ACP), including an Addendum to the ISA Summary that provides information specific to the HALEU Demonstration. The ISA is a compilation of the design and analysis documentation utilized to: 1) identify the potential accident sequences that could occur, 2) designate items relied on for safety (IROFS) to either prevent such accidents or mitigate their consequences to an acceptable level, and 3) identify the management measures to provide reasonable assurance of the availability and reliability of IROFS.

The ISA Summary is a synopsis of the ISA and contains the information required by 10 CFR 70.65(b). The ISA Summary is updated to reflect changes to the ISA. Neither the ISA nor the ISA Summary is incorporated as part of this license. The ISA documentation is available to the U.S. Nuclear Regulatory Commission (NRC) by request at the ACP through the Regulatory Manager. The ISA Summary (Reference 1), and its Addendum for the HALEU Demonstration (Reference 21), ~~is~~ are maintained as a separate documents from the license application~~,~~ and ~~is~~ are submitted separate from this license application. In addition to providing a synopsis of the results of the ISA, the ISA Summary and its Addendum describe~~s~~ the methods and criteria utilized in the safety analysis and describes the qualifications of the team performing the ISA.

In the context of this chapter, the general use of the term ISA Summary is intended to include the ISA Summary for the commercial ACP deployment (Reference 1) as well as the Addendum (Reference 21) that is uniquely associated with the HALEU Demonstration. Information that is applicable only to the commercial ACP operation will be noted as "non-HALEU" or "commercial ACP"; whereas, aspects that are unique to the HALEU Demonstration will be noted as "HALEU". References to specific tables or sections in the ISA Summary are intended to refer to those entries in Reference 1.

3.1 Safety Program and Integrated Safety Analysis Commitments

3.1.1 Process Safety Information

~~The Chemical Process Safety program is described in Chapter 6.0 of this license application. Consistent with this program, t~~The Licensee compiles and maintains an up-to-date database of process-safety information. Written process-safety information is used in updating the ISA and in identifying and understanding the hazards associated with the processes. The compilation of written process-safety information includes information pertaining to:

- The hazards of materials used or produced in the process, which includes information on chemical and physical properties (e.g., toxicity, acute exposure limits, reactivity, and chemical and thermal stability) such as those included on Material Safety Data Sheets (meeting the requirements of 29 CFR 1910.1200(g));

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

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

- The applicability of 29 CFR 1910.119 (Process Safety Management) and 40 CFR Part 68 (Risk Management Plan) to operation of the ACP to assure that chemicals not related to the licensed material are evaluated as necessary.

The ISA considers ~~chemical~~ process safety through~~-~~out the analysis development. Process safety is considered when identifying the credible accident scenarios, developing the IROFS, and establishing the management measures to ensure the health and safety of the workforce and public. The ~~ISA and~~ ISA Summary ~~are~~ is maintained and updated by written procedures using qualified personnel to ensure that process safety information is accurately reflected in accordance with 10 CFR 70.72. The license should be conditioned as follows: Upon completion of the design and updating of the appropriate documentation involving process safety information, the Licensee shall provide the Commission with 120 days advance notice of its plan to introduce UF_6 in the American Centrifuge Plant in order to conduct its inspections involving process safety information that are required by 10 CFR 70.32(k). It is acknowledged that the ACP is a modular process that may be deployed in phases, such that notice to introduce UF_6 may be issued for approval to begin operations in a portion of the ACP (e.g. notice may be issued for deployment of the HALEU demonstration, independent of the full deployment of all other modules of the complete ACP.)

3.1.2 Integrated Safety Analysis

An ISA of the design and operation of the 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). The ISA is a collection of the design documentation and programmatic information reviewed and utilized during the course of the ISA effort. This information is available on site for NRC review.

The ISA documentation is sufficiently detailed to identify the following:

- Radiological hazards;

- Chemical hazards that could increase radiological risk;

- Facility hazards that could increase radiological risk;
- Chemical hazards from materials involved in processing licensed materials;
- Credible accident sequences;
- Consequences and likelihood of each accident sequence; and
- IROFS including the assumptions and conditions under which they support compliance with the performance requirements of 10 CFR 70.61.

Should the addition of new processes or other changes to the ACP be necessary, evaluations of appropriate complexity for each process will be performed in accordance with 10 CFR 70.72, using established ISA methods to ensure the processes can be carried out in a manner such that compliance with the performance requirements of 10 CFR 70.61 are maintained. The ISA methods utilized for the ACP are described in Section 3.1.2.1 of this license application.

The Licensee maintains the ISA and ISA Summary so that it is accurate and up-to-date by means of a suitable configuration management system, described in Section 11.1 of this license application. ACP procedures specify the criteria for changing the ISA Summary. Changes to the ACP are evaluated against the ISA and ISA Summary using a change process that meets the requirements of 10 CFR 70.72. Changes to the ISA Summary are submitted to the NRC in accordance with 10 CFR 70.72(d)(1) and (3). ~~The Licensee will provide to the Commission, 180-days prior to the introduction of UF_6 in the American Centrifuge Plant, a revised ISA Summary that incorporates all changes that have occurred since the issuance of the materials license.~~ The ISA accounts for any changes made to the ACP or its processes (e.g., changes to the site, operating procedures, or control systems). Any facility change, operational change, or change in the process safety information that may alter the parameters of an accident sequence is evaluated by means of the ISA methods. The Licensee evaluates proposed changes to the ACP or its operations by means of the ISA methods and designates new or additional IROFS, along with appropriate management measures, as necessary. The Licensee will periodically review IROFS per the requirements of 10 CFR 70.62(a)(3) to ensure their availability and reliability for use, and consistency with the ISA. As the final design is developed for the ACP, the management system and design approach will require that the final designs be reviewed against the ISA to ensure the ISA accurately reflects the ACP design and operations, identifies the credible accident sequences and appropriate assumptions, and credits the IROFS necessary to meet the performance requirements of 10 CFR 70.61. The license should be conditioned as follows: Upon completion of the design and updating of the ISA and ISA Summary, the Licensee shall provide the Commission with 120 days advance notice of its plan to introduce UF_6 in the ~~American Centrifuge Plant~~ACP (or into an operational module of the ACP, such as the HALEU Demonstration) in order to conduct its inspections involving the ISA and ISA Summary that are required by 10 CFR 70.32(k).

The Licensee also evaluates the adequacy of existing IROFS and associated management measures and makes any required changes to the ACP and/or its processes. If a proposed change results in a new type of accident sequence (e.g., different initiating event or significant changes in the consequences) or increases the consequences and/or likelihood of a previously analyzed accident sequence within the context of 10 CFR 70.61, the Licensee evaluates whether changes to existing IROFS and associated management measures are required, or if new IROFS or management measures are required. For any changes that require prior NRC approval under 10 CFR 70.72, the Licensee will submit an amendment request in accordance with 10 CFR 70.34 and 70.65.

The Director, Nuclear Safety is responsible for maintaining the ISA and ISA Summary (i.e., reviewing proposed changes, performing analyses, and ensuring implementation of required updates). The Regulatory Manager is responsible for submitting the required changes to the NRC and coordinating information requests from the NRC.

Suitably qualified personnel update and maintain the ISA and ISA Summary. The ISA Team consists of at least one team leader who is formally trained and knowledgeable in the ACP's ISA methods and individuals with specific, detailed experience in the operation, hazards, and safety design criteria of the particular process being evaluated. Personnel with appropriate experience and expertise in engineering and process operations are utilized in the maintenance and updating of the ISA and ISA Summary. Written procedures are used to implement the ISA process and are maintained onsite. For any revisions to the ISA Summary, personnel having qualifications similar to those of ISA Team members who conducted the original ISA are used.

3.1.2.1 Integrated Safety Analysis Methodology

The ISA analyzes the hazards associated with ACP operation, its associated direct support equipment and support systems, and the buildings and facilities where it is located. This analysis does not address hazards associated with sabotage, chemical hazards that do not result from the processing of licensed nuclear material or have the potential for adversely affecting radiological safety, or Standard Industrial Hazards as presented in Section 3.1.2.3.1.3.2 of this chapter.

3.1.2.2 Selection of Evaluation Method

The guidelines presented in Appendix A of NUREG-1513 (Reference 2) serve as a basis for selecting the Hazard Evaluation Method, using the methodology in the flowchart, Figure A.1 of NUREG-1513. The method was selected using accepted evaluation techniques, experience, and judgment. Answering the questions at each decision branch led to a selection of the Preliminary Hazard Analysis (PHA) method or the What-If/Checklist (WI/CL) method of analysis. The specific questions at each branch were answered as follows:

-Is the Hazard Evaluation (HE) Study for regulatory purposes?	-Yes.
-Is a specific HE method required?	-No.
-Is this a recurrent review?	-No.
-What type of results are needed?	-A list of specific accident situations.
-Will these results be used in a QRA*?	-No.
-Is the process operating? Are procedures available?	-No.

-Is detailed design information available?	-No.
-Is basic process information available?	-Yes. Consider using WI (What If), PHA, or WI/CL.

*QRA = Quantitative Risk Assessment

As a result, the ISA Team selected a hybrid method that incorporated elements of both the WI/CL and PHA methods. The WI/CL method combines the broad spectrum of accidents that can be postulated by a brainstorming team of experts with the detailed and comprehensive structure provided by a systematic Hazard Identification and Event Category checklist. Additionally, the use of a tabular accident recording form borrowed from the PHA technique provides for the effective listing and presentation of accidents along with their causes, hazard category, risk assessment and potential preventive and mitigative controls.

3.1.2.3 Description of Selected Integrated Safety Analysis Method

The selected Hazard Analysis (HA) method for the ISA involves a combination of the PHA and WI/CL methods, as discussed above, which incorporates an unmitigated and mitigated approach. The method and approach has the advantage of providing a comprehensive and systematic process for addressing baseline facility and process hazards and credible accidents associated with those hazards, while the process and facility are still in the conceptual or preliminary design stages, thus helping to identify early in the design process those controls that are necessary to protect the public and workers.

