USEC
A Global Energy Company

October 11, 2007
GDP 07-0036

Mr. Michael F. Weber
Director, Office of Nuclear Material Safety and Safeguards
Attention: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Paducah Gaseous Diffusion Plant (PGDP)
Docket No. 70-7001, Certificate No. GDP-1
Transmittal of Revision 109 to Certification Application USEC-01

Dear Mr. Weber:

In accordance with 10 CFR 76, the United States Enrichment Corporation (USEC) hereby submits six copies of Revision 109 to the USEC-01 certification documents for the Paducah Gaseous Diffusion Plant. These revisions include the following changes:

- Revision 109 incorporates Technical Safety Requirements (TSR) changes that were previously submitted for your review in accordance with 10 CFR 76.45, and approved in your letter dated July 18, 2007 as Amendment 11 to Certificate of Compliance GDP-1. Revision 109 also incorporates associated changes to the Safety Analysis Report (SAR) that have been reviewed in accordance with 10 CFR 76 and have been determined to not require prior NRC approval. Revision 109 is provided in Enclosure 1. Revision 109 is effective September 8, 2007.

Revision bars are provided in the right-hand margin to identify changes.

Should you have any questions regarding this matter, please contact Steven Toelle at (301) 564-3250. There are no new commitments contained in this submittal.

Sincerely,

S. A. Toelle

Steven A. Toelle
Director, Regulatory Affairs

Enclosures: 1. Oath and Affirmation
2. USEC-01, Application for United States Nuclear Regulatory Commission Certification, Paducah Gaseous Diffusion Plant, Revision 109, Copy Numbers 1 through 6.

cc: R. DeVault, DOE	USEC-01, Copy Nos. 641
D. Hartland, NRC Region II	(w/o)
J. Henson, NRC Region II	USEC-01, Copy Nos. 442, 664
G. Janosko, NRC HQ	(w/o)
M. Raddatz, NRC Project Manager	(w/o)
NRC Senior Resident Inspector - PGDP	USEC-01, Copy No. 697

NMSS01

Enclosure 1
GDP 07-0036

Oath and Affirmation

OATH AND AFFIRMATION

I, Steven A. Toelle, swear and affirm that I am the Director, Regulatory Affairs of the United States Enrichment Corporation (USEC), that I am authorized by USEC to sign and file with the Nuclear Regulatory Commission Revision 109 to USEC-01, Application for United States Nuclear Regulatory Commission Certification, Paducah Gaseous Diffusion Plant, as described in USEC Letter GDP 07-0036, that I am familiar with the contents thereof, and that the statements made and matters set forth therein are true and correct to the best of my knowledge, information, and belief.

S. A. Toelle

Steven A. Toelle

On this 11th day of October, 2007, the person signing above personally appeared before me, is known by me to be the person whose name is subscribed to within the instrument, and acknowledged that he executed the same for the purposes therein contained.

In witness hereof I hereunto set my hand and official seal.

Rita Peak

Rita Peak, Notary Public
State of Maryland, Montgomery County
My commission expires December 1, 2009

Enclosure 2 to
GDP 07-0036

USEC-01
Application for the United States
Nuclear Regulatory Commission Certification
Paducah Gaseous Diffusion Plant
Revision 109

APPLICATION FOR NUCLEAR REGULATORY COMMISSION CERTIFICATION
PADUCAH GASEOUS DIFFUSION PLANT (USEC-01)
REMOVAL/INSERTION INSTRUCTIONS
September 8, 2007 - REVISION 109

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* Administrative correction only. Corrected revision number for page 2.4-8 to Revision 96.

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3.3.5.9.2 Stage Instrumentation

The purpose of stage instrumentation is to control the flow of process gas between stages. Gas flow is maintained by holding a constant pressure on the barrier. Stages have similar instruments which function alike. The process gas is controlled at each stage by a stage control valve whose position is indicated and set by a stage controller. The controller can be operated on automatic or manual control. A typical stage pressure control is shown in Figure 3.3-19.

3.3.5.9.3 Temperature Instrumentation

Cell temperatures are regulated by controlling the coolant pressure in the coolant systems. This is based on the principle that fluids such as the coolant have specific vapor pressures associated with temperature. Therefore, a coolant pressure can be specified that will yield the desired UF_6 temperature.

Coolant pressures are monitored and controlled at the local cell panel. Alarms are actuated on the local cell panel, the ACR and from the ADP system in the ACR ("000" and "00" only) when the coolant temperature exceeds the set limits.

The temperatures of individual stages are monitored by thermocouples installed in the gas lines and indicated at the local cell panel.

3.3.5.9.4 Analytical Equipment

The process gas stream is monitored as necessary to maintain the proper assay of material and to determine the concentration of gases such as nitrogen, coolant, fluorine, and ClF_3. Several types of analyzers are used which include mass spectrometers (refer to Section 3.3.3.2 for a description) for assay measurement (referred to as assay machines) and miscellaneous gas concentration detection equipment (referred to as line recorders); infrared and ultraviolet analyzers for fixed and portable measurement of F_2, ClF_3, UF_6, coolant, and other gases; and space recorders for measurement of UF_6 at low concentrations. Connections are provided at each cell to accommodate portable analytical instrument usage whereas most fixed application instruments can be aligned to various locations via manifolds to assist in activities such as inleakage location.

3.3.5.9.5 UF_6 Release Detection System

The Cascade UF_6 Release Detection Systems have detection and alarm functions only. They are available to monitor cascade equipment that is operated above atmospheric pressure. The UF_6 Release Detection Systems are important to safety as described in Section 3.15. Figure 3.3-20 provides a simplified block diagram of a typical cascade UF_6 Release Detection System.

The operation of the systems are described in the following paragraphs.

Multiple detectors are installed in cell housings, bypass housings, and above the "B" seals on the axial flow compressors. The detectors are typically mounted inside, near the top of the housings. The housing of interbuilding tie-lines that operate at pressures exceeding atmospheric are also equipped with release detectors. The detectors are connected to signal conditioners that monitor detector status, provide a means to test the detectors, and process output signals from the detectors to produce the appropriate alarm indications.

