Mixed Oxide Fuel Fabrication Facility
Request for Additional Information
Chemical Safety

General Chemical Safety RAIs

CS 1

Revise the license application (LA) to include a description of the overall safety strategy for each of the explosion events that were identified in the integrated safety analysis (ISA) summary. The information should include a discussion of the different parameters (i.e. temperature, pressure, reactant concentrations, flow rates, etc.) affecting each explosion event and the credited Items Relied on for safety (IROFS).

10 *Code of Federal Regulations* (CFR) 70.22(a)(7) requires that each application for a license contain a description of equipment and facilities which will be used by Shaw AREVA MOX Services (the applicant) to protect health and minimize danger to life or property.

NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," recommends the following in Section 8.4.3.1, Acceptance Criterion B: "[i]n the chemical process description, the applicant identifies the names and formulae of chemical reactants and products (input and output) to process steps, rates of reactions, and the operating conditions (e.g., temperature, pressure, flow rate and pH), and identifies which chemicals contact licensed materials or could significantly impact operations with licensed materials. The chemical process description includes sufficient information (e.g., mass/energy/radioactivity balances, process flow diagrams, and descriptive equations) to enable the reviewers to understand the hazards associated with the chemical processes."

Additionally, the following is recommended in Section 8.4.3.5 Acceptance Criterion D of NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility,": "IROFS are identified for those accident sequences containing a chemical/process failure that may lead to radiological consequences that exceed the performance requirements of the 10 CFR 70.61."

CS 2

Revise the ISA summary to clearly define the nominal, analytical, and safety limits for process parameters that are controlled as part of the safety strategy to prevent each explosion event. Describe the margin between the nominal and safety limits.

Guidance provided in the NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.5 Acceptance Criterion C, recommends that the process safety controls include a description of the process and engineering design features used to control each process step, including set point ranges and any special administrative or procedural controls.

10 CFR 70.23(a)(4) states that a LA will be approved when the Commission determines that the applicant's proposed procedures to protect health and minimize danger to life and property are adequate.

10 CFR 70.64(b)(2) requires that facility and system design must incorporate, to the extent practicable, features that enhance safety by reducing challenges to IROFS.

CS 3

For each explosion event identified in the ISA summary, revise Table 5.3.6-4 to clarify the manner in which the IROFS function as an integrated system to render each explosion event highly unlikely. Table 5.3.6-4 "Summary of Explosion Event Evaluations," is unclear in its descriptions of how the IROFS presented in the table function in relation to the performance requirements of §70.61; which IROFS in which "trains" must function in unison to render the event highly unlikely; and how IROFS failures will be detected (e.g., it is unclear how "FS – Fail Safe" is a means for detecting IROFS failure).

10 CFR 70.65(b)(6) states that the ISA summary must contain "[a] list briefly describing each item relied on for safety which is identified pursuant to §70.61(e) in sufficient detail to understand their functions in relation to the performance requirements of §70.61."

CS 4

Revise Table 5.3.6-5 "List of Sole IROFS for Explosion Events," in the ISA summary to include, for each sole IROFS, a complete description of the IROFS safety function.

10 CFR 70.65(b)(8) requires that the ISA summary contain a descriptive list that identifies all IROFS that are the sole item preventing or mitigating an accident sequence that exceeds the performance requirements of §70.61.

CS 5

Revise Section 4.2 of the ISA summary to provide schematic diagrams and a discussion of the IROFS (and their associated safety functions) for the raffinates reception tank (purification unit [KPA]*TK9000), control tank (KPA*TK9100), recycling tank (purification unit [KPA]*TK9500), plutonium (Pu) rework tank (KPA*TK8500), and Pu rework tank (KPA*TK8000).

10 CFR 70.22(f) requires that each application for a license to possess and use special nuclear material in a Pu processing and fuel fabrication facility will provide a description and safety assessment of the design bases of the principal structures, systems, and components of the plant.

CS 6

Revise Section 11.2 of the LA and Section 4.2 of the ISA summary to provide the control schemes (and supporting safety analysis) for monitoring and controlling 'tank heels' (throughout the aqueous polishing process) with respect to materials transfers into 'empty tanks.'

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10 CFR 70.22(f) requires that each application for a license to possess and use special nuclear material in a Pu processing and fuel fabrication facility will provide a description and safety assessment of the design bases of the principal structures, systems, and components of the plant.

CS 7

Include a commitment in the LA for providing fresh (not recycled) diluent feed to diluent washing pulsed columns (KPA*PULS2100 and KPA*PULS3100).

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10 CFR 70.22(f) requires that each application for a license to possess and use special nuclear material in a Pu processing and fuel fabrication facility will provide a description and safety assessment of the design bases of the principal structures, systems, and components of the plant.

10 CFR 70.64(a)(1) requires that the design must be developed and implemented in accordance with management measures, to provide adequate assurance that IROFS will be available and reliable to perform their function when needed.

Chemical Process Systems Designated as IROFS RAIs

CS 8

Revise the LA (Sections 11.2.13 and 11.3) and ISA summary (Section 4.2 and Section 4.3) to provide a complete description of the integrated design and operation of the off-gas (KWG) and heating, ventilation and air conditioning (HVAC)/confinement units. This description should include all relevant design features, including types and location of high-efficiency particulate air filters, instruments and sensors, methods of operation under both normal and abnormal conditions (including start up and shutdown), and safety limits.

10 CFR 70.22(a)(7) states that each application for a license shall contain a description of equipment and facilities which will be used by the applicant to protect health and minimize danger to life and property.

10 CFR 70.61(e) requires that each engineered or administrative control or control system necessary to comply with paragraphs (b), (c), and (d) of 10 CFR 70.61 be designated IROFS, and the safety program established pursuant to 10 CFR 70.62 ensure that each IROFS will be available and reliable to perform its intended function when needed.

10 CFR 70.65(b)(2) requires that the ISA summary contain a general description of the facility with emphasis on those areas that could affect safety. 10 CFR 70.65(b)(3) requires that the ISA summary contain a description of each process analyzed in the ISA in sufficient detail to understand the theory of operation; the hazards that were identified in the integrated safety analysis; and a general description of the types of accident sequences.

Decanning RAI

CS 9

Clarify Section 4.2.1.2 of the ISA summary relating to tap density measurements in the decanning unit to describe which feedstocks require tap density measurements to meet Mixed Oxide Fuel Fabrication Facility (MFFF) acceptance requirements.

The applicant stated at the on-site review on August 22-23, 2007, that tap density measurements will only be performed on Pit Disassembly and Conversion Facility (PDCF) feed. The description in Section 4.2.1.2 of the ISA summary states that both alternate feedstock (AFS) and PDCF will undergo tap density measurements. Clarify the ISA summary to reflect which type of feed will undergo tap density measurements and provide the technical basis.

10 CFR 70.64(a)(5) requires that the design must provide for adequate protection against chemical risks produced from licensed material, facility conditions which affect the safety of licensed material, and hazardous chemicals produced from licensed material.

Recanning RAI

CS 10

Revise the LA to include pertinent information to assure that incoming AFS and PDCF materials: 1) remain within the specifications of materials evaluated and presented in the ISA summary and previously approved in the staff's Safety Evaluation Report for the Construction Authorization Request (CAR) (NUREG-1821); 2) arrive packaged to the U.S. Department of Energy (DOE) 3013 standard; and 3) that any rejected material will be repackaged to the DOE 3013 standard.

10 CFR 70.22(a)(7) states that each application for a license shall contain a description of equipment and facilities which will be used by the applicant to protect health and minimize danger to life and property.

Electrolyzer RAIs

CS 11

Revise Section 5.3 of the ISA summary to either include an accident sequence for a potential upset condition of generating higher oxidation states of chlorine (HOC) during dechlorination and dissolution in the electrolyzer or demonstrate that the event is either not-credible, or can not cause an intermediate or high consequence as per 10 CFR 70.61 and Section 8.4.3.3 of NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility."

CS 12

Revise Section 5.3 of the ISA summary to include a demonstration of "highly unlikely" for any credible accident sequence involving the electrolyzer (HOC's during dechlorination and dissolution). For any credible accident sequence with intermediate or high consequences as stated in 10 CFR 70.61, the applicant must demonstrate that the event is highly unlikely. Additional guidance is provided in Section 8.4.3.3 of NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility."