The HA provides a systematic analysis of potential process-related, and external hazards including natural phenomena, that can affect the public and facility workers. The analysis considers the potential for both equipment failure and human error. In performing the HA, the ISA Team provides a thorough, predominantly qualitative evaluation of the spectrum of risks to the public, the workers, and the environment due to accidents involving the identified hazards. NUREG-1513 and NUREG-1520 (References 2~~1~~ and 3~~2~~) ~~require~~ state that the hazard ~~analysis~~ analyses comprehensively identify credible accidents and their causes, and estimate the frequency and consequences. Estimates of consequences and frequencies are performed in the hazard analysis such that attention is focused on those scenarios that have risk to the public, workers and the environment that exceeds the 10 CFR 70.61 performance requirements.

The Hazard Analysis for the ISA is developed using two primary activities:

- Hazard Identification
- Hazard Evaluation

3.1.2.3.1 Hazard Identification

Hazard Identification is a comprehensive and systematic process by which all known hazards (hazardous materials and energy) associated with the facility and process are identified, recorded, and screened by the ISA Team. In the HA, screening is performed to eliminate material/energy types and quantities that are considered "common hazards".

The Hazard Identification is divided into three steps:

- Sectioning of the facility;
- Facility information gathering and walkdowns; and
- Screening for Standard Industrial Hazards.

3.1.2.3.1.1 Sectioning the American Centrifuge Plant

Partitioning of the facility into "sections" facilitates hazard identification and evaluation. These sections may be based on specific operations, individual or grouped facility systems, specific function(s), types of material being handled, and/or physical boundaries inside the facility. In this process, interactions between the facilities are considered in the analysis to assure that the full range of events is evaluated.

The hazard identification and evaluation process applied to the commercial ACP operation included partitioning of the facility into the following sections:

- Cylinder Storage Areas (CY)
- Feed Area of Feed and Withdrawal Building (FB)
- Interconnecting Process Piping (FP)
- Process Buildings (PB) includes Process Support Building
- Withdrawal Area of Feed and Withdrawal Building (WS)
- Recycle/Assembly Building/Centrifuge Training and Testing Facility/Interplant Transfer Corridor (RA)
- Customer Services Building (BT)
- Transportation Activity (TA)
- Feed and Product Shipping and Receiving Building (SR)
- Criticality Events (CE)

The hazard identification and evaluation tables presented in the ISA Summary Appendices use the ACP section acronym identifiers as noted above. The hazard identification and evaluation process considered the applicable ACP activities including startup, normal operation, shutdown, and maintenance activities, as well as potential concurrent construction activities.

3.1.2.3.1.2 Information Gathering and Walkdowns

Facility information gathering is the key element in the process of identifying hazardous materials and energy sources that are currently known or which may be associated with each facility section, particularly at the conceptual design stage of a project. This information gathering process includes "paper walkdowns," which consist of a team review of current design documentation, system drawings, functional performance requirements, procedures, etc., in the context of Hazard Identification. In addition, the process uses direct interactions with the designers and/or system engineering personnel responsible for the specific sections of the facility. Also, if the design involves a modification to an existing facility, it is generally helpful to perform a physical walkdown of the facility as well to aid in the identification of potential hazards. The ISA Team uses a comprehensive hazards checklist that provides a structured method for conducting hazard identification. A sampling of items included on the checklist is shown in Table A-1 in Appendix A of the ISA Summary.

Using the results of the information gathering process, including paper and physical walkdowns and designer or operator interviews, the ISA Team creates a comprehensive list of all expected hazards, including radiological hazards and chemical hazards. The completed Hazard Identification Tables, as provided in Appendix B of the ISA Summary, are used to document the results of the Hazard Identification process and are developed for each facility section.

The ACP ISA Team hazards analysis and evaluation process used design and process information available from the various feasibility studies performed for the ACP as well as existing design, process, and safety analysis documentation applicable to the Gaseous Diffusion Plant (GDP) for those facilities, systems or processes similar to the ACP. Additionally, the ACP ISA Team performed physical facility walkdowns and observation of the current GDP facilities and operations including those used for feed, sampling and withdrawal processes and cylinder storage. Existing facilities proposed for use with the ACP were also walked down including the process buildings used for the GDP and facilities proposed for use as feed, blending, and transfer operations.

3.1.2.3.1.3 Screening of Chemical and Standard Industrial Hazards

The third step in the Hazard Identification process is the screening of chemical hazards and standard industrial hazards.

3.1.2.3.1.3.1 Chemical Hazards

At NRC-licensed fuel cycle facilities, the unacceptable consequences of concern (within NRC's regulatory authority) include those that result in the exposure of workers or members of the public to excessive levels of radiation and hazardous concentrations of certain chemicals. The mechanism for ~~such~~ a radiological exposure could be a release of radioactive material, or an inadvertent nuclear chain reaction involving special nuclear material (criticality). The release of hazardous chemicals is also of regulatory concern to NRC to the extent that such hazardous releases result from the processing of licensed nuclear material or have the potential for adversely affecting radiological safety. OSHA and EPA are responsible for regulating other aspects of chemical safety at the facility.

The consideration of radiological, including fissile, and chemical hazards includes radioactive materials, fissile materials, and chemical inventory, in all areas where such material is normally present or credibly could be present.

Non-radioactive chemicals that require hazard evaluation are those that are present or could be present in amounts exceeding the threshold quantity (TQ) listed in *Risk Management Programs for Chemical Accidental Release Prevention,* 40 CFR Part 68 (Reference 4), the TQ listed in *Process Safety Management (PSM) of Highly Hazardous Chemicals,* 29 CFR 1910.119 (Reference 5), or the threshold planning quantity (TPQ) listed in *Emergency Planning and Notification,* 40 CFR Part 355 (Reference 6).

The screening of the chemical inventory is conducted as follows:

- Eliminate a chemical if it is not present in quantities greater than the TQs established for that material

- Eliminate a chemical if it has been previously analyzed to be an insignificant hazard and there is nothing to indicate that a more detailed evaluation is required.

- Eliminate a chemical if one of more of the following is valid:

  - The material is identified as a sample

  - The material is used in a laboratory setting and in laboratory scale quantities. Materials whose maximum amount at a given location or segment is under ten pounds are designated as being a laboratory quantity.

- Consider elimination of the chemical if it satisfies one or more of the following criteria:

  - The material is commonly used in industry and/or by the general public. Materials such as vehicle fuel and common industrial solvents are normally screened.

  - The material is a true solid (e.g., not a finely divided powder) under normal circumstances and does not present an airborne concern.

  - The material does not and cannot cause harm via the inhalation pathway from an acute exposure.

The ACP ISA Team examines each identified hazard for each section based on material/energy types and quantities using the general guidance given above and considers its potential contribution as an initiator for events involving release of radiological material, hazardous energy, or hazardous chemicals. If the identified chemical hazard does not meet the appropriate screening criteria, the chemical is carried forward to the Hazard Evaluation phase.

3.1.2.3.1.3.2 Standard Industrial Hazards

Standard Industrial Hazards are defined as hazards that are routinely encountered and accepted in general industry and construction, and for which national consensus codes and/or standards (e.g., OSHA or transportation safety) exist to guide safe design, operation or handling, without the need for special analysis for safe design and/or operational parameters. Typical examples would be slips, trips, and falls; routine industrial or construction noise; lifting equipment; welding equipment; and normal office hazards. They would also include substances and hazards that would be expected to be found for personal, family, or household use.

The following characteristics are used to classify hazards as standard industrial hazards:

- The hazard is controlled by OSHA regulations or national consensus standards (e.g., American Society of Mechanical Engineers, American National Standards Institute, National Fire Protection Association, Institute of Electrical and Electronic Engineers, National Electric Code), where these standards are adequate to define special safety requirements, unless in quantities or situations that initiate events with serious impact to the public or workers.

- Hazards such as noise, electricity, flammable materials, welding operations, small quantities of chemicals that would likely be found in homes or general retail outlets, and hazardous materials transported on the open road in DOT specified containers are considered to be common hazards encountered in everyday life.

Examples of common hazards/standard industrial hazards include:

- Specific materials (e.g., lead and asbestos) that have their own control program;

- Thermal energy sources (potential for burns);

- Electrical shock hazards;

- Gas cylinders transported and stored in DOT configuration;

- Personnel pinches, trips, falls, slips, etc.;

- Confined space hazards; and

- Hazards typically found in office areas.

3.1.2.3.2 Hazard Evaluation

The Hazard Evaluation (HE) constitutes the primary focal point of the HA. Hazards are characterized in the context of actual or anticipated facility operations and processes by considering feasible events, estimating event frequency, and estimating consequences of the event. The purpose of the HE is to ensure a comprehensive assessment of facility hazards and to focus attention on those events that pose the greatest risk to the public and on-site workers. The HE described herein applies to facility hazards other than criticality; HE for criticality events is described in Section 3.1.2.3.2.7 for the commercial ACP (non-HALEU) and Section 3.1.2.3.2.8 for HALEU Demonstration. The scope of the HE includes:

- Identified aspects of facility process and operation.
- Natural phenomena (e.g., earthquakes, tornadoes, straight winds), other external events (e.g., aircraft and vehicular impact), facility events external to the process (e.g., fires, explosions), and ~~nuclear criticality (where applicable)~~process deviations, including failures of IROFS.
- Consideration of the entire spectrum of possible events for a given hazard in terms of both frequency and consequence levels.
- Hazards addressed by other programs and regulations (e.g., PSM, OSHA, *Resource Conservation and Recovery Act,* DOE, EPA) if loss of control of the hazard could result in a release of radiological material/hazardous chemicals or a nuclear criticality.

The scope of the HE does not include:

- Willful acts, such as sabotage.
- Hazardous events that meet the screening criteria given in Section 3.1.2.3.1.3.2 of this chapter.
- Events that would be associated with chemicals screened as described in Section 3.1.2.3.1.3.1 of this chapter.
- Events necessitating a change, either deliberate or inadvertent, to the design of the facility or process.

The HE process is divided into three steps:

- Identification of Initial Conditions and Assumptions;
- Unmitigated Hazard Evaluation; and
- Mitigated Hazard Evaluation.

Initial conditions (ICs) are assumptions that are used to establish a reference baseline for analysis during an evolving design or to clarify a point of analysis that might otherwise be unstated. As such, ICs are normally established and documented prior to or during the HE process.

The Unmitigated HE postulates events that could occur within, or otherwise impact the facility, and assigns event frequencies and event consequences without regard to preventive or mitigative design features or programs, which may be an integral part of facility operations. The unmitigated HE is primarily a qualitative and conservative evaluation of facility hazards to identify those events of most concern to public and worker safety.

