AREVA

July 13, 2009
REL:09:034

U. S. Nuclear Regulatory Commission
Director, Office of Nuclear Material
Safety and Safeguards
Attn: Document Control Desk
Washington, D.C. 20555

Gentlemen:

Subject: Amended Response to Request For Additional Information Regarding the Review of the AREVA NP Inc., Fuel Fabrication Facility Supercritical CO_2 License Amendment Application; License No. SNM-1227; Docket No. 70-1257 (TAC L32689)

On May 6, 2009, AREVA NP (AREVA) received from the NRC a Request For Additional Information (RAI) relative to the license amendment application AREVA submitted on June 12, 2008 in support of the Supercritical CO_2 Extraction process.

On June 5, 2009 AREVA provided a response to the request for additional information with two exceptions. Two questions, Radiation Protection question 3 and Criticality Safety question 7, could not be completely addressed within the prescribed 30 days. The responses and associated attachments provided at that time contained proprietary/ business sensitive information and AREVA requested that the NRC handle it as such.

Attached to this letter is a complete response to all of the NRC's requests including Radiation Protection question 3 dealing with the release of pressurized materials resulting in exposure by way of injection, and Criticality Safety question 7 dealing with proposed IROFS 6910 and 6911. Changes to the responses are highlighted in yellow. Those portions highlighted in green are the sections that AREVA requests be withheld from the public in accordance with 10 CFR 2.390. Attachment II provided with the June 5, 2009 response is not included as it has not changed and does not contain any proprietary / business sensitive information.

A copy of the redacted version of the RAI responses is also provided.

Also, as requested by Mr. Rafael Rodriguez via telephone on 7/08/2009, AREVA confirms that, all pressure vessels in the supercritical CO2 uranium recovery process with a diameter of more than six inches have been constructed and certified to ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

NMSS01

AREVA NP INC.
An AREVA and Siemens company

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Please contact me on 509-375-8409 if you have questions or need additional assistance regarding this response.

Very truly yours,

R. E. Link, Manager
Environmental, Health, Safety & Licensing

/mah

Enclosures

cc: Mr. Rafael Rodriguez,
U.S. Nuclear Regulatory Commission
Fuel Manufacturing Branch
Mail Stop EBB-2-C-40
Rockville, MD 20852-2738

STATE OF WASHINGTON)
: ss
COUNTY OF BENTON)

Robert E. Link, being duly sworn on oath, states as follows:

1. I am employed by AREVA NP Inc. (AREVA NP) as Manager, Environmental, Health, Safety & Licensing in Richland, Washington. I am responsible for the overall administration of the safety programs at AREVA NP's Richland, Washington nuclear fuel fabrication facility, including regulatory licensing and permitting. This affidavit is based on my first hand, personal knowledge and is submitted in my capacity as Manager, Environmental, Health, Safety and Licensing.

2. I am familiar with the contents of the "Amended Response to Request for Additional Information Regarding the Review of the AREVA NP Inc., Fuel Fabrication Facility Supercritical CO_2 License Amendment Application" package and NRC Requests for Additional Information (RAIs) associated with that package. This RAI response has been classified and designated as "Proprietary" by AREVA NP in accordance with the document control system and policies established by AREVA NP for the control and protection of proprietary and confidential information.

3. AREVA NP is engaged in the business of designing and manufacturing nuclear fuel assemblies for commercial nuclear reactors. Within the United States, there are two additional firms that design and manufacture nuclear fuel for commercial nuclear reactors and there are several other companies outside of the United States that engage in the same business as AREVA NP. Competition among these companies including AREVA NP is fierce and

manufacturing costs of the nuclear fuel are critical to the maintenance of market share and to the growth of market share among utility customers.

4. The RAI response package contains commercial information of a confidential nature that is not available in public sources or available to the public. This information contained in the license amendment package is commercial and confidential because it:

A. Reveals distinguishing aspects of AREVA NP's manufacturing processes by relating sequences of operations and/or sub-operations to optimize the efficiency and performance of manufacturing operations which a competitor within the field of nuclear fuel manufacturing may adapt for their own processes, reducing the competitor's expenditure of resources to achieve the same efficiencies, thereby gaining a competitive advantage to the disadvantage of AREVA NP.

B. Reveals the use of process chemical additives for the enhancement of chemical processes which are believed to be unique in the industry both in terms of type and application, which if revealed to a competitor would provide for an unfair competitive advantage by reducing any expenditure by the competitor to develop and test the same concepts.

C. Reveals aspects of privately funded development of process controls and parameters derived by AREVA NP over the course of optimizing the performance of waste treatment and other processes.

D. Reveals technical rationale developed by AREVA NP relating to plant layout, structure, process flow and other technical information which a competitor could readily use without

expenditure of funds and replicate in its facilities thereby gaining a competitive advantage to the disadvantage of AREVA NP.

5. AREVA NP Inc. will suffer considerable competitive harm if the contents of the license amendment package are made available to AREVA NP domestic and international competitors. Finally, this material cannot be reasonably segregated from other material which may not meet the criteria set forth in 10 CFR § 2.390.

Dated this 13th day of July, 2009.

Robert E. Link
Manager, Environmental, Health, Safety & Licensing

STATE OF WASHINGTON)
: ss
COUNTY OF BENTON)

On this 13th day of July, 2009, before me, the undersigned, a Notary Public in and for the State of Washington, duly commissioned and sworn, personally appeared Robert E. Link to me known to be the Manager, Environmental, Health, Safety & Licensing of AREVA NP Inc., the corporation that executed the foregoing instrument, and acknowledged the said instrument to be the free and voluntary act and deed of said corporation, for the uses and purposes therein mentioned, and on oath stated that he is authorized to execute the said instrument.

Witness my hand and official seal hereto affixed the day and year first above written.

Mary Anne Heilman
Notary Public in and for the State of Washington,
residing at Kennewick, Washington.
MY COMMISSION EXPIRES: June 9, 2012

ATTACHMENT I (Rev. 1)

Responses to
REQUEST FOR ADDITIONAL INFORMATION
AREVA NP, INC.
SUPERCRITICAL CO_2 LICENSE AMENDMENT APPLICATION
(TAC L32689)

A large number of the RAI requests deal with the general concern that the NRC has regarding the designation of IROFS. The NRC reviewers have identified numerous instances where system design features provide some degree of safety function and the reviewers have questioned why these design features have not been classified as IROFS in accordance with CFR 70.22 (a)(7) and 10 CFR 70.61 (e).

Included with the license amendment application is an ISA summary which includes a description of the equipment and facilities that will be used to protect health and minimize danger to life and property as required by 10CFR 70.22 (a) (7). AREVA believes that the information provided in the amendment application is sufficient to meet this requirement.

10 CFR 70.61 (e) requires that "Each engineered or administrative control or control system necessary to comply with paragraphs (b), (c) or (d) of this section shall be designated as an item relied on for safety." Paragraphs (b) and (c) define high and intermediate consequence events and state that these events must be highly unlikely and unlikely respectively. Paragraph (d) further states that accidental nuclear criticality must be limited by assuring that under normal and credible abnormal conditions, all nuclear processes are subcritical, including use of an approved margin of subcriticality for safety."

The ISA summary Included with the license amendment application dated June 12, 2008 is an also includes a description of all declared IROFS as required by 10CFR 70.61 (e). AREVA believes that the information provided in the amendment application is sufficient to meet this requirement.

Attachment II addresses the generic underlying issue as to why certain types of design features are not classified as IROFS although these features provide a safety function. This response applies in the general sense to questions RP-1, RP-2, RP-4, NCS-3, NCS 4, NCS 5, NCS 6, Ch-1, Ch-2, Ch-3, Ch-4, Ch-5, Ch-7, Ch-8, and Ch-9.

Further justification as to why specific components meet the criteria listed above and are not classified as IROFS is provided below in response to each specific question.

A) Radiation Protection

1. In section 10.0, page 20, of the license amendment application, the third sentence of the first bullet states that "mechanical design" of the extractor vessel precludes a "catastrophic release due to deterioration of the gasket or wear of the mechanical closure system." The application does not define what design feature prevents these types of deteriorations. Consistent with 70.22(a)(7)and 70.61(e), provide a description of the features of the "mechanical design" which precludes deterioration of the gasket and wear of the closure system. Describe what controls (i.e., inspections, preventive maintenance, etc.) AREVA will use to mitigate the wear and tare on the equipment and if AREVA will declare any of these controls as Items Relied on For Safety (IROFS). Alternatively, justify why these controls should not be designated as IROFS.

AREVA Response:

[redacted]

[redacted] Details of the cap closure mechanism are available for review on site.

2. In section 10.0, page 20, of the license amendment application, the second bulleted paragraph states that small leaks will be used as an indicator to preempt a catastrophic vessel failure. The mitigative features of these leaks are contingent on the use of ductile materials and inspections. Consistent with 70.22(a)(7)and 70.61(e),, explain whether these ductile materials are designated as IROFS and if the inspection for leaks will be a management measure. Describe how AREVA will use indications of leaks to locate weakening areas in the vessel prior to a catastrophic release, and what actions will be taken when such a leak is detected.

AREVA Response:

The subject items that are composed of ductile materials, i.e., the pressure vessels and ancillary devices such as connecting tubing and fittings, are not designated as IROFS, but the described safety-critical attribute, ductility, exists within the boundary of these items, just as such attributes

might exist within the boundary of an IROFS. The attribute of ductility is a design feature of these items, and its effectiveness as a defense against catastrophic failure is based on the metallurgical structure of ductile materials and the fact that their characteristic failure mode is one of gradual displacement under load, rather than the instantaneous displacement characteristic of brittle materials such as ceramics.

