

**Safety Evaluation Report (SER) for the USEC American Centrifuge Plant  
Feed and Withdrawal Amendment  
SNM-2011, Amendment 1**

**1.0 GENERAL INFORMATION**

The design of the American Centrifuge Plant (ACP), located in Piketon, Ohio, was previously found to meet the applicable requirements of Title 10 of the Code of Federal Regulations (10 CFR), Part 70 as documented in NUREG-1851, "Safety Evaluation Report for the American Centrifuge Plant in Piketon, OH," (NRC, 2006).

In a letter dated November 17, 2008, USEC Inc. (USEC) submitted a license amendment request (LAR) to the U.S. Nuclear Regulatory Commission (NRC) to make changes to the feed and withdraw system design for the ACP. NRC staff held a meeting with USEC on November 18, 2008, to discuss the request.

The staff reviewed the submittal and provided a request for additional information on February 12, 2009. The licensee provided responses to the request for additional information on April 3, 2009, and a revised submittal dated May 18, 2009.

Proposed revisions to the previously approved Integrated Safety Analysis (ISA) Summary and proposed change pages to the previously approved license application were submitted. The licensee submitted a detailed description and justification of the proposed changes which focused on consolidating feed, withdrawal, blending, and transfer capabilities in the X-3346 Feed and Withdrawal Building by eliminating the X-3356 Product and Tails Withdrawal Building and moving sampling capability to a new facility designated as the X-3344 Customer Services Building. Additionally, the licensee proposed removing the X-7756S, X-7746N, and X-7746E Cylinder Storage Yards. USEC stated that these changes would allow for safer liquid uranium hexafluoride (UF<sub>6</sub>) operations.

**2.0 ORGANIZATION AND ADMINISTRATION REVIEW**

No safety significant changes were made to organization and administration at the ACP under this submittal.

**3.0 INTEGRATED SAFETY ANALYSIS AND ISA SUMMARY REVIEW**

**3.1 BACKGROUND**

The purpose of the NRC's review of the licensee's ISA and ISA Summary is to evaluate whether the amendment meets the regulatory requirements specified in 10 CFR Part 70, Subpart H, "Additional Requirements for Certain Licensees Authorized to Possess a Critical Mass of Special Nuclear Material." The review determined whether appropriate hazards and baseline design criteria (BDC) have been addressed. The review also determined whether acceptable items relied on for safety (IROFS) including initial conditions (ICs), management measures, and likelihoods and consequences have been designated for higher-risk accident sequences and whether, with IROFS, the performance requirements of 10 CFR 70.61 have been met. The review also determined whether programmatic commitments to maintain the ISA and ISA Summary are acceptable.

In particular, this review considered information the licensee provided related to:

- The use of BDC for the design of the facility, in accordance with 10 CFR 70.64(a);
- Commitments regarding the licensee's safety program, including the ISA, pursuant to the requirements of 10 CFR 70.62; and
- ISA Summaries submitted in accordance with 10 CFR 70.62(c)(3)(ii) and 70.65.

### 3.1.1 Regulatory Requirements

The regulatory guidance applicable to the ISA and ISA Summary for the ACP is listed in Section 3.1 of NUREG-1851 (NRC, 2006).

### 3.1.2 Regulatory Guidance and Acceptance Criteria

The applicable regulatory guidance and exceptions to that guidance as it was applied to the review of the ACP and this amendment are addressed in Section 3.2 of NUREG-1851 (NRC, 2006).

## 3.2 STAFF REVIEW AND ANALYSIS

This chapter of the SER addresses (1) the safety program and ISA commitments, and (2) the ISA Summary and ISA documentation. The safety program and ISA commitments are found in the LAR (USEC, 2008b). The ISA Summary (USEC, 2008a) review was focused on the differences in the ISA Summary for the original license application and the ISA Summary for the amendment.

### 3.2.1 Safety Program and ISA Commitments

The ISA program and commitments are the same as those evaluated by the staff in section 3.3.1 of NUREG-1851 (NRC, 2006).

### 3.2.2 ISA Summary and ISA Documentation

#### 3.2.2.1 General Description of Site

The site geography, topography, nearby land and water use, special and transient populations, and meteorology were described in Chapter 1.0 of the originally approved ISA Summary. The resistance of the facility to natural phenomena and external man made hazards were discussed in Section 2.5 of the originally approved ISA Summary and evaluated in Section A.3.1.1 of NUREG-1851 (NRC, 2006). No safety significant changes were made during this license amendment request.

#### 3.2.2.2 General Description of the Facility

The facility was described in Chapter 2.0 of the originally approved ISA Summary and was evaluated in Section A.3.1.2 of NUREG-1851 (NRC, 2006). The primary changes in this amendment to the facility will be elimination of Building X-3356 (product and tails withdrawal) and the consolidation of feed and withdrawal operations into Building X-3345.

### 3.2.2.3 Description of Processes, Hazards, and Accident Sequences

#### 3.2.2.3.1 Processes

**[Sensitive Information – Withheld Under 10 CFR 2.390]**

#### 3.2.2.3.2 Hazards

**[Sensitive Information – Withheld Under 10 CFR 2.390]**

### 3.2.2.4 Compliance with the Performance Requirements of 10 CFR 70.61

Information regarding accident sequence evaluation and IROFS designation is presented in Chapter 3.0 of the LAR (USEC, 2008b) and Chapters 4.0, 6.0 and 7.0 and Appendices C, E, F, and K of the ISA Summary (USEC, 2008a).