3.3.5.9.5.1 Detectors

The UF_6 detectors in the cascade operate by means of a cold cathode tube and dual ionization chambers—one chamber to detect UF_6 release reaction products in the air, and one that serves as a reference to help stabilize the detector's sensitivity for changes in ambient temperature, humidity, and pressure. In the detection chamber, ambient air in the gap between two charged electrodes is ionized by an alpha-emitting source. As the concentration of particles in the air increases to a characteristic point, the cathode tube produces an output signal. Detector sensitivity is maintained by twice each shift applying a bias voltage to the detectors, which increases the voltage at the cathode starter electrode and produces an electrical simulation of the presence of UF_6 reaction products. Records from the many tests conducted on detector sensitivity, operating at elevated temperatures, indicate that a firing of detector heads on an eight-hour interval is sufficient to maintain a sensitivity that will detect UF_6 leaks.

The UF_6 release quantity that would actuate the detectors is established as follows. On the basis of the drawing of a typical cell housing ("000"), it was calculated that the volume internal to the cell housing was approximately 116,000 ft^3 (after subtracting the volume of the cell equipment itself). Assuming a release that is perfectly mixed within the cell housing, a release of 2.14 lb of UF_6 would provide a concentration of 200 mg/m^3 which would activate all of the detectors in the cell housing within 30 seconds. It should be noted that a release in cell housings with smaller volumes than the "000" equipment housings ("00" or withdrawal area housings) would actuate all the leak detectors at smaller release quantities. Actually, the release would initially have two components: the reaction products of UF_6 and H_2O, and unreacted UF_6. The reaction of UF_6 with moisture in the cell housing air would contribute approximately 124 BTU/lb UF_6 reacted. At 50% relative humidity, there would be enough moisture in the cell housing air to react with about 1500 lb UF_6 and would generate about 200,000 BTU. The reaction would be primarily adiabatic due to the rapid reaction rate and the poor heat transfer mechanisms from the gas phase to the cell housing and cell equipment. Assuming adiabatic reaction, the temperature of the gases in the cell housing would increase initially by about 120 °F from a normal operating temperature of about 200 °F. If there were only 10% relative humidity, the initial temperature increase would be about 25 °F. It should be noted that the reaction products would be considerably hotter initially because complete mixing would not occur instantaneously.

The heat of reaction would cause the reaction products to rise to the top of the cell housing and spread out along the top. Since the UF_6 leak detectors are within about 3 feet from the top of the cell housing which is approximately 19 ft in height, it would only take a fraction of the amount discussed earlier to cause the detectors to actuate. This is consistent with plant experience with the ability of the UF_6 detectors to detect very small leaks that required considerable searching and leak testing to discover. This indicates that, for the postulated accidents described in Section 4.3.2, that one operational detector in the cell housing would be more than adequate to detect the release. It also points out that a release of the magnitude described in the Section 4.3.2 would actuate every operational detector in the cell housing and probably within adjacent bypass and cell housings as the release spread through the bypass housings. The time to reach the concentration required would be within seconds of the postulated releases.

The number of detectors required to be operational to detect the releases postulated should be one per cell housing. The housing of interbuilding tie-lines that operate at pressures exceeding atmospheric should have one operational detector at each end of the tie line. However, due to the extreme non-specificity and sensitivity of the detectors and their desired operational capability of detecting very small releases, it is desirable to have more than one detector operational per cell housing since actuation of one detector is not necessarily an indication of a

3.3.7.1.7 Buffer System

Where needed, there are two buffer systems in the cascade. One system supplies the compressor flanges, blowout preventers, control valves, and buffered expansion joints, and the other supplies only the cascade block valves.

Instrumentation is provided to monitor buffer flow and pressure. An alarm is provided in the ACR on high buffer flow (indicating buffered component leakage) or abnormal buffer pressure. To determine the location of the alarm, the local cell cubicle and buffer cabinet is checked.

3.3.7.1.8 Recycle Valve Control

When the difference between "A"-suction and high-side pressures exceeds the compression ratio tolerance, a pressure blind switch (PBS) opens the recycle valve automatically to bring the compression ratio within tolerance and avoid compressor surging.

A pressure indicator is provided to monitor this differential pressure. A recycle PBS control is provided to manually operate the recycle valve.

3.3.7.1.9 Cell Pressure Control

Cell pressure is controlled through use of the PLI and PIC controllers.

The purpose of the PLI is to aid in controlling cascade inventory, operation of cascade equipment, and normal and abnormal inventory shifts to protect cascade equipment. The PLIs are located on the ACR cell panels (located on the local cell panel in C-310).

PICs located on the local cell panels (one for each stage of the cell), use the output signal of the cell PLI to control the position of the stage control valves in order to establish cell pressures at or near the PLI setpoint. Together, the PLI and PICs are used to fine-tune the cascade for optimum performance. This control system can be overridden for manual control of stage control valve position. PLIs and PICs are used in conjunction with the surge drums and the F/S systems to control cascade disturbances due to inventory shifts.

3.3.7.1.10 Block Valve Control

Block valves are controlled from a valve control center (VCC) located beside each local cell panel. The VCC houses a main electrical breaker and individual valve breakers for the motor-operated valves associated with that cell. The control panel of the VCC has a mimic (single line representation) of the cell and bypass piping. Valve position-indicating lights and pistol-grip controls (close-stop-open) for each individual valve are located directly on the mimic. Switches are provided to accomplish multi-valve operations, including stopping traveling valves, taking a cell off-stream, and initiating a cascade split.

3.3.7.1.11 Air Circuit Breaker and Motor Breaker Controls

In the C-333, Process Building and the C-337 Process Building ("000" buildings), a primary control switch at the local cell panel is used to close the switchyard air circuit breaker (ACB) to start four of the stage motors. A second control switch (permissive) allows closure of the motor circuit breakers and starting of the other four stage motors. The primary control switch can be used to stop all eight stage motors. An ACR control switch is also available to open the ACB to trip the stage motors.