The only failure mechanism identified by the ISA Team for the designated attribute of ductility is loss of configuration control, e.g., unauthorized replacement by a brittle component. During the engineering evaluation of the materials and their operating environment, no inherent paths to spontaneous degradation or failure, e.g., stress corrosion or embrittlement, were identified. Further, this attribute is judged not subject to being "degraded without a justifying safety review" *(NUREG-1520)*. Once installation has been properly verified, this attribute requires no plant-applied management measure (e.g., a PM/IRM) to ensure its continued availability, and it cannot be easily defeated by accidental action of operating personnel. This attribute is based on physical laws: the metallurgical structure of the material. It is therefore designated a "design feature" and not an IROFS.

AREVA Richland applies management measures, as needed, to such safety-critical attributes, but also notes that the application of management measures to an item does not require that the item be designated an IROFS. Initial construction and verification of construction to code is considered a management measure verified, but not directly applied, by AREVA Richland. A similar comment may be applied to the state-mandated periodic pressure vessel inspection.

Any leak in such a high-pressure system will be visible, audible, and readily detected by operators. Liquid pooling will likewise be visually detected. Because of the obvious nature of leaks, a procedurized leak-detection protocol is not judged necessary. Per existing procedures, detection of a leak would prompt an immediate notification of maintenance and/or engineering and an investigation proportionate to the extent and significance of the leak, followed by whatever corrective action is deemed necessary Potential corrective actions could range from tightening of a loose fitting, to complete replacement of a component following discovery of a minor flaw. Operating procedures for this process will also point out that even a small leak in a high-pressure system has potential safety significance.

3. The ISA Summary included in the license amendment application did not identify an accident sequence involving a release of pressurized materials resulting in exposure by way of injection. Consistent with 10 CFR 70.62(c)(i), address the potential for injection (i.e., a small release, not catastrophic, at or near contact between personnel and equipment) as a possible exposure mechanism when dealing with high pressure systems.

AREVA Response:

AREVA has researched this issue, has completed the following qualitative analysis, and has concluded that it is highly unlikely for an individual to receive an exposure by way of injection that would result in a high or intermediate consequence as defined by 10 CFR 70.61.

Data:

- The production plant normal operating pressure is approximately [redacted]
- The production plant contains less than 400 feet of high-pressure tubing that may at times contain SNM.
- Industry data for small-bore pipe indicate leak rates on the order of 10^{-3} to 10^{-4} per year per 100 feet of pipe*.

- Note: The 10^{-4} leak rate is judged conservative for this application because such leaks, as recorded, are almost invariably due to corrosion, and we are dealing with stainless steel tubing compatible with the working fluid.

- The process expert hired by AREVA as the process engineer for this project reports that he has seen no such leaks in his professional experience. (Although of a relatively short duration (< 1 operating year), no pinhole leaks were detected in operation of the pilot plant.)

Assumptions:

- Tubing leak rates are no worse than those of small-bore pipe.
- Fitting leaks are typically dispersed leaks that do not constitute an injection hazard.
- Vessel leaks likewise do not constitute a significant injection hazard, due to thick walls, relatively low probability, and pressure drop through the vessel wall.
- Near-contact with skin (< 1 cm based on process testing) is a requirement for injection.
- During normal operation, the glove box will prevent operator access in the proximity of any high-pressure tubing.
- No more than 10% of actual tubing leaks have "nozzle characteristics" that can have potential for injection injury (also judged a conservative figure based on engineering judgment following attempts to create a nozzle for a process test).

Necessary Enabling Condition:

- A person is present inside the hood (in proximity to tubing) during operation:
  - An operator will never be within 6 inches of pressurized tubing during operation.
  - The system is pressurized during a maintenance operation (i.e., when a person is within 6 inches of pressurized tubing, in violation of plant standard lock-and-tag procedures) no more than 0.05% of the time (conservatively assuming maintenance at 5% of the time, and violation of lock-and-tag at 0.01 probability), giving an index number conservatively rounded up to -3. Note: During the PM for hydrostatic testing, the system will be essentially empty of SNM, and is bounded by the above violation.

Conclusion:

For the production plant, the probability index for an injection is conservatively judged to be less than -7: (-3 [i.e., -4 leak rate per 100 ft, judged conservative, for 400 ft of tube, rounded up to -3 as an additional conservative measure]) + (-1 [conservative fraction that could lead to injection]) + (-3 [maintenance person in proximity to tube]) = -7.

* References: 1) Process Safety Institute, Course 209 (LOPA); 2) Rijnmond Report: Rijnmond Public Authority, 1982.

4. Accident sequence 186-87 in the ISA Summary states in the "notes" section that: "...periodic inspection to applicable codes is judged by the ISA Team to make the initiating event at least highly unlikely." Similar language was included in the third paragraph of Section 6.4, and the second paragraph of Section 10.0 of the license amendment application. The "periodic inspection" appears to be necessary to make the accident highly unlikely. Consistent with 10 CFR 70.62(d), explain whether these "periodic inspections" are management measures and identify the IROFS to which the management measures apply. Alternatively, identify these inspections as IROFS. Justify why items identified in the "notes" sections of accident sequences 186-87, 186-88, 186-92, 186-94, etc. rely on inspection, welding, use of ductile material, etc. to render the events "highly unlikely," yet these items are not declared as IROFS or management measures.

AREVA Response:

AREVA Richland applies management measures, as needed, to such safety-critical attributes, but also notes that the application of management measures to an item does not require that the item be designated an IROFS. Initial construction and verification of construction to code is considered a management measure verified, but not directly applied, by AREVA Richland. A similar comment may be applied to the state-mandated periodic pressure vessel inspection. The ISA Summary lists, under each IROFS, the **types** of management measures applied; more detailed information is available for inspection on site.

The complete quote from the accident sequence notes is ***"Construction and*** periodic inspection to applicable codes is judged by the ISA Team to make the initiating event at least highly unlikely" (emphasis added). Initial construction is judged the crucial factor. A similar comment applies to welded piping construction, which is accepted as being more reliable than threaded pipe. AREVA Richland does not take the position that the state-mandated inspections are necessary to make the subject accidents "highly unlikely", but instead, that they "serve as features that enhance safety" *(10 CFR 70.64)*. Also, the "notes" are not lists of IROFS nor of management measures, but instead serve as historical, supporting information and help to show the thought processes of the ISA Team.

The subject items that are composed of ductile materials, i.e., the pressure vessels and ancillary devices such as connecting tubing and fittings, are not designated as IROFS, but the described safety-critical attribute, ductility, exists within the boundary of these items, just as such attributes might exist within the boundary of an IROFS. The attribute of ductility is a design feature of these items, and its effectiveness as a defense against catastrophic failure is based on the metallurgical structure of ductile materials and the fact that their characteristic failure mode is one of gradual displacement under load, rather than the instantaneous displacement characteristic of brittle materials such as ceramics.

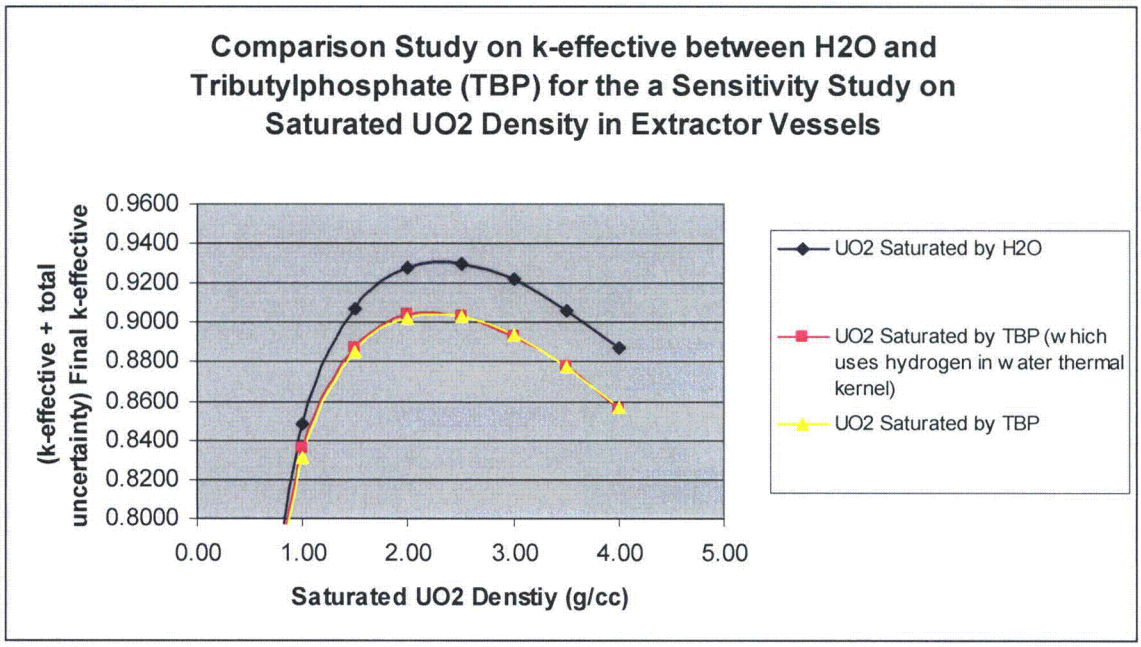
The only failure mechanism identified by the ISA Team for the designated attribute of ductility is loss of configuration control, e.g., unauthorized replacement by a brittle component. During the engineering evaluation of the materials and their operating environment, no inherent paths to spontaneous degradation or failure, e.g., stress corrosion or embrittlement, were identified. Further, this attribute is judged not subject to being "degraded without a justifying safety review" *(NUREG-1520)*. Once installation has been properly verified, this attribute requires no plant-applied management measure (e.g., a PM/IRM) to ensure its continued availability, and it cannot be easily defeated by accidental action of operating personnel. This attribute is based on physical laws: the metallurgical structure of the material. It is therefore designated a "design feature" and not an IROFS.