Previously, in NUREG-1851 (NRC, 2006) the staff concluded that the licensee: (1) identified all credible hazards related to this type of facility; (2) identified accident sequences that could exceed the performance requirements of 10 CFR 70.61 through the application of an appropriate accident identification method in accordance with NUREG-1513 (NRC, 2001) (see Section 3.3.2 of NUREG-1851 (NRC, 2006)); (3) identified appropriate chemical dose and radiological dose values for determining intermediate consequence and high consequence events (see Section 3.3.2.4 NUREG-1851 (NRC, 2006)); (4) determined the consequences in accordance with the fuel facility accident analysis guidance in NUREG-6410 (see Appendix B in NUREG-1851 (NRC, 2006)); (5) established appropriate definitions for likelihood and applied those definitions in an acceptable manner to demonstrate that intermediate consequence events are “unlikely” and high consequence events are “highly unlikely” (see Section 3.3.2.3 of NUREG-1851 (NRC, 2006)).

In regard to the significance of the proposed changes regarding compliance with 10 CFR 70.61, the staff concludes the following:

- There is no significant increase in the probability of occurrence or consequences of previously evaluated accidents. The increases in probability of occurrence are minor and high consequence accidents remain “highly unlikely.” The addition of lubricating oil for the vacuum pumps does not require an upgrade to the design basis of the existing sprinkler system although minor modifications to the system and dikes on the floor will be required. Also, fire department response has been added as an IROFS.
- The proposed changes do not create any new or different types of accident sequences. Battery explosions on cylinder transporters are similar to battery explosions on centrifuge transporters.
- There is no significant reduction in the margin of safety. The elimination of liquid UF<sub>6</sub> blending/transfer operations eliminates two accident sequences and five IROFS offsets the risk from higher inventory available in some modified sequences.
- Also, the proposed changes and associated failure modes do not impact or modify the facility response as previously evaluated, create the possibility of a different type of malfunction of IROFS equipment than previously evaluated, or represent a new unanalyzed type of malfunction.

Management measures as they support the effectiveness of IROFS were reviewed as part of the technical review of accident sequences. The only accident sequence types that can potentially result in intermediate or high consequences at this facility are UF<sub>6</sub> release events (i.e., caused by fires, loss of confinement, natural phenomena, and external events) and criticality accidents (i.e., which are assumed to have a high consequence to the worker). The staff conducted a sample review of selected IROFS related to chemical safety, criticality safety, fire protection, and structural design for selected accident sequences and determined that management measures were adequately identified to ensure that the IROFS will be available and reliable when needed to perform their safety function (see Chapter 11 of NUREG-1851 (NRC, 2006)).

The X-3344 Building is designed to withstand a 10,000 year return period seismic event for the Piketon area. The 10,000 year return corresponds to the most conservative assumption of ground acceleration that was applied during the original licensing review of the ACP. All buildings which contained liquid UF<sub>6</sub> were designed to this specification, which makes its application appropriate for the X-3344 Building.

The X-3346 Building is designed to withstand a 1,000 year return period seismic event for the Piketon area. The 1,000 year return corresponds to the second most conservative assumption of ground acceleration that was applied during the original licensing of the ACP. All buildings which contain items relied on for safety but no liquid UF<sub>6</sub> were designed to this specification, which makes its application appropriate for the X-3346 Building. This approach is consistent with that taken during the original licensing of the ACP and evaluated by the staff in NUREG-1851 (NRC, 2006).

In that the ACP is a new facility, 10 CFR 70.64 specifies criteria for both the facility design and the design process. Compliance with the Baseline Design Criteria and Defense-In-Depth requirements was previously evaluated in Section 3.3.3 of NUREG-1851 (NRC, 2006) and reevaluated for each discipline specific review documented in this SER.

Consistent with Section 3.4.3.2(4) of NUREG-1520 (NRC, 2002) the ISA Summary (USEC, 2008a) provides information which demonstrates compliance with the performance requirements of 10 CFR 70.61 including (a) accident sequence evaluation and IROFS designation, (b) management measures, (c) requirements of criticality monitoring, and (d) requirements for new facilities or new processes at existing facilities, and is therefore, acceptable. The staff concludes that the ISA Summary (USEC, 2008a) meets the requirements of 10 CFR 70.65(b)(4).

#### 3.2.2.5 ISA Team Qualifications and ISA Methods

The licensee's ISA team is the same as that was described in the previously approved ISA Summary submitted during original licensing of the facility. The qualifications of the licensee's ISA team and the adequacy of the licensee's methods were evaluated in Section A.3.1.5 of NUREG-1851 (NRC, 2006). No changes were made during this license amendment request.

#### 3.2.2.6 Descriptive List of IROFS

The descriptive list of IROFS is the same as that evaluated in Section A.3.1.6 NUREG-1851 (NRC, 2006) except as noted throughout Section 3.2.2 of this SER.