In the C-331, Process Building and the C-335, Process Building ("00" buildings), the switchyard ACB typically remains closed, and stage motors are started by closing the motor breakers using control switches at the local cell panel. A primary control switch starts five stage motors by closing the motor circuit breaker "A". Closure of a second control switch (permissive) allows starting of the other five stage motors. The primary control switch can be used to stop all ten stage motors. An ACR motor stop button is also available to open the motor breakers and trip the stage motors.

In C-310, closure of a primary control switch starts six stage motors by closing the motor circuit breaker. Closure of a second control switch (permissive) allows starting of the other six stage motors. The primary control switch can be used to stop all 12 stage motors. The primary control switch forms part of the boundary of the important to safety Cell Remote Manual Shutdown System as described in Sections 3.3.4 and 3.15.

Cells are always started at the local panel, but can be shut down from the local panel, ACR (except C-310), emergency shutdown switches on the cell floor, or CCF.

3.3.7.1.12 Instrument Cubicle Low Temperature Alarm

Instrument lines containing gas from various positions in the cascade cell go from the cell floor to the local cell panel on the operating floor. The instrument cubicle is heated to prevent UF_6 freeze-out in these instrument lines. Since instrument line freeze-out could cause inaccurate cell status indications, there is a low temperature alarm installed to alert operating personnel of a low instrument cubicle temperature condition.

3.3.7.1.13 UF_6 Release Detection Alarm System

A UF_6 Release Detection System (or process gas leak detection-PGLD) is used to detect a UF_6 release in areas with equipment that operates above atmospheric pressure. Detectors are installed inside cell housings, cell bypass housings, unit bypass housings, interbuilding tie-line housings, and in interbuilding booster stations.

The system annunciates alarms at the unit/cell level in the ACR and at the individual detector head level at the local cell panel ("000" and "00" buildings only) upon detection of UF_6 outleakage. Further description is given in Section 3.3.5.

3.3.7.2 Area Control Room

Each process building (C-310, C-315, C-331, C-333, C-335, and C-337) has an ACR located on the ground floor. The purpose of each ACR is to permit operators to monitor process equipment, make changes in operation, and take corrective action to mitigate abnormal operating conditions. All operating cells except C-310 cells can be shut down and isolated from the building's ACR. The C-310 cells must be shut down at the local panels.

The C-611-R elevated storage tank has a capacity of 300,000 gal (about 1135 m^3). When it is 90% full, the tank is capable of supplying the maximum flow rate for approximately 73 minutes with no HPFWS pumps operating. It is also capable of supplying 2250 gpm (8.6 m^3/min) with no pumps operating for a duration of two hours. This is slightly greater than 60% of the maximum flow demand.

3.15.7.2.4 System Classification

The fire protection system within the process buildings is required to:

- Minimize the potential for a large fire that could damage the UF6 primary system integrity in the enrichment cascade; the large fire event was not considered as having the potential for exceeding the off-site EBE EGs.
- Minimize the likelihood of a large fire that could threaten UF6 primary system integrity in the withdrawal facilities.

The combustible fuel loading in these facilities is controlled in accordance with the Fire Protection Program (see Section 5.4). Based on this, the fire protection systems within the scope of this section meet the criteria for classification as an AQ system.

3.15.7.2.5 Boundary

The AQ boundary for the high pressure fire water system is defined in Table 3.15-2.

3.15.7.3 UF6 Release Detection System

3.15.7.3.1 Safety Function

The UF_6 release detection system shall detect and annunciate in the ACR, UF_6 releases in enrichment cascade operating equipment that is operated above atmospheric pressure. The UF_6 release detection system for the feed, withdrawal, and toll transfer and sampling facilities shall detect UF_6 releases and provide an alarm to alert personnel to take appropriate action (i.e., investigate to verify a release occurred and, if necessary, evacuate the area affected by the release). Other systems that perform alarm and mitigation functions are discussed in other sections (see Sections 3.15.4.1, 3.15.4.8, and 3.15.5.2).

3.15.7.3.2 Functional Requirements

Each of the UF_6 detection systems in the areas of the enrichment cascade that are intended to be operated above atmospheric pressure, and in the withdrawal, feed, and toll transfer and sampling (zones 2, 3, and 5-8) facilities shall be designed in accordance with the following functional requirements to ensure the capability to accomplish the required safety function:

- The system shall monitor the designated areas of the facility for UF6 releases outside of the UF6 primary system.
- The system shall provide, in the ACR, an alarm indication of a UF6 release from the UF6 primary system.

3.15.7.3.3 System Evaluation

Enrichment cascade. The safety function of the system is to detect a UF_6 release from the UF_6 primary system and provide an alarm to alert on-site personnel in the ACR. This facilitates early detection by the operators allowing them to initiate required actions to minimize the release. The system is designed to detect releases in those areas that have the potential for a large UF_6 release and provide an alarm in the ACR.

The detector heads are located in "000" or "00" areas that are intended to be operated above atmospheric pressure. Detectors are installed inside cell housings, cell bypass housings, unit bypass housings, interbuilding tie-line housings, and in interbuilding booster stations. Operation of these detector heads is required during a UF_6 release. The detectors heads would be subjected to an environment associated with the release of UF_6 and its reaction products. However, the response time is relatively quick once the smoke is detected based on operational history. Once a detection signal is generated, the alarm circuit will be sealed in and operator action will be required to clear the alarm. Therefore, the environmental conditions during an event should not cause failure of the detection system. Additionally, there are multiple detector heads in each area to provide detection capability. Normal operation environments can also cause some spurious operations due to various causes and result in detector failures. These are typically detected during the testing process and the detector head will not reset. However, these are typically limited to one detector at a time. With multiple detectors located in each area, additional protection is provided to ensure system operability. Based on these requirements and evaluation, the system can accomplish the required safety function and meet its functional requirements.

Feed, toll transfer (zones 2, 3, and 5-8), and withdrawal facilities. The safety functions of the withdrawal, feed, and toll transfer and sampling facility UF_6 release detection systems are to detect a UF_6 release from the UF_6 primary system and provide an alarm to alert on-site personnel to take appropriate action (i.e., investigate to verify a release occurred and, if necessary, evacuate the area affected by the release). The systems are designed to detect releases in those areas that have the potential for a UF_6 release and provide an alarm inside the facility ACR. Operating history has shown the system to be capable of detecting releases and providing an alarm. Based on these requirements and operating history, the safety function of the system can be accomplished. Credit is also taken for these systems for nuclear criticality safety. See Section 3.15.10.2.7.