CS 13

Revise Section 5.3 of the ISA summary to provide a description of any IROFS necessary to prevent HOC from entering the KPA, or prevent accumulation of HOC in aqueous raffinate tanks

and off-gas systems. Alternatively, justify why IROFS are not needed for the dechlorination process to comply with 10 CFR 70.61 and Section 8.4.3.4 of NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility."

Sampling RAIs

CS 14

Revise the ISA summary Section 5.3.6 to list IROFS sampling in Table 5.3.6-5 as a sole IROFS for EXP12, Pu (VI) Oxalate Explosion and any other applicable events or to describe the features which ensure the "dual redundant samples" are sufficiently independent that designation as a Sole IROFS is not required.

10 CFR 70.65(b) requires that the ISA summary must contain descriptive list that identifies all IROFS that are the sole item preventing or mitigating an accident sequence that exceeds the performance requirements of §70.61.

NUREG 1718 "Standard Review Plan for the Review of an Application for a Mixed Oxide Fuel Fabrication Facility" Section 5.4.3.2.B.xi.b states the description of IROFS. The applicant describes the essential features of each IROFS that are required to achieve adequate reliability. The applicant should indicate features of the IROFS that affect its independence from other IROFS.

CS 15

Revise the ISA summary Section 5.3.6 to demonstrate how implementation of IROFS sampling adds to the determination that the likelihood of EXP 12, Pu (IV) Oxalate Explosion, and other applicable events, is highly unlikely, specifically how the single failure criterion of the highly unlikely definition is met.

10 CFR 70.65(b) requires that the ISA summary contain information that demonstrates the licensee's compliance with the performance requirements of §70.61.

CS 16

Revise the LA to include a description of the IROFS sampling procedures. Identify the design basis features of the elements (i.e. homogenization, manual sampling, tank isolation) of IROFS sampling currently described in the Nuclear Safety Evaluation (NSE) for IROFS sampling. Include commitments to any codes and standards which will be relied upon.

10 CFR 70.22(a) states that each application for a license shall contain proposed procedures to protect health and minimize danger to life and property.

CS 17

Revise the ISA summary to describe the safety function and functional requirements of each element of IROFS sampling currently described in the NSE for IROFS sampling. Include a list and description of the IROFS (such as the sampling plan, and the air operated valves which control tank discharge) which will be applied to each element to ensure that IROFS sampling will be available and reliable to perform its safety function when needed.

10 CFR 70.65(b) states that the ISA summary contain a list briefly describing each IROFS which is identified pursuant to §70.61 in sufficient detail to understand their functions in relation to the performance requirements of §70.61.

CS 18

Revise the ISA summary or provide other documentation to be maintained as part of the ISA, to describe the assumptions which provide the basis for not requiring homogenization of reagent tanks and powder containers as elements of IROFS sampling.

"Homogenization of Reagent Tanks" and "Homogenization of Powder Containers" are currently listed in the NSE for IROFS sampling as elements of sampling. However, the sole discussion of these items is a statement that homogenization is not required. The underlying basis or assumptions for this determination are not documented or discussed.

10 CFR 70.62(c)(1) states that each licensee or applicant shall conduct and maintain an ISA that is of appropriate detail for the complexity of the process, that identifies each IROFS identified pursuant to §70.61(e) and the assumptions and conditions under which the item is relied on to support compliance with the performance requirements of §70.61.

Chemical Interactions RAIs

CS 19

Revise Section 4.2.4.2 of the ISA summary and Section 8.3 of the LA to evaluate the hazards associated with the use of carbohydrazide and morphaline borane, and provide consistency between the ISA summary and the LA.

The ISA summary Section 4.2.4.2 states that the oxygen scavengers, carbohydrazide and morpholine borane are present in the steam in the process steam and condensate (SPS) system. However, Chapter 8 of the LA does not include these chemicals in the chemical inventory lists, as suggested in NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," page 8.0-2, item B. The hazardous characteristics and incompatibilities of these chemicals are not currently addressed in Chapter 8 of the LA. These chemicals, present in steam from the SPS system, come into contact with licensable material (ISA summary section 4.2.4.2) by way of steam spargers used in the process.

Assess the hazardous characteristics and incompatibilities of these chemicals and include this information in the chemical interaction matrix and the hazardous characteristics and incompatibilities table in Section 8.3 of the LA.

CS 20

Revise Chapter 8 of the LA to demonstrate compliance with 70.62(c)(iv) and the guidance in NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," page 8.0-2, item B regarding the following chemical hazards and incompatibilities:

The following chemical hazards and incompatibilities presented below were omitted from Table 8.1-1 of the LA relative to that presented in Table 8-4 of the MFFF CAR. The applicant has

committed to chemical safety controls as IROFS in the ISA summary. The particular application of this IROFS would preclude mixing of hazardous or incompatible chemicals. Omission of hazards and/or incompatibilities could potentially result in an incomplete chemical safety control IROFS strategy. Alternatively, describe why the hazards and incompatibilities indicated below will not effect the chemical safety control IROFS.

Chemical	Hazard Omitted	Incompatibility omitted
Hydroxylamine nitrate (HAN)	--	Strong oxidizers, strong reducing agents, HNO_3, combustible material
Nitrogen dioxide	Corrosivity, explosivity, chemical burn	metals

CS 21

Revise Section 8.3 of the LA to indicate expected normal process interactions between chemicals that would occur and the conditions (concentration, temperature, time, etc.) that would be controlled to allow safe operating conditions, per the guidance provided in NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," page 8.0-2, item B.

Normal process conditions allow interactions of some chemicals listed as incompatible in Table 8.1-1 of the LA (e.g., nitric acid and HAN).

CS 22

Revise the ISA summary and LA to ensure accuracy of chemical nomenclature and/or chemical descriptions as indicated below.

a. Hydrogen (H)

The prevalent use of the chemical term 'hydrogen' to describe "H^+" is inaccurate and incorrect. "H^+" is a 'proton' or hydronium ion (in aqueous solutions), while "hydrogen" refers to the gas, H_2. These two species have very different chemical reactivities/properties and safety considerations. Inaccurate and confusing chemical safety analyses may result from such chemical descriptions. Specific example from ISA summary p. 4.2.5-8: "The silver II ions react with hydrogen peroxide to form non-ionized silver, oxygen and hydrogen." Mass balance interpretation from this chemical description:

$$Ag^{+2} + H_2O_2 \rightarrow Ag^0 + O_2 + H_2 \qquad \text{Eq 1}$$

This reaction cannot happen due to electron balance. The mass balance written in the ISAs:

$$2Ag^{+2} + H_2O_2 \rightarrow 2Ag^{+1} + O_2 + 2H^+ \qquad \text{Eq 2}$$

Equation 2 makes chemical sense and depicts one example of items involving the use of "hydrogen" when the cation was the correct species. The mass balance equations appear to be correct, but the text describing the reactions needs correction throughout the LA and ISA summary.

b. Chlorine (CI)

'Chlorine' is inaccurately used to describe both Cl gas (Cl_2) and chloride (Cl^-). This is prevalent in various sections of the ISA summary and LA dealing with the dechlorination process.

c. Silver (Ag) and others

1. Equation 1 and 2 also reveal an incorrect description of the oxidation state of Ag. Non-ionized Ag has an oxidation state of zero as indicated in Eq.1, above. Ag^{+1} is referred to as 'non-ionized silver', as evidenced in the mass balance equation in the ISAS (reproduced in Eq 2).

Additionally, Table 8.1-5 in the LA has some minor chemical formula clarifications/ corrections:

2. Silver oxide is indicated as AgO. As written this would indicate that the laboratory chemical is Ag(II) oxide. If this is correct, additional information is needed in reference to this material, as stability issues for this oxidation state of Ag usually prohibits it from being used as an ordinary laboratory reagent.

3. Sodium hydrogen sulfate's chemical formula is indicated as $NaHS_4$. This is likely a typographical error in need of correction.

4. The condensed chemical formula for sodium oxalate is usually written as $Na_2C_2O_4$ rather than $C_2Na_2O_4$.

10 CFR 70.9 requires that information provided to the Commission by an applicant for a license or by a licensee or information required by statute or by the Commission's regulations, orders, or license conditions to be maintained by the applicant or the licensee shall be complete and accurate in all material respects.