### 3.2.2.7 Quantitative Standards

The licensee's proposed quantitative standards for chemical consequences are evaluated in Section 3.3.2.4 of NUREG-1851 (NRC, 2006). No changes were made during this license amendment request.

### 3.2.2.8 Descriptive List of Sole IROFS

The list of sole IROFS is the same as that evaluated in Section A.3.1.8 of NUREG-1851 (NRC, 2006) except that Liquid Primary System Integrity (7.3.4.13) has been removed as an IROFS. This IROFS is no longer necessary because there are no longer any liquid UF<sub>6</sub> transfer operations outside of the autoclave containment.

### 3.2.2.9 Description of the definitions of "Unlikely," "Highly Unlikely," and "Credible"

The licensee's definitions are evaluated in Section A.3.1.9 of NUREG-1851 (NRC, 2006). No changes were made during this license amendment request.

### 3.2.3 On-site ISA Review

No on-site review was required for review of this amendment.

## 3.3 EVALUATION FINDINGS

The staff finds that the facility description in the licensee's ISA Summary (USEC, 2008a) is consistent with the guidance of Section 3.4.3.2(2) of NUREG-1520 (NRC, 2002) and meets the requirements of 10CFR70.65(b)(2) and is, therefore, acceptable.

The staff finds that the information which demonstrates compliance with 70.61 is consistent with the guidance of section 3.4.3.2(4) of NUREG-1520 (NRC, 2002) and meets the requirements of 10 CFR 70.65(b)(4), and is, therefore, acceptable.

## 4.0 RADIATION PROTECTION REVIEW

### 4.1 BACKGROUND

The purpose of the NRC's review of the licensee's radiation protection (RP) program is to evaluate whether the application provides adequate information to protect the radiological health and safety of workers and that it is in compliance with the associated regulatory requirements in 10 CFR Part 70.

#### 4.1.1 Regulatory Requirements

Regulations applicable to establishment of an RP program are presented in 10 CFR Part 20, Subpart B, "Radiation Protection Programs."

#### 4.1.2 Regulatory Guidance and Acceptance Criteria

The guidance applicable to NRC's review of the RP section of the license application (LA) (USEC, 2006b) is contained in Chapter 4 of "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility," NUREG-1520 (NRC, 2002). Chapter 4 of NUREG-1520 (NRC, 2002) is applicable in its entirety. The acceptance criteria applicable to this review are contained in Sections 4.4.1.3, 4.4.2.3, 4.4.3.3, 4.4.4.3, 4.4.5.3, 4.4.6.3, 4.4.7.3, and 4.4.8.3 of NUREG-1520 (NRC, 2002).

#### 4.2 STAFF REVIEW AND ANALYSIS

The nature of the change is to eliminate processing of liquid UF<sub>6</sub> at the ACP outside of the autoclaves used to heat cylinders. This is accomplished in part by increasing the capability to sublime and desublime UF<sub>6</sub> directly from the cylinders and freezers/sublimers used for feed and product withdrawal. This will be the method used for blending as well as cylinder emptying and filling. This has resulted in both a significant reduction of hazards from transfer of liquid UF<sub>6</sub> and increased the MAR associated with the feed, withdrawal, and interconnecting equipment and piping. In addition, moving the withdrawal area to the X-3346 Building increased consequences to off-site receptors because it is closer to the plant boundary.

Regardless of the increased MAR, increased consequences, and additional components associated with the change, the performance requirements of 10 CFR 70.61 continue to be met using a combination of IROFS previously identified and reviewed/approved by the NRC.

#### **[Sensitive Information – Withheld Under 10 CFR 2.390]**

#### 4.3 EVALUATION FINDINGS

The staff reviewed the submittal and noted that the Radiation Protection program, as described in Chapter 4.0 of the previously approved License Application, will not be affected. The Radiation Protection program for the ACP was found to meet the applicable requirements of 10 CFR Part 70 as documented in NUREG-1851 (NRC, 2006).

The NRC staff finds that for this amendment request, the licensee has performed an ISA to identify and evaluate those hazards and potential accidents as required by the regulations. Specifically, the staff finds reasonable assurance that the licensee has accurately evaluated the modifications to the process and that all non-criticality, radiation events have either reduced occurrence or mitigations as appropriate for the level of potential consequence and thus meet the performance requirements specified in 10 CFR 70.61.

### **5.0 NUCLEAR CRITICALITY SAFETY REVIEW**

#### 5.1 BACKGROUND

The purpose of this review is to determine whether the licensee's nuclear criticality safety (NCS) program is adequate to support safe design, construction, and operation of the facility, as required by 10 CFR Part 70. In addition, the purpose of this review is to determine whether the Integrated Safety Analysis (ISA) and ISA Summary meet the regulatory requirements specified in 10 CFR Part 70, Subpart H, "Additional Requirements for Certain Licensees Authorized to Possess a Critical Mass of Special Nuclear Material," for NCS.

The purpose of the NCS programmatic review is to determine whether: (1) the applicant has provided for the appropriate management of the NCS program; (2) the applicant has identified and committed to the responsibilities and authorities of individuals for developing and implementing the NCS program; (3) the facility management measures described in 10 CFR 70.62 have been committed to and will support implementing and maintaining the NCS program; and (4) an adequate NCS program is described, which includes identifying and committing to the NCS methods and NCS technical practices used to ensure the safe operation of the facility, as required by Part 70. This includes review of the licensee's criticality code validation report to determine whether its use of calculational methods provides assurance that processes will be subcritical under normal and credible abnormal conditions, as specified in 10 CFR 70.61(d).