Similar comments apply to "welded construction", which, like ductility, is an attribute of the installed system. It is listed here as an attribute that enhances the reliability of the piping system, an item intended to "serve as a feature that enhances safety" *(10 CFR 70.64)*.

B) Nuclear Criticality Safety

1. The criticality safety analysis summary (CSAS) indicates that the calculations used to demonstrate subcriticality were all performed using normal density water. Consistent with 10 CFR 70.61(d), demonstrate that normal density water is at least as effective at moderating neutrons as the actual chemicals used in the process under normal and credible abnormal conditions.

AREVA Response:
Included below is data comparing k-effective calculations for several different densities of UO2 saturated with TBP and H2O inside of an extractor vessel. The results show higher k-effective values for H2O.



2. According to Section 5.4.3 of the CSAS, the determination that process vessels are favorable geometry relies on the assumption that the UO_2 concentration does not exceed 500 g U/L. Consistent with 10 CFR 70.61 (d), demonstrate that it is at least highly unlikely for UO_2/ash in the process vessels to exceed a concentration of 500 g U/L. This demonstration should include credible process upsets and possible long-term accumulations of material.

AREVA Response:

Section 5.4.3 of the CSAS makes the statement that "all concentrations of UN solution and UO_2-H_2O solutions up to 500 g U/l remain adequately subcritical in process vessels with a diameter less than 15 inches. This discussion was meant to illustrate the large amount of conservatism in the criticality safety analysis. [redacted] The wall is 316L stainless steel which is highly resistant to corrosion from nitric acid. The Chemical Engineers Handbook, fifth edition pg 23-21 provides data that indicates a corrosion rate for this material of < 0.02 inches per year, considering actual acid concentrations (<62%) and actual process temperatures (<170ºF), the inside diameters of these vessels are expected to remain favorable geometry for the lifetime of the facility.

Additionally, the Sandvik corrosion database shows that Sandvik 3R60, which is closely related to 316L, i.e. both fit the range of 316L specifications, reports that when this material is exposed to 65% HNO3 at 70 ºC (158 ºF)the corrosion rate is less than 0.1mm

(0.0039 in) / year.

http://www2.sandvik.com/sandvik/0140/internet/se01659.nsf/HandbookWeb/A90C2B8EBB5A933E4125662B0034F92A

Section 5.4.3 also states that it is possible for some trace amounts of ash (containing UO_2) to enter the subject process vessels. [redacted] Additionally, the process chemicals in these down stream vessels contain sufficient amounts of nitric acid that any trace amounts of UO_2 present will be dissolved before any unsafe buildup could occur.

3. Accident sequence 186-5 is described as at least "highly unlikely" because a funnel break prevents backflow of solutions into the tri-butyl phosphate supply drum. Consistent with 10 CFR 70.65 (b)(6) and 70.61 (e), explain why the funnel break is not designated as an IROFS when funnel breaks in other parts of the facility are designated as IROFS (e.g., IROFS 6117). Justify that it is at least highly unlikely for the funnel break to be adversely changed or bypassed during installation, maintenance, or normal operations of the process.

AREVA Response:

Clarification and implementation of the distinction between design features and IROFS is a work in progress at AREVA Richland. Some design features, including the subject IROFS 6117, were incorrectly designated as IROFS during the initial creation of the facility ISA. As time and manpower permits, such inconsistencies and errors are under review and being corrected during the ongoing ISA updating process. The referenced IROFS is to the Polyhall tank and during our five-year review is on the list of items to be removed from the IROFS category to Design Feature category.

The only failure mechanism identified by the ISA Team for the designated design feature (funnel break) is loss of configuration control, e.g., unauthorized replacement by a direct pipe connection. In the ISA Team evaluation of the design, no inherent paths to spontaneous degradation or failure (e.g., plugging) were identified. Further, this feature is judged not subject to being "degraded without a justifying safety review" *(NUREG-1520)*. Once installation has been properly verified, it requires no plant-applied management measure (e.g., a PM/IRM) to ensure its continued availability, and it cannot be easily defeated by accidental action of operating personnel. The safety-related attribute, prevention of backflow, is based on physical laws: There is no credible path for counter-pressurization. The item is therefore designated a "design feature" and not an IROFS.

4. Accident sequence 186-15 is described as at least "highly unlikely" because "the insulation is shielded from direct contact with spraying process fluid, tightly fills its shield walls, and is composed entirely of closed-cell foam." Consistent with 10 CFR 70.65 (b)(6) and 70.61 (e), explain why these design features are not designated as IROFS. Justify that it is at least highly unlikely for any of these design features to adversely change during installation, maintenance, normal operations of the process or process upsets.

AREVA Response:

Since the original submittal, the system design has been modified and the internal stainless steel shield wall was deleted. This fact is judged to have no significant deleterious effect on the resistance to degradation of the foam insulation, and has the advantage of keeping the foam visible.

The only failure mechanism identified by the ISA Team for the designated design feature (closed-cell polyethylene foam) is loss of configuration control, e.g., unauthorized replacement by an absorptive insulating material. In the ISA Team evaluation of the design, no inherent paths to spontaneous degradation or failure (e.g., degradation of the foam from exposure to process chemicals, maintenance materials, or personnel action) were identified. Further, this feature is judged not subject to being "degraded without a justifying safety review" *(NUREG-1520)*. Once installation has been properly verified, this feature requires no plant-applied management measure (e.g., a PM/IRM) to ensure its continued availability, and it cannot be easily defeated by accidental action of operating personnel. The safety-related attribute, prevention of undetected accumulation of SNM, is based on physical laws: two bodies cannot occupy the same space at the same time. The item is therefore designated a "design feature" and not an IROFS.

More detailed information about the material used in construction of this feature, e.g., chemical inertness of the closed-cell foam, is available for inspection on site.

5. Accident sequence 186-16 is described as at least "highly unlikely" because "a hood surrounding the process columns provides adequate spacing," and there is "no reason or motive for transporting containers of uranium-bearing material" near the hood. Consistent with 10 CFR 70.65 (b)(6) and 70.61 (e):

    a. Explain why the hood is not designated as IROFS. Justify that it is at least "highly unlikely" for the hood to be adversely changed or removed during installation, maintenance, or normal operations of the process.

    b. Justify the statement that there is "no reason or motive for transporting containers of uranium-bearing material" near the hood. The ISA Summary indicates that uranium-bearing material is routinely transported and stored within the room, and it appears that the only pathway through the room is next to the hoods surrounding the process columns.

AREVA Response:

The only failure mechanism identified by the ISA Team for the subject design feature (hood), as related to the subject Accident Sequence 186-16, is loss of configuration control, e.g., unauthorized removal of the hood or some portion thereof, combined with concurrent operation of the extraction equipment. In the ISA Team evaluation of the design, no inherent paths to spontaneous degradation or failure were identified. Further, this attribute is judged not subject to being "degraded without a justifying safety review" *(NUREG-1520)*. Once installation has been properly verified, it requires no plant-applied management measure (e.g., a PM/IRM) to ensure its continued availability, and it cannot be easily defeated by accidental action of operating personnel. The safety-related attribute, spacing, is based on physical laws: The physical barrier prevents manual transport of materials adjacent to the columns. The item is therefore designated a "design feature" of the system, and not an IROFS.

Many practices and programmatic requirements basic to operations at AREVA Richland prevent operation of any equipment while the surrounding hood is breached or is found otherwise

defective. Standard practice for turnover from Operations to Maintenance requires that systems first be shut down and emptied of SNM by Operations personnel. Turnover back to Operations requires closure and inspection of the maintenance process to ensure that the equipment is adequately prepared for restart. Details of these programmatic practices and requirements (i.e., management measures) are available for inspection on site.

Although containers of uranium-bearing material are routinely stored within the room (as opposed to processing through the $SCCO_2$ System), the sole entrance/exit used for their transport is at an opposite corner of the room away from the hood. All storage locations for these containers are restricted to the area between the entrance/exit and the subject hood, and the ISA Team identified no reason or motive to transport SNM containers "through" the room. Since the original submittal, however, a design change has been implemented and the ISA Team now identifies a single transport path the skirts the hood itself, i.e. transport of ash containers from the northwest entrance to the dumbwaiter at the south end of the SSCO2 system. This path, however, is not judged to invalidate the concept that the hood will prevent these containers from being brought into proximity with the SSCO2 vessels. Floor Plan Drawing CSA-616,520 illustrates these facts, and further site inspection would also verify the described layout.

6. Accident sequences 186-17, -18, and -19 are described as at least "highly unlikely" because liquids will flow into catch trays or onto the room floor where a favorable geometry will be maintained. Consistent with 10 CFR 70.65 (b)(6) and 70.61 (e), explain why these design features are not designated as IROFS, when the floor is listed as an IROFS (e.g., IROFS 6127) for other process areas. Justify that it is at least "highly unlikely" for any of these design features to adversely change during installation, maintenance, or normal operations of the process.

AREVA Response:

Clarificaton and implementation of the distinction between design features and IROFS is a work in progress at AREVA Richland. Some design features, including the subject IROFS 6127, were incorrectly designated as IROFS during the initial creation of the facility ISA. As time and manpower permits, such inconsistencies and errors are under review and being corrected during the ongoing ISA updating process.

The subject design features (room floor and catch trays) ensure safe-slab geometry for any process fluids they might be called upon to contain. The total liquid volume that could potentially end up in a catch pan is small enough that the depth of the maximum spill of uranium-containing moderated solution will be less than 1.0 inch in any enclosure catch pan.