If event risk to the public or workers exceeds the 10 CFR 70.61 performance requirements, a more refined analysis may be conducted as part of the Mitigated HE to refine the event frequency and consequences for the event(s) of concern. Alternately, preventive and mitigative features incorporated within the facility and its associated safety programs may be selected and credited as Items Relied on for Safety (IROFS). The Mitigated HE is then developed from the results of the more detailed analysis and/or the crediting of selected preventive and mitigative features to bring the risk of the events within the 10 CFR 70.61 Performance Requirements.

3.1.2.3.2.1 Initial Conditions

In order to establish the boundaries of the ISA, the bounding conditions for the ACP must be identified. These boundaries are the operating conditions and limitations under which the ACP is anticipated to operate and in turn are used to establish the ICs credited in the ISA. ICs are the boundary conditions credited in the ISA and are used to establish an analysis reference baseline. ICs are credited during the development of the unmitigated frequencies and event consequences in the ISA. ICs capture assumptions to be used during design evolution or clarify points of analysis that might otherwise be unstated. ICs typically delineate specific conditions that are part of normal facility operations or delineate specific features of the facility that are unlikely to change and are used in establishing the frequencies or consequences of events. ICs have the potential to impact the results of the hazard analysis. ICs are normally established and documented, prior to, or during the HE process, when events are postulated and evaluated. To preserve the integrity of ICs, they are credited and treated as IROFS.

In general, ICs represent assumptions made in the consequences or probability analyses, or specific passive and active design features credited in the probability analyses. Three examples are: 1) the header isolation features which serve to limit the material at risk as assumed in the consequence analyses (commercial plant only), 2) the combustible materials control program serves to limit the presence of material that could fuel facility fires, and 3) the structural seismic specifications serve to establish minimum structural requirements to reduce the frequency of certain events.

Feed, product, and tails header isolation features serve to limit the amount of licensed material that could be released from the process during a loss of confinement event. This allows the consequence analysis to assume a realistic amount of material at risk. In this instance, the IC credits the active design features to limit inleakage to the entire process.

The combustible materials control program serves to limit the amount of combustibles that could be present in an area where licensed material is located. This reduces the probability that a fire could be initiated or spread and grows in intensity causing a release of licensed material. The IC allows the probability analysis to establish the unmitigated frequency for fire related events. The IC credits the fact that good housekeeping practices will ensure combustible materials are adequately controlled.

Structural seismic specifications state that the process building is designed to withstand a 1,000-year return period seismic event. This precludes or significantly reduces the ~~frequency~~ probability of building debris from falling on and damaging the operating cascade during a seismic event of this magnitude or less. The IC credits the design of the building in preventing or reducing the ~~frequency~~ probability of a release occurring as a result of a seismic event. Identifying and crediting certain ICs in this manner is advantageous in that it eliminates the postulation of a release resulting from an event with an unreasonable event frequency (e.g., a release from a 50-year return period seismic tremor).

ICs that are associated with a specific or a limited number of events are identified in the event description of those events in bold type font followed by IROFS numbers. ICs that apply to many events, such as cylinder integrity specifications, are not repeated in the event description of each event (except for criticality events, where all applicable ICs are identified).

3.1.2.3.2.2 Unmitigated Hazard Evaluation

Information related to Unmitigated HE is collected and organized in "Hazard Evaluation Tables." These tables are useful as a guide for performing HE, and they provide an effective format for documenting both unmitigated and mitigated HE results. HE Tables are generated to address the non-screened hazards associated with the systems and areas identified during the hazard identification process. The HE Tables may be based on facility sections, systems, activities, or areas, and generally include the following information:

- Event Number and Category;
- Event Description (including location, release mechanism, material at risk, initial conditions specific to the event, and hazard source);
- Cause(s);
- Unprevented Event Frequency Level;
- Unmitigated Consequence Level (categorized as Low, Intermediate or High); and
- Unprevented/Unmitigated Risk Bin (categorized as A or B).

For an unmitigated analysis, estimated values are provided in the columns pertaining to Unprevented Event Frequency and Unmitigated Consequences. Additionally, any preventive and mitigative controls that may be available within the facility are listed in their respective HE Table columns as provided in Appendix C of the ISA Summary. However, no credit is taken for the available controls during the unmitigated hazard analysis (unless the control is listed as an Initial Condition).

3.1.2.3.2.2.1 Event Number and Category

In the HE Tables, events are identified by a unique sequential reference. The first two letters typically represent the facility section (~~i.e.,~~e.g., "PB" for ACP Process Building) as indicated in Section 3.1.2.3.1.1 above, the first number represents the event category as described below, and the second number (following the hyphen) represents the event sequential number.

Events are categorized according to the nature of the postulated release mechanism. Table A-3 in Appendix A of the ISA Summary provides some additional information regarding event categories and associated hazardous material and energy sources. The categories are as follows:

- Fire (Category 1)
- Explosion (Category 2)
- Loss of Containment/Confinement (Category 3)
- Direct Radiological/Chemical Exposure (Category 4)
- Nuclear Criticality (Category 5)
- External Hazards (Category 6)
- Natural Phenomena (Category 7)

3.1.2.3.2.2.2 Event Description

A brief description of a postulated event is given in this column of the HE Tables. The event description defines the nature of the event and includes the event type, location, release mechanism, Material-at-Risk (MAR), initial conditions (if applicable), and hazard source. Using the results of the Hazard Identification process as a basis, the ISA Team develops event scenarios for each facility system or area where a potential exists for a release of hazardous energy and/or material. The scenarios cover a broad spectrum of credible events for a given hazard; from low consequence events, for which procedures or equipment may be credited in providing adequate protection, to credible high consequence events. Events typically progress to and result in a release of hazardous material~~ or a nuclear criticality~~.

3.1.2.3.2.2.3 Cause

The event cause specifically states the failure, error, operational, and/or environmental condition that initiates the progression of occurrences that leads to the event. The cause(s) need to be clearly identified in order to support event frequency estimates. The cause(s) listed typically identify the major contributors and do not necessarily provide an exhaustive list of every possible cause. The Hazard Identification Tables (Appendix B of the ISA Summary) are used as a guide in developing specific causes for events. When multiple causes are apparent, they are separately numbered in the HE Table Cause column for the event.

3.1.2.3.2.2.4 Unprevented Frequency Level

3.1.2.3.2.2.4.1 Internal and External Initiated Events

Unprevented (sometimes termed "Unmitigated") frequency level evaluation is a predominantly qualitative (or semi-quantitative) process that involves assigning a frequency level to each event (event is defined as the progression of occurrences necessary to release hazardous material/energy, i.e., from initiator, through to the point of release) in the HE Tables. The term "unprevented" is used to designate an event frequency derived during the unmitigated HE before preventive features are credited to reduce the event frequency. Frequency levels with numerical descriptions, which are based on NUREG-1520, Section 3.4.3.2 (9) Quantitative Definitions of Likelihood (Reference 3) are summarized in Table A-4, Frequency Evaluation Levels in Appendix A of the ISA Summary. Specifically, a "Highly Unlikely" event is defined as an event with a frequency less than 10^{-5} occurrences per year, while an "Unlikely" event is defined as an event with frequency range greater than or equal to 10^{-5} and less than 10^{-4} occurrences per year. An event considered to be "Not Unlikely" is defined as an event with a frequency range of greater than 10^{-4} occurrences per year. Table A-4 in Appendix A of the ISA Summary provides a ~~summation~~ summary of the frequency evaluation levels used in the hazard evaluation tables.

Identified credible events can be included in the HE Tables. A "Credible" event is considered to be an event that can reasonably occur in the absence of controls. Events determined to be not credible meet one or more of the following criteria:

1. An external event for which the frequency of occurrences can conservatively be estimated as less than once in a million years ($<10^{-6}$/yr),
2. A process deviation that consists of a sequence of many unlikely ~~human actions~~events or errors for which there is no reason or motive (In determining that there is no reason for such ~~actions~~errors, a wide range of possible motives, short of intent to cause harm, must be considered. Complete ignorance of safety procedures is possible for untrained personnel, which should be considered a credible possibility. Necessarily, no such events can ever have actually happened in any fuel cycle facility for processes similar to ACP processes), or
3. Process deviations for which there is a convincing argument, given physical laws, that they are not possible, or are ~~unquestionably~~ extremely unlikely (The validity of the argument must not depend on any feature of the design or materials controlled by the facility's system of IROFS or management measures).

Sources of event frequency could include generic initiator database information and failure rate data from other sites (of which portions may be evaluated as applicable to ACP operations), centrifuge event history, natural phenomena frequency levels, engineering calculations, analyst judgment, and enrichment process expert opinion. The frequency level is recorded in the HE Tables in Appendix C of the ISA Summary according to the Table A-4 lettering scheme. Uncertainties in frequency levels are accommodated by erring in the conservative direction from best-estimate value. This practice is particularly important when an event frequency is just below the next highest frequency level. For example, the ISA Team considers the sources of frequency-related information, the methods used to evaluate that information, and the uncertainty associated with the evaluation process. With this information, the team might collectively decide to designate an event "Unlikely" if the event has been estimated to have an event release frequency at the high (more frequent) end of the "Highly Unlikely" frequency level.

The basis for each Unprevented Event Frequency Level listed in the HE Tables is provided in Appendix E of the ISA Summary. In general, to arrive at the unprevented frequency level for an event, a frequency for the initiator is determined through engineering judgment or by using existing applicable data when available. Then given the initiator frequency, conditional probabilities for each step in the progression to a release are estimated and combined with the initiator frequency to yield an event frequency in terms of occurrences/year. During the unmitigated phase of the HA, a control is not credited for its preventive properties when estimating the unprevented event frequency (unless the control is credited as a preventive Initial Condition in the determination of the initial unprevented frequency). If an event has multiple causes, an event frequency is developed for each cause and the cumulative event frequency is used as the overall event frequency listed in the Unprevented Frequency Level column of the table.

3.1.2.3.2.2.4.2 Natural Phenomena Hazards

For Natural Phenomena Hazard (NPH) events the severity of the design basis event (DBE) and its associated return period establish the design basis for the facility. The frequency ranges provided in Appendix A of the ISA Summary, Table A-4, are used to determine the unprevented frequency level. By design, there will be no adverse consequences to the workers or the public from a DBE. A less frequent (and more severe) event is not postulated, consistent with the philosophy that the facilities are designed to withstand the DBE. The DBE frequency for the major NPH events is provided in Table A-10 in Appendix A of the ISA Summary.