The NCS ISA review is performed to determine whether: (1) the ISA program is acceptable for NCS; (2) the ISA has been acceptably performed and will be maintained for NCS; and (3) the ISA Summary contains necessary information, such that the NCS accident sequences are "highly unlikely."

#### 5.1.1 Regulatory Requirements

The NCS review of the applicant's NCS program should verify if the information the applicant provided meets the requirements of 10 CFR 70.22 and 70.65, which, respectively, specify the general and additional content of a license application (LA). In addition, the NCS review should verify compliance with the regulatory requirements in 10 CFR 70.24, 70.52, 70.61, 70.62, 70.64, 70.65, 70.72, and 10 CFR Part 70, Appendix A.

The NCS review of the applicant's ISA program and ISA Summary should verify if the information the applicant provided meets the requirements of 10 CFR 70.62 and 70.65, which, respectively, specify: (1) the requirements for establishing and maintaining a safety program (10 CFR 70.62), including an ISA program that addresses NCS; (2) requirements for conducting and maintaining an ISA (10 CFR 70.62(c)) for NCS; and (3) requirements for the contents of an ISA Summary (10 CFR 70.65(b)) for NCS.

#### 5.1.2 Regulatory Guidance and Acceptance Criteria

The regulatory guidance applicable to the NCS review of the applicant's NCS program is contained in Chapter 5 of NUREG-1520 (NRC, 2002). The acceptance criteria are outlined in Sections 5.4.3.1, 5.4.3.2, 5.4.3.3, and 5.4.3.4 of NUREG-1520 (NRC, 2002). This includes the use of NRC NCS Regulatory Guide 3.71 (NRC, 2004b), which modified the use of the American National Standards Institute/American Nuclear Society (ANSI/ANS) Series-8 NCS standards (ANSI/ANS, 1975, 1981, 1983a, 1983b, 1984, 1987a, 1987b, 1991, 1995, 1996a, 1996b, 1997a, 1997b, 1997c, and 1998).

The acceptance criteria used for the NCS review of the applicant's ISA program and ISA Summary (USEC, 2006a) are outlined in Sections 3.4.3.1 and 3.4.3.2 of NUREG-1520 (NRC, 2002).

## 5.2 STAFF REVIEW AND ANALYSIS

### **[Sensitive Information – Withheld Under 10 CFR 2.390]**

The staff reviewed the submittal and noted that the Nuclear Criticality Safety (NCS) program as described in Chapter 5.0 of the previously approved License Application will not be affected. The NCS program for the ACP was previously found to meet the applicable requirements of 10 CFR Part 70, as documented in NUREG-1851 (NRC, 2006). Additionally, the licensee stated in its response to the request for additional information that an approved nuclear criticality safety evaluation (NCSE) would be written for each of the sub-systems in the feed and withdrawal facility. The licensee further stated that, “NCSEs will be written to the as-built design of the ACP and contain the NCS double contingency controls and other requirements needed to comply with the NCS program.”

### **[Sensitive Information – Withheld Under 10 CFR 2.390]**

## 5.3 EVALUATION FINDINGS

The staff reviewed the submittal and found the amendment request will not result in new criticality safety accident sequences or reduced safety margin.

Based upon review of the LAR (USEC, 2008b) and ISA Summary (USEC, 2008a), staff finds that the licensee has described the facility, equipment, and processes in sufficient detail to meet the requirements of 10 CFR 70.22 and 70.65, consistent with the acceptance criteria of NUREG-1520.

In addition to the findings in Sections 5.4 and C.4 of NUREG-1851 (NRC, 2006), and based on the information in the submittal, the NRC staff also finds reasonable assurance that the licensee has identified criticality hazards and accident sequences and credited IROFS sufficient to meet the performance requirements of 10 CFR 70.61, consistent with the acceptance criteria of NUREG-1520.

## 6.0 CHEMICAL PROCESS SAFETY REVIEW

### 6.1 BACKGROUND

The purpose of NRC’s review of the licensee’s chemical safety program and the design of the facility is to evaluate whether the application will adequately protect workers, public, and the environment during normal operations against chemical hazards of licensed material and its by-products. The chemical safety program and the facility’s design must also protect against facility conditions and/or operator actions that can affect the safety of licensed materials and present an increase in chemical risk.

#### 6.1.1 Regulatory Requirements

The regulatory bases for the review are the general and additional contents of an application that addresses chemical process safety, as required by 10 CFR 70.22 and 70.65. In addition, the chemical process safety review should provide reasonable assurance of compliance with 10 CFR 70.61, 70.62, and 70.64.

## 6.1.2 Regulatory Guidance and Acceptance Criteria

The guidance applicable to NRC's review of chemical process safety for the proposed facility is contained in Chapter 6 of "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility," NUREG-1520 (NRC, 2002). This chapter is applicable in its entirety. The staff also uses NUREG-1601, "Chemical Process Safety at Fuel Cycle Facilities" (NRC, 1997a), and NUREG-1513, "Integrated Safety Analysis Guidance Document" (NRC, 2001), as guidance documents for this review. The acceptance criteria applicable to this review are contained in Section 6.4.3 of NUREG-1520 (NRC, 2002).