The only failure mechanism identified by the ISA Team for the subject design features (floor and catch trays) is loss of configuration control, e.g., unauthorized replacement of the catch trays with other items that do not posses safe-slab geometry, or unauthorized construction of an unfavorable geometry sump in the room. The flat-floored room is large enough to ensure that the maximum credible fluid loss from the system will maintain a safe-slab geometry. In the ISA Team evaluation of the design, no inherent paths to spontaneous degradation or failure of these features were identified. Further, these features are judged not subject to being "degraded without a justifying safety review" *(NUREG-1520)*. Once installation has been properly verified, they require no plant-applied management measure (e.g., a PM/IRM) to ensure their continued availability, and they cannot be easily defeated by accidental action of operating personnel. The safety-related attribute, maximum fluid depth, is based on physical laws: Fluid will spread out to its own level on a flat surface, and will overflow the lip of a catch tray. The subject items are

therefore designated "design features" and not IROFS.

Detailed information related to fluid capacities and equipment dimensions is available for inspection on site.

7. Accident sequence 186-24 indicates that a criticality event in the unfavorable geometry ash preparation equipment will be prevented by two IROFS (6910 and 6911). IROFS 6910 limits the total uranium content within containers in the infeed staging system to 15.8 kg. IROFS 6911 prevents the addition of ash into the ash preparation equipment if the system detects that more than 7 kg of material has been held up in the equipment. Consistent with 10 CFR 70.61 (d):
   a. Justify that these IROFS are independently capable of preventing a criticality accident.
   b. Explain how this equipment is limited to 45 percent of a critical mass. It appears that certain assumptions about the uranium content of the ash in the hold-up material must be made to meet this requirement. It is not clear what assumptions are verified before ash is added to this equipment. Section 5.4.2.3 of the December 10, 2008, license renewal application requires that workstations controlled only by fissile material mass shall be limited to no more that 45 percent of the minimum critical mass when engineered controls are not used to prevent double batching.

AREVA Response:

a. IROFS 6910 implements a uranium mass control by administrative action with a computer overcheck to prevent > 15.8 kg U in the ash preparation equipment. A computer routine in the "Waste Data Base" management system prevents construction of a "pick list" of containers whose collective content exceeds the 15.8 kg U limit. After a batch of containers is selected and transported to the UO2 Building, a barcode scan is required prior to their placement on the SCCO2 container infeed staging system, which helps ensure that incorrect containers are excluded from the downstream ash preparation equipment.
   Three determinations of SWUR ash U content are made upstream of the "pick list":
   - An NDA of drum waste is completed prior to creating a SWUR process batch (Note: each batch is limited to 795 grams 235U).
   - Drum waste is then sorted and repackaged into burn boxes with a subsequent independent assay of U content.
   - A laboratory analysis for U content is completed for each ash container.
   - Correlations between these three determinations are found to agree, in the aggregate, to within 20%.

   Introduction of an ash container into the ash preparation equipment by any means other than the dumbwaiter is prevented by system design.

   Additionally, the dumbwaiter, used to transport buckets to the input station, will not transport containers until a second container barcode scan has been completed and the container is confirmed to be part of the current process batch.

   After each process batch has been processed, a supervisor verifies that a visual inspection for hold up, and a clean out if needed, has been completed prior to providing the computer controlling the elevator authorization to initiate the next process batch.

   IROFS 6911 implements control on the total mass of material in the feed preparation equipment using a set of scales and a PLC which are completely independent from IROFS 6910.

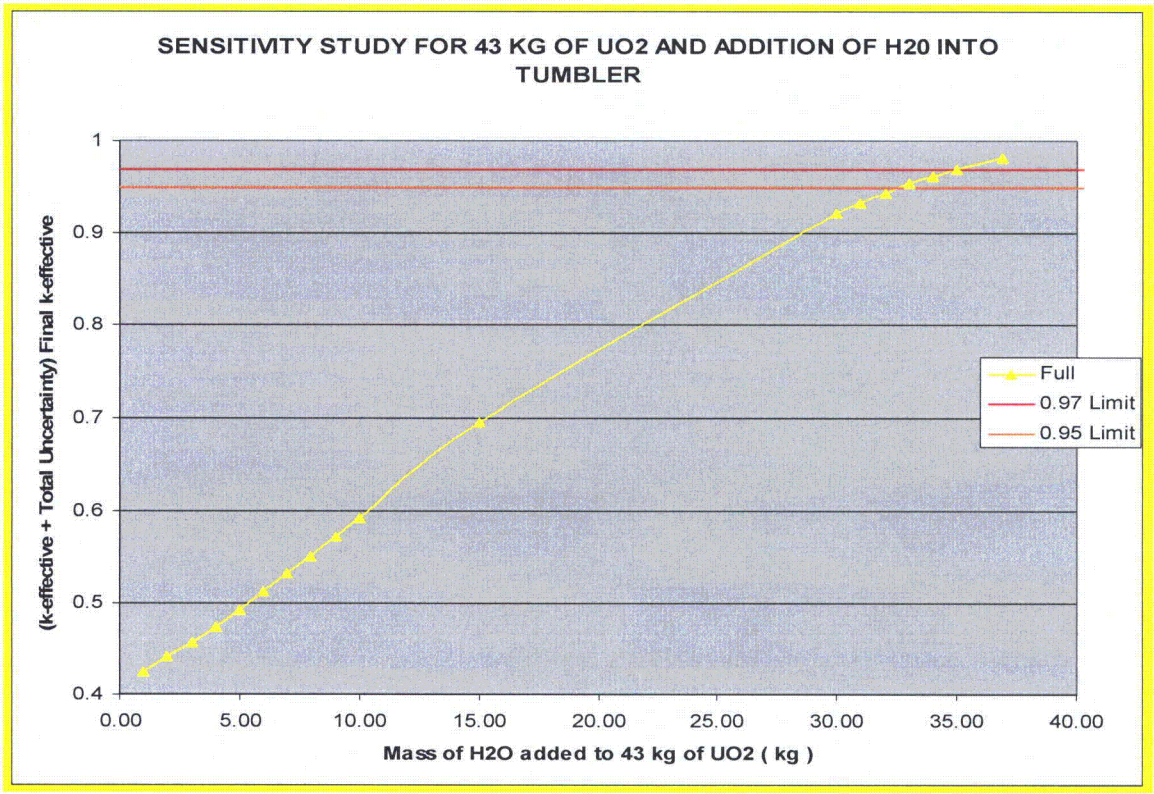
The infeed container dumbwaiter motor is interlocked with a scale at the dumbwaiter infeed and with the extractor basket scale downstream within the feed preparation system, to prevent elevation of any additional container by the dumbwaiter (and transfer into the ash preparation equipment) if the scale system indicates an accumulated holdup > 7 kg.

Key aspects of this IROFS are the fact that the plant wide mass limit on 5-gallon containers is 18 kg net weight of U-bearing compounds, and that no more than two 5-gallon containers of ash/feed material are processed through the feed preparation equipment at a time.

Dumbwaiter geometry prevents elevation of more than two containers at a time, and an interlock prevents another pair of 5-gallon containers being elevated before the feed preparation equipment is emptied.

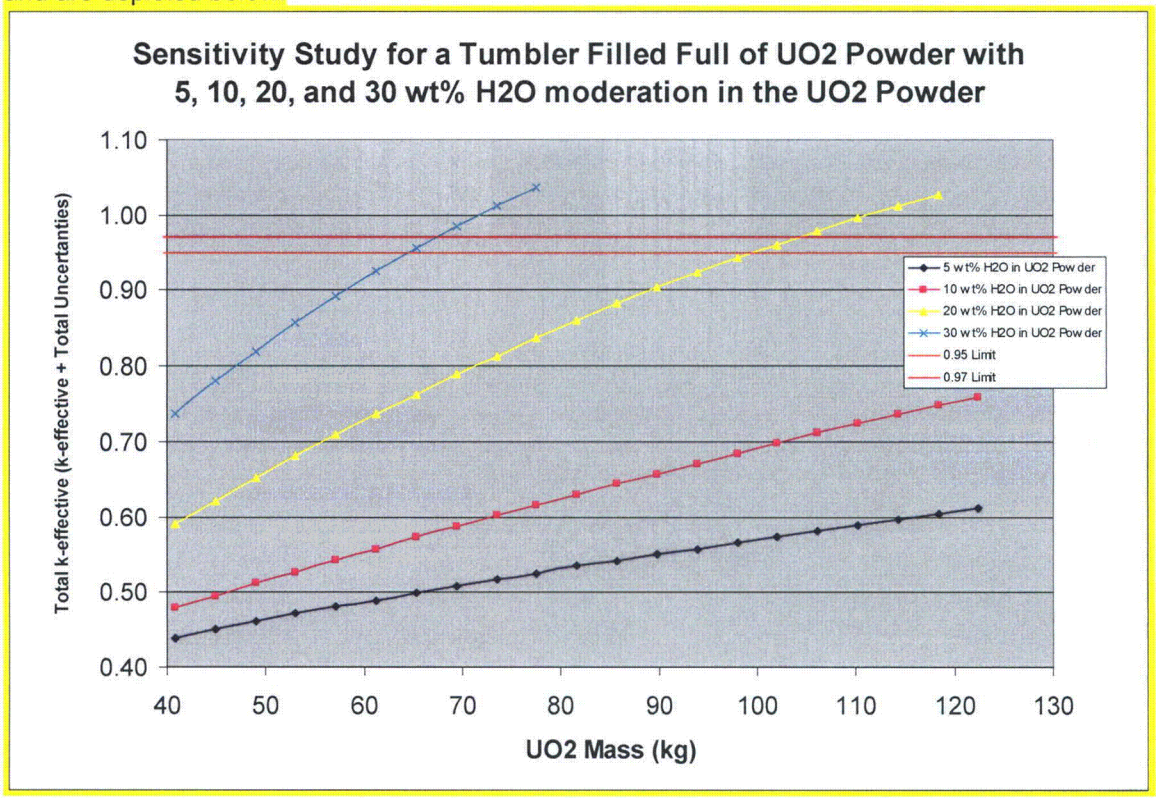
Upstream plant-wide controls on SBCs prevent overbatching (i.e., the contents of each are limited to ≤ 18 kg).