3.1.2.3.2.2.5 Unmitigated Consequence Level

Event consequences are documented by specifying the impact on the receptors. For unmitigated HA purposes, consequences are defined as the dose or exposure at specified receptor locations based upon unmitigated release of hazardous material/energy. Consequences are a function of the type and characteristics of the hazard, the quantity of hazardous material/energy released, the release mechanism, relative location of the release, and any relevant transport characteristics. Consequences are determined from (1) simple source term calculations, (2) existing safety documentation, and/or (3) qualitative assessment. The ISA Team utilizes its discretion, expertise, and knowledge of facility hazards to select one or more of the above methods appropriate for consequence determination. As in frequency evaluation, the consequence errs in the conservative direction, especially for those events with consequences at the high end of a given level. During unmitigated consequence determination, a Structure, System, and Component (SSC) or administrative control is not credited for its mitigative properties (except in those cases where the control is being credited as a mitigative IC in the determination of the initial unmitigated consequences).

Consequences are evaluated at various receptor locations to assess health effects associated with the postulated event. Table A-5 in Appendix A of the ISA Summary gives the consequence levels for radiological releases and Table A-6 provides the consequence levels for chemical releases, along with their relationship to specified receptor locations, using the maximally exposed individual at each receptor location. Appendix I of the ISA Summary presents the environmental consequences to comply with the Performance Requirements presented in 10 CFR 70.61(c)(3). The consequences presented in Tables A-5 and A-6 comply with the Performance Requirements presented in 10 CFR 70.61(b)(1-4) and 10 CFR 70.61(c)(1-4). Receptors and their locations are as follows:

Off-site Off-site receptors are the public or everyone outside the site boundary or Controlled Area. Off-site exposures are conservatively estimated (semi-quantitatively) for the public at a distance from the point of release to the nearest site boundary as follows:

Facility	Off-site Receptor Distance in meters (ft)
Feed and Withdrawal Building, X-3346	500 (1,640)
Feed and Product Shipping and Receiving Building, X-3346A	500 (1,640)
Interconnecting Process Piping, X-2232C	500 (1,640)
Cylinder Storage Areas – X-745G-2, X-745H, X-7746W, and X-7746S	500 (1,640)
Transportation Routes	500 (1,640)
Process Buildings, X-3001 and X-3002 (also includes Process Support Building, X-3012)	700 (2,297)
Recycle/Assembly BuildingFacility, X-7725	700 (2,297)
Centrifuge Training and Test Facility, X-7726	700 (2,297)
Interplant Transfer Corridor, X-7727H	700 (2,297)
Customer Services Building, X-3344	500 (1,640)

WCA Workers in the Controlled Area are workers typically outside the restricted area, but within the controlled area of the site boundary. For evaluation purposes, these workers are located outside the last possible barrier from the hazard and at the worst possible location. Exposures are estimated (semi-quantitatively) for the WCA receptor at a distance of 100 meters (m). Typically, this would represent a point near to the exterior walls of the analyzed facility, but far enough outside that releases could have the potential to reach ground level. In general, exposures are calculated assuming exposure times are three minutes for pressurized release events, 20 minutes for fire events, and 60 minutes for slow release events.

WRA Workers in the Restricted Area are workers inside the facility. This category of receptors includes those workers in the immediate area of the hazard, and those workers in the same room or building who would quickly become aware of the hazardous condition and evacuate immediately. Exposures for the WRA are estimated qualitatively, but in all cases it is assumed that the WRA receives a dose at least as significant as the dose received by the WCA.

The Unmitigated Consequence Level column of the HE Tables indicate the estimated unmitigated impact of the release event on each of the three receptors in terms of the consequence bins of "High," "Intermediate," and "Low" as described in Table A-5 for radiological consequences and Table A-6 for chemical consequences in Appendix A of the ISA Summary.

Consequences are estimated from simple source term calculations, and/or qualitative assessment. Prior to determining the consequences of an airborne release of radionuclides, the Source Term (ST) for the radionuclides must be determined under the assumed conditions. Using the ST as input, the dose to each receptor is then determined.

3.1.2.3.2.2.5.1 Source Term Derivation

Radiological Consequences

In order to have conservative estimates of consequences from the accidental release of the UF_6 and UO_2F_2 inventory relating to the ACP operations, source term estimates are performed. For the type of inventory in the ACP process systems, the airborne pathway of released UF_6 and UO_2F_2 is of primary concern. The airborne source term is typically estimated by the following five-component linear equation taken from DOE-HDBK-3010-94 (Reference 7) as suggested in the *Nuclear Fuel Cycle Facility Accident Analysis Handbook*, NUREG/CR-6410 (Reference 8).

$$\text{Source Term (ST)} = \text{MAR} \times \text{DR} \times \text{ARF} \times \text{RF} \times \text{LPF}$$

where:

MAR = Material-at Risk: amount of hazardous material available to be acted upon by a given physical stress,

DR = Damage Ratio: fraction of MAR actually impacted by the accident,

ARF = Airborne Release Fraction: the coefficient used to estimate the amount of material suspended in air as an aerosol, vapor or gas and thus available for airborne transport due to physical stress from a given accident,

RF = Respirable Fraction: fraction of airborne radionuclides or chemical aerosols that can be transported through air and inhaled into the human respiratory system, and

LPF = Leak Path Factor: fraction of radionuclides or chemical aerosols in the air transported through some confinement, deposition or filtration mechanism.

The product of the MAR x DR was conservatively determined in the unmitigated analysis on an event by event basis to estimate that quantity of the available material which could be acted upon by the event, taking into consideration the nature of the event, and the distribution of the material in the vicinity of the event. The combination of ARF and RF is selected from DOE-HDBK-3010-94 (Reference 7) based on conservative assumptions regarding the physical form of the material and the available energy during an event. The ARF~~/~~ and RF values depend on the event type (e.g., fire, explosion, impact, loss of confinement) and the form of the hazardous material released (e.g., predominantly UF_6 and HF gas, uranium bearing solution, and UO_2F_2 particulate). These tabulated values may be modified by calculations based on physical properties of the materials involved and the system being evaluated. A conservative value of 1.0 is typically used for the LPF in the unmitigated analysis.

The ARFs and RFs used for the consequence determination are categorized by the release mechanism and material form. The release mechanisms used are as follows:

- Fire
  - Events where the hazardous material confinement mechanism is breached by fire or is impacted by the fire.

- Explosion
  - External Explosion – Events caused by ignition of fuels or explosive gas, e.g., hydrogen generation, vehicle fuel tanks, etc.
  - Internal Explosion – Generation of explosive concentrations of flammable gases in a steel container (centrifuge casing) as a result of decomposition of contained materials due to heat, friction, etc. triggered by heat, static charge, or spark.
  - Pressurized release – Material is vented out of a container due to built up pressure.

- Loss of Containment/Confinement
  - Ambient release – Breach events with resulting release of material (e.g., leaks, etc.)
  - External Impacts/Fall – Mishandling and dropping events, impacts from external sources.

The material form during a release is:

- Predominantly Gas – UF_6 and HF from the reaction of UF_6 with moist air.
- Particulate – UO_2F_2 from the reaction of UF_6 with moist air, and UO_2F_2 stored in B-25 boxes.
- Liquid – waste containing uranium bearing solution stored in the Satellite Accumulation Areas throughout the ACP facilities.

The ARFs and RFs listed in Table 4.4-1 of the ISA Summary were taken from the DOE Handbook on Airborne Release Fractions/Rates, DOE-HDBK-3010-94 (Reference 7). The bounding release fractions were selected.

Once doses for the Public and WCA receptors are determined, these consequences are assigned as "High," "Intermediate," and "Low" according to Table A-5 in Appendix A of the ISA Summary using the radiological consequence levels for each specified receptor. For events not involving radiological consequences, the radiological consequence level is designated as "NA" (Not Applicable). The indicated consequence level bin (High, Intermediate, Low) for the WRA receptor, however, is selected qualitatively by identifying the calculated 100 m (WCA) receptor dose for each event as an initial baseline reference point. For release events, the WRA would be aware of a nearby release, as UF_6 releases are readily identified by sight, unpleasant odor, and physical discomfort if inhaled. Thus, it was assumed that the WRA would promptly relocate to avoid the release. For these events, the WRA consequence level was assumed to be equal to the WCA receptor, who is assumed to be unaware of the release.

WRA exposure equivalent to the WCA exposure is explained by using a simple expanding gas hemisphere as a release model in most cases. Assuming that the gas hemisphere radius expands at a rate of 1 m/s and the receptor walks away from the release point at 1 m/s within the cloud, it can be shown that the airborne chemical concentration levels drop off by approximately a factor of 100 within a radius of approximately 40-50 m. Workers in restricted areas could evacuate at a faster rate, putting themselves ahead of the leading edge of the expanding cloud or minimizing exposure during evacuation even if they evacuate in the direction of the plume.

~~For criticality events, since the consequences only take place in a localized area (well under 100 meter distance), the dose received by the WRA is assumed to be "High" and the dose expected for the WCA and the Off-site public is assumed to be "Low."~~

Chemical Consequences and Chemical Consequence Standards

Exposure levels resulting from the accidental release of UF_6/HF were semi-quantitatively, or in the case of the WRA, qualitatively, assessed to determine airborne concentrations at each receptor. Each chemical release consequence is evaluated using the source term equation above, incorporating the same DR, ARF x RF values that were applied in the radiological consequence analysis in order to conservatively estimate the amount of UF_6/HF that becomes airborne (source term) as a result of the event. In general, the maximum off-site and on-site concentrations are then calculated by multiplying the source term by an appropriate dispersion factor (Π/Q) for the respective locations (WCA: 100 m, and Off-site: 500 m or 700 m). Similar to the radiological case above, downwind airborne concentration values for UF_6/HF releases are estimated using a Π/Q spreadsheet that calculates straight-line Gaussian plume dispersion for the receptors of interest. For the WCA, Π/Q is evaluated with a wind speed of 4.5 m/s and D atmospheric stability class. For the off-site public, Π/Q is evaluated with a wind speed of 1.0 m/s and F atmospheric stability class. Release duration depends on the nature of the event. Explosion, fire, and impact/leak events are assumed to have a 3-minute, 20-minute and 8 hour release duration, respectively. For fire events that do not involve any cylinders, the release will be assumed to occur over 20 minutes to account for the time to involve sources and breach of containment. When a cylinder is subject to fire, the internal pressure of the cylinder will build up to the rupture pressure resulting in a sudden release. In the ISA, the fire induced cylinder rupture is treated as explosion with a 3-minute release duration. The 8-hour time for impact/leak events reflects the expected conditions for low-energy steady-state releases resulting from simple breach of containment events. Although release rates varied, once the material was released from its confinement, LPFs from the building were assumed to be 1.0 for events in the unmitigated consequence analysis.

