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AIRBORNE EXPRESS

21G-03-0039
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ACF-03-0045

February 10, 2003

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

References:
1) Docket No. 70-143; SNM License 124
2) Letter from B.M. Moore to NRC, Revised Integrated Safety Analysis Summary for Uranyl Nitrate Building, dated August 23, 2002 (21G-02-0268)
3) Letter from NRC to B. M. Moore, Nuclear Fuel Services, Inc., (TAC NO. L31688) Request for Additional Information Related to Nuclear Criticality Safety Evaluation and ISA Summary for Uranyl Nitrate Building, dated January 10, 2003

Subject: Reply to Request for Additional Information Concerning Nuclear Criticality Safety Evaluation and Integrated Safety Analysis Summary for the Uranyl Nitrate Building

Dear Sir:

Nuclear Fuel Services, Inc. (NFS) hereby submits its reply to the subject Request for Additional Information (RAI), to support NRC approval of the license amendment application for the Uranyl Nitrate Building.

Based upon the discussions and understanding reached at the NFS/NRC meetings on December 18 and 19, 2002 and February 4, 2003 and the conference call of February 6, 2003, NFS is submitting its 17 responses to the referenced RAI questions/comments. In regard to the NFS response to RAI question No. 1, NFS is prepared to conduct further discussions as may be necessary to resolve any differences as to the proper approach to the matter. NFS remains willing to have further discussions as may be necessary to resolve all matters.

NMSS01

If you or your staff have any questions, require additional information, or wish to discuss this, please contact me, or Mr. Rik Droke, Licensing and Compliance Director at (423) 743-1741. Please reference our unique document identification number (21G-03-0039) in any correspondence concerning this letter.

Sincerely,

NUCLEAR FUEL SERVICES, INC.

B. Marie Moore

B. Marie Moore
Vice President
Safety and Regulatory

Attachment

JSK/lsn

cc:
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Mr. Dan Rich
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ATTACHMENT

NFS Reply to NRC Request for Additional Information Concerning Nuclear Criticality Safety Evaluation and Integrated Safety Analysis Summary for the Uranyl Nitrate Building

(23 Pages to follow)

Nuclear Fuel Services (NFS) Response to Nuclear Regulatory Commission (NRC) Request for Additional Information Regarding Blended Low-Enriched Uranium Project Uranyl Nitrate Building Revised Integrated Safety Analysis Summary (Letter dated January 10, 2003 TAC No. L31688)

NRC:

1. **Revise the definitions of "highly unlikely" and "unlikely" to meet the acceptance criteria of Standard Review Plan (SRP) NUREG-1520, to which NFS committed in their ISA plan.**

   NFS's response, dated December 23, 2002, to item 2.2 of NRC's request for additional information does not justify NFS's definitions for highly unlikely and unlikely. Part of NFS's justification is provided in their response to item 2.1 and states that the definitions of highly unlikely and unlikely were shifted one order of magnitude due to the "conservative" IROFS failure indices used by NFS. The SRP gives a range of failure indices for different types of IROFS. This is because for a given type of IROFS there can be a wide range of failure frequencies. NFS chose to use the most conservative value for the failure indices (instead of providing justification for using the less conservative value) and then NFS shifted the definitions of highly unlikely and unlikely in a less conservative direction than given in the SRP. However, when a range is given for failure indices, the most conservative value should be used UNLESS otherwise justified which has not been done in this case. Using the more conservative failure indices does not justify the use of a less conservative value for the definitions of highly unlikely and unlikely especially given the uncertainties present in the overall analysis.

   Revision of the definitions of highly unlikely and unlikely is necessary to ensure that the likelihood of a criticality is sufficiently low given the potential consequences, that the performance requirements of 10 CFR 70.61 are not exceeded, and that the goal of no inadvertent nuclear criticality accidents is met.

NFS RESPONSE:

The manner in which the terms "Unlikely" and "Highly Unlikely" are defined in the ISA Summary is fully compliant with the regulatory requirements specified in Title 10 Code of Federal Regulations (CFR), Part 70, Subpart H.