The graph shown below indicates that a total material mass (UO_2-H_2O) of 53 kg [(18+18+7)*1.24] in the feed preparation equipment has a k_{eff} significantly less than 0.95. This mass limit assumes that the entire contents could adsorb additional water up to a 24% gain (the maximum water content of hydrated calcium oxide is 24%). This value of additional water gain is highly conservative as it assumes that the feed material possesses simultaneously, the hygroscopic properties of CaO and the nuclear properties of UO_2.



The graph furthermore shows that keff approaches 0.97 for a UO2 mass loading of 43 kg with an additional mass loading of H2O up to 35 kg. The keff sensitivity study was performed in the tumbler due to its capacity and unfavorable geometry.

Further sensitivity studies were performed on moderator content for various mass loadings and are depicted below.



This graph shows that keff remains less than 0.97 for overbatched conditions where water is added to the UO2 powder until the water content of the total mixture is 30 wt% H2O for a total UO2-H2O mass loading of 93.28 kg (65.30 kg of UO2 and 27.98 kg H2O) which gives a keff of 0.9554 including total uncertainties and where water is added to the UO2 powder until the water content of the total mixture is 20 wt% H2O for a total UO2-H2O mass loading of 127.53 kg (102.03 kg of UO2 and 25.50 kg H2O) which gives a keff of 0.9605 including total uncertainties.

b. Section 5.4.2.3 of the license states in section 5.4.2.3 "Mass may be controlled such that the k_{eff} of the unit / process meet the guidelines in Section 5.4.2.1". Section 5.4.2.1 sets k_{eff} limits of 0.95 for normal conditions and 0.97 for abnormal conditions. These values of k_{eff} must include bias and calculation uncertainties. The preceding graph demonstrates that the required k_{eff} limits are met.

8. According to accident sequence 186-27, the addition of improper feed material into the unfavorable geometry ash preparation equipment is prevented by two IROFS (6911 and 6912). Both IROFS control the amount of feed material using an interlock on the dumbwaiter. Consistent with 10 CFR 70.61 (d), describe any common mode failures that exist between these two IROFS, or indicate if the interlock mechanisms are separate controls. If common mode failures do exist, justify the failure indices listed in the ISA Summary.

AREVA Response:

IROFS 6911 and 6912 are judged functionally independent. Although both rely on disabling the bucket dumbwaiter lifting motor, each will have a separate, independent set of electrical contacts and the interlock operating the contacts for each will be controlled by a different computer or controller. Both sets of contacts must engage in order for the dumbwaiter motor to operate.

IROFS 6911 relies on a material balance calculated on the holdup of ash in the basket loading equipment. The holdup is the difference between the mass of feed material input and the mass of material removed. The material balance is calculated by the supercritical CO_2 main PLC. The PLC will lock out the bucket dumbwaiter motor to prevent the buckets from being delivered to the basket loading equipment if the inventory in the basket loading equipment exceeds 7 kg.

IROFS 6912 uses a barcode scanner to scan the bar code on each bucket as it is placed in the dumbwaiter. The barcode scanner is connected to an independent PLC controller. If the bucket scanned is not an approved feed material bucket from the current batch input queue, then the controller will lock out the dumbwaiter motor. The ash batch input queue software is configured so that no more than 15.8 kg of uranium can be placed in the queue. The feed material input bucket queue is a set of rollers that will hold no more than 8 buckets. Bucket barcodes are scanned as the buckets are placed on the rollers to assure that they match the input queue buckets.

9. IROFS 1614 (pipe and roof integrity to control moderation) in the ISA Summary does not appear to receive any preventive maintenance or other type of management measure. Consistent with 10 CFR 70.65(b)(4), justify the failure index of -3 assigned to this IROFS.

AREVA Response:

Perhaps it would help to first clarify the way this IROFS is used. Index PFOD = -3 is assigned to IROFS 1614. This is not a failure frequency index; instead, it represents the probability of failure on demand for the IROFS, not applied to the entire HRR plant as a unit, but instead to individual, specific, restricted areas of the plant, with respect to each individual accident sequence where the IROFS is used. In this regard, for failure of the IROFS to have occurred, the quantity of fluid leaked must be "significant", i.e., sufficient to approach optimal moderation of a MCM as described in the individual accident sequences. The fluid must also leak into the immediate vicinity of the SNM. For example, a small roof leak trickling down a wall (which is typical of roof leaks) several feet away from an array of stored containers of SNM would not be judged to fail the subject IROFS if the accident sequence required the leaked fluid to penetrate into the containers through damaged or open lids.

The RAI question appears to be whether the assigned PFOD is justifiable, considering that AREVA does not list a specific PM for testing and maintaining roof and pipe integrity. Regular roof inspection and maintenance, and immediate response to incipient pipe and roof leaks as soon as they are detected, is basic to normal building maintenance at AREVA Richland. Incipient leaks typically allow ample time for detection and appropriate response. These practices effectively substitute here for a formal PM; plant history shows that both pipe and roof leaks begin slowly and are readily detected, such that they are corrected before becoming a significant threat to moderation control. With respect to plant piping, this IROFS relies upon the attribute of ductility in prevention of a catastrophic break. The assigned PFOD is based on plant history, applied with engineering judgment, e.g., by comparing the performance of this IROFS with the reliability of more specific passive engineered and active engineered IROFS. A PFOD = -3 is judged a conservative assignment for a passive engineered IROFS.

To reiterate, roof integrity is automatically tested with each significant rainstorm. Also, where large-area roof integrity is of prime importance, e.g., in the Dry Conversion area, AREVA uses a duplex roof with active engineered leak detection between the roofs.

C) Chemical Safety

1. Sections 3.0, 6.0, and Table 1 of the license amendment application show pressurized process vessels and equipment as part of the extraction process. Most of them will operate at high pressures (up to 3,000 psig) and would appear to have some safety significance. Section 6.2 mentions that: "...a catastrophic release of the working fluid is precluded by primary and secondary containment which have management measures...management measures include periodically inspecting the process vessels in conformance with applicable pressure vessel codes and standards." Management measures are applied to IROFS. However, the license amendment application does not identify any IROFS, safety programs, or other criteria for these process vessels and equipment. Consistent with 10 CFR 70.61(e) and 70.62, identify the IROFS and describe what safety programs will apply to these pressurized process vessels and equipment. Alternatively, justify why IROFS are not required.

AREVA Response:

AREVA Richland applies management measures, as needed, to such safety-critical attributes, but also notes that the application of management measures to an item does not require that the item be designated an IROFS. Initial construction and verification of construction to code is considered a management measure verified, but not directly applied, by AREVA Richland. A similar comment may be applied to the state-mandated periodic pressure vessel inspection.

The subject items that are composed of ductile materials, i.e., the pressure vessels and ancillary devices such as connecting tubing and fittings, are not designated as IROFS, but the safety-critical attribute, ductility, exists within the boundary of these items, just as such attributes might exist within the boundary of an IROFS. The attribute of ductility is a design feature of these items, and its effectiveness as a defense against catastrophic failure is based on the metallurgical structure of ductile materials and the fact that their characteristic failure mode is one of gradual displacement under load, rather than the instantaneous displacement characteristic of brittle materials such as ceramics.

The only failure mechanism identified by the ISA Team for the designated attribute of ductility is loss of configuration control, e.g., unauthorized replacement by a brittle component. During the engineering evaluation of the materials and their operating environment, no inherent paths to spontaneous degradation or failure, e.g., stress corrosion or embrittlement, were identified. Further, this attribute is judged not subject to being "degraded without a justifying safety review" *(NUREG-1520)*. Once installation has been properly verified, this attribute requires no plant-applied management measure (e.g., a PM/IRM) to ensure its continued availability, and it cannot be easily defeated by accidental action of operating personnel. This attribute is based on physical laws: the metallurgical structure of the material. It is therefore designated a "design feature" and not an IROFS.

The "secondary containment" listed above refers to the process hood that surrounds the high-pressure equipment, which would serve to contain escaping gas (less than a catastrophic break)

and ensure that it is exhausted outside the building. The HVAC system for the supercritical CO2 system is sized to contain the maximum credible system leak while maintaining negative pressure in the containment hoods. Calculations are available on site for inspection.

The process hood is also designated a design feature, because the only failure mechanism identified by the ISA Team for the hood is loss of configuration control, e.g., unauthorized removal of the hood or some portion thereof, combined with concurrent continuing operation of the extraction equipment. During the engineering evaluation of the design, no inherent paths to spontaneous degradation or failure of this item were identified. Further, the hood is not subject to being "degraded without a justifying safety review" *(NUREG-1520)*. Once installation has been properly verified, it requires no plant-applied management measure (e.g., a PM/IRM) to ensure its continued availability, and it cannot be easily defeated by accidental action of operating personnel. The safety-related attribute, containment, is based on physical laws: Rapid gas transport through a solid barrier will not occur, and escaping gas will seek the path of least resistance, i.e., the exhaust system. The hood is therefore designated a "design feature" and not an IROFS.

Many practices and programmatic requirements basic to operations at AREVA Richland prevent operation of any equipment while the surrounding hood is breached or is found otherwise defective. Maintenance activities for instance might require temporary breach of the hood. Standard practice for turnover from Operations to Maintenance requires that systems first be shut down and emptied of SNM by Operations personnel. Turnover back to Operations requires closure and inspection of the maintenance process to ensure that the equipment is adequately prepared for restart. Details of these programmatic practices and requirements (i.e., management measures) are available for inspection on site.