The withdrawal facilities are equipped with several systems that can detect and annunciate an alarm in the ACR upon a UF_6 release. These systems include: (1) the UF_6 release detection system - low voltage system at the UF_6 withdrawal room ceiling, (2) the UF_6 release detection system - high voltage ("old") system for UF_6 condensers, accumulator, and piping heated housings, and (3) UF_6 release detection system - high speed centrifugal pumps (C-315 only). A high-voltage (200 VDC) or low-voltage (24 VDC) UF_6 release detection system can be used to monitor the C-315 high speed centrifugal pumps. These systems are classified as alarm-only building UF_6 detection systems for operations performed within the withdrawal facilities. The low voltage UF_6 release detection systems is also credited for nuclear criticality safety by limiting the release of fissile material.

3.15.7.3.4 System Classification

The UF_6 release detection system that is located in any "000" or "00" areas that are intended to be operated above atmospheric pressure (including inside the cell housings, cell bypass housings, unit bypass housings, interbuilding tie-line housings and other piping and equipment housings) and in interbuilding booster stations are required to:

- Detect UF6 releases and annunciate in the ACR; and
- Be used, in conjunction with the compressor motor manual trip system, to reduce the UF_6 primary system pressure and minimize any UF_6 releases.

Use of this system in this manner will minimize exposure of on-site personnel to UF_6 and ensure the off-site EGs are not exceeded. Credit is taken for this system to prevent exceeding the off-site EBE EGs in the large UF_6 release to atmosphere (Section 4.3.2.1.7) EBE. Therefore, this system meets the criteria for classification as a Q system.

The UF_6 detection systems in the feed, toll transfer and sampling (zones 2, 3, and 5-8), and withdrawal facilities are required to:

- Aid in the detection of UF6 releases for several events, and
- Minimize the exposure to on-site personnel.

However, these systems are not essential for the protection of the off-site public since for any significant release of UF_6 material that could threaten off-site EBE EGs, other methods of indicating that a release has occurred are also available (i.e., visual detection). These systems only provide an alarm to alert on-site personnel that a potential UF_6 release has occurred enabling them to take appropriate action (i.e., investigate to verify a release occurred and, if necessary, evacuate the area affected by the release). Therefore, these systems meet the criteria for classification as an AQ system.

3.15.7.3.5 Boundary

The Q, AQ, and AQ-NCS boundaries for the UF_6 release detection system are defined in Tables 3.15-1, 3.15-2, and 3.15-3 respectively.

3.15.7.4 Inventory Instrumentation Required for Nuclear Material Accountability

3.15.7.4.1 Safety Function

The inventory instrumentation performs a safeguards function by providing a means to demonstrate compliance with NMC&A requirements.

3.15.8.1.1 Chemical Safety Function

The non-radiological chemical systems are required to perform the following chemical safety functions:

- Maintain integrity to the process, which minimizes the potential for releasing toxic gas into the atmosphere.
- Ensure that the fluorine primary system is relieved on high pressure to minimize the potential for a failure of the primary system integrity.
- Detect releases from the primary system and provide an alarm indication of the release.

3.15.8.1.2 Functional Requirements

The non-radiological chemical systems shall be designed and maintained for the intended service. The fluorine distribution system shall have pressure relief available on the low pressure side of the C-410-K multi-tube trailer pressure reducing station, the C-410-D storage tanks, and the fluorine distribution header in C-410-D. These systems shall actuate at or below the MAWP of the part with the lowest MAWP in the associated section of the fluorine distribution system. These systems discharge to an elevated stack upon activation. The toxic gas leakage detection system shall be designed to provide alarm indications upon detection of releases from the primary system.

3.15.8.1.3 System Evaluation

The non-radiological chemical systems are required to prevent releases of toxic gas to the atmosphere during normal operations. This safety function is accomplished by retaining system integrity during normal operations and upset events. The design requirements ensure that the primary systems can withstand the operating conditions assumed in the accident analysis and are appropriate for the chemical being used.

Primary ClF_3 system integrity is protected by maintaining tank pressure to less than atmospheric pressure. This minimizes the potential for a release of Mixed Gas from the storage tanks at the C-350 drying agent storage building. The ClF_3 is vaporized into the C-350 Mixed Gas storage tank which is used for controlled flow of the Mixed Gas. A release of Mixed Gas or F_2/N_2 from a ruptured primary system could result in an uncontrolled release at ground level.

The fluorine primary system integrity is protected by a pressure relief system available on the low pressure side of the C-410-K tube trailer pressure reducing station, the C-410-D storage tanks, and the fluorine distribution header in C-410-D. These relief systems vent to the elevated stack upon activation. A release of fluorine from a ruptured primary system could result in an uncontrolled release at ground level.

Toxic gas detectors are located in areas where a significant release of toxic gas could occur. The required safety action is to detect a release and provide indications of the release. The safety action is accomplished by having detectors appropriate to the toxic gas present (chlorine, fluorine, etc.) and providing both audible and visible alarm indications. The system provides on-site protection for personnel by detecting a release and alerting personnel to immediately evacuate the area.

3.15.8.1.4 System Classification

The non-radiological chemical systems are required to:

- Provide primary system integrity during normal operation for the toxic gas distribution process to minimize the consequences to on-site personnel from releases of toxic gases from the process (e.g., distribution system breaches).
- Minimize the potential for failure of the primary system integrity and provide protection for on-site personnel during pressure increase events;
- Detect a toxic gas release and provide alarm for personnel in the immediate vicinity of the release.

The non-radiological chemical systems are classified as AQ systems.

3.15.8.1.5 Boundary

The AQ boundaries for the non-radiological chemical systems are defined in Table 3.15-2.

3.15.9 Building Structures and Confinement

3.15.9.1 Process Buildings

The process buildings house the UF_6 primary systems including the feed facilities, enrichment and purge cascades, withdrawal facilities, and the toll transfer and sampling facility. These buildings include the enrichment process buildings (C-310, C-310-A, C-315, C-331, C-333, C-335, and C-337), the feed buildings (C-333-A, and C-337-A), and the toll transfer and sampling facility (C-360). This section includes the tie-line structures connecting the main cascade process buildings.