In the ISA, two simple diffusion models were developed as source term input into the straight-line Gaussian plume model spreadsheet based on a calculation for molecular diffusion from breaches in the UF_6 confinement in which no heating is involved. For releases not resulting from fire, the pre- and post-processing steps to account for plume rise and heavy gas behavior become less critical to the evaluation. The HGSYSTEM code, which is a refined Gaussian model, is not necessary to achieve the appropriate level of accuracy in this situation. Even for releases from cylinders containing liquid UF_6, the key is the size of the release relative to the surrounding atmosphere. For the liquid cylinder drop event, a flash model is developed for the evaluation of the source term. The ISA does not attempt to develop a cylinder fire model but instead uses the results from the simulation analysis used in the Cylinder Yard SAR (Reference 23). For additional detail with regard to chemical consequence determination for specific events and groups of similar events, refer to Appendix D, Event Consequence Development, of the ISA Summary.

The calculated airborne concentrations from the release and dispersion models estimated at the receptors of interest are then compared to the chemical consequence limits selected by the ISA Team. The chemical consequence limits selected are the Emergency Response Planning Guidelines (ERPGs) given in Table A-6 of Appendix A of the ISA Summary. The ERPGs are airborne concentration limits used for emergency response personnel, below which are believed that nearly all individuals could be exposed for up to one hour without experiencing certain health effects. The ERPG-1, ERPG-2, and ERPG-3 values for UF_6 are 5 mg/m^3, 15 mg/m^3, and 30 mg/m^3, respectively. Since UF_6 can readily react with the moisture in the air forming uranium compounds and HF, the chemical effects of HF have to be considered also. The ERPG-1, ERPG-2, and ERPG-3 values for HF are 1.5 mg/m^3, 16.4 mg/m^3, and 41 mg/m^3, respectively. Special ERPG values for 10-minute exposures are also used for HF, with the ERPG-1, ERPG-2, and ERPG-3 values being 1.5 mg/m^3, 41 mg/m^3, and 139 mg/m^3, respectively (Reference 9). Instead of using the ERPG values for uranium compounds, the ISA uses the uranium intakes of 10 mg, 30 mg, and 40 mg as the equivalency for ERPG-1, ERPG-2, and ERPG-3, respectively (Reference 10). From Table A.1-1 (Reference 11), the 50 percent lethality limit of soluble uranium compounds uptake is 1.63 mg U/kg body weight. With a 50 percent retention, it can be shown that the 50 percent uranium lethal intake is 228 mg for a person of 70 kg (154.4 lb). As a result, the ISA uses a 40 mg intake, which is approximately half of the 50 percent lethal intake as the equivalency of the ERPG-3. Comparison of the calculated chemical airborne concentrations at the receptor to the appropriate ERPG values (or uranium intake values) allows the assignment of a chemical consequence level of High, Intermediate, or Low to each receptor as outlined in Table A-6. For events not involving chemical consequences, the chemical consequence level is designated as "NA" (Not Applicable). Unless otherwise stated, exposures are assumed to be for one hour for all receptors and the one-hour ERPG values will be used.

High consequences for the Off-site receptor are generally based on airborne concentrations exceeding the ERPG-2 value (or 30 mg uranium intake), while Intermediate consequences to the Off-site receptor are based on exceeding the ERPG-1 value (or 10 mg uranium intake). High consequences to the WCA and WRA receptors are based on airborne concentrations exceeding the ERPG-3 value (or 40 mg uranium intake), while intermediate consequences to the WCA and WRA receptors are based on concentrations exceeding the ERPG-2 value (or 30 mg uranium intake). For those events that involve only the release of UF_6 from cylinders or pipes in the absence of fire, the rate of diffusion of UF_6 is generally very low such that the UF_6 has sufficient time to react with air and the product UO_2F_2 has time to deposit or plate out. Only the peak HF concentrations are used to compare with the ERPG values for both on-site and off-site receptors during these events. The consequence classification for HF is based upon the peak HF concentration at any time during the event.

Environmental Consequences

Environmental consequences were addressed by the ISA Team when considering the credible accident scenarios where release quantities exceeded the levels established by the Performance Requirements of 10 CFR 70.61(c)(3). The methods used and results are provided in Appendix I of the ISA Summary.

3.1.2.3.2.2.6 Unmitigated Risk Level

Using event frequency and consequence levels, the events are "binned" in frequency-consequence space to assess relative risk in accordance with 10 CFR 70.61. A risk rank for each receptor is individually determined for both radiological consequences and chemical consequences. The objective of risk binning is to focus attention on those events that pose the greatest risk to the public and workers. Higher risk events are candidates for additional analysis and/or selection of IROFS to reduce the risk.

Tables A-7, A-8, and A-9 in Appendix A of the ISA Summary are risk binning matrices for the three receptor locations considered in the ISA [i.e., WRA (close-in), WCA (100 m), and Off-site (500 m or 700 m)]. Table A-7 is the risk binning matrix for the Worker in the Restricted Area, who is typically located anywhere inside the facility with the hazardous release or hazardous condition. Table A-8 is the risk binning matrix for the Worker in the Controlled Area

(100 m receptor) located outside the facility. Table A-9 is the risk binning matrix for off-site receptors (Public).

In each of these tables, a rectangular matrix defines bins in frequency-consequence space. Each bin that is lettered with the letter "A" indicates that 10 CFR 70.61 Performance Requirements are exceeded, in which case IROFS must be implemented to reduce the risk. Alternately, bins designated with the letter "B" indicates that 10 CFR 70.61 Performance Requirements are met, and no IROFS are required.

Accidents that are considered not to be "Credible" are generally not shown, but would have a risk rank of "B." Accidents that have Low consequences have a risk rank of "B." In either case, the risk rank of "B" requires no further analysis or designation of IROFS to control risk (unless the control is an IC, in which case the control would be designated as an IROFS).

The HE Tables in Appendix C of the ISA Summary provide a bin letter in the unmitigated risk level column for both radiological and chemical consequences, representing risk for each receptor location for each of the postulated events.

3.1.2.3.2.3 Available Preventive and Mitigative Controls

3.1.2.3.2.3.1 Preventive Controls

A preventive control is any feature that may be relied upon to reduce the frequency of a hazardous event (up to the point of release of hazardous material/energy). The selection of preventive controls is made without regard to any possible pedigree of the feature such as procurement level or current classification. Preventive controls might include engineered features (e.g., SSCs), administrative controls (e.g., operator actions), natural forces or physical phenomena (e.g., ambient conditions, buoyancy, gravity), or inherent features (e.g., physical or chemical properties, location, elevation) operating individually or in combination. Controls that could serve preventive functions are listed in the Preventive Controls column of the HE Tables, and are sub-divided into administrative and engineered (design) controls for each event. It is from this list that the controls needed to prevent hazardous events are selected. The ISA Team utilize this list to select and subsequently credit preventive controls as IROFS to reduce the frequency of the postulated release events. The prevented event frequency as given for a particular event takes into account any credited (bolded) preventive controls (preventive IROFS) in the HE Tables which act to reduce the frequency of the event (i.e., to reduce the frequency of the initiator and/or to reduce the ~~frequency~~ probability of the progression of occurrences which ultimately lead to the release of hazardous material/energy).

3.1.2.3.2.3.2 Mitigative Controls

Mitigative controls are any features that could reduce the consequences associated with the release of hazardous material/energy. The identification of such controls is made without regard to any possible pedigree of the feature such as procurement level or current classification. Mitigative controls are those that are assumed to be operable during an event or post event, and are not required to be operating prior to the event initiation. Therefore, mitigative controls must be capable of withstanding the environment of the event. These might include engineered features (e.g., SSCs, detection systems), administrative controls (e.g., operator actions), natural forces or physical phenomena (e.g., ambient conditions, buoyancy, gravity), or inherent features (e.g., physical or chemical properties, location, elevation) operating individually or in combination. Controls that could serve mitigative functions are listed in the Mitigative Controls column of the HE Tables, and are sub-divided into administrative and engineered (design) controls for each event. It is from this list that the controls needed to mitigate hazardous events are selected. The ISA Team utilize this list to select and subsequently credit mitigative controls (mitigative IROFS) to either reduce the material released once a release occurs, or reduce the consequences of the release event to the receptors of interest.

3.1.2.3.2.3.3 Subdivision of Preventive and Mitigative Controls

Preventive and mitigative controls can be subdivided into active engineered controls, passive engineered controls, and administrative controls. Active engineered controls are physical devices that use active sensors, electrical components, or moving parts to maintain safe process conditions without any required human action. Passive engineered controls are devices that use only fixed physical design features to maintain safe process conditions without any required human action. Administrative controls are procedurally required or prohibited actions, combined with or without a physical device that alerts the operator that the action is needed to maintain safe process conditions, or otherwise adds substantial assurance of the required human performance.

3.1.2.3.2.4 Control Selection and Mitigated Hazard Evaluation Development

Following the Unmitigated Hazards Evaluation step, controls were identified using the methodology given in NUREG-1520 (Reference 3) for designation as IROFS. The controls selected as IROFS are necessary to bring the risk of unprevented and unmitigated accidents to within the Performance Requirements of 10 CFR 70.61, or to capture Initial Conditions that were established in the unmitigated Hazards Analysis as safety basis controls. Controls include engineered controls such as SSCs and also administrative controls or programs that provide a safety function. Defense in Depth (DID) concepts utilizing non-credited controls were also incorporated into the control strategy for a postulated event whenever possible.

3.1.2.3.2.4.1 Control Selection Method

First, candidate non-credited controls for each postulated event are listed in the Preventive Controls Column and Mitigative Controls Column of the HE Tables in Appendix C. The candidate controls for each event can then be either: 1) credited as IROFS, if necessary, to prevent or mitigate a release event, or 2) remain non-credited controls, which are available to provide DID, but which require no control "pedigree." For those events in which the unmitigated risk exceeds Performance Requirements of 10 CFR 70.61, appropriate controls are required to be selected from the candidate controls and credited as IROFS in preventing and/or mitigating the subject event until the mitigated risk is within the Performance Requirements. Other controls which exist but which are not selected and designated as IROFS, provide a DID function.