2. 2. Section 8.2 of the license amendment application states that: "Catastrophic failure of pressure vessels and/or piping is prevented by design, construction, and periodic inspection in conformance with applicable pressure vessel codes and standards." It further states that: "Catastrophic release due to over-pressurization in the process system is prevented by...pump design...and...equipping the process vessels with rupture disks or pressure relief valves." During the December 2008 site visit, AREVA identified management measures (e.g., design control, inspections, conformance with the standards in the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section VIII, Division 1) for reducing the initiating frequency to "highly unlikely" for many accident sequences involving pressure vessels and/or piping. Management measures are applied to IROFS. However, the license amendment application does not identify any IROFS for pressure vessels and/or piping. Consistent with 10 CFR 70.61(b), (c), (e) and 70.62:

   a) Identify the IROFS, associated management measures, and any other safety information for the pressure vessels and/or piping. Alternatively, justify why IROFS are not required.

   b) b) Since pressure relief is used to prevent catastrophic failures, which likely constitute at least intermediate events, identify which pressure relief devices are IROFS. Alternatively, justify why IROFS are not required.

AREVA Response:

A typical quote from the accident sequence notes dealing with catastrophic failure of pressure vessels and/or piping is ***"Construction and*** periodic inspection to applicable codes is judged by the ISA Team to make the initiating event at least highly unlikely" (emphasis added). Initial construction is judged the crucial factor. A similar comment applies to welded piping construction, which is accepted as being more reliable than threaded pipe. AREVA Richland does not take the position that the state-mandated inspections are necessary to make the subject accidents "highly unlikely", but instead, that they "serve as features that enhance safety" *(10 CFR 70.64)*. Also, the "notes" are not lists of IROFS nor of management measures, but instead serve as historical, supporting information and help to show the thought processes of the ISA Team.

The subject items are composed of ductile materials, i.e., the pressure vessels and ancillary devices such as connecting tubing and fittings. These are not designated as IROFS, but the described safety-critical attribute, ductility, exists within the boundary of these items, just as such attributes might exist within the boundary of an IROFS. The attribute of ductility is a design feature of these items, and its effectiveness as a defense against catastrophic failure is based on the metallurgical structure of ductile materials and the fact that their characteristic failure mode is one of gradual displacement under load, rather than the instantaneous displacement characteristic of brittle materials such as ceramics.

The only failure mechanism identified by the ISA Team for the designated attribute of ductility is loss of configuration control, e.g., unauthorized replacement by a brittle component. During the engineering evaluation of the materials and their operating environment, no inherent paths to spontaneous degradation or failure, e.g., stress corrosion or embrittlement, were identified. Further, this attribute is judged not subject to being "degraded without a justifying safety review" *(NUREG-1520)*. Once installation has been properly verified, this attribute requires no plant-applied management measure (e.g., a PM/IRM) to ensure its continued availability, and it cannot be easily defeated by accidental action of operating personnel. This attribute is based on physical laws: the metallurgical structure of the material. It is therefore designated a "design feature" and not an IROFS.

Similar comments apply to "welded construction", which, like ductility, is an attribute of the installed system. It is listed here as an attribute that enhances the reliability of the piping system, an item intended to "serve as a feature that enhances safety" (10 CFR 70.64).

AREVA Richland applies management measures, as needed, to such safety-critical attributes, but also notes that the application of management measures to an item does not require that the item be designated an IROFS. Initial construction and verification of construction to code is considered a management measure verified, but not directly applied, by AREVA Richland. A similar comment may be applied to the state-mandated periodic pressure vessel inspection.

At the time of submittal of the application for license amendment, pump design was considered the controlling design feature in this application. All of the subject pumps were driven by compressed air and were so constructed that Richland site compressed air, even under any credible upset condition, could not reach a pressure high enough to endanger the integrity of the pressure vessels via these pumps. The pumps were therefore designated as design features that made overpressurization of the vessels via pumping at least "highly unlikely". Now, however, a major design change to all of the pumps has rendered them capable of generating much higher pressures, assuming, among other faults, failure of the equipment that controls their input air pressure. Certain accident sequences, including Accident Sequence 8.2 (186-64), have therefore

been revised, some new accident sequences have been created, and appropriate IROFS designated to preclude catastrophic failure of a pressure vessel or connecting line due to overpressurization by an air-driven pump. Changes to the accident sequences are shown highlighted in Attachment II.

With the exception of pressure relief devices specifically listed in the new and revised accident sequences dealing with the pump change described above, AREVA Richland does not take the position that the referenced pressure relief devices are necessary to make the subject accidents "highly unlikely", but instead, that they "serve as features that enhance safety" *(10 CFR 70.64)*. These items are therefore not designated as IROFS.

3. Sections 1.0 and 8.2 of the license amendment application state that: "Catastrophic releases [from the extractor vessels due to human error, mechanical degradation, or frequent openings] are prevented by passive design features." Examples given are: (1) the design ensures the lids cannot be manually opened while under significant internal pressure; and (2) large pressure relief valves that remain open until the lid is completely closed to prevent buildup of high pressures in the vessel under unsafe lid positions. AREVA stated during the December 2008 site visit that the extractor vessels would be designed and inspected in accordance with the ASME Code, Section VIII, Division 1. The design features of the extractor vessels appear to be serving a safety function. The management measures (e.g., design controls, inspections, conformance with ASME Code, Section VIII, Division 1) were identified for reducing the initiating frequency to "highly unlikely" for many accident sequences involving extractor vessels, yet no IROFS were identified either during the site visit or in the license amendment application. Consistent with 10 CFR 70.61(e), 70.62, and 70.65(b)(6):

   a) Identify the IROFS that the management measures apply to.

   b) Identify the IROFS and associated management measures for the following accident sequences: 186-84, 186-86, 186-87, and 186-88. These accident sequences appear to rely on design features to render the initiating events as "highly unlikely," thus serving a safety function. Alternatively, justify why IROFS are not required.

AREVA Response:

This RAI appears to be concerned not only with the lids of the extractor vessels, but also with the general construction of the extractor vessels and the associated pipe and fittings.

A typical quote from the accident sequence notes dealing with catastrophic failure of pressure vessels and/or piping is ***"Construction and*** periodic inspection to applicable codes is judged by the ISA Team to make the initiating event at least highly unlikely" (emphasis added). Initial construction is judged the crucial factor. A similar comment applies to welded piping construction, which is accepted as being more reliable than threaded pipe. AREVA Richland does not take the position that the state-mandated inspections are necessary to make the subject accidents "highly unlikely", but instead, that they "serve as features that enhance safety" *(10 CFR 70.64)*.

The subject items are composed of ductile materials, i.e., the pressure vessels and ancillary devices such as connecting tubing and fittings. These are not designated as IROFS, but the

described safety-critical attribute, ductility, exists within the boundary of these items, just as such attributes might exist within the boundary of an IROFS. The attribute of ductility is a design feature of these items, and its effectiveness as a defense against catastrophic failure is based on the metallurgical structure of ductile materials and the fact that their characteristic failure mode is one of gradual displacement under load, rather than the instantaneous displacement characteristic of brittle materials such as ceramics.

The only failure mechanism identified by the ISA Team for the designated attribute of ductility is loss of configuration control, e.g., unauthorized replacement by a brittle component. During the engineering evaluation of the materials and their operating environment, no inherent paths to spontaneous degradation or failure, e.g., stress corrosion or embrittlement, were identified. Further, this attribute is judged not subject to being "degraded without a justifying safety review" *(NUREG-1520)*. Once installation has been properly verified, this attribute requires no plant-applied management measure (e.g., a PM/IRM) to ensure its continued availability, and it cannot be easily defeated by accidental action of operating personnel. This attribute is based on physical laws: the metallurgical structure of the material. It is therefore designated a "design feature" and not an IROFS.

Similar comments apply to "welded construction", which, like ductility, is an attribute of the installed system. It is listed here as an attribute that enhances the reliability of the piping system, an item intended to "serve as features that enhance safety" (10 CFR 70.64).

AREVA Richland applies management measures, as needed, to such safety-critical attributes, but also notes that the application of management measures to an item does not require that the item be designated an IROFS. Initial construction and verification of construction to code is considered a management measure verified, but not directly applied, by AREVA Richland. A similar comment may be applied to the state-mandated periodic pressure vessel inspection.

Mechanical design of the extractor vessel lids ensures that they cannot be manually opened while under significant internal pressure, and includes vent paths that remain open until the lid is completely closed. These vents prevent buildup of high pressures in the extractor vessels unless the lids are sufficiently closed to withstand the design pressures.

The only failure mechanism identified by the ISA Team for the extractor vessel lids is loss of configuration control, e.g., unauthorized replacement by a non-conforming component. In the ISA Team evaluation of the design, materials, and operating environment, no inherent paths to spontaneous degradation or failure, e.g., mechanical wear resulting from long use, were identified. Further, these features are judged not subject to being "degraded without a justifying safety review" *(NUREG-1520)*. Once installation has been properly verified, they require no plant-applied management measure (e.g., a PM/IRM) to ensure continued availability, and they cannot be easily defeated by accidental action of operating personnel. The safety-significant aspects of the design are based on physical laws, e.g., the mechanical strength of the material. They are therefore designated "design features" and not IROFS.

Details of the mechanical design, and supporting calculations, are available for inspection on site.

4. Accident sequence 186-91 in the ISA Summary describes a failure of a pressurized process line due to impact, such as mobile equipment. The ISA Team rendered the initiating event as not credible, or at least "highly unlikely," due to multiple design features, such as pipe routing, hoods, and barriers, installed such that they prevent significant impact by mobile equipment. These design features appear to serve a

safety function. However, the ISA Team concluded that IROFS were not required. Consistent with 10 CFR 70.61(e), 70.62, and 70.65(b)(6), identify the IROFS and associated management measures for this accident sequence. Alternatively, justify why IROFS are not required.