## 6.2 STAFF REVIEW AND ANALYSIS

### 6.2.1 Process Description

The licensee describes the gas centrifuge process in Chapter one of the LAR (USEC, 2008b).

The plant process is designed to enrich natural UF<sub>6</sub> in gaseous form by separating a feed stream containing the naturally occurring proportions of uranium isotopes into a product stream enriched in the uranium-235 (<sup>235</sup>U) isotope up to 10 weight percent <sup>235</sup>U and a tails stream depleted in the <sup>235</sup>U isotope. The process, which is entirely physical in nature, mechanically separates the isotopes using a fast rotating cylinder (centrifuge). This separation occurs because there is a difference in centrifugal forces between the isotopes of uranium since they have different molecular weights. No nuclear reactions or significant chemical changes are expected to occur during normal operations. The feed, product, and tails streams are all in the form of UF<sub>6</sub>. The nominal capacity of the facility will be about 3.8 million separative work units per year.

#### 6.2.1.1 Gas Centrifuge Process

The ACP is comprised of various buildings/facilities and areas on the U. S. Department of Energy (DOE) reservation in Piketon, Ohio. The ACP primarily utilizes existing buildings and facilities which were part of DOE's Gas Centrifuge Enrichment Plant, built in the early 1980s, but will also use newly constructed buildings and facilities. The facility is divided into the following operations:

- Receipt of UF<sub>6</sub>;
- Feeding of UF<sub>6</sub> into the enrichment process;
- Enrichment processing using the cascade centrifuge machines;
- Enriched and depleted UF<sub>6</sub> withdrawal;
- UF<sub>6</sub> sampling to ensure it meets customer specifications;
- UF<sub>6</sub> product material transfer into customer cylinders;
- Loading of UF<sub>6</sub> cylinders for shipment to customers; and
- Handling of waste generated from the entire process.

Proposed changes to the process primarily involve the feed, withdrawal, sampling and product transfer operations.

**[Sensitive Information – Withheld Under 10 CFR 2.390]**

The licensee provides more detailed discussion of the processes described above in the LAR (USEC, 2008b) and the ISA Summary (USEC, 2008a).

#### 6.2.1.2 Chemical Process Inventories

The licensee will possess inventories of chemicals maintained below the threshold quantities set forth by the Occupational Safety and Health Administration (OSHA) Process Safety Management (PSM) standard, 29 CFR 1910.119, and the U. S. Environmental Protection Agency (EPA) Risk Management Program standard, 40 CFR Part 68. UF<sub>6</sub> and its reaction compounds will comprise the greatest quantities of hazardous materials at the ACP.

The licensee expects to possess source material and special nuclear material as part of the process and byproduct radioactive materials as calibration sources. The majority of the calibration sources will be sealed and will not constitute a chemical hazard in the facility.

No changes are proposed to the licensee's chemical safety control strategy. Staff has previously reviewed the control strategy and continues to find it acceptable.

#### 6.2.1.3 Hazardous Chemicals and Chemical Interactions

The main chemical hazard present in the ACP will be UF<sub>6</sub> and its by-products. Other chemicals expected to be used at the ACP include lubricant oil, gases (e.g., nitrogen), diesel fuel, and chemical trap media. **[Sensitive Information – Withheld Under 10 CFR 2.390]** Lubricant oil primarily comprises a combustible hazard and the addition of this system is addressed in the fire hazards section of this SER.

#### 6.2.1.4 Process Description Conclusion

The staff finds that the licensee has provided process descriptions that are sufficiently detailed to allow an understanding of the proposed changes and their effects on chemical process hazards. The information that the licensee provided, as described above, meets the guidance in Section 6.4.3.1(1) of NUREG-1520 and is therefore acceptable.

#### 6.2.2 Chemical Accident Sequences

The ISA Summary and Chapter 3 of the LAR (USEC, 2008b) discuss the screening criteria the licensee used to identify chemicals for further analysis in the hazard evaluation. The methodology used to perform the hazards evaluation phase is also discussed in these chapters. No changes are proposed to the screening criteria or the hazards evaluation methodology. Staff has previously reviewed this information and continues to find it acceptable.

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The analyses of certain accident sequences analysis including likelihood and/or unmitigated consequences of these sequences have changed, due to both the proposed process changes and to the availability of more detailed design information. Staff has reviewed the information provided by the licensee and evaluated the licensee's analyses for these sequences. A comprehensive list of added, deleted, and revised accident sequences is included in Section 3.2.2.3.2 of this SER.

### 6.2.2.1 Review of Chemical Accident Sequences

Staff performed a risk-informed review of the licensee's revised evaluations of selected accident sequences significant to chemical safety.

Changes made to the sampling process and transfer between parent and daughter cylinders result in the elimination of liquid UF<sub>6</sub> activities outside of autoclaves. These process changes resulted in the revision or elimination of several accident sequences involving liquid UF<sub>6</sub>, which allowed for the elimination of several IROFS. Staff evaluated the changes proposed by the licensee and concludes that the licensee's revisions and eliminations of accident scenarios are appropriate and that the remaining IROFS provide adequate protection against these sequences.