The unprevented frequency and unmitigated consequences of each event are compared with the 10 CFR 70.61 Performance Requirements for each receptor. These Performance Requirements for each of the three receptors (WRA, WCA, and Off-site) are presented in Tables A-7, A-8, and A-9 in Appendix A of the ISA Summary. Those unmitigated events whose risk exceeded the 10 CFR 70.61 Performance Requirements were marked for control selection to reduce the event frequency or mitigate the event consequences to within the Performance Requirements. Preventive controls that were credited for reducing the frequency in the Mitigated HA columns are set in bold font type followed by IROFS numbers in the HE Tables Preventive Controls column and are also provided in the List of IROFS in Section 7.2 of the ISA Summary. The prevented event frequency given for a particular event takes into account any credited (bolded) preventive controls in the HE Tables, which act to reduce the frequency of the event. Preventive controls not explicitly credited in this way to reduce frequency provide DID. Similarly, mitigative controls that were credited in mitigating consequences are set in bold font type followed by IROFS numbers in the HE Tables Mitigative Controls column and are also provided in the List of IROFS in Section 7.2 of the ISA Summary. The mitigated consequences estimated for a particular event takes into account any credited (bolded) mitigative controls in the HE Tables which act to reduce the severity, material released, or dose (or chemical exposure) due to the event.

Table F-1 in Appendix F of the ISA Summary, a control selection table for risk reduction, was developed by the team for each unmitigated event with risk exceeding the established Performance Requirements to record the process of selecting controls that would reduce the frequency of, and/or lessen the severity of, each applicable event to within the Performance Requirements. The table presents the credited risk reduction to the applicable receptors for each credited control (i.e., IROFS). Estimated frequency reduction values for each credited preventive IROFS were given to arrive at a "prevented" event frequency for each event cause. Similarly, estimated consequence (dose or chemical exposure) reduction values for each credited mitigative IROFS were presented to arrive at a mitigated consequence for each receptor. The prevented frequency and the reduced consequence level for receptors that did not require controls (i.e., those receptors with an unmitigated risk in the "B" risk bin) are designated as "NA."

3.1.2.3.2.4.2 Control Selection Preference

In general, controls were selected using an order of preference. The first controls credited were the "see and flee" controls, which include Emergency Response Actions; Alert, Notification, and Protective Actions; and Trained Operator Actions. These controls are credited with reducing potential radiological and chemical consequences to all receptors. These controls were applied first, as crediting receptors with minimizing their exposure to a hazardous chemical release is a control of very high reliability. Then, additional controls were applied, as necessary, with preference given to certain types of controls over other types of controls. In general, available preventive controls were generally selected before additional mitigative controls so as to prevent or reduce the frequency of the event rather than attempt to mitigate the event consequences after the event has occurred. If available, engineered or designed controls were selected before administrative controls to utilize the inherent reliability advantage of designed systems or components over that of required human action compliance. In the case of engineered controls, where possible, passive engineered controls were generally selected before active engineered controls due to the increased reliability of a passive engineered feature. Factors such as reliability, durability, life cycle cost, facility operating life, applicability to multiple events, etc. were also considered during control selection and had some influence on the preferred selection strategy.

3.1.2.3.2.4.3 Preventive or Mitigative Value of Control

While it is often difficult to estimate the value of a specific control in providing event frequency reduction or consequence mitigation, several general guidelines were used to assist in control value estimation, in the absence of more detailed information.

3.1.2.3.2.4.3.1 Preventive Control Value

With regard to preventive controls, a passive engineered control (such as a nozzle or orifice in limiting flow, or a concrete jersey barrier for limiting vehicle access or impacts) would typically be credited as providing a frequency reduction of three orders of magnitude (frequency may be reduced by 1×10^{-3}). An active engineered control (such as negative pressure ventilation system, an automatic valve or an automatic fire suppression system) would be credited as providing a frequency reduction of two orders of magnitude (frequency may be reduced by 1×10^{-2}). An administrative control (such as operator actions) would typically be credited as providing a frequency reduction of only one order of magnitude (reduced by 1×10^{-1}) due to the potential for human error. These values are supported by, and are generally more conservative than the example control values outlined in Table A-10 of Appendix A of the ISA Summary as compared to Chapter 3 of NUREG-1520 (Reference 3). It should be noted that these are general preventive control values that the ISA Team considered as a starting point. Any vulnerabilities or strengths in a particular control could be reason for the team to vary the general value of these types of controls for the specific situations involved in a particular event.

3.1.2.3.2.4.3.2 Mitigative Control Value

Mitigative controls reduce either the amount of material released, or the potential dose or airborne chemical concentration to a receptor attributed to the release. The value of the mitigative control varies with the effectiveness of the control with relation to the nature and energy of the release event. For instance, the value of certain mitigative controls (e.g., HEPA filtration) may be fairly easy to quantify. As a general example, HEPA filtration incorporates an engineered efficiency of approximately 99.9 percent, and therefore may be confidently considered to reduce the dose to an external receptor by three orders of magnitude (dose reduction by approximately 1,000) due to the efficiency of the filtration mechanism (given that the released hazardous material, in fact, follows the filtered release path and the filter survives the event intact). In some events, a mitigative control such as a centrifuge casing was credited with sufficient confinement capability relative to the nature of the event, so as to limit the subsequent doses to receptors.

However, the determination of the mitigative value of an administrative control such as worker evacuation from the immediate scene of an unfiltered radiological or chemical release is more subjective and difficult to quantify. The ACP utilizes a "See and Flee" policy to protect the health and safety of workers who may encounter a release of UF_6 or other hazardous material. The policy is for employees to promptly move to a safe location away from the immediate release area. The "See and Flee" policy has been utilized effectively at the gaseous diffusion plants for numerous years, in conjunction with other plant programs/controls, in limiting exposures to plant workers to safe levels (thousands of hours of operation with hundreds of thousands of pounds of in-process UF_6 at pressures much greater than the pressures in the ACP). The results have been minimal exposure to workers, even from a sizable release. In addition, experience indicates that workers can readily recognize even incidental releases of UF_6 and take appropriate actions to evacuate the area of the release. "See and Flee" is credited with mitigative values on a case-by-case basis, with appropriate consideration that the worker in the vicinity of the release has the ability to evacuate due to the conditions likely to be present during the postulated accident scenarios. In general for this analysis, the worker's ability to recognize a radiological or chemical upset condition and immediately evacuate the area was qualitatively estimated to reduce the dose to the worker by a range of approximately two to three orders (1/100 to 1/1,000) of magnitude. This value is subjective and may vary on a case-by-case basis depending on the nature and rapidity of the event, worker awareness, available egress routes, and the ability and time to take protective action (evacuation). In general, the ISA Team considered that WCA protective actions were also worth approximately two orders of magnitude (1/100) consequence reduction, again subject to specific event conditions. For the Off-site Public, the mitigative control of alert/notification and sheltering/evacuation was deemed by the ISA Team to result in a conservative consequence reduction of only one order of magnitude (1/10), in that the response of the public is considered to be less reliable than that of trained site workers. Refer to Tables F-1 through F-11 and the associated text in Appendix F of the ISA Summary for the values assigned to each credited preventive and mitigative IROFS for each event cause and receptor.

Controls were required to be credited in all events for which the unmitigated risk exceeded 10 CFR 70.61 performance requirements. In addition, for certain events (including events whose unmitigated risk did not exceed performance requirements), Initial Conditions may have been credited inherently in the unprevented frequency and unmitigated consequences for certain events, by initially limiting the frequency or consequences of the event. For example, for the massive river flooding event, the location and elevation of the site well above the Maximum Probable Flood crest level was credited as an initial condition in establishing the unprevented frequency for the event in the "Highly Unlikely" frequency level. The team would look for and capture these types of Initial Conditions as an inherent credited control (an IROFS) for that event, regardless as to whether the unmitigated risk associated with the event exceeded Performance Requirements.

3.1.2.3.2.4.4 Control Selection Results

The credited controls identified for each event were grouped and consolidated, and are presented in Table 7.2-1 of the ISA Summary, including controls credited as initial conditions. Table 7.2-1 presents grouped controls under an appropriate Control Strategy heading, whether the control constitutes a design feature, or an administrative control, and the applicable event(s) from the HE Tables in Appendix C of the ISA Summary to which the control applies. A description of each credited control (i.e., IROFS) is also given in Chapter 7.0 of the ISA Summary including the safety function and credited attributes of the control. IROFS are also denoted by controls listed in bold type followed by IROFS numbers in the Preventive and Mitigative Controls column of the HE Tables in Appendix C of the ISA Summary. As previously noted, the preventive and mitigative reduction values of these IROFS are presented in Tables F-1 through F-11 and the associated text of Appendix F of the ISA Summary for each event.

3.1.2.3.2.4.5 Implementation of Controls

Procedural IROFS listed in Table 7.2-1 of the ISA Summary and IROFS which involve operation of equipment to perform the safety function, also require associated training conducted to familiarize Workers with the procedure and/or equipment. In addition, for each SSC credited as an IROFS, periodic surveillances (inspections) and preventive maintenance should be developed for the SSC during implementation, as validation of the operability of the SSC. Other general programmatic controls such as facility configuration control and inventory control are not specifically identified or credited as an IROFS for each event, although implementation of these controls is assumed to maintain the continuing validity of the IROFS.

3.1.2.3.2.5 Mitigated Risk Level

Once the prevented event frequency and mitigated consequence levels are determined from the crediting of IROFS, the events are risk-binned again in frequency-consequence space to assess the mitigated risk relative to 10 CFR 70.61 Performance Requirements. Similar to the unmitigated analysis, Tables A-7, A-8, and A-9 are also used as the risk binning matrices for the mitigated risk comparison for each receptor (WRA, WCA, and Off-site, respectively). Following the crediting of IROFS, the mitigated risk for the event is expected to fall in a bin designated "B," indicating the Performance Requirements have been met. If the mitigated risk bin remains within the "A" designation indicating the Performance Requirements are still exceeded, then either additional analysis must be performed, or additional IROFS must be identified and credited. The mitigated risk level for receptors that did not require controls (i.e., those receptors with an unmitigated risk in the "B" risk bin) is designated as "NA." While not preferred, in the event that no additional IROFS are available or no more refinement is to be gained from any additional analysis that might confirm a reduced risk when compared to that previously estimated in the unmitigated Hazard Evaluation, then the NRC may at their discretion, consider acceptance of a "Residual Risk" from the event to Workers or to the Public.