AREVA Response:

The subject design features and attributes are not designated as IROFS.

All high-pressure pipe is routed inside of hoods. The only failure mechanism identified by the ISA Team for the designated design features is loss of configuration control, e.g., inadvertent deletion or replacement by non-conforming components. In the ISA Team evaluation of the design, materials, and operating environment, no inherent paths to spontaneous degradation or failure, e.g., mechanical wear resulting from long use, were identified. Further, these features are judged not subject to being "degraded without a justifying safety review" *(NUREG-1520)*. Once installation has been properly verified, they require no plant-applied management measure (e.g., a PM/IRM) to ensure continued availability, and they cannot be easily defeated by accidental action of operating personnel. The safety-significant aspects of the design are based on physical laws, e.g., physical shape and mechanical strength of the materials. They are therefore designated "design features" and not IROFS.

Details of the mechanical design, installation, and supporting calculations, are available for inspection on site.

5. Accident sequence 186-94 in the ISA Summary describes a failure of the TBP/CO_2 Holding Tank. The ISA Team rendered the initiating event as not credible, or at least "highly unlikely," due to construction and periodic inspection in accordance with the ASME Code, Section VIII, Division 1. This requires initial and subsequent inspections by inspectors qualified by the ASME. During the December 2008 site visit, AREVA stated that an inspector from the State of Washington would fulfill this role, and periodic inspections would occur biannually. AREVA also stated visual inspection by the operators for wear would be part of AREVA's operating procedures. These elements appear to serve a safety function. However, the ISA Team concluded that IROFS were not required. An ASME Form U1A ("Manufacturer's Data Report For Pressure Vessels") was also reviewed during the site visit for one of the pressure vessels, and it did not indicate any allowance for corrosion, thus highlighting the need for inspections. Consistent with 10 CFR 70.61(e), 70.62, and 70.65(b)(6), identify the IROFS and associated management measures for this accident sequence. Alternatively, justify why IROFS are not required.

AREVA Response:

A typical quote from the accident sequence notes dealing with catastrophic failure of pressure vessels and/or piping is ***"Construction and*** periodic inspection to applicable codes is judged by the ISA Team to make the initiating event at least highly unlikely" (emphasis added). Initial construction is judged the crucial factor. A similar comment applies to welded piping construction, which is accepted as being more reliable than threaded pipe. AREVA Richland does not take the position that the state-mandated inspections are necessary to make the subject accidents "highly unlikely", but instead, that they "serve as features that enhance safety" *(10 CFR 70.64)*.

The subject items are composed of ductile materials, i.e., the pressure vessels and ancillary devices such as connecting tubing and fittings. These are not designated as IROFS, but the described safety-critical attribute, ductility, exists within the boundary of these items, just as such attributes might exist within the boundary of an IROFS. The attribute of ductility is a design feature of these items, and its effectiveness as a defense against catastrophic failure is based on the metallurgical structure of ductile materials and the fact that their characteristic failure mode is one of gradual displacement under load, rather than the instantaneous displacement characteristic of brittle materials such as ceramics.

The only failure mechanism identified by the ISA Team for the designated attribute of ductility is loss of configuration control, e.g., unauthorized replacement by a brittle component. During the engineering evaluation of the materials and their operating environment, no inherent paths to spontaneous degradation or failure, e.g., stress corrosion or embrittlement, were identified. Further, this attribute is judged not subject to being "degraded without a justifying safety review" *(NUREG-1520)*. Once installation has been properly verified, this attribute requires no plant-applied management measure (e.g., a PM/IRM) to ensure its continued availability, and it cannot be easily defeated by accidental action of operating personnel. This attribute is based on physical laws: the metallurgical structure of the material. It is therefore designated a "design feature" and not an IROFS.

AREVA Richland applies management measures, as needed, to such safety-critical attributes, but also notes that the application of management measures construction to code is considered a management measure verified, but not directly applied, by AREVA Richland. A similar comment may be applied to the state-mandated periodic pressure vessel inspection.

Materials of construction are judged compatible with the working fluids and significant corrosion is not anticipated over the life of the facility; therefore, a corrosion allowance is judged superfluous to an item not designated an IROFS. Initial construction and verification of Supporting documentation is available for inspection on site. Visual inspection for wear is not required for the subject vessel, as the ISA Team identified no mechanism for mechanical wear. The only pressure vessels in the subject system that might be subject to mechanical wear are the extractor vessels which are discussed under question 3 above.

6. Accident sequence 186-98 in the ISA Summary describes a failure of the TBP/CO_2 Separator Tank (V-71). The ISA Team concluded that this accident sequence is categorized as "C" for its chemical consequences, and "B" for its radiological consequences. The ISA Team concluded that this sequence has consequences similar to a single process line break inside a hood. Accident sequence 186-88 represents such scenario and has consequence categories of "E" for both chemical and radiological exposures. Consistent with 10 CFR 70.9, 70.61(b), 70.62, 70.65(b)(6):

   a) Justify the apparent inconsistency between these two accident sequences, given the fact that they have similar consequences. Describe any IROFS or management measures that may be required for accident sequence 186-98 as a result of this apparent inconsistency. Alternatively, justify why IROFS are not required.

   b) Sheet 2 of the process flow sheet shows that the TBP/CO_2 Separator Tank (V-71) has a rupture disk (RD-711). This disk seems to perform a safety function for

this accident sequence (i.e., relieve overpressure so that a catastrophic vessel failure cannot occur). Clarify if this rupture disk is an IROFS. Alternatively, justify why this rupture disk should not be designated as an IROFS.

AREVA Response:

The apparent inconsistency in consequence categories for Accident Sequence 186-88 and 186-98 is due to the fact that the higher consequences could result from a pipe break outside of a hood, which is the worst-case situation dealt with in Accident Sequence 186-88. A single process line break inside a hood, as dealt with in Accident Sequence 186-98, is judged to have a lower consequence. Also note: In the original submittal, the system design called for some pipe outside a hood. This was later changed, and now all high-pressure pipe is routed within a hood. Accident Sequence 186-88 is no longer valid.
Detailed consequence calculations are available for inspection on site in the referenced documents.

AREVA Richland does not take the position that the referenced rupture disk is necessary to make the subject accident "highly unlikely", but instead, that it "serves as a feature that enhances safety" *(10 CFR 70.64)*. This device is therefore not designated as an IROFS.

7. Accident sequence 186-102 in the ISA Summary describes the mechanical failure of the Tri-butyl Phosphate (TBP) Acidification Column (V-80). The ISA Team rendered the initiating event as not credible, or at least "highly unlikely," due to construction and periodic inspection in accordance with the ASME Code, Section VIII, Division 1. These elements appear to serve a safety function. However, the ISA Team concluded that IROFS were not required. Consistent with 10 CFR 70.61(e), 70.62, and 70.65(b)(6):

   a) Identify the IROFS and associated management measures for this accident sequence. Alternatively, justify why IROFS are not required.

   b) Sheet 4 of the process flow sheet shows that the TBP Acidification Column (V-80) has a rupture disk (RD-801). This disk seems to perform a safety function for this accident sequence (i.e., relieve overpressure so that a catastrophic vessel failure cannot occur). Clarify if this rupture disk is an IROFS. Alternatively, justify why this rupture disk should not be designated as an IROFS.

AREVA Response:

AREVA Richland does not take the position that the referenced rupture disk is necessary to make the subject accidents "highly unlikely", but instead, that it "serves as a feature that enhances safety" *(10 CFR 70.64)*. This device is therefore not designated as an IROFS.

A typical quote from the accident sequence notes dealing with catastrophic failure of pressure vessels and/or piping is ***"Construction and*** periodic inspection to applicable codes is judged by the ISA Team to make the initiating event at least highly unlikely" (emphasis added). Initial construction is judged the crucial factor. A similar comment applies to welded piping construction, which is accepted as being more reliable than threaded pipe. AREVA Richland does not take the position that the state-mandated inspections are necessary to make the subject accidents "highly unlikely", but instead, that they "serve as features that enhance safety" *(10 CFR 70.64)*. Also, the "notes" are not lists of IROFS nor of management measures, but instead serve as

historical, supporting information and help to show the thought processes of the ISA Team.

The subject items are composed of ductile materials, i.e., the pressure vessels and ancillary devices such as connecting tubing and fittings. These are not designated as IROFS, but the described safety-critical attribute, ductility, exists within the boundary of these items, just as such attributes might exist within the boundary of an IROFS. The attribute of ductility is a design feature of these items, and its effectiveness as a defense against catastrophic failure is based on the metallurgical structure of ductile materials and the fact that their characteristic failure mode is one of gradual displacement under load, rather than the instantaneous displacement characteristic of brittle materials such as ceramics.

The only failure mechanism identified by the ISA Team for the designated attribute of ductility is loss of configuration control, e.g., unauthorized replacement by a brittle component. During the engineering evaluation of the materials and their operating environment, no inherent paths to spontaneous degradation or failure, e.g., stress corrosion or embrittlement, were identified. Further, this attribute is judged not subject to being "degraded without a justifying safety review" *(NUREG-1520)*. Once installation has been properly verified, this attribute requires no plant-applied management measure (e.g., a PM/IRM) to ensure its continued availability, and it cannot be easily defeated by accidental action of operating personnel. This attribute is based on physical laws: the metallurgical structure of the material. It is therefore designated a "design feature" and not an IROFS.

AREVA Richland applies management measures, as needed, to such safety-critical attributes, but also notes that the application of management measures to an item does not require that the item be designated an IROFS. Initial construction and verification of construction to code is considered a management measure verified, but not directly applied, by AREVA Richland. A similar comment may be applied to the state-mandated periodic pressure vessel inspection.