3.15.9.1.1 Safety Function

The process buildings provide a significant role in minimizing both the on-site and off-site releases of UF_6 and ensure that the following safety functions are accomplished:

- Provide limited holdup of UF6 releases to allow deposition of uranium and slower release rates to atmosphere (cascade facilities and withdrawal facilities only), and;
- Maintain structural integrity during evaluation basis natural phenomena events (i.e., earthquakes, high winds, and flooding) to the degree needed to prevent failure of the UF6 primary system.

3.15.9.1.2 Functional Requirements

The functional requirements are no different than the safety function.

3.15.9.1.3 System Evaluation

Process buildings C-310, C-310-A, C-315, C-331, C-333, C-335, and C-337 are the structural facilities housing the operations associated with the enrichment and purge cascade facilities and the

Table 3.15-1. Boundary Definition for Q Structures, Systems, and Components (continued).

System	Facility	Boundary Definition	Support Systems
Liquid UF_6 Cylinder Handling Equipment (Section 3.15.6.3 and 3.15.10.2.9)	C-310 C-315 C-360	1. Scale carts ; 2. C-360 levelator which includes: a. Hydraulic lift, b. The hydraulics, c. Rail stop, d. Interlock switch (prevents cart motion when levelator is not in position). 3. C-360 Elevator which includes: a. Hydraulic lift, b. Hydraulics, c. Elevator key lock, the interlock on the elevator door to prevent opening when the elevator floor is not level with the floor, and d. Deadman switch. 4. Rail stops located at the head of the C-310 and C-315 cylinder fill/weigh stations.	No support systems are required.
Cylinder Scale Cart Movement Prevention System (Sections 3.15.6.5 and 3.15.10.2.8)	C-310 C-315 C-360	1. Differential pressure sensors 2. Solenoid valves 3. Associated interlocks on the air supply to the scale cart.	The scale carts fail safe upon loss of air.
UF_6 Release Detection System (Section 3.15.7.3)	C-331 C-333 C-335 C-337	The UF_6 release detection system that is located in any "000" or "00" areas that are intended to be operated above atmospheric pressure (including inside the cell housings, cell bypass housings, unit bypass housings, and interbuilding tie-line housings) and in interbuilding booster stations, including: 1. Leak detector heads 2. Associated signal conditioners 3. Signal cable from the detector heads to the signal conditioner 4. Alarm annuciators in ACR 5. Electrical signal lines and associated alarm circuitry 6. 120 VAC power supply back to the first breaker 7. 125 VDC power supply back to the first breaker	120-VAC power - Required for the UF_6 release detection system to support 200 VDC power supply to the detectors 125 VDC power - Required to annunciate alarms in the ACR

Table 3.15-1. Boundary Definition for Q Structures, Systems, and Components (continued).

System	Facility	Boundary Definition	Support Systems
Process Building Cranes (Section 3.15.9.2)	C-310 C-315	Bridge crane rails, crane structure and structural supports for the C-310 and C-315 cranes parked over/near pressurized process piping or the Normetex pumps.	No support systems are required.

Table 3.15-2. Boundary Definition for AQ Structures, Systems, and Components (continued).

System	Facility	Boundary Definition	Support Systems
Enrichment and Purge Cascade, interbuilding tie-line, and Product and Tails Withdrawal Facility Structures (Section 3.15.9.1)	C-310 C-310-A C-315 C-331 C-333 C-335 C-337	1. Foundations 2. Base plates 3. Building frames 4. Column anchorage 5. Load bearing walls 6. Reinforcing tees 7. Bracing 8. Seismic expansion joints (gaps between floor sections) 9. Connections 10. Supports for important to safety piping 11. Siding at the cell floor and above 12. Roof	No support systems are required.
Feed and Toll Transfer and Sampling Facility Structures (Section 3.15.9.1)	C-333-A C-337-A C-360	1. Foundations 2. Base plates 3. Building frames 4. Column anchorage 5. Load bearing walls 6. Reinforcing tees 7. Bracing 8. Supports for important to safety piping	No support systems are required.
Process Building Cranes (Section 3.15.9.2)	C-333 C-337	1. Bridge crane rails, crane structure and structural supports for the C-333 and C-337 cranes parked over unit bypass piping.	No support systems are required.
Cascade Equipment Housings (Section 3.15.9.3)	C-331 C-333 C-335 C-337	For housings over UF_6 primary system piping and equipment, defined in 3.15.3.3, intended to be operated above atmospheric pressure: 1. Steel frame surrounding UF_6 primary systems. 2. Non-metallic or sheet metal panels attached to the framing.	No support systems are required.

Table 3.15-2. Boundary Definition for AQ Structures, Systems, and Components (continued).

System	Facility	Boundary Definition	Support Systems
Miscellaneous Waste Storage & Handling and Support Structures (Section 3.15.9.4)	C-300 C-400 C-409 C-710 C-720 C-720-A C-720-B C-720-C C-720-K C-746-Q1	1. Foundations 2. Base plates 3. Building frames 4. Column anchorage 5. Load bearing walls 6. Reinforcing tees 7. Bracing 8. Seismic expansion joints (gaps between floor sections) 9. Connections	No support systems are required.

(i.e., reaction products of UF_6 and moisture) or (2) the odor of HF, which is a product of the reaction of UF_6 and moisture. The visual indication or the odor of HF will provide indication of (1) the occurrence of a release and (2) the need for the workers to evacuate the area of the release. All the cascade UF_6 processing equipment and major piping are enclosed in housings to maintain normal operating temperatures. The configuration of the housings required to maintain normal operating temperatures, and therefore to keep UF_6 in the gaseous state, provides an inherent barrier against UF_6 releases within the housing. Although the housings provide the local worker with additional time to detect the release and evacuate the area, the housings are not considered an essential control for this receptor rather they provide further assurance that workers will be able to evacuate the area in accordance with the plant see and flee policy. Personnel protective equipment (PPE) or other protective measures (e.g. emergency egress capability) must be available for personnel operating process building cranes.