3.1.2.3.2.6 Evaluation of Mitigative IROFS Failure

A consideration in the identification of mitigative IROFS is the possibility that these controls could fail to perform their safety functions. Given this possibility, events for which mitigative controls were credited were evaluated to examine the residual risk associated with the postulated failure upon demand of each mitigative IROFS. The approach used in this evaluation develops a series of sub-events designed to demonstrate that the risk of the event following failure of one or more of the credited mitigative controls is still within the 10 CFR 70.61 Performance Requirements. This evaluation is summarized in Appendix K of the ISA Summary.

The sub-events involve postulating the simultaneous occurrence of the primary event AND the failure upon demand of one or more of the mitigative IROFS. The ~~frequency~~ probability of failure upon demand of mitigative IROFS was developed in a manner similar to that for assigning preventive values to IROFS described in Section 3.1.2.3.2.4.3.1. Each sub-event is then evaluated in the same manner as that described in Sections 3.1.2.3.2.2, 3.1.2.3.2.3, and 3.1.2.3.2.4. In some cases, the likelihood of the combination of the primary event and the failure of mitigative IROFS fall in the Highly Unlikely frequency range. In these cases, no further evaluation is necessary. In other cases in which the resulting frequency of the primary event in combination with the failure of a mitigative IROFS falls in either the Not Unlikely or the Unlikely frequency range, the consequences of those "combination events" must be shown to be sufficiently low such that the final risk still falls in the "B" risk bin.

3.1.2.3.2.7 Evaluation of Criticality Events for Commercial ACP Operation

The methodology utilized for evaluating criticality events for the commercial ACP operations (i.e., non-HALEU) is described in this section. The method for evaluating criticality events for HALEU Demonstration is described in Section 3.1.2.3.2.8. Additionally, changes to criticality accident sequences for commercial plant (i.e., non-HALEU ACP) will be performed using the methodology provided in Section 3.1.2.3.8.

Criticality Events are derived and evaluated in a similar manner as radiological and chemical release events are revised and evaluated. Reviews are conducted of the ACP facilities and operations to determine the hazards that are present then further review is conducted to determine the credible accident sequences. The credible accident sequences are evaluated to determine the potential consequences and the frequency with which the accident sequences could occur assuming no controls. Criticality events are assumed to have high consequences in a localized area, so they must be made "Highly Unlikely." (For criticality events, since the consequences only take place in a localized area (well under 100 meter distance), the dose received by the WRA is assumed to be High and the dose expected for the WCA and the Off-site public is assumed to be Low.) No mitigative controls are available to reduce the assumed high consequences to within the 10 CFR 70.61 Performance Requirements.

In addition to the requirement to make high consequence events "Highly Unlikely," criticality events must have double contingency controls. For the initial ACP ISA effort, Nuclear Criticality Safety (NCS) Reports were generated to document the NCS analysis of the general ACP facilities and operations. The NCS Reports identified "What-If" events to assist in the establishment of double contingency controls as required by 10 CFR 70.24.

A review of the NCS Reports was conducted and documented within an Engineering Evaluation (Reference 15) to ensure the "What-If" events were adequately addressed by criticality event sequences. Those "What-If" events determined not to credibly contribute to a criticality event were documented as such. Those "What-If" events determined to credibly contribute to a criticality event were documented in the ISA and evaluated to ensure the frequency of the associated criticality event was "Highly Unlikely" by identifying appropriate IROFS as necessary. Release events that could lead to a subsequent criticality that have been made "Highly Unlikely" due to chemical consequences require no further analysis for subsequent criticality concerns, as the initiating release is already "Highly Unlikely."

As the ACP design is finalized, NCS Evaluations (NCSEs) will be generated to document the NCS analysis of the specific ACP facilities and operations. Similar to the review performed on the NCS Reports, a review of the NCSEs will be conducted and documented to ensure the NCSE "What-If" events are adequately addressed by criticality event sequences. The NCSEs will be reviewed to ensure agreement with the ISA. Any required ISA changes will be processed in accordance with 10 CFR 70.72 requirements.

Finally, consideration for chemical release events was made to address the large release events that were mitigated to be "Low" consequences, but could still release hazardous material in quantities that exceed the minimum critical mass (20 kg UF_6 at 10 wt. percent ^{235}U per Reference 16). Appropriate additional controls were credited as necessary to ensure a subsequent criticality to those release events was "Highly Unlikely."

3.1.2.3.2.8 Evaluation of Criticality Events for HALEU Demonstration

The method for evaluating criticality events for HALEU Demonstration is described in this section, in conjunction with the following aspects of Section 3.1.2.3.2, "Hazard Evaluation," of the ISA Summary that apply to both criticality and non-criticality events: (1) the use of initial conditions from Section 3.1.2.3.2.1, (2) the criteria for events that are considered "Credible" from Section 3.1.2.3.2.2.4.1, and (3) consideration of Natural Phenomena Hazards from Section 3.1.2.3.2.2.4.2. Other aspects of the methods described in this and other portions of Section 3.1.2.3.2 of the ISA Summary do not apply. With regard to consequence, criticality is presumed to be "high consequence." Since the consequences only take place in a localized area (well under 100 meter distance), the dose received by the WRA is assumed to be High and the dose expected for the WCA and the Off-site public is assumed to be Low. Mitigative controls are not applied. The method used for hazard evaluation of criticality events is described below.

The evaluation of HALEU Demonstration Criticality Events was performed in accordance with the deterministic, parameter-based approach of NUREG-1520, Chapter 5, Appendix C, "Example Procedure for Subcriticality Evaluation." This method demonstrates compliance with the requirement of 10 CFR 70.61(d) to ensure that, under normal and credible abnormal conditions, all nuclear processes are subcritical, including an approved margin of subcriticality for safety. As stated in NUREG-1520, Chapter 5, Appendix A, "Nuclear Criticality Safety Performance Requirements and Double-Contingency Principle" (DCP), 70.61(d) is more restrictive than 70.61(b), and "if one meets § 70.61(d), then one also automatically meets § 70.61(b)." Whereas "the spectrum of credible abnormal conditions in 10 CFR 70.61(d) need not consider upsets beyond those required for compliance with the double contingency principle", "adherence to the DCP can be one means of meeting the performance requirements of § 70.61(d) (and therefore also § 70.61(b))." This deterministic approach of NUREG-1520, Chapter 5, Appendix C was selected for evaluating criticality hazards in the HALEU Demonstration ISA because it is based on the traditional, time-tested approach to NCS as endorsed in Chapter 5 of NUREG-1520, with its long track record of safety in the nuclear fuel industry.

Criticality Events for the HALEU Demonstration Project were derived and evaluated through the process of generating Nuclear Criticality Safety Evaluations (NCSEs). The NCSEs were developed using a parameter-based method that begins with "a consideration of normal and abnormal conditions." Such an approach provides assurance that all conditions that can lead to an inadvertent criticality are identified. Controlled parameters, and limits on those parameters, are identified to ensure subcriticality. The specific controls with the safety function of maintaining controlled parameters within their safety limits are documented in NCSEs. Systems of controls which together perform the same safety function (i.e., maintain a particular safety limit) may be grouped together in items relied on for safety (IROFS). Failure of an IROFS is considered to have occurred when it fails to perform its safety function (*i.e.*, when the associated safety limit is exceeded).

Demonstration of subcriticality under 10 CFR 70.61(d) is done through means of compliance with the DCP which requires at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible. The following guidance is provided on the various terms in the definition of the DCP.

- *Unlikely* changes in process conditions should be expected to occur rarely, or not at all, during the lifetime of the facility. Operational events that occur regularly should not be credited as a contingency relied on to meet the DCP (although they may constitute part of a contingency if a combination of events may be considered unlikely).

- *Independent* changes in process conditions are such that one contingency neither causes another contingency nor increases its likelihood of occurrence. The existence of any credible common-mode failure of both contingencies means that it is not valid to consider them independent. Therefore, independent changes in process conditions are ensured by following the preference for control of diverse parameters or, when relying on single-parameter control, demonstrating the lack of any credible common-mode failure.

- *Concurrent* does not mean that the two changes in process conditions must occur simultaneously, but that the effect of the first contingency persists until the second contingency occurs. Therefore, concurrence of changes in process conditions is addressed by providing means for prompt detection and correction of abnormal conditions (e.g., periodic surveillance, process monitoring).

- *Changes in process conditions* do not imply that reliance on two different parameters is mandatory to satisfy the Double Contingency Principle. Reliance on two different parameters is preferred over reliance on multiple controls on a single parameter. It is difficult to achieve complete independence when controlling one parameter. In those cases in which single parameter control cannot be avoided, the analysis in the applicable NCSE will ensure and document that no common-mode failures exist.

As stated in NUREG-1520, Chapter 5, Appendix A, the DCP is sufficient for satisfying the 70.61(b) criterion as well when:

1. Controls are established on system parameters to preclude changes in process conditions, and these controls are designated as IROFS;

2. The condition resulting from the failure of a leg of double contingency has been shown to be subcritical with an acceptable margin; and

3. Controls are sufficiently reliable to ensure that each change in process conditions necessary for criticality is "unlikely." Management measures are established to ensure they are available and reliable to perform their safety function.

To provide additional guidance for satisfying the criteria discussed above, NUREG-1520, Chapter 5, Appendix A contains several examples of scenarios implementing the Double Contingency Principle that are stated as satisfying the performance requirements of 10 CFR 70.61. For scenarios that can be shown to satisfy the Control Sets below, no additional justification is needed for why the performance requirements of 10 CFR 70.61 are satisfied.

Control Set A: *A passive geometry control in which no credible failure mode (e.g., bulging, corrosion, or leakage) exists and which has been placed under configuration management.* An example scenario consistent with this definition is a favorable geometry vessel in a benign environment for which corrosion or degradation is not credible, vessel construction is so robust that a leak is not credible, and there is no credible means for the material to accumulate in an unfavorable configuration.