Explosion Events RAIs

Sintering Furnace Hydrogen Explosion

CS 23

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CS 24

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CS 25

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CS 26

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CS 27

Revise Sections 5.3.6.2.1.4 “Loss of Pressurized Gas Supply with Air Infiltration,” 5.3.6.2.1.5 “Ar-H Mixture in Furnace Airlock Exposed to Glovebox Atmosphere,” 5.3.6.2.1.6 “Air enters Ar-H network Through Interfacing System Line,” and 5.3.6.2.2 “Steam Explosions,” of the ISA summary to demonstrate that IROFS controllers are available and reliable to perform their function when needed.

10 CFR 70.65(b)(3) states that the ISA summary must contain a general description of the facility with emphasis on those areas that could affect safety.

The acceptance criteria in NUREG-1718, “Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility,” Section 3.4.3.2(3), Processes, states that a description at a systems level is acceptable provided that it permits the NRC reviewer to adequately evaluate: (1) completeness of the hazard and identification tasks; and (2) the likelihood and consequences of the accidents identified.

CS 28

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CS 29

Revise Section 5.3.6.2.1.4 “Loss of Pressurized Gas Supply with Air Infiltration,” of the ISA summary to provide the assumptions and results of calculations confirming that the time required for oxygen detector actuation and argon purging is short enough to prevent a detonation or deflagration in the sintering furnace.

10 CFR 70.65(b)(3) states that the ISA summary must contain a general description of the facility with emphasis on those areas that could affect safety.

The acceptance criteria in NUREG-1718, “Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility,” Section 3.4.3.2(3), Processes, states that a description at a systems level is acceptable provided that it permits the NRC reviewer to adequately evaluate: (1) completeness of the hazard and identification tasks; and (2) the likelihood and consequences of the accidents identified.

CS 30

Section 5.3.6.2.1.4, “Loss of Pressurized Gas Supply with Air Infiltration” states that “[r]apid combustion (i.e., deflagration) could occur inside the furnace due to this inleakage resulting in overpressurization of the furnace and a subsequent potential release of radioactive material.”

Revise Section 5.3.6.2.1.4 of the ISA summary to clarify if all types of explosions are being prevented or just a detonation. If a deflagration is not “highly unlikely” explain the mechanism for H_2 deflagrations that may occur within the sintering furnace following a seismic event (or other loss of gas supply with air infiltration event) and provide the estimated pressure rise and the design levels of pressure for the furnace shell. Demonstrate that detonation is highly unlikely considering potential concentration ranges of H_2 in air. Concentration ranges under accident conditions may also be considered to show that deflagrations inside the furnace are also highly unlikely if this is the intent of the design.

10 CFR 70.65(b)(3) states that the ISA summary must contain a general description of the facility with emphasis on those areas that could affect safety.

The acceptance criteria in NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 3.4.3.2(3), Processes, states that a description at a systems level is acceptable provided that it permits the NRC reviewer to adequately evaluate: (1) completeness of the hazard and identification tasks; and (2) the likelihood and consequences of the accidents identified.

Radiolysis RAIs

CS 31

Revise Section 5.3.6.2.3, "Radiolysis Induced Explosion," of the ISA summary to provide the estimated air flows for the emergency scavenging air system. Also provide the maximum flow of H_2 and other flammable gases under upset conditions and the resulting percentage of lower flammable limit for the mixture of flammable gases.

10 CFR 70.65(b)(3) states that the ISA summary must contain a general description of the facility with emphasis on those areas that could affect safety.

The acceptance criteria in NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 3.4.3.2(3), Processes, states that a description at a systems level is acceptable provided that it permits the NRC reviewer to adequately evaluate: (1) completeness of the hazard and identification tasks; and (2) the likelihood and consequences of the accidents identified.

CS 32

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CS 33

Revise Section 5.3.6.2.3 of the ISA summary to provide the technical basis for ensuring that dilution air, or scavenging air, will be available and reliable to perform its safety function of keeping H_2 concentrations below 1% in specified vessels. Include a discussion of and the results of H_2-air mixing calculations. In Section 5.3.6.2.3 of the ISA summary it is stated that dilution air, or scavenging air, will be provided to the vapor space of tanks and vessels in order to ensure that the H_2 concentration does not reach explosive limits, based on NFPA 69.

Section 8.4.3.5 (A) of the NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," states that the applicant should identify chemical process safety controls used to prevent or mitigate potential accidents along with appropriate safety analyses.

CS 34

Revise Section 5.3.6.2.3 of the ISA summary to clarify the assumption of constant H_2 generation which was used to calculate the expected H_2 generation rates in tanks and vessels.

Section 8.4.3.5 (A) of NUREG-1718, “Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility,” states that the applicant’s identification of chemical process safety controls used to prevent or mitigate potential accidents should be supported by appropriate safety analyses.

CS 35

Revise Section 5.3.6.2.3 of the ISA summary to justify the lack of continuous H_2 monitoring in MFFF vessels and equipment evaluated in explosion event EXP-03 (radiolysis events). Guidance provided in Regulatory Guide 3.7, “Monitoring of Combustible Gases and Vapors in Plutonium Processing and Fuel Fabrication Plants,” states that assurance that the established processing and operating procedures are maintaining safe conditions should be provided by suitable continuous monitoring systems.

10 CFR 70.64(a)(5) states that the design must provide for adequate protection against chemical risks produced from licensed material, facility conditions which affect the safety of licensed material, and hazardous chemicals produced from licensed material.

10 CFR 70.22 states that each application for a license shall contain a description of equipment and facilities which will be used by the applicant to protect health and minimize danger to life or property.

CS 36

Revise Section 5.3.6.2.3 of the ISA summary to include a discussion of the technical basis for determining the appropriate scavenging air flow rates to tanks and vessels and other effected equipment. The discussion should include the results of the calculations and the assumptions that were used in the analyses.

Section 8.4.3.5 (A) of NUREG-1718, “Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility,” states that the applicant’s identification of chemical process safety controls used to prevent or mitigate potential accidents should be supported by appropriate safety analyses.

CS 37

Revise Section 5.3.6.2.3 of the ISA summary to provide the technical basis for the ventilation rates for the KPA*PULS3000 column. According to Section 5.3.6.2.3 of the ISA summary, in the case of a seismic event, nitrogen purge gas will be provided to KPA PULS3000 in order to maintain H_2 concentrations below 1%. However, there is no discussion of how the nitrogen purge gas system will assure that maximum H_2 concentration rates are not exceeded.

Section 8.4.3.5 (A) of NUREG-1718, “Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility,” states that the applicant’s identification of chemical process safety controls used to prevent or mitigate potential accidents should be supported by appropriate safety analyses.

CS 38

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CS 39

Revise Section 11.3 of the LA and Section 5.3.6.2.3 of the ISA summary to include details on

the design of the vents in the waste drums and demonstrate they will be available and reliable upon demand to maintain a H_2 concentration within the drum to less than 1%.

Page 11.3-60 of the LA indicates that "[w]aste drums and boxes that contain transuranic waste are fitted with passive hydrogen gas vents. The vents are filtered vents that allow diffusion of hydrogen gas that may be generated by radiolysis from the waste drum headspace."

Section 8.4.3.5 (C) of NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," states that the discussion should describe the process safety features that are relied upon for chemical process safety, including the number and quality of controls used to protect against or mitigate accidents involving the release of hazardous chemicals that are produced from the licensed material or that may impact the safety of licensed material, as determined by the ISA.

CS 40

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(Hydroxylamine nitrate) HAN

CS 41

Revise the ISA summary to include a discussion of the safety analysis of the following five scenarios, involving the storage and use of HAN that could lead to accident sequences whose unmitigated consequences could exceed the performance requirements of § 70.61:

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Describe the results of the analysis, including a demonstration of the manner in which the IROFS designated for EXP04 render each of these scenarios "highly unlikely."

10 CFR 70.61(e) requires that each engineered or administrative control or control system necessary to comply with paragraphs (b), (c), of (d) of 10 CFR 70.61 will be designated IROFS, and the safety program established pursuant to 10 CFR 70.62 will ensure that each IROFS will be available and reliable to perform its intended function when needed.

10 CFR 70.65(b)(2) requires that the ISA summary contain a general description of the facility with emphasis on those areas that could affect safety. 10 CFR 70.65(b)(3) requires the ISA summary to contain a description of each process analyzed in the ISA in sufficient detail to understand the theory of operation; and the hazards that were identified in the integrated safety analysis; and a general description of the types of accident sequences.