The licensee proposes eliminating Machine Isolation IROFS, which had been credited in multiple cascade events involving a loss of confinement. The licensee's justification for eliminating this IROFS is an unmitigated consequence analysis which determined that the consequences to all receptors are "low" without the need to credit the Machine Isolation Valves. The determination of low consequence is predicated on the assumption that a slow release occurs from a breach once the vacuum in the system has equalized with atmospheric pressure. Because the enrichment process operates at less than atmospheric pressure, this is a valid assumption as long as the breach is not open to heated sources of UF<sub>6</sub>. Due to this pressure differential, a breach will result in an initial intake of air into the system followed by a slow diffusion of UF<sub>6</sub> out of the system. The assumption of isolation is supported by multiple valves, pressure sensors, and other safety devices incorporated into the cascade design which function keep centrifuges isolated. The licensee determined that concurrent failure of safety features resulting in exposure of a rupture to a heated UF<sub>6</sub> source is not a credible event. A rupture without a heated source is not unlikely but is low consequence. Staff has reviewed the licensee's assumptions and evaluation of this event and concurs with the licensee's conclusions.

The proposed changes to the feed process increase the capacity of the freezer/sublimers, resulting in an increased MAR, and an increase in the release rate in case of a rupture accident. The IROFS credited for protection against freezer/sublimers rupture accidents are mitigative IROFS. Because of the increased MAR, it is necessary for both IROFS to function as designed to decrease the consequences of a freezer/sublimers rupture to low consequence. At the previous level, only one of the IROFS would need to function. The licensee also reevaluated the likelihood of freezer/sublimers ruptures based on the more detailed design information of the equipment and facility that is now available. Staff reviewed the licensee's evaluation of freezer/sublimers rupture accidents and determined that the credited IROFS provide adequate protection for these sequences.

### 6.2.2.2 Chemical Accident Sequences Conclusion

The staff concludes that the licensee has appropriately identified changes to chemical accident sequences, resulting from the proposed changes in the license amendment. The information provided by the licensee meets the accident sequence and likelihood guidance in Section 6.4.3.1(2) of NUREG-1520 and is therefore acceptable.

### 6.2.3 Chemical Accident Consequences

The ISA Summary addresses the chemical quantitative risk levels used in determining the impact of potential accidents on the workers and the public. The licensee identified and used appropriate techniques and valid assumptions in estimating the consequences from analyzed chemical accident sequences. No changes are proposed to the quantitative risk levels or evaluation techniques. Staff has previously reviewed this information and continues to find it acceptable. Assumptions made in the evaluation of certain accident scenarios have changed due to the proposed process changes or to the more detailed design information currently available for certain equipment and processes. Staff reviewed the information provided in the LAR (USEC, 2008b), ISA Summary (USEC, 2008a), and supporting documentation and evaluated the validity of the revised assumptions.

The staff finds that the licensee has identified and used appropriate techniques and valid assumptions in estimating the consequences from analyzed chemical accident sequences and that the consequences have been conservatively estimated. Based on the review of the ISA Summary and the review of selected accident sequences, the staff also concludes that the licensee has adequately identified the consequences of the accident sequences involving the chemical hazards of licensed materials and hazardous chemicals produced from licensed material. The information provided by the licensee provided, as described above, meets the guidance in Sections 6.4.3.1 of NUREG-1520, and is therefore acceptable.

### 6.2.4 IROFS and Management Measures

#### 6.2.4.1 Chemical Process IROFS

The accident consequences and the need for IROFS were determined by applying the criteria described in 10 CFR 70.61. IROFS were selected to prevent or mitigate the consequences to the public, workers, and the environment. Chapter 7 of the ISA Summary describes the safety functions of all identified IROFS and the specific accident sequences that take credit for each IROFS. The licensee proposed changes to credited IROFS in certain accident scenarios based on the proposed process changes and revised accident analyses discussed above. In other cases, the licensee determined that existing crediting IROFS remain adequate and appropriate to prevent or mitigate revised accident sequences. The staff reviewed credited IROFS for revised accident sequences and concludes that the licensee has adequately identified chemical process IROFS to prevent and/or mitigate the consequences of accident sequences involving the chemical hazards of licensed materials and hazardous chemicals produced from licensed material.

#### 6.2.4.2 Management Measures

After selecting the IROFS, management measures were selected to ensure that IROFS would be available and reliable to perform their safety function when required. Management measures are applied based on a Quality Level (QL) assigned to each IROFS. No changes to management measures or methods for assigning QLs are proposed. Staff has previously reviewed this information in NUREG-1851 (NRC, 2006) and continues to find it acceptable.

### 6.3 EVALUATION FINDINGS

The staff evaluated the LAR (USEC, 2008b) using the criteria previously listed. Based upon review of the LAR (USEC, 2008b) and ISA Summary (USEC, 2008a), staff finds that the

licensee has described the facility, equipment, and processes in sufficient detail to meet the requirements of 10 CFR 70.22 and 70.65, consistent with the acceptance criteria of NUREG-1520 Section 6.4.