Operational personnel in the ACR — Operational personnel who are required to take mitigative action are located in the ACR, which typically would not be impacted by the event. However, during cold weather periods, the air on the cell floor is recirculated inside the building to minimize heat loss and maintain building temperatures. This mode of operation could result in elevated concentrations of HF in the ACR area, which would result in evacuation of the ACR. An evaluation of this potential concern concluded that adequate time is available for operators to perform the required actions prior to evacuation should the need arise. However, once these essential actions have been accomplished, the essential control to protect these personnel is evacuation, if required, upon detection of the release by sight or by odor.

Workers outside the process buildings — The essential controls for protecting on-site personnel outside the process buildings are (1) detection of the release, (2) minimization of the release by tripping applicable cells, (3) temporary holdup of the release by the existing process building structure, and (4) training of on-site personnel to evacuate areas upon detection of a release by sight or by odor. The first essential control is to detect the release of UF_6. As stated previously, the motor load indicators provide an indication of a pressure increase in the affected cell. Typically, this indication will be detected, and corrective action will be taken prior to any failure in the primary system. However, should a release occur, the equipment that has the potential for causing a large release [i.e., "000" or "00" areas that are intended to be operated above atmospheric pressure (including inside the cell housings, cell bypass housings, unit bypass housings, interbuilding and tie-line housings and in interbuilding booster stations)] building compressors which are intended to operate above atmospheric pressure) are equipped with UF_6 release detection that alarms in the applicable ACR. Other portions of the cascade do not have operating pressures or inventories sufficient to result in any significant consequences outside the building, and this receptor would not be applicable (see Section 4.2.6.4). The second essential control, is for operators to trip the appropriate cell(s) to reduce the pressure and minimize the release of UF_6. Tripping the cell would quickly end the release as the compressors stop and the system pressure falls to atmospheric pressure. Pressure at an interbuilding booster compressor can be reduced, if needed, by tripping the compressor motor or by tripping adjacent enrichment cell compressor motors. Once the pressure has dropped to atmospheric pressure or below, the release of material is effectively terminated for any potential exposure outside the process building. Sufficient time is then available to perform any necessary valve evolutions to isolate the cell. The third essential control, process building holdup, is provided by the existing process building structure. The process building structure is expected to reduce the potential hazardous material concentrations to receptors outside of the building by holdup of a portion of the UF_6 released, and by causing most of the UF_6 that escapes the building to be released via the exhaust and roof vents flush with the top of the building. If workers outside of the process building have received no other instructions for action to be taken (i.e., shelter in place or take cover), then the essential control for these receptors is to evacuate their areas if a release is detected by sight or by odor.

Off-site public — Because this event, as described, could involve a significant UF_6 release, a scenario is presented that determines how much material must be released at the assumed conservative flow rate to result in a 10 mg U exposure at the nearest site boundary. This information is evaluated and described in the accident analysis for a large UF_6 release to atmosphere (Section 4.3.2.1.7). For the worst-case conditions, the results indicate that it takes 11,700 lb (5307 kg) of UF_6 to reach a 10 mg U exposure at the nearest site boundary. With the conservative release rate assumed, this would result in a release time of 1.5 min. Based on the minimum time-frame to breach the primary system, the operator would have to trip the cell(s) within 4 min (i.e., 2.5 min to reach failure and 1.5 min of release) to meet EGs 1 and 2. For portions of the cascade not operating at maximum pressures and for smaller equipment, more time would be available for the operator to take action to mitigate the event. This allows adequate time for the operators to act. This is based on operational history associated with typical cascade operating configurations (i.e., no breach has occurred from this initiator), the typical location of the operators when the event is initiated (i.e., at the ACR and cell panel), operator training, and the early indications available (i.e., motor load indicators and UF_6 release detectors).

d. <u>Comparison With Guidelines</u>

The EGs for the AE frequency category from Table 4.2-2 were compared with the consequences associated with the event scenario. The EG associated with preventing overpressure (EG 3) cannot be ensured because of the lack of automatic trips on high cascade pressures associated with existing cascade configurations. However, operational history associated with typical cascade operating configurations indicates that this EG is likely to be met because no failures have occurred from this transient. If EG 3 is not met, the other EGs for protection against releases are applicable to the event. For workers in the immediate area, specific exposures were not calculated because of variables and uncertainties associated with the calculations and because of obvious evacuation actions that would be taken by the worker. However, the controls identified (i.e., see and flee, and PPE or other protective measures for crane operators) will maintain exposures within EGs 1 and 2 to the extent practical. Actions required of operational personnel in the ACR were evaluated, and they can be accomplished to meet the requirement for EG 6. In the event that the release ultimately affects habitability of the ACR, this receptor would be able to evacuate the area before EGs 1 and 2 are exceeded. In addition, based on the controls identified (i.e., release detection, cell trip, building holdup, and evacuation of areas upon detection of a release), EGs 1 and 2 would be met for workers outside the process building. Finally, an analysis was performed to determine the worst-case scenario at which an off-site exposure of 10 mg U would be reached at the nearest site boundary. Results of this analysis indicated that the operator action could be accomplished within the time frame to meet the EGs.

e. <u>Summary of SSCs and TSR Controls</u>

The essential controls for the B-stream block valve closure event associated with meeting EG 3 are to minimize the potential for failing the primary system due to pressure increase. Based on the results of this analysis, the essential controls associated with this EG are summarized as follows:

- Motor load indicators in ACR—indication of pressure increase (i.e., significant increase in motor load) (EG 3 only); and
- Compressor motor manual trip in ACR—decrease pressure (EG 3 only).

Essential mitigation of any UF_6 releases associated with this event (EGs 1, 2, and 6) are summarized as follows:

- Compressor motor manual trip in ACR—minimize release for all receptors except local worker (EG s 1, 2, and 6);
- UF_6 release detection system for "000" or "00" areas that are intended to be operated above atmospheric pressure (including inside the cell housings, cell bypass housings, unit bypass housings, interbuilding tie-line housings, and in interbuilding booster stations)—all receptors except local worker (EGs 1, 2, and 6);
- Equipment housing holdup for compressors operating above atmospheric pressure—off-site public (EGs 1 and 2);
- Visual/odor detection of release, worker training, and evacuation of affected area—all on-site workers (EGs 1 and 2);
- Administrative control—personal protective equipment (PPE) or other protective measures shall be available to personnel operating process building cranes (EGs 1 and 2); and
- Process building holdup—workers outside process building and the off-site public (EGs 1 and 2).