CS 42

Section 5.3.6.2.4 of the ISA summary indicates a "safety basis value" for iron concentration at 1.1×10^{-3} M. Provide the basis for this concentration.

Guidance provided in the NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.5 Acceptance Criterion B, recommends that the applicant identify the design basis that provides safety for normal operations.
10 CFR 70.64(a)(5) requires that each prospective applicant address chemical protection. The design must provide for adequate protection against chemical risks produced from licensed material, facility conditions which affect the safety of licensed material, and hazardous chemicals produced from licensed material.

CS 43

Revise the discussion on page 5.3.6-24 of the ISA summary to include an evaluation of the increase in solution acidity in the oxidation column (KPA*CLMN6000) during "recirculation" of process fluid between KPA*CLMN6000 and KPA*TK6010 following upset conditions that interrupt the Pu product stream flow to the column. Provide a justification for the lack of IROFS sampling in KPA*SET3300 prior to re-initiation of process flow and demonstrate that any increases in the acidity of solution in the oxidation column will remain within the safety limits established for streams potentially containing HAN.

10 CFR 70.62(c)(iv) requires each applicant to conduct an ISA that is of appropriate detail for the complexity of the process, that identifies potential accident sequences caused by process deviations or other events internal to the facility and credible external events.

CS 44

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CS 45

Revise the LA and ISA summary to demonstrate that vessel vent sizing is adequate to limit the risk of a HAN explosion event to highly unlikely. Provide design information, including a description of the methodology to determine the vent sizes, reliability information of the components in the system, and safety control schemes that support assumptions made in the design. This information should also include a discussion of the margin between safety limits and actual vent sizes.

Page 5.3.6-27 of the ISA summary states: "[v]ent sizing calculations have been performed to verify the adequacy of vent sizes considering all credible upset conditions that could affect the off-gas generation rate. Given the appropriate design criteria, process vessel vents are a passive–engineered control with a high degree of reliability designed to perform their safety function considering all credible failures."

10 CFR 70.22(a)(7) states that each application for a license contain a description of equipment and facilities which will be used by the applicant to protect health and minimize danger to life and property.

10 CFR 70.65(b)(2) requires that the ISA summary contain a general description of the facility with emphasis on those areas that could affect safety. 10 CFR 70.65(b)(3) requires the ISA summary to contain a description of each process analyzed in the ISA in sufficient detail to understand the theory of operation; the hazards that were identified in the integrated safety analysis; and a general description of the types of accident sequences.

CS 46

Revise the LA and ISA summary to clearly specify the length of time that the di-nitrogen

tetroxide flow must be established in the oxidation column (KPA*CLMN6000) prior to initiating the flow of HAN-bearing process fluid to the column, and provide justification for the statement on page 5.3.6-28 of the ISA summary that, "a failure of NO_x flow is not an immediate cause for shutdown, because the downstream vessels (air stripping column, plutonium reception tank, and the KCA batch constitution tanks) are designed for the possibility of receiving HAN. Should such a failure occur, the operator may try to restore NO_x flow within a specified time frame, after which it will be necessary to flush…."

10 CFR 70.64(b)(2) requires that facility design must incorporate, to the extent practicable, features that enhance safety by reducing challenges to IROFS.

CS 47

Revise Section 5.3.6.2.4 of the ISA summary to clearly define the control scheme associated with 'Administrative Controls to Limit Reagent Residence Time' under off-normal conditions.

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10 CFR 70.64(a)(1) requires that the design must be developed and implemented in accordance with management measures, to provide adequate assurance that IROFS will be available and reliable to perform their function when needed.

CS 48

Revise Section 11.2.6 of the LA to provide design information on the heat exchangers associated with the Pu stripping pulsed column (KPA*PULS3000), uranium (U) scrubbing pulsed columns (KPA*PULS3200), Pu barrier mixer-settler (KPA*MIXS4000), and U stripping mixer-settler (KPA*MIXS5000). This description should include a detailed discussion of the design assumptions and results of supporting calculations (i.e., provide nominal heat transfer fluid flow rates and the nominal flow rates of process fluids used in the heat transfer calculations, etc.), safety limits, the margin between safety limits and operational limits, and the demonstration that all IROFS will be available and reliable to perform their safety function when needed.

10 CFR 70.22(f) requires that each application for a license to possess and use special nuclear material in a Pu processing and fuel fabrication facility will provide a description and safety assessment of the design bases of the principal structures, systems, and components of the plant.

CS 49

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CS 50

Revise Section 11.2.6 of the LA to provide design information on all of the mixer-settlers in the AP process. This description should include a detailed discussion of the design assumptions and results of supporting calculations (i.e., provide the nominal flow rates of process fluids, O/A ratios, a description of which liquid phase is normally continuous, etc.), start up schemes, safety limits, the margin between safety limits and operational limits, and the demonstration that all IROFS will be available and reliable to perform their safety function when needed.

Page 11.2.6-11 of the LA states, "[t]he mixer-settler operates with continuous aqueous and organic phases." It is unclear from this statement which phase is continuous under which conditions.

Guidance provided in NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.5 Acceptance Criterion A, pursuant to 10 CFR 70.61(e), recommends that the applicant's identification of chemical process safety controls used to prevent or mitigate potential accidents are supported by appropriate safety analyses, and the applicant provides reasonable assurance that these safety controls will be available and reliable upon demand.

10 CFR 70.22(f) requires that each application for a license to possess and use special nuclear material in a Pu processing and fuel fabrication facility will provide a description and safety assessment of the design bases of the principal structures, systems, and components of the plant.

CS 51

Revise Section 11.2.6 of the LA to provide design basis information on the oxidation column (KPA*CLMN6000) and the air stripping column (KPA*CLMN6500). This description should include a detailed discussion of the design assumptions and results of supporting calculations (i.e., provide the nominal flow rates of gas and liquid, calculated superficial velocities), start up schemes, safety limits, the margin between safety limits and operational limits, and the demonstration that all IROFS will be available and reliable to perform their safety function when needed. This demonstration should also include a discussion of off-normal column operations, such as flooding and channeling, and describe the planned recovery scheme in the occurrence of these events.

Guidance provided in NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.5 Acceptance Criterion A, pursuant to 10 CFR 70.61(e), recommends that the applicant's identification of chemical process safety controls used to prevent or mitigate potential accidents are supported by appropriate safety analyses, and the applicant provides reasonable assurance that these safety controls will be available and reliable upon demand.

10 CFR 70.22(f) requires that each application for a license to possess and use special nuclear material in a Pu processing and fuel fabrication facility will provide a description and safety assessment of the design bases of the principal structures, systems, and components of the plant.

CS 52

Revise Section 11.8.3 of the LA to provide design basis information on the HAN stripping column in the Hydroxylamine Nitrate System (RHN). This description should include a detailed discussion of the function of the column and associated equipment; design assumptions and results of supporting calculations, start up schemes, safety limits, the margin between safety limits and operational limits, and the demonstration that all IROFS will be available and reliable to perform their safety function when needed. This demonstration should also include a discussion of normal and off-normal operations.

Guidance provided in NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.5 Acceptance Criterion A, pursuant to 10 CFR 70.61(e), recommends that the applicant's identification of chemical process safety controls used to prevent or mitigate potential accidents are supported by appropriate safety analyses, and the applicant provides reasonable assurance that these safety controls will be available and reliable upon demand.

10 CFR 70.22(f) requires that each application for a license to possess and use special nuclear material in a plutonium processing and fuel fabrication facility will provide a description and safety assessment of the design bases of the principal structures, systems, and components of the plant.

CS 53

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CS 54

Revise Section 5.3.6.2.4 of the ISA summary to provide a discussion of the credibility of a HAN explosion event in the mixer settler KPA*MIXS4000 due to a reduction of the aqueous flow rate entering the mixer settler. If the event is credible, provide the IROFS that would be used to prevent or mitigate the event to make it highly unlikely.

Item 4 of 10 CFR 70.65(b) requires that the applicant's ISA summary contain information that demonstrate compliance with the performance requirements of 10 CFR 70.61. 10 CFR 70.61 requires that the risk of all credible events must be controlled to be unlikely or highly unlikely, as appropriate.

CS 55

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CS 56

Revise Section 5.3.6.2.4 of the ISA summary to provide a discussion of the credibility of a HAN explosion event resulting from adding a heated process solution to KPA*MIXS4000 due to a malfunctioning of a heater (e.g. EX4010). If the event is credible, explain how this event would affect downstream vessels. Demonstrate that a single failure of a heater will not initiate a HAN explosion event.