The staff also finds reasonable assurance that the licensee has identified chemical hazards and accident sequences and credited IROFS sufficient to meet the performance requirements of 10 CFR 70.61, consistent with the acceptance criteria of NUREG-1520 Section 6.4.

## **7.0 FIRE SAFETY REVIEW**

### **7.1 BACKGROUND**

The purpose of this review is to conclude, with reasonable assurance, that the licensee has designed a facility that provides adequate protection against fires and explosions that could affect the safety of licensed materials and thus present an increased radiological risk. The review should also establish that the application has considered radiological and chemical consequences of fires and will institute suitable safety controls to protect workers, the public, and the environment.

#### **7.1.1 Regulatory Requirements**

The regulatory basis for the fire safety review should be the general and additional contents of application, as required by 10 CFR 30.33, 10 CFR 40.32, 10 CFR 70.22 and 70.65. In addition, the fire safety review should focus on providing reasonable assurance of compliance with 10 CFR 70.61, 70.62, and 70.64.

#### **7.1.2 Regulatory Guidance and Acceptance Criteria**

The acceptance criteria the NRC uses for reviews of fire safety are outlined in Sections 7.4.3.1 through 7.4.3.5 of NUREG-1520 (NRC, 2002).

### **7.2 STAFF REVIEW AND ANALYSIS**

The licensee fire protection program, including its commitment to applicable codes and standards was evaluated by the staff in section 7.3 of NUREG-1851 (NRC, 2006). No changes were made during this license amendment request.

The licensee's procedure for developing pre-fire plans was evaluated in section 7.3.1.4 of NUREG-1851 (NRC, 2006). Applicable pre-fire plans, including those for the X-3344 Building and the X-3346 will be available for NRC review to support the feed and withdrawal operational readiness and management measures verification review.

The licensee's procedure for developing Fire Hazards Analyses was evaluated in NUREG-1851 (NRC, 2006). Fire Hazard Analyses for Building X-3344 and X-3346 (USEC, 2009a) were evaluated as part of the Feed and Withdrawal Amendment review and found to be in accordance with guidance provided in National Fire Protection Association (NFPA) Standard 801, "Standard for Fire Protection for Facilities Handling Radioactive Materials."

The ACP facility design in regard to fire protection was evaluated in section 7.3.3.1 of NUREG-1851 (NRC, 2006). The Feed and Withdrawal modifications do not result in changes to the fire

protection aspects of the facility design as evaluated in Section 7.3.3.1 of NUREG-1851 (NRC, 2006).

The ACP facility active-engineered fire protection systems are evaluated in Section 7.3.3.2 of NUREG-1851 (NRC, 2006). No changes were made during this license amendment request.

#### 7.2.1 Process Fire Hazards and Special Hazards

Process fire hazards and special hazards evaluated from the proposed change to the ISA Summary (USEC, 2008a) are the same as evaluated in Section D.3.2 of NUREG-1851 (NRC, 2006) with the following exceptions:

#### **[Sensitive Information – Withheld Under 10 CFR 2.390]**

#### 7.2.3 IROFS Related to Fire Safety

The IROFS related to fire safety are the same as the IROFS evaluated by the staff in Section D.3.3 of NUREG-1851 (NRC, 2006). No IROFS for fire safety were added or modified during this license amendment request.

### 7.3 EVALUATION FINDINGS

The amendment application is consistent with the guidance in Sections 7.4.3.2 and 7.4.3.4 of NUREG-1520 (NRC, 2002) regarding fire hazards analysis and process fire safety.

The dominant fire risk to safety and health of workers and the public for the proposed process is a fire that could lead to loss of confinement of UF<sub>6</sub>. This includes a fire damaging the centrifuge machines and piping that provide UF<sub>6</sub> confinement, or resulting in hydraulic rupture of UF<sub>6</sub> cylinders inside or on the outdoor storage pad. The licensee's submittals provide sufficient information, in accordance with requirements of 10 CFR 70.65, regarding potential fire hazards, consequences, and required controls for the proposed processes. The NRC staff determined that the licensee demonstrated compliance with the performance requirements of 10 CFR 70.61 for fire protection related to postulated accident scenarios. The licensee has identified a reasonable set of IROFS and defense-in-depth protection to ensure that the risks are within the performance requirements of 10 CFR 70.61.

Based on the design of the facility, relative to fire protection and the designation of IROFS and measures that provide defense-in-depth, the staff concludes with reasonable assurance that the facility also meets the requirements of 10 CFR 30.33, 40.30, 70.22, and 70.64(a)(3), regarding baseline design criteria for protection against fire and explosions, and 10 CFR 70.64(b) defense-in-depth.

## **8.0 EMERGENCY MANAGEMENT REVIEW**

No safety significant changes were made to emergency management at the ACP under this submittal.

## 9.0 ENVIRONMENTAL PROTECTION REVIEW

By letter dated August 23, 2004, USEC submitted an application for a license to construct and operate a uranium enrichment facility in Piketon, Ohio (the ACP). NRC staff completed an environmental impact statement, which provided a complete and thorough analysis of the potential environmental impacts of the proposed action (NUREG-1834). USEC now seeks a license amendment to Materials License SNM-0211 to revise its feed and withdrawal system design at the ACP.