Based on the above essential controls, the resulting important to safety SSCs and TSRs are as follows:

- The motor load indicators, UF_6 compressor motor manual trip systems, UF_6 release detection system, equipment housings, and process buildings are identified as important to safety SSCs. See Section 3.15 for details including safety classification.
- TSRs are provided for the motor load indicators; cascade cell trip function; UF_6 release detection system; and administrative requirements for procedures and training of workers for evacuation actions, and for protective equipment/measures for crane operators.

4.3.2.1.4 Limited UF_6 Release to Atmosphere (Primary System Integrity)

a. <u>Scenario Description</u>

Small passive failures in the primary system may result in limited releases of UF_6 into the process buildings. These could be caused by initiators such as failures of instrument lines, expansion joints, weld joints, etc., that could be caused by vibration, fatigue, or corrosion. These types of failures are expected frequently enough to place them in the AE category.

A limited UF_6 release event was evaluated in the PrHA, and it was determined that the consequences could include significant on-site impact in the above atmospheric pressure operating mode if no mitigation were provided.

The primary concern associated with this event is controlling the UF_6 release. The applicable EGs (see Table 4.2-2) associated with this event are all the EGs for the AE frequency range. EG 3 is not addressed in this scenario because the primary system is assumed to fail, and EG 4 is addressed by the NCS Program (see Section 5.2). The safety actions of (1) building holdup, and (2) emergency response by local personnel would be required to maintain the effects of the UF_6 release within EGs 1, 2, and 6. Because of the limited size of the releases for this event, no additional action is required to keep the effects of the UF_6 release within EGs 1, 2, and 6 for areas outside the process buildings. These actions protect on-site personnel and will maintain habitability of the required control area in accordance with EG 6 as well. In addition, although it is not considered essential, termination of these releases would typically be accomplished via the means identified for other scenarios such as the B-line block valve failure event (Section 4.3.2.1.3).

The limited UF_6 release to atmosphere is the most limiting primary system integrity failure event for the AE category. For larger primary system integrity failures that could result in a large UF_6 release, the frequency is considered to be significantly lower. Such failures are addressed in the large UF_6 release to atmosphere event (see Section 4.3.2.1.7).

b. <u>Source-Term Analysis</u>

The limited UF_6 release to atmosphere event is considered to be an AE because minor passive failures of equipment or operator error can initiate the event and because of operational history. Many variables associated with this event must be characterized to develop a source term. These variables include:

- The duration of the release;
- The size of the potential system failure;
- The location of the failure in the cascade (i.e., "2X", "00," "000", or auxiliary equipment); and
- The initial pressures and associated flow rate of UF_6 at the break.

For equipment operating below atmospheric pressure, the source term for this event would be minimal because of inleakage, and no additional consideration is warranted. However, for equipment operating above atmospheric pressure, some release of UF_6 would be expected although as indicated by operational history, the releases are typically very small. This event is associated with minor passive failures only. The size of the failure in the primary system is expected to be small and significantly less than that described for the B-stream block valve closure event (see Section 4.3.2.1.3). Based on the potential source term, this event is bounded by the B-stream block valve closure event (Section 4.3.2.1.3).

c. <u>Consequence Analysis</u>

The consequence analysis for the limited UF_6 release to atmosphere event is subdivided to address the on-site receptors.

Local workers in the immediate area — Workers in the immediate area of the release could be exposed to a significant uranium dose and/or HF exposure. In the event of a release, the plant see and flee policy requires personnel to evacuate the area for their own protection. The essential method of detection for workers within the cascade process buildings is (1) visual indication of a "white smoke" applicable cells, (3) temporary holdup of the release by the existing process building structure, and (4) training of on-site personnel to evacuate areas upon detection of a release by sight or by odor. The first essential control is to detect the release of UF_6. Equipment that has the potential for causing a large release [i.e., "000" or "00" areas that are intended to be operated above atmospheric pressure (including inside the cell housings, cell bypass housings, unit bypass housings, interbuilding and tie-line housings and in interbuilding booster stations)] are equipped with UF_6 release detection that alarms in the applicable ACR. Other portions of the cascade do not have operating pressures or inventories sufficient to result in any significant consequences outside the building, and this receptor would not be applicable (see Section 4.2.6.4). The second essential control, is for operators to trip the appropriate cell(s) to reduce the pressure and minimize the release of UF_6. Tripping the cell would quickly end the release as the compressors stop and the system pressure falls to atmospheric pressure. Pressure at an interbuilding booster compressor can be reduced, if needed, by tripping the compressor motor or by tripping adjacent enrichment cell compressor motors. Once the pressure has dropped to atmospheric pressure or below, the release of material is effectively terminated for any potential exposure outside the process building. Sufficient time is then available to perform any necessary valve evolutions to isolate the cell. The third essential control, process building holdup, is provided by the existing process building structure. The process building structure is expected to reduce the potential hazardous material concentrations to receptors outside of the building by holdup of a portion of the UF_6 released, and by causing most of the UF_6 that escapes the building to be released via the exhaust and roof vents flush with the top of the building. If workers outside of the process building have received no other instructions for action to be taken (i.e., shelter in place or take cover), then the essential control for these receptors is to evacuate their areas if a release is detected by sight or by odor.