Criterion A of Section 8.4.3.5 of NUREG-1718 recommends that the applicant's identification of chemical process safety controls used to prevent potential accidents are supported by the appropriate safety analysis, and the applicant provides reasonable assurance that these safety controls will be available and reliable upon demand. 10 CFR 70.23(a)(3) requires that the applicant's proposed equipment adequately protect health and to minimize danger to life or property.

CS 57

Revise Section 5.3.6.2.4 of the ISA summary to indicate if the controls used to keep the nitric acid concentration within the safety limits are credited as IROFS for the U stripping mixer settler (KPA*MIXS5000), U diluent washing mixer-settler (KPA*MIXS5100), the U reception tank (KPA*TK5200), and the U vessel (KPA*TK5300).

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10 CFR 70.65(b)(4) requires that the applicant's ISA summary contain information that demonstrate compliance with the performance requirements of 10 CFR 70.61. 10 CFR 70.61 requires that the risk of all credible events must be controlled to be unlikely or highly unlikely, as appropriate. 10 CRF 70.61(e) requires that each control used to prevent or mitigate credible events shall be designated as an IROFS.

CS 58

Revise Section 5.3.6.2.4 of the ISA summary to provide a description of the HAN explosion event in the KWG unit and the controls used to prevent the occurrence of such event.

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10 CFR 70.65(b)(3) requires a description of the hazards that were identified in the ISA pursuant to §70.62(c)(1)(i)—(iii) and a general description of the types of accident sequences. 10 CFR 70.65(b)(6) requires a description of the IROFS in sufficient detail to understand their function in relation to the performance requirements of 10 CFR 70.61.

CS 59

Revise Section 5.3.6.2.4 of the ISA summary to include the most recent changes indicated for the explosion event EXP04 (HAN explosion) as described in the NSE. Include a sufficient level of detail to understand the theory of operation and hazards identified for this event in accordance with 10 CFR 70.65(b)(3) and Sections 8.4.3.3, 8.4.3.4, and 8.4.3.5 of NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility."

Applicable updates include the safety basis values for process and ambient cell temperature, concentrations of HAN, nitric acid and Pu, a list of IROFS by process node, a sampling plan, and applicable process evolutions.

CS 60

Provide justification for the omission of the heat of reaction in the modeling for the temperature limits for KPA*TK9500 and KPA*CLMN6000 and update the ISA summary as appropriate.

The modeling of temperature limits for KPA*TK9500 and KPA*CLMN6000 do not appear to include the heats of reaction (ΔH_r) for the dissolution of NO_X gas in water (reaction 10 in the kinetic model). This reaction has a relatively large heat of reaction, which could potentially contribute significantly to the overall heat generation rates. KPA*TK9500 and KPA*CLMN6000 use NO_X gas to consume HAN. This will support accident sequence determinations as indicated in Section 8.4.3.3 of NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility."

CS 61

Provide the technical basis for the assumption that HAN destruction using NO_X gas is instantaneous. This will support accident sequence determinations as indicated in Section 8.4.3.3 of NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility."

CS 62

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CS 63

Revise Section 5.3.6.2.4 of the ISA summary to provide the concentration of HAN entering the process via KPA*PULS3000 and KPA*MXS4000. This will support chemical accident sequences and consequences as indicated in Sections 8.4.3.3 and 8.4.3.4 of the NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility."

CS 64

Revise Section 5.3.6.2.4 of the ISA summary, as appropriate, to update any applicable supporting calculations (e.g., those supporting pressure and temperature limits) as a result of the HAN concentration change. This will support chemical accident sequences and consequences as indicated in Sections 8.4.3.3 and 8.4.3.4 of NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility."

CS 65

Justify the assumption in the kinetic model that there is no reaction front for HAN reactions, i.e., the assumption that the reaction is occurring homogeneously throughout the vessel.

Reconcile this assumption with pictures presented during the January 15, 2009, in-office review which appear to show a reaction front. This will support chemical accident sequences and consequences as indicated in Sections 8.4.3.3 and 8.4.3.4 of NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility."

CS 66

Revise Section 5.3.6.2.4 of the ISA summary to describe start-up HAN testing efforts or plans to demonstrate the validity of the safety limits established by the kinetic model. This will support chemical accident sequences and consequences as indicated in Sections 8.4.3.3 and 8.4.3.4 of

NUREG-1718, “Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility.”

CS 67

Revise Section 4.8 of the ISA summary to demonstrate that an explosion event in the RHN unit will not affect licensed material or the availability or reliability of any IROFS.

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This will support process safety information as indicated in Section 8.4.3.5 of NUREG-1718, “Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility.”

CS 68

Revise Section 4.8 of the ISA summary to demonstrate that hydrogen peroxide used in the HAN stripping column in the RHN system in the Aqueous Polishing Area (BAP) building will not inadvertently enter the KPA process.

Hydrogen peroxide is used in the HAN stripping column in the BAP building of the RHN system (Figure 4.8-22 ISA summary, sheet 2). Demonstrate that it is either highly unlikely for this solution to enter the KPA process, or highly unlikely to adversely affect licensed material or availability of IROFS. This will support process safety information as indicated in section 8.4.3.5 of NUREG-1718, “Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility.”

CS 69

Revise Section 5.3.6.2.4 of the ISA summary to describe how failure of temperature controls in KPA*PULS 3000 would affect the HAN strategy and potential for a HAN accident scenario. This will support process safety information as indicated in Section 8.4.3.5 of NUREG-1718, “Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility.”

Hydrogen Peroxide

CS 70

Revise Section 5.3.6.2.5 of the ISA summary to provide a discussion of the credibility of unsafe interactions between hydrogen peroxide and nitric acid in the receiving tanks (KDB*TK3000, KDD*TK3000 and KDD*TK4000) and the assumptions used to support your conclusions. If the event is credible, provide the maximum nitric acid concentration allowed in those receiving tanks and explain how the concentration will be kept within safety limits. Provide the basis for this concentration.

Table 8.1-1 in the LA lists the hazardous characteristics and incompatibilities associated with the chemicals used in the MFFF. This table states that hydrogen peroxide is incompatible with nitric acid. However, hydrogen peroxide will be mixed with nitric acid in the receiving tank to reduce Ag and Pu.

10 CFR 70.62(a) states that each licensee or applicant shall establish and maintain a safety program that demonstrate compliance with the performance requirements of §70.61. Guidance provided in the NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.5, Acceptance Criterion B, recommends that the applicant identify the design basis that provides safety for normal operations. Criterion A of the same section of NUREG-1718 recommends that the applicant's identification of chemical process safety controls used to prevent or mitigate potential accidents are supported by the appropriate analysis.

CS 71

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Hydrazoic Acid

CS 72

Revise Section 5.3.6.2.10 of the ISA summary to explain whether the interactions between the vapor hydrazoic acid and the off-gas system metal piping contribute to significant formation of metal azides and how these interactions are prevented.

On page 5.3.6-75 of the MFFF ISA summary the applicant states that the metal azide explosion event group is addressed in the metal azide explosion, Section 5.3.6.2.11. However, this item was not addressed in the metal azide explosion section.

NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.3, Acceptance Criterion A recommends that accident sequences include the chemical hazard evaluation, which identifies the potential interactions between process chemicals, licensed materials, process conditions, facility personnel/operators, and structures, systems, and components.

CS 73

Revise Section 5.3.6.2.10 of the ISA summary to explain how hydrazoic acid vapor is destroyed in the off-gas system.

On pages 5.3.6-75 and 5.3.6-76 of the MFFF ISA summary the applicant explains the paths of the aqueous, organic, and vapor hydrazoic acid, but only explains how the hydrazoic acid is destroyed in the aqueous and organic paths.

10 CFR 70.65(b)(3) requires the ISA summary to contain a description of each process analyzed in the ISA in sufficient detail to understand the theory of operation, the hazards that were identified in the ISA; and a general description of the types of accident sequences.

NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.1, Acceptance Criterion B recommends that the chemical process description include sufficient information to enable the reviewers to understand the hazards associated with the chemical processes.

CS 74

Revise Section 5.3.6.2.10 of the ISA summary to clarify the intent of recycling the rejected solvent batches through the purification cycle rework tank (KPA*TK8500) and eventually reaching the KPA Pu stripping column (KPA*PULS3000). Using this recycling path could potentially exceed the HN_3 safety basis in KPA*PULS3000.