8. Accident sequence 186-119 in the ISA Summary describes the mechanical failure of Scrub Column (V90). The ISA Team rendered the initiating event as not credible, or at least "highly unlikely," due to construction and periodic inspection in accordance with the ASME Code, Section VIII, Division 1. These elements appear to serve a safety function. However, the ISA Team concluded that IROFS were not required. Consistent with 10 CFR 70.61(e), 70.62, and 70.65(b)(6):

   a) Identify the IROFS and associated management measures for this accident sequence. Alternatively, justify why IROFS are not required.

   b) Sheet 4 of the process flow sheet shows that the Scrub Column (V-90) has a rupture disk (RD-901). This disk seems to perform a safety function for this accident sequence (i.e., relieve overpressure so that a catastrophic vessel failure cannot occur). Clarify if this rupture disk is an IROFS. Alternatively, justify why this rupture disk should not be designated as an IROFS.

AREVA Response:

AREVA Richland does not take the position that the referenced rupture disk is necessary to make the subject accident "highly unlikely", but instead, that it "serves as a feature that enhances safety" *(10 CFR 70.64)*. This device is therefore not designated as an IROFS.

A typical quote from the accident sequence notes dealing with catastrophic failure of pressure vessels and/or piping is ***"Construction and*** periodic inspection to applicable codes is judged by the ISA Team to make the initiating event at least highly unlikely" (emphasis added). Initial construction is judged the crucial factor. A similar comment applies to welded piping construction, which is accepted as being more reliable than threaded pipe. AREVA Richland does not take the position that the state-mandated inspections are necessary to make the subject accidents "highly unlikely", but instead, that they "serve as features that enhance safety" *(10 CFR 70.64)*.

The subject items are composed of ductile materials, i.e., the pressure vessels and ancillary devices such as connecting tubing and fittings. These are not designated as IROFS, but the described safety-critical attribute, ductility, exists within the boundary of these items, just as such attributes might exist within the boundary of an IROFS. The attribute of ductility is a design feature of these items, and its effectiveness as a defense against catastrophic failure is based on the metallurgical structure of ductile materials and the fact that their characteristic failure mode is one of gradual displacement under load, rather than the instantaneous displacement characteristic of brittle materials such as ceramics.

The only failure mechanism identified by the ISA Team for the designated attribute of ductility is loss of configuration control, e.g., unauthorized replacement by a brittle component. During the engineering evaluation of the materials and their operating environment, no inherent paths to spontaneous degradation or failure, e.g., stress corrosion or embrittlement, were identified. Further, this attribute is judged not subject to being "degraded without a justifying safety review" *(NUREG-1520)*. Once installation has been properly verified, this attribute requires no plant-applied management measure (e.g., a PM/IRM) to ensure its continued availability, and it cannot be easily defeated by accidental action of operating personnel. This attribute is based on physical laws: the metallurgical structure of the material. It is therefore designated a "design feature" and not an IROFS.

9. Accident sequence 186-127 describes the mechanical failure of the UNH Stripper Column (V100). The ISA Team rendered the initiating event as not credible, or at least "highly unlikely," due to construction and periodic inspection in accordance with the ASME Code, Section VIII, Division 1. These elements appear to serve a safety function. However, the ISA Team concluded that IROFS were not required. Consistent with 10 CFR 70.61(e), 70.62, and 70.65(b)(6):

    a) Identify the IROFS and associated management measures for this accident sequence. Alternatively, justify why IROFS are not required.

    b) Sheet 4 of the process flow sheet shows that the UNH Stripper Column (V100) has a rupture disk (RD-1001). This disk seems to perform a safety function for this accident sequence (i.e., relieve overpressure so that a catastrophic vessel failure cannot occur). Clarify if this rupture disk is an IROFS. Alternatively, justify why this rupture disk should not be designated as an IROFS.

AREVA Response:

AREVA Richland does not take the position that the referenced rupture disk is necessary to make the subject accident "highly unlikely", but instead, that it "serves as a feature that enhances safety" *(10 CFR 70.64)*. This device is therefore not designated as an IROFS.

A typical quote from the accident sequence notes dealing with catastrophic failure of pressure vessels and/or piping is ***"Construction and*** periodic inspection to applicable codes is judged by the ISA Team to make the initiating event at least highly unlikely" (emphasis added). Initial construction is judged the crucial factor. A similar comment applies to welded piping construction, which is accepted as being more reliable than threaded pipe. AREVA Richland does not take the position that the state-mandated inspections are necessary to make the subject accidents "highly unlikely", but instead, that they "serve as features that enhance safety" *(10 CFR 70.64)*. Also, the "notes" are not lists of IROFS nor of management measures, but instead serve as historical, supporting information and help to show the thought processes of the ISA Team.

The subject items are composed of ductile materials, i.e., the pressure vessels and ancillary devices such as connecting tubing and fittings. These are not designated as IROFS, but the described safety-critical attribute, ductility, exists within the boundary of these items, just as such attributes might exist within the boundary of an IROFS. The attribute of ductility is a design feature of these items, and its effectiveness as a defense against catastrophic failure is based on the metallurgical structure of ductile materials and the fact that their characteristic failure mode is one of gradual displacement under load, rather than the instantaneous displacement characteristic of brittle materials such as ceramics.

The only failure mechanism identified by the ISA Team for the designated attribute of ductility is loss of configuration control, e.g., unauthorized replacement by a brittle component. During the engineering evaluation of the materials and their operating environment, no inherent paths to spontaneous degradation or failure, e.g., stress corrosion or embrittlement, were identified. Further, this attribute is judged not subject to being "degraded without a justifying safety review" *(NUREG-1520)*. Once installation has been properly verified, this attribute requires no plant-applied management measure (e.g., a PM/IRM) to ensure its continued availability, and it cannot be easily defeated by accidental action of operating personnel. This attribute is based on physical laws: the metallurgical structure of the material. It is therefore designated a "design feature" and not an IROFS.

10. During the December 2008 site visit, AREVA stated that visual inspections would be conducted every time an extractor vessel was opened to identify any signs of degradation. These activities would be included in AREVA's operating procedures. The license amendment application only discusses inspection activities that are required to assure conformance with the applicable codes and standards. It does not describe any inspection activities conducted by AREVA on the extractor vessels, or other vessels, equipment and piping used in the proposed process, that are not related to any code compliance. An ASME Form U1A ("Manufacturer's Data Report For Pressure Vessels") was also reviewed during the site visit for one of the pressure vessels, and it did not indicate any allowance for corrosion, thus highlighting the need for inspections. Consistent with 10 CFR 70.62, describe the inspection activities that AREVA will conduct on the vessels, equipment and piping used in the proposed process, in addition to those inspections required to assure conformance with the applicable codes and standards. Identify which of these inspections or types of inspections are performed on or otherwise support IROFS.

AREVA Response:

The extractor vessel caps will be visually inspected each time the caps are removed from the vessel for wear and deterioration, however these inspections are not required to prevent high or intermediate consequences. Special emphasis will be given to the seals which seal the cap to the

vessel wall and the inside of the ash baskets. Any deterioration in the physical condition of the caps, which are fabricated from the same material (316L SS) as the extractor vessels and separations columns, will be an indication of potential deterioration of the process vessels and will initiate further inspection of the vessels themselves. In addition, the ash baskets will be periodically inspected periodically for wear and corrosion. Because the baskets are also fabricated from the same material (316L SS) as the extractor vessels and separations columns and are subjected to the same conditions as the vessels, any deterioration in the physical condition of the baskets will be an indication of the potential problems with the process vessels. If deterioration of the baskets is noted then further inspections of the process vessels will be initiated.

D) Management Measures

Section 9.1 of the license amendment application describes the quality standards and records. This section does not clearly explain if AREVA will implement its quality assurance program consistent with Section 8.8 of its ISA Summary. Consistent with 10 70.4 and 70.62, revise the license amendment application to clarify how AREVA will implement its quality assurance program.

AREVA Response:

The license amendment application is to add a new process to the activities authorized by license SNM-1227. All of the quality assurance program requirements of this existing license will be applied to this new installation. AREVA believes that it is unnecessary to change the amendment application as it has not requested any exemptions from the existing license requirements.

E) Emergency Preparedness

1. In its license amendment application, AREVA states that the current version of the emergency plan has been deemed sufficient to support the proposed CO_2 process. Consistent with 10 CFR 70.22 (i)(1)(ii) and 70.32(i), justify the rationale to reach such conclusion. In addition, describe if any revisions to the following sections of the emergency plan are necessary, or why such revisions are not required to support the proposed process:

   a) Description of the UO2 building in Section 1.2.2.3, which currently does not have information regarding the proposed CO2 process.

   b) Section 1, Table 2, which currently does not have information regarding tri-butyl phosphate.

   c) Description of the "Onsite Monitoring Equipment" in Section 6.4.1, and whether any new instrumentation will be identified to support the proposed CO2 process.

   d) Section 7.1, which currently does not describe if the CO_2 process will affect any existing Emergency Plan Implementing Procedures.

AREVA Response:

Item a) is descriptive material that does not impact the effectiveness of the plan. In fact we have numerous processes that are not specifically listed in this description. This portion of the plan

will be reviewed and updated as appropriate within a few months of the start up of this SSCO2 process. The absence of this descriptive material does not impact the effectiveness of the current plan.

Item b) It is true that we don't have TBP on this table. The inventory level is currently small enough and will remain small enough to have minimal impact for any type of emergency response.

Item c) Radiation monitoring is adequately covered in the existing EP description. Process monitoring will be provided. Section 6.4.1.2 of the EP will be reviewed and updated as appropriate within a few month of the start-up of the SSCO2 Process. The absence of this descriptive material does not impact the effectiveness of the current plan.

Item d) This specific item will be addressed by the EP coordinator as the system nears start-up. This is the type of item AREVA would normally expect the NRC to review during an on-site readiness review.