Off-site public — Because this event, as described, could involve a significant UF_6 release, a scenario is presented that indicates how much material is required to be released at the assumed conservative flow rate to result in the 30 mg U exposure at the nearest site boundary. For the worst-case conditions, the results indicate that it takes about 31,200 lb (14,165 kg) of UF_6 to reach a 30 mg U exposure at the nearest site boundary. With the conservative release rate assumed, this would result in a release time of about 4 min. The large UF_6 release to atmosphere event is characterized by the B-stream block valve closure event. The large UF_6 release to atmosphere event ignores the time required to reach a 40-psia (0.27-MPa) cascade pressure, at which the primary system is assumed to fail (about 2.5 min, see Section 4.3.2.1.3). This extra time would allow the operator even more time to react to the event (i.e., about 6.5 min to trip the compressors for the worst case assumptions). There is sufficient time for operator response based on operator presence near the controls when this event is expected to occur. In addition, with any quicker response time, different wind conditions, ventilation system settings, or variations in the wake effects, the resulting consequences would be below the guidelines.

d. <u>Comparison With Guidelines</u>

For workers in the immediate area, specific exposures were not calculated because of variables and uncertainties associated with the calculations and because of obvious evacuation actions that would be taken by the worker. However, the controls identified (i.e., see and flee, and PPE or other protective measures for crane operators) will maintain exposures within EGs 1 and 2 to the extent practical. Actions required of operational personnel in the ACR were evaluated, and they can be accomplished to meet the requirement for EG 6. In the event that the release ultimately affects habitability of the ACR, this receptor would be able to evacuate the area before EGs 1 and 2 are exceeded. In addition, based on the controls identified (i.e., release detection, cell trip, building holdup, and evacuation of areas upon detection of a release), EGs 1 and 2 would be met for workers outside the process building. Finally, an analysis was performed to determine the worst-case scenario at which an off-site exposure of 30 mg U would be reached. Results of this analysis indicated that the operator action could be accomplished within the time frame to meet the EGs.

e. **Summary of SSCs and TSR Controls**

Based on the results of this analysis, the essential controls for the large UF_6 release to atmosphere event are summarized as follows:

- Compressor motor manual trip in ACR—minimize release for all receptors except local worker (EGs 1, 2, and 6);
- UF_6 release detection system for "000" or "00" areas that are intended to be operated above atmospheric pressure (including inside the cell housings, cell bypass housings, unit bypass housings, interbuilding tie-line housings and in interbuilding booster stations)—all receptors except local worker (EGs 1, 2, and 6);
- Equipment housing holdup for compressors operating above atmospheric pressure—off-site public (EGs 1 and 2);
- Visual/odor detection of release, worker training, and evacuation of affected area—all on-site workers (EGs 1 and 2);
- Administrative control—personal protective equipment (PPE) or other protective measures shall be available to personnel operating process building cranes (EGs 1 and 2); and
- Process building holdup—workers outside process building and the off-site public (EGs 1 and 2).

Based on the above essential controls, the resulting important to safety SSCs and TSRs are as follows:

- The UF_6 compressor motor manual trip systems, UF_6 release detection system, equipment housings, and process buildings are identified as important to safety SSCs. See Section 3.15 for details including safety classification.
- TSRs are provided for the cascade cell trip function; UF_6 release detection system; and administrative requirements for procedures and training of workers for evacuation actions, and for protective equipment/measures for crane operators.

4.3.2.1.8 Heavy Equipment Drop (Primary System Integrity)

a. **Scenario Description**

During process building operations, the change-out of cascade equipment for maintenance requires that heavy equipment (converters, compressors, valves, etc.) occasionally be moved over operating cells by overhead building cranes and lifting fixtures. If this equipment should be dropped because of a failure of the crane or lifting rig, the primary system could be breached, and UF_6 released if the cell is operating above atmospheric pressure. The fall of a crane itself is not considered a credible release initiator. The cranes that are normally parked over cascade equipment have been shown to be seismically qualified in this position (see Section 3.15). The greatest potential for a UF_6 release would be from a drop of a converter on a B-bypass line operating at the maximum operating pressure. The heavy equipment drop

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SECTION 2.4 SPECIFIC TSRS FOR ENRICHMENT CASCADE FACILITIES

2.4.4 GENERAL LIMITING CONDITIONS FOR OPERATION

2.4.4.1 UF_6 RELEASE DETECTION SYSTEM

LCO 2.4.4.1: At least the minimum number of the UF_6 release detection heads inside the areas of the cascade stated in the ACTIONS table below shall be operable prior to steady state operations above atmospheric pressure.

APPLICABILITY: Modes: Cascade Mode 2. Other cascade associated equipment, steady state operations above atmospheric pressure.

ACTIONS:

Condition	Action	Completion Time
A. Fewer than the minimum of 3 of the UF_6 release detection heads for each cell housing roof and cell exhaust duct in buildings C-331 and C-335 are operable.	A.1 Perform a continuous UF_6 smoke watch on the cell or cells affected by PGLD detection head inoperability. TSR 1.6.2.2(d) is not applicable.	1 hour
B. Fewer than the minimum of 3 of the UF_6 release detection heads for each cell housing roof and inter cell housing in buildings C-333 and C-337 are operable.	B.1 Perform a continuous UF_6 smoke watch on the cell or cells affected by PGLD detection head inoperability. TSR 1.6.2.2(d) is not applicable.	1 hour
C. Fewer than the minimum of 3 of the UF_6 release detection heads in each defined section of the cell bypass are operable.*	C.1 Perform a continuous UF_6 smoke watch on the cell bypass or bypasses affected by PGLD detection head inoperability. TSR 1.6.2.2(d) is not applicable.	1 hour
D. Fewer than the minimum of 3 of the UF_6 release detection heads in each defined section of the unit bypass are operable.*	D.1 Perform a continuous UF_6 smoke watch on the unit bypasses affected by PGLD detection head inoperability. TSR 1.6.2.2(d) is not applicable.	1 hour
E. Either of the minimum of 2 UF_6 detector heads (the detector head located in a B Booster Pump housing, or the detector head located over the pump) inoperable.	E.1 Perform a continuous UF_6 smoke watch on the B Booster Pump affected by PGLD detection head inoperability. TSR 1.6.2.2(d) is not applicable.	1 hour
F. Fewer than the minimum of 1 of the UF_6 release detection heads in each end of the interbuilding tie-line housing are operable.	F.1 Perform a continuous UF_6 smoke watch on the interbuilding tie-line housing end(s) affected by the PGLD inoperability. TSR 1.6.2.2(d) is not applicable.	1 hour

*"Defined Section" defined in Basis.