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10 CFR 70.65(b)(3) requires the ISA summary to contain a description of each process analyzed in the ISA in sufficient detail to understand the theory of operation, the hazards that were identified in the integrated safety analysis, and a general description of the types of accident sequences.

NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.1, Acceptance Criterion B recommends that the chemical process description include sufficient information (e.g., mass/energy/radioactivity balances, process flow diagrams, and descriptive equations) to enable the NRC reviewers to understand the hazards associated with the chemical processes.

CS 75

Revise Section 5.3.6.2.10 of the ISA summary to provide the basis for stating that hydrazoic acid is preferentially destroyed over HAN based on reaction kinetics.

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NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.5, Acceptance Criterion A recommends that the applicant's identification of chemical process safety controls used to prevent or mitigate potential accidents are supported by appropriate safety analyses.

CS 76

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CS 77

Revise Section 5.3.6.2.10 of the ISA summary to explain the transfer options of organic solutions potentially containing hydrazoic acid in the rework tank (KPA*TK 8500) and how the hydrazoic acid is planned to be destroyed.

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10 CFR 70.65(b)(3) requires the ISA summary to contain a description of each process analyzed in the ISA in sufficient detail to understand the theory of operation; the hazards that were identified in the ISA; and a general description of the types of accident sequences.

NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.1, Acceptance Criterion B recommends that the chemical process description include sufficient information (e.g.,mass/energy/radioactivity

balances, process flow diagrams, and descriptive equations) to enable the NRC reviewers to understand the hazards associated with the chemical processes.

CS 78

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CS 79

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CS 80

Revise Section 5.3.6.2.10 of the ISA summary to include the strategy and any applicable IROFS that ensure the nitric acid concentration added to the solvent washing mixer settler (KPB*MIXS 1000) is low enough not to produce hydrazoic acid vapors. Additionally, include the strategy to prevent the formation of vapor hydrazoic acid in KPB*MIXS 1100 and the azide ion safety limit for the hydrazoic acid explosion event.

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10 CFR 70.65(b)(3) requires the ISA summary to contain a description of each process analyzed in the ISA in sufficient detail to understand the theory of operation, the hazards that were identified in the ISA, and a general description of the types of accident sequences.

NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.1, Acceptance Criterion G recommends that the identification and description of chemicals process limits identify and discuss the limits in terms of parameters that may be considered as IROFS (such as chemical concentrations, temperature, pressure) and address the consequences of exceeding these limits. The process description should identify those limits that conservatively bound potential off-normal and accident conditions and that would be suitable for subsequent consequence analyses.

CS 81

Revise pg. 5.3.6-83 of the ISA summary to correct the statement below to read "alkaline waste tank" instead of "neutralization tank."

On page 5.3.6-83 of the ISA summary the applicant states, "[f]or both causes, failure of the normal level control system would have to occur prior to the pumped flow from the solvent recovery unit or the gravity feed from the sodium nitrite reagent unit to cause a high level in the neutralization tank."

NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.1, Acceptance Criterion B recommends that the chemical process description include sufficient information to enable the reviewers to understand the hazards associated with the chemical processes.

CS 82

Revise Section 5.3.6.2.10 of the ISA summary to provide the technical basis of the safety limit which ensures that the nitrites concentration is acceptably in excess of the azide concentration and explain why this limit provides sufficient margin to prevent the hydrazoic acid explosion event.

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NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.1, Acceptance Criterion G recommends that the identification and description of chemicals process limits identify and discuss the limits in terms of parameters that may be considered as IROFS (such as chemical concentrations, temperature, pressure) and address the consequences of exceeding these limits. The process description should identify those limits that conservatively bound potential off-normal and accident conditions and that would be suitable for subsequent consequence analyses.

NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.5, Acceptance Criterion A recommends that the applicant's identification of chemical process safety controls used to prevent or mitigate potential accidents are supported by appropriate safety analyses, and the applicant provides reasonable assurance that these safety controls will be available and reliable upon demand.

Solvent

CS 83

Revise Section 5.3.6.2.6.1 "Process Temperature Events Involving TBP and\or HTP," of the ISA summary to provide a curve or table of liquid temperature vs. percent lower flammable limit for TBP, HTP, and all other combustible process solutions for the range of temperatures expected under normal and upset conditions and provide an evaluation of the available safety margin.

10 CFR 70.65(b)(3) states that the ISA summary must contain a general description of the facility with emphasis on those areas that could affect safety.

The acceptance criteria in NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 3.4.3.2(3), Processes, states that a description at a systems level is acceptable provided that it permits the NRC reviewer to adequately evaluate: (1) completeness of the hazard and identification tasks; and (2) the likelihood and consequences of the accidents identified.

CS 84

Revise Section 5.3.6.2.6.1 "Process Temperature Events Involving TBP and/or HTP," of the ISA summary to provide the design basis for process vessels and pipes listed as IROFS. Include the allowable pressures and temperatures and the expected maximum pressures and temperatures for these pipes and vessels.

10 CFR 70.65(b)(3) states that the ISA summary must contain a general description of the facility with emphasis on those areas that could affect safety.

The acceptance criteria in NUREG-1718, “Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility,” Section 3.4.3.2(3), Processes, states that a description at a systems level is acceptable provided that it permits the NRC reviewer to adequately evaluate: (1) completeness of the hazard and identification tasks; and (2) the likelihood and consequences of the accidents identified.

CS 85

Revise Section 5.3.6.2.6.2 “Room Temperature Events Involving TBP and/or HTP,” of the ISA summary to clearly describe the events that will initiate a purge in the N_2 purge gas system.

10 CFR 70.65(b)(3) states that the ISA summary must contain a general description of the facility with emphasis on those areas that could affect safety.

The acceptance criteria in NUREG-1718, “Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility,” Section 3.4.3.2(3), Processes, states that a description at a systems level is acceptable provided that it permits the NRC reviewer to adequately evaluate: (1) completeness of the hazard and identification tasks; and (2) the likelihood and consequences of the accidents identified.

Red Oil

CS 86

Revise the LA and ISA summary to provide specific design basis information that clearly shows that the single process vessel vent per vessel system proposed is capable of remaining available and reliable to perform its safety function (i.e., maintaining an ‘open system’ during normal and off-normal operations). Include a description of the criteria used, determination of failure modes considered (including common mode and multiple failures), and safety margin built into the design.

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NUREG-1821, “Final Safety Evaluation Report on the Construction Authorization Request for the Mixed Oxide Fuel Fabrication Facility at the Savannah River Site, South Carolina,” (p 8-49) identified the following commitment on the part of the applicant: “...the availability and reliability of the vent path is not in question, as it will be addressed during the license application phase.”

Guidance provided in NUREG-1718, “Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility,” Section 8.4.3.5 Acceptance Criterion A, pursuant to 10 CFR 70.61(e), recommends that the applicant provides reasonable assurance that these safety controls will be available and reliable upon demand.

10 CFR 70.22(f) requires that each application for a license to possess and use special nuclear material in a Pu processing and fuel fabrication facility will provide a description and safety assessment of the design bases of the principal structures, systems, and components of the plant.

10 CFR 70.61(e) requires that each engineered or administrative control or control system necessary to comply with paragraphs (b), (c), of (d) of 10 CFR 70.61 will be designated IROFS,

and the safety program established pursuant to 10 CFR 70.62 will ensure that each IROFS will be available and reliable to perform its intended function when needed.

10 CFR 70.65(b)(2) requires that the ISA summary contain a general description of the facility with emphasis on those areas that could affect safety, and 10 CFR 70.65(b)(3) requires the ISA summary to contain a description of each process analyzed in the ISA in sufficient detail to understand the theory of operation, the hazards that were identified in the ISA, and a general description of the types of accident sequences.

CS 87

Revise the LA and ISA summary to describe, for each IROFS, the margin between safety limits and operating ranges. For example, provide a discussion of amount of insoluble organic material that can accumulate in a slab settler before density control takes effect and how this relates to the "layer" of organic material expected to be in the slab settler during normal operations.