Control Set B: *Two passive controls in which there is a credible failure mode, and there are sufficient management measures to ensure the controls continue to perform their safety functions (e.g., periodic surveillance to detect corrosion/bulging).* An example scenario consistent with this definition is a storage array in which fissile material is stored in fixed geometry containers, and the spacing between containers is provided by fixed devices, with geometry and spacing controls ensured by the configuration management program and by periodic walkthroughs of the storage array process area.

Control Set C: *One passive control under configuration management and one active engineered control whose reliability is ensured by periodic functional testing, maintenance, and an alarm to automatically indicate its failure.* An example scenario consistent with this definition is a calciner relying on geometry and moderation control in which geometry control is provided by limiting the calciner interior to the height of a single layer of fissile material boats, and moderation control is provided by monitoring of the calciner temperature. Temperature control is ensured by thermocouples that alarm if the temperature drops below a minimum set-point.

Control Set D: *One engineered and one enhanced administrative control in which the instrumentation and devices included in the administrative control are subject to periodic functional testing and maintenance, and the operator action is performed routinely or reinforced by periodic drills and training.* An example scenario consistent with this definition is a vessel in which the volume of fissile solution is controlled by the diameter of the tank and by procedurally limiting the solution height. In addition, the operator actions are supported with a high-level switch equipped with an alarm.

Control Set E: *One engineered control and one simple administrative control in which the reliability of the administrative control is subject to a high degree of redundancy.* An example scenario consistent with this definition is a solution transfer from favorable to unfavorable geometry relying on two controls on concentration. Two different operators are required to draw separate samples which are then analyzed in the laboratory by two different methods and shown to be within concentration limits before transfer is authorized. In addition, the area supervisor maintains control of a key to the transfer pump so that the procedure may not be inadvertently bypassed. These operator actions are backed up with an in-line sodium iodide detector that automatically closes an isolation valve if concentration limits are exceeded.

Control Set F: *Two administrative controls that are independent (e.g., performed by different individuals or verified by a supervisor), for which human factors have been considered in the design of the process such that the operation is not prone to error, and there is sufficient margin to require multiple failures before the criticality control limit can be exceeded.* An example scenario consistent with this definition is a glovebox relying on dual mass control in which two operators or an operator and a supervisor must confirm that placing material into the glovebox will not result in the mass limit being exceeded. In addition, criticality would require the mass limit to be exceeded multiple times, which would be difficult to achieve and would be readily apparent.

The Control Set being referenced as a basis for satisfying the Double Contingency Principle for a given HALEU Demonstration Criticality Event is documented in the appropriate Double Contingency Evaluation Table for HALEU Demonstration Criticality Events, contained in Appendix C of LA-3605-0003A, *Addendum 1 of the Integrated Safety Analysis Summary for the American Centrifuge Plant – HALEU Demonstration* (Reference 21). Additional justification is provided for any scenario that does not fall into one of the above Control Sets (e.g., by ensuring there is no credible event leading to criticality, or by crediting natural and credible course of events). An example of this type of scenario is a facility storing contaminated soil or equipment with a very low uranium concentration in which there is no known concentration mechanism that can lead to a critical configuration.

The Control Sets satisfy the requirements of the Double Contingency Principle and the performance requirements of 10 CFR 70.61 (b) and (d), and are summarized in Table A-1 of Appendix A of LA-3605-0003A (Reference 21).

3.1.3 Management Measures

ACP IROFS are identified in the ISA Summary. Management measures are utilized to maintain the IROFS so that they are available and reliable to perform their safety functions when needed. Management measures are the principal mechanism by which the reliability and availability of each IROFS is ensured. Management Measures are described in Chapter 11.0 of this license application. Any IROFS deficiencies are addressed in accordance with the Corrective Action Program.

3.2 Integrated Safety Analysis Summary

An ISA Summary for the ACP (Reference 1) and *Addendum 1 of the ISA Summary for the ACP – HALEU Demonstration* (Reference 21), meeting the requirements of 10 CFR 70.65(b) was prepared in accordance with the guidance contained in Chapters 3.0 and 5.0 of NUREG-1520, *Standard Review Plan for the Review ~~of a License Application for a~~ Fuel Cycle ~~Facility~~Facilities License Applications,* and NUREG-1513, *Integrated Safety Analysis Guidance Document*. The ISA Summary is being submitted for review (separate from this license application).

3.3 Items Relied on For Safety Boundary Definition

In order to ensure IROFS are available and reliable, their boundaries must be clearly established. The IROFS boundary determination process relies upon the ISA to identify and define the IROFS and their functions. The boundary determination process then uses the ISA and ACP design documentation to establish and identify what structures, systems, components, and actions are required to fulfill the IROFS functions. IROFS boundaries are defined using CMP-3601-0001, "IROFS Boundary Determination Plan."

3.4 Seismic Specifications

Seismic specifications for the ACP design are based on the risks and potential consequences from seismic events involving the primary facilities. This approach results in two criteria being applied depending upon whether or not the normal operations therein involve liquid UF_6. Facilities where liquid UF_6 operations occur (non-HALEU, commercial ACP operations only) are required to withstand the forces resulting from a 10,000-year return period seismic event. All other facilities (including both non-HALEU commercial ACP operations and the HALEU Demonstration) are required to withstand the forces resulting from a 1,000-year return period seismic event because UF_6 operations therein involve UF_6 in either gas or solid form.

The X-3344 Customer Services Building (used in non-HALEU commercial ACP operations only) is designed to withstand a 10,000-year return period seismic event for the Piketon, Ohio area. This correlates to a conservative assumption of 0.48 gravity Peak Ground Acceleration (PGA) (Reference 13). The corresponding vertical earthquake ground motion is two-thirds of the horizontal ground motion or 0.32 gravity PGA. These PGA values are based on earlier geotechnical studies (References 13, 17, and 18). The results of these studies are documented and summarized in EE-3100-0003, *Summary of ACP Seismic Design Values* (Reference 19).

The X-2232C Interconnecting Process Piping; X-3001 and X-3002 Process Buildings; X-3012 Process Support Building; X-3346 Feed and Withdrawal Building; X-3346A 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 are designed to withstand a 1,000-year return period seismic event for the Piketon, Ohio area. This correlates to a conservative assumption of 0.15 gravity PGA (Reference 12). The corresponding vertical earthquake ground motion is 0.1 gravity PGA.

IROFS structures, systems, and components required to function in response to seismic events are constructed and/or installed to withstand the forces stated above. Non-IROFS structures, systems, and components are constructed and/or installed, as necessary, to ensure they cannot adversely affect IROFS structures, systems, and components.

Seismic response spectra for the ACP are documented in EE-3100-0003, *Summary of ACP Seismic Design Values* (Reference 19). The 10,000-year response spectrum identified in the summary has been used to perform dynamic analyses of the X-3344 to ensure it can withstand a 10,000-year return period event. The 1,000-year response spectrum identified in the summary has been or will be used to perform dynamic analyses of the X-2232C, X-3001 X-3002, X-3346, and X-3346A to ensure they can withstand a 1,000-year return period event. Dynamic analyses of the X-3012, X-7725, X-7726, and X-7727H were performed as part of the original plant design to ensure their design integrity using the original seismic response spectrum associated with a 1,000-year return period event (Reference 12). It was deemed unnecessary to repeat these analyses because the ACP is not changing the design or installed configuration of these facilities and the response spectrum used in the original analysis (Reference 2) adequately bounds the current response spectra derived from more recent geotechnical studies (Reference 13, 17 and 18). A comparison of the original response spectrum to the current response spectrum is documented in EE-3901-0004 *Dynamic Analysis Verification on Existing ACP Buildings* (Reference 20). These analyses ensure that the primary facilities are adequately designed to prevent collapse of the structures during major seismic events and ensure the subsequent release of licensed material in a manner that could cause the 10 CFR 70.61 Performance Requirements to be exceeded is highly unlikely. All other process support or process related buildings or structures will be designed or have been previously designed for a 1,000-year return period event. Non-IROFS structures have been or will be designed using regional building code values.

The original PGA listed in ORO-EP-120 (Reference 12) for a 1,000-year event is 0.15g. This PGA value is the same as used in the 1982 Beavers study (Reference 14~~5~~), the 1995 three-site seismic study that included the Portsmouth reservation (Reference 22~~19~~), and the current ACP seismic design criteria (Reference 19~~18~~). There are minor differences in the response spectra for the ACP.

3.5 Integrated Safety Analysis Maintenance

As stated previously, the ISA is a compilation of the design and analysis documentation utilized to identify the potential accident sequences that could occur, designate IROFS to either prevent such accidents or mitigate their consequences to an acceptable level, and identify the management measures to provide reasonable assurance of the availability and reliability of IROFS. The ISA Summary is a synopsis of the ISA and contains the information required by 10 CFR 70.65(b). The ISA Summary is updated to reflect changes to the ISA.

The ISA accounts for any changes made to the ACP facilities or its operations are evaluated in accordance with the requirements of the 10 CFR 70.72 change process. Any facility change, operational change, or change in the process safety information that may alter the parameters of an accident sequence is evaluated by means of the ISA methods. The Licensee periodically reviews IROFS per the requirements of 10 CFR 70.62(a)(3) to ensure their availability and reliability for use and consistency with the ISA. The Licensee evaluates whether changes to existing IROFS and associated management measures are required, or if new IROFS or management measures are required. The bases (including assumptions and initial conditions) for the ISA are maintained and controlled via the various management measures identified in Chapter 11.0 of this license application. This includes, but is not limited to the preventive maintenance, corrective action, configuration management, and audit/assessment programs.

~~For any changes to the accident sequences in the ISA, or the addition of any new accident sequences to the ISA, the Licensee shall address and document the following considerations in the ISA: (1) The accident sequence will specify whether the event is characterized by a frequency of occurrence or by a probability of failure on demand, and will perform all necessary mathematical operations appropriate to the type of event;. (2) The accident sequence will distinguish between frequencies and probabilities applicable to a single item and those applicable to a population of identical items; (3) The accident sequence will take demand rates into consideration, for all items characterized by a failure on demand; (4) The applicant will justify independence for any combination of repeated events, or else reduce the assigned likelihood of the combined failure to conservatively bound common-mode failures; and (5) For criticality accident sequences, the accident sequence will consider whether less reactive physical conditions could lead to a higher likelihood of criticality.~~

3.6 References

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