NRC staff has concluded that the following changes in process operations and equipment will not have a significant individual or cumulative environmental impact on the human environment:

- Consolidation of feed and withdrawal facilities;
- Pre-process of feed material to remove light gases;
- Replace product withdrawal cold traps with simpler vacuum pump/cold box system; and
- Eliminate liquid transfer of the UF<sub>6</sub> product.

This amendment request can be considered administrative and procedural in nature, and satisfies the criteria in 10 CFR 51.22 (c)(11) for a categorical exclusion. Those criteria are as follows:

- (i) There is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite;
- (ii) There is no significant increase in individual or cumulative occupational radiation exposure;
- (iii) There is no significant construction impact; and
- (iv) There is no significant increase in the potential for or consequences from radiological accidents.

The staff's analysis as to why these changes are not significant are as follows:

- The proposed changes do not result in any new or unusual sources of hazardous substances. Therefore, there is no significant change in the types and/or the amounts of effluents that may be released offsite.
- The proposed changes will not create any new or unusual radiological or chemical releases, so there is no significant increase in individual or cumulative occupational radiation exposure.
- Elimination of the liquid transfer for the UF<sub>6</sub> product results in an increase in the safety margin, allowing for the termination of two accident sequences. As a result, there is no significant increase in the potential for or consequences from radiological accidents.
- Given the deletion of a planned building and the consolidation of existing facilities, the footprint for construction has increased by approximately 10,000 ft<sup>2</sup>. This increase represents less than one percent (0.24%) of expansion and does not affect any resources. For that reason, it does not result in a significant construction impact.

The changes identified in the license amendment meet all of the criteria identified above for a categorical exclusion. Therefore, NRC staff has determined that the changes have insignificant impacts on the human environment and an environmental assessment is not required.

## **10.0 DECOMMISSIONING REVIEW**

NRC staff has reviewed the decommissioning cost estimate for the ACP (license number SNM-2011) located at Piketon, Ohio, according to NUREG-1757, Volume 3, "Financial Assurance, Recordkeeping, and Timeliness." Based on this review, NRC staff has determined the cost estimate submitted by the licensee is acceptable and that the licensee is required to adjust the decommissioning cost estimate and associated financial assurance on a regular basis in accordance with License Conditions 16 and 17.

NRC staff has reviewed the draft certification of financial assurance for the ACP (license number SNM-2011) located at Piketon, Ohio, according to NUREG-1757, Volume 3, "Financial Assurance, Recordkeeping, and Timeliness." Based on this review, NRC staff has determined that the draft certification of financial assurance submitted by the licensee specifies the appropriate information. Final original executed certificates of financial assurance should be provided on a regular basis along with the final original executed financial assurance mechanisms as required in License Conditions 16 and 17.

NRC staff has reviewed the draft financial assurance mechanisms for the ACP (license number SNM-2011) located at Piketon, Ohio, according to NUREG-1757, Volume 3, "Financial Assurance, Recordkeeping, and Timeliness." Based on this review, NRC staff has determined that the draft financial assurance mechanisms and supporting documentation submitted by the licensee conform to NRC guidance. Final original executed financial assurance mechanisms covering each total incremental decommissioning cost are required in accordance with License Conditions 16 and 17.

## **11.0 MANAGEMENT MEASURES REVIEW**

No safety significant changes were made to management measures at the ACP under this submittal.

## **12.0 MATERIAL CONTROL AND ACCOUNTING REVIEW**

The changes were to clarify the use of cold boxes to permit monitoring of cylinder weights during de-sublimation, the inventory of the blending/transfer systems during normal operations, and the measurement practice applied for the uranium purity of the product and tail cylinders. The staff review confirms that the Fundamental Nuclear Material Control (FNMC) Plan changes submitted by USEC do not decrease the overall effectiveness of the material control and accounting program implemented pursuant to 10 CFR Part 74, Subpart C. Accordingly, the staff approves of the FNMC Plan changes.

## **13.0 PHYSICAL AND TRANSPORTATION SECURITY REVIEW**

Changes to physical and transportation security were made via other submissions and evaluation findings were issued separately.

## REFERENCES

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

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

(NRC, 2006) U.S. Nuclear Regulatory Commission (NRC) NUREG-1851, “Safety Evaluation Report for the American Centrifuge Plant in Piketon, Ohio,” September 2006.

(USEC, 2008a) USEC Inc., “Integrated Safety Analysis Summary for the American Centrifuge Plant in Piketon, Ohio,” proposed change, November 2008.

(USEC, 2008b) USEC Inc., “License Application for the American Centrifuge Plant in Piketon, Ohio” proposed change, November 2008.

(USEC, 2009a) USEC Inc. “Submittal of USEC Inc.’s Response to a Request for Additional Information for the American Centrifuge Plant License Amendment for Feed and Withdrawal System Design Changes,” AET 09-0027, April 3, 2009.

(USEC, 2009b) USEC Inc. “Submittal of USEC Inc.’s Response to a Request for Additional Information for the American Centrifuge plant License Amendment for Feed and Withdrawal System Design Changes,” AET 09-0028, April 3, 2009.

(USEC, 2009c) USEC Inc, Secure E-mail from Terry Sensue to James Downs, “NRC RAI for the Feed and Withdrawal System Design Changes – Lube Oil System,” May 7, 2009.

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