NUREG-1821, "Final Safety Evaluation Report on the Construction Authorization Request for the Mixed Oxide Fuel Fabrication Facility at the Savannah River Site, South Carolina," (p 8-50) identifies the following commitment on the part of the applicant: "[t]he applicant will establish safety setpoints, with margin, less than the 125 ^{o}C design basis value as part of any later application…"

Guidance provided in the NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.5 Acceptance Criterion C, recommends that the process safety control discussion (in the LA) include a description of the process and engineering design features used to control each process step, including set point ranges and any special administrative or procedural controls.

10 CFR 70.22(a)(8) requires that each application for a license shall contain proposed procedures to protect life or property.

10 CFR 70.23(a)(4) states that a LA will be approved when the Commission determines that the applicant's proposed procedures to protect health and minimize danger to life and property are adequate.

10 CFR 70.64(b)(2) requires that facility and system design must incorporate, to the extent practicable, features that enhance safety by reducing challenges to items relied on for safety.

CS 88

Revise the ISA summary Section 4.2 and Section 5.3.6.2.7 to provide a description of the safety analysis used to evaluate the physicochemical behavior of soluble and insoluble TBP and its decomposition products in the aqueous Pu nitrate stream as it reacts with NO_X in the oxidation column (KPA*CLMN6000) and air stripping column (KPA*CLMN6500). This description should include assumptions employed in the analysis (to include normal and off-normal operation) of potential TBP and associated nitration reactions in KPA*CLMN6000 and KPA*CLMN6500 and analysis results.

Guidance provided in the NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.5 Acceptance

Criterion A, recommends that the applicant's identification of chemical process safety controls used to prevent or mitigate potential accidents are supported by appropriate safety analyses, and the applicant provides reasonable assurance that these safety controls will be available and reliable upon demand.

10 CFR 70.62(c)(iv) requires each applicant to conduct an ISA that is of appropriate detail for the complexity of the process, that identifies potential accident sequences caused by process deviations or other events internal to the facility and credible external events.

CS 89

Revise the ISA summary Section 4.2 and 5.3.6.2.7 to include a description of the applicant's review of third phase and "interfacial crud" formation. This description should include assumptions employed in the analysis of potential third phase and/or interfacial crud formation and a description of all IROFS employed to prevent/mitigate its formation and related hazards as they pertain to explosion event, EXP-07.

Guidance provided in the NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.5 Acceptance Criterion A, recommends that the applicant's identification of chemical process safety controls used to prevent or mitigate potential accidents is supported by appropriate safety analyses, and the applicant provides reasonable assurance that these safety controls will be available and reliable upon demand.

10 CFR 70.62(c)(iv) requires each applicant to conduct an ISA that is of appropriate detail for the complexity of the process, that identifies potential accident sequences caused by process deviations or other events internal to the facility and credible external events.

CS 90

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CS 91

Revise the ISA summary, to provide a clear basis for the maximum credible amount of TBP and provide data on the reliability of equipment, particularly the slab settler and automatic sampling system, that justify that the assumed values are reasonable and include a description of the margin between the safety limits and operational limits. The applicant's evaporative cooling strategy is based on a maximum "credible" amount of TBP expected in downstream tanks and equipment (i.e., 42 L of TBP); and this amount is highly reliant on the function of the diluent washing columns, IROFS slab settler, and IROFS sampling (as in the case of KPA*TK9100).

Guidance provided in the NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.5 Acceptance Criterion A, pursuant to 10 CFR 70.61(e) recommends that the applicant's identification of chemical process safety controls used to prevent or mitigate potential accidents is supported by the appropriate safety analyses, and the applicant provides reasonable assurance that these safety controls will be available and reliable upon demand.

10 CFR 70.64(b)(2) requires that facility and system design must incorporate, to the extent practicable, features that enhance safety by reducing challenges to IROFS.

CS 92

Revise the LA (Section 11.2.11) and ISA summary (Section 4.2 and Section 5.3.6.2.7) to provide a complete description of the design and operation of the evaporators in the Acid Recovery (KPC) and KCD units. This description should include relevant design features, including types and location of instruments and sensors, methods of operation under both normal and abnormal conditions (including start up and shutdown), safety limits, and the margin between safety limits and anticipated operational limits.

10 CFR 70.22(a)(7) states that each application for a license shall contain a description of equipment and facilities which will be used by the applicant to protect health and minimize danger to life and property.

10 CFR 70.22(f) requires that each application for a license to possess and use special nuclear material in a Pu processing and fuel fabrication facility will provide a description and safety assessment of the design bases of the principal structures, systems, and components of the plant.

10 CFR 70.61(e) requires that each engineered or administrative control or control system necessary to comply with paragraphs (b), (c), of (d) of 10 CFR 70.61 will be designated IROFS, and the safety program established pursuant to 10 CFR 70.62 will ensure that each IROFS will be available and reliable to perform its intended function when needed.

10 CFR 70.65(b)(2) requires that the ISA summary contain a general description of the facility with emphasis on those areas that could affect safety, and 10 CFR 70.65(b)(3) requires the ISA summary to contain a description of each process analyzed in the ISA in sufficient detail to understand the theory of operation, the hazards that were identified in the integrated safety analysis, and a general description of the types of accident sequences.

CS 93

Provide a discussion of how the MFFF red oil prevention/mitigation strategy meets or exceeds Defense Nuclear Facility Safety Board (DNFSB) recommendations for control of red oil explosions with respect to the guidance provided in NUREG-1718, “Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility,” Section 8.4.3.1.

Guidance provided in the NUREG-1718, “Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility,” Section 8.4.3.1, Acceptance Criterion G recommends the discussion of limits in terms of parameters that may be considered as IROFS, and the applicant should address the consequences of exceeding these limits. For approval of the application, the applicant must demonstrate that the proposed procedures to protect the public are adequate as required by 10 CFR 70.23.

DNFSB/TECH-33, “Control of Red Oil Explosions in Defense Nuclear Facilities,” provides conservative bounding conditions for the prevention of red oil explosion events and is considered a reasonable and generally accepted good engineering practice (RAGAGEP) approach to red oil control in defense nuclear facilities.

CS 94

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CS 95

Revise the ISA summary (Section 5.3.6.2.7) to include a discussion of the models used to develop the evaporative cooling and heat transfer sub-strategies. Provide information on the validation and verification performed for the modeling in order to demonstrate that strategies based on modeling render the event "highly unlikely." Discussion should include consideration of the effects of dissolved metals and other impurities on the decomposition of TBP and subsequent heat generation rates.

Guidance provided in the NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.4, Acceptance Criterion A recommends that the applicant provides information to support the conclusion that the models used are appropriate for the application and physical phenomena occurring, that the models have been validated and verified, and that the assumed data input leads to a conservative estimate of potential consequence.

10 CFR 70.22(f) requires that each application for a license to possess and use special nuclear material in a Pu processing and fuel fabrication facility will provide a description and safety assessment of the design bases of the principal structures, systems, and components of the plant.

CS 96

Demonstrate that the degree of mixing in vessels and equipment is sufficient to render the vessel contents thermally homogeneous (i.e., avoid the formation of 'hot spots' within the vessel). Provide the basis for this determination.

Red oil explosion events have occurred when thermally hot material were added to vessels containing unknown or insufficiently characterized material (e.g., Tomsk-7). These additions led to stratification and uncontrolled heating of vessel contents resulting in an explosion event.

Guidance provided in NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.5, Acceptance Criterion A, pursuant to 10 CFR 70.61(e) recommends that the applicant's identification of chemical process safety controls used to prevent or mitigate potential accidents is supported by appropriate safety analyses, and the applicant provides reasonable assurance that these safety controls will be available and reliable upon demand.

CS 97

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CS 98

Revise the ISA summary to clearly indicate which hazard analysis methods were employed to evaluate hazards associated with TBP-Nitrate (Red Oil) explosion events. Page 5.1-4 of the ISA summary states that, "[w]hile HAZOP and What-If/Checklist evaluations are the main

techniques used; supplemental hazard evaluations were performed in specific instances to support the ISA Summary. These included FMEA, Fault Tree and Event Tree evaluations. Selection of these techniques followed the same selection process as described above." It is not clear which, if any, supplementary techniques (in addition to hazards and operability study) were employed by the applicant in the analysis of the red oil explosion event. If additional techniques were employed, discussion of the technique along with its results and applicability should be supplied.

10 CFR 70.65(b)(2) requires that the ISA summary contain a general description of the facility with emphasis on those areas that could affect safety, and 10 CFR 70.65(b)(3) requires the ISA summary to contain a description of each process analyzed in the ISA in sufficient detail to understand the theory of operation, the hazards that were identified in the ISA, and a general description of the types of accident sequences.

CS 99

Demonstrate that density controllers in tanks, in the KPC, and in other equipment, will be available and reliable to perform their safety function as required.

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10 CFR 70.64(a)(1) requires that the design must be developed and implemented in accordance with management measures, to provide adequate assurance that IROFS will be available and reliable to perform their function when needed.

CS 100

Revise Tables 8.1-1, 8.1-3, and 8.1-4 in the LA to include the potential deleterious effects of the degradation products of TBP/solvent compounds and include them in the chemical interaction matrix.

Guidance provided in NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.2 Acceptance Criterion B, recommends that the list of chemical interactions include potential reactions and interactions between materials stored and used at the facility that have the potential to affect the safe handling of licensed radioactive materials, as determined by the ISA.

10 CFR 70.64(a)(5) requires that the design must provide for adequate protection against chemical risks produced from licensed material, facility conditions which affect the safety of licensed material, and hazardous chemicals produced from licensed material.

CS 101

Revise the ISA summary to provide a description of how the pulse columns and mixer settlers will be drained, if necessary, after process upsets to ensure that organic solvent (especially Pu and U-loaded solvent) is stored or dispositioned such that a red oil explosion event is rendered "highly unlikely."

10 CFR 70.22(f) requires that each application for a license to possess and use special nuclear material in a Pu processing and fuel fabrication facility will provide a description and safety

assessment of the design bases of the principal structures, systems, and components of the plant.

10 CFR 70.65(b)(2) requires that the ISA summary contain a general description of the facility with emphasis on those areas that could affect safety. 10 CFR 70.65(b)(3) requires the ISA summary to contain a description of each process analyzed in the ISA in sufficient detail to understand the theory of operation, the hazards that were identified in the ISA, and a general description of the types of accident sequences.

CS 102

Demonstrate that, for vessels and equipment which rely upon IROFS density indicators and

controllers for organic phase interface control, these systems will be capable of determining the location of the interface regardless of which phase is the lighter phase.

A credible scenario involves a phase inversion where complexed uranium or plutonium in the organic phase increases its density above the overlying aqueous phase to reduce effective heat transfer.

10 CFR 70.64(a)(1) requires that the design must be developed and implemented in accordance with management measures, to provide adequate assurance that IROFS will be available and reliable to perform their function when needed.

CS 103

Revise the ISA summary to include a discussion of the effects of radiolysis on the decomposition of TBP and its importance in the AP process relative to other TBP degradation mechanisms.

10 CFR 70.65(b)(2) requires that the ISA summary contain a general description of the facility with emphasis on those areas that could affect safety. 10 CFR 70.65(b)(3) requires the ISA summary to contain a description of each process analyzed in the ISA in sufficient detail to understand the theory of operation, the hazards that were identified in the ISA, and a general description of the types of accident sequences.

Metal Azides

CS 104

Revise Section 5.3.6.2.11 of the ISA summary to provide the technical basis for the assertion that Pu azide formation in the Pu stripping pulsed column (KPA*PULS3000) is not a safety concern. Include a discussion of the Pu and U ion effects on azide formation and precipitation.

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Guidance provided in the NUREG-1718, “Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility,” Section 8.4.3.1, Acceptance Criterion B recommends that the chemical process description includes sufficient information to enable the reviewers to understand the hazards associated with the chemical process.

CS 105

Revise section 5.3.6.2.11 of the ISA summary to include a discussion of the effects of Ag ion on azide formation and precipitation in the KPA unit. Also, provide the safety strategy to prevent any explosion hazard caused by mixing the silver ions with hydrazoic acid.

On page 5.3.6-85 of the ISA summary the applicant states, "[o]nly Ag^+ is a significant concern for azide precipitation in the purification unit." However, how this metal ion affects azide formation and precipitation was not addressed in Section 5.3.6.2.11 of the ISA summary. Guidance provided in the NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.5, Acceptance Criterion A recommends the identification of chemical process safety controls used to prevent or mitigate potential accidents; supported by appropriate safety analyses, and provide reasonable assurance that these safety controls will be available and reliable upon demand.

CS 106

Revise Section 5.3.6.2.11 of the ISA Summary to clearly describe which controls are AP process controls and which controls are IROFS controls used to prevent the entrance of azides into high-risk areas such as KPA, KCA, KPB, KWD, and drip trays.

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Section 8.4.3.5 (A) of NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," recommends the identification of chemical process safety controls used to prevent or mitigate potential accidents; supported by appropriate safety analyses, and provide reasonable assurance that these safety controls will be available and reliable upon demand.

CS 107

Revise Section 5.3.6.2.11 of the ISA summary to provide additional information to clearly demonstrate that precipitation of sodium azides is not credible in the KPB. This should include a description of how other chemicals present in the alkaline solution can affect the solubility of sodium azide (NaN_3).

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Guidance provided in NUREG-1718, "Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility," Section 8.4.3.5, Acceptance Criterion A recommends the identification of chemical process safety controls used to prevent or mitigate potential accidents; supported by appropriate safety analyses, and provide reasonable assurance that these safety controls will be available and reliable upon demand.

CS 108

Revise Section 5.3.6.2.11 of the ISA summary to include a cross-reference to the event description and safety analysis for the hydrazoic acid explosion event, EXP-10 (Section 5.3.6.2.10). Include the technical bases and assumptions used to support the analysis.

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Guidance provided in the NUREG-1718, “Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility,” Section 8.4.3.1 Acceptance Criterion B recommends that the chemical process description includes sufficient information to enable the reviewers to understand the hazards associated with the chemical process.

CS 109

Revise and clarify Section 5.3.6.2.11 of the ISA summary to specify the minimum amount of leaked solution that can be detected in a drip tray by the level instrumentation. If the volume of leaked solution is less than the minimum detectable amount, demonstrate that metal azide explosion event is still highly unlikely or a low consequence event.
On page 5.3.6-88 of the ISA summary the applicant states, “[a] leak into a drip tray, which is not detectable (e.g., a leak into the tray which is too small to trigger the level transmitter in the drip tray sump) would not pose a credible metal azide explosion hazard in the event of dry out of the drip tray.”

Guidance provided in NUREG-1718, “Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility,” Section 8.4.3.3 Acceptance Criterion A recommends that the bases and references used in the chemical accident sequences are supported by applicable data and references.

CS 110

Revise Section 5.3.6.2.11 of the ISA summary to clearly describe the IROFS and normal process controls used to ensure that the maximum liquid level in the KPB mixer-settler (KPB*MIXS1000) is not reached.

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Guidance provided in NUREG-1718, “Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility,” Section 8.4.3.5 Acceptance Criterion B recommends that the application identifies the design basis that provides safety for normal conditions.

CS 111

Revise Section 5.3.6.2.11 of the ISA summary to demonstrate that an upset situation where azide ions or sodium azides could reach the second KPB solvent recovery tank (KPB*TK4000) is highly unlikely.

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Guidance provided in NUREG-1718, “Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility,” Section 8.4.3.1, Acceptance Criterion B recommends that the chemical process description includes sufficient information to enable the reviewers to understand the hazards associated with the chemical process.

Pu (VI) Oxalate

CS 112

Revise Section 11.2 of the LA and Section 5.3.6.2.12 of the ISA summary to clearly describe the design basis information used to ensure temperatures do not exceed safety requirements in equipment where Pu (VI) oxalate may be present. Include the margin between safety limits and operating ranges.

NUREG-1821, "Final Safety Evaluation Report on the Construction Authorization Request for the Mixed Oxide Fuel Fabrication Facility at the Savannah River Site, South Carolina," (p 8-51) identified the following commitment on the part of the applicant: "… controls will be in place to ensure that temperatures do not exceed 219^{o}C where plutonium (VI) oxalate may be present (e.g., in the oxalic mother liquor recovery unit and in the oxalic precipitation and oxidation unit)." NUREG 1718 "Standard Review Plan for the Review of an Application for a Mixed Oxide Fuel Fabrication Facility", Section 8.4.3.1.G Chemical Process Limits states that: "[t]he identification and description of chemical process limits identify and discuss the limits in terms of parameters that may be considered as IROFS (such as chemical concentrations, temperature, pressure) and address the consequences of exceeding these limits. The process description identifies those limits that conservatively bound potential off-normal and accident conditions and that would be suitable for subsequent consequence analyses."