For purposes of nuclear criticality safety, the failure index for "unlikely" will be properly justified based on the margin of safety. The controls will also be justified as being independent to establish double contingency as being "highly unlikely." Sufficient justification will be provided (in the NCSE and/or the ISA Summary) to demonstrate that the likelihood of a criticality is sufficiently low. It should also be noted that safety primarily relies on the detailed ISA/NCSE performed by qualified NCS personnel knowledgeable about the facility's details rather than on a generalized risk scheme.

During the rulemaking process, the NRC acknowledged[1] it was impractical to generically define the terms "Unlikely" and "Highly Unlikely" because Part 70 applies to different types of fuel cycle facilities. Accordingly, the application of the terms in the rule [10 CFR 70, Subpart H] will be necessarily specific to the individual context in which they are applied. The NRC also noted that general guidance on the application of the terms "Unlikely" and "Highly Unlikely" would be provided to aid in the implementation of this provision to the rule.

10 CFR70.65 (9) specifies that the licensee provide, "a description of the definitions of unlikely, highly unlikely and credible as used in the integrated safety analysis." NFS stated in the ISA plan submittal that these definitions would be provided in the ISA Summary and that the Standard Review Plan (SRP) would be used as the guidance document. The SRP is an NRC guidance document that presents an adequate method to meet the requirements specified in the rule. Page iii of the SRP states, "The SRP is not a substitute for NRC regulations and compliance is not required." NFS has, however, relied on the SRP for guidance in ISA program development. Page 3.23 of Chapter 3 of the SRP specifies that, "Qualitative methods require qualitative definitions." As such, qualitative failure indices are assigned based on an adaptation of the qualitative probability index numbers in Table A-10 (Chapter 3, Appendix A of the SRP). These definitions are provided in Section 9 of the UNB ISA Summary. NFS has incorporated the qualitative criteria from the SRP into qualitative criteria for the ISA program.

The NFS utilized failure probability indices for IROFS are based on the SRP (Refer to Chapter 3, Appendix A, Table A-10). The failure probability indices in the SRP, used to establish the highly unlikely definition, are described as ranges (spread over two orders of magnitude). As shown in Table 1 below, the chosen probability indices are conservative in that the least negative indices are applied. As a result, the definition of highly unlikely corresponds to a –4 highly unlikely index using the most conservative (least negative) failure probability index values. If the least conservative (most negative) failure probability index values were chosen along with an index of –5 to define highly unlikely, the same safety envelope would be established. Therefore, it is appropriate to use failure probability indices within the defined highly unlikely range (i.e., –4 or –5). It would not be appropriate to use the most conservative (least negative) failure probability indices in addition to a highly unlikely value of –5 because it is contradictory to the range that defines highly unlikely. It is also inappropriate to choose the least conservative (most negative) failure probability index values with a highly unlikely definition of –4. In addition, Table A-9 (Chapter 3, Appendix A of the SRP) defines failure frequency index values based on types of IROFS and there is no –5 index in this table.

The establishment of these indices is essential to the uniform application of likelihood. The basic premise is to establish a consistent qualitative safety envelope for application

[1] See NRC Reply to Comment E.5 in *Domestic Licensing of Special Nuclear Material; Possession of a Critical Mass of Special Nuclear Material*, Federal Register, Volume 65, No. 181, pp. 56219.

and review, while at the same time ensuring the performance requirements are met. Page 3-25 of Chapter 3 of the SRP states, "consistency means the degree to which the same results are obtained when the method is applied by different analysts. This is important to maintain an adequate standard of safety because ISAs of future facility modifications may be performed by individuals not involved in conducting the initial ISA." In addition, page 3-24 of Chapter 3 of the SRP states, "If the applicant's definitions are qualitative, they are acceptable if they meet the following criteria: a) are reasonably clear and based on objective criteria, b) can reasonably be expected to consistently distinguish accidents that are highly unlikely from those that are merely unlikely." The supplied definitions meet these criteria.

During the development of NFS' risk index approach, NFS reviewed the risk index methodologies for other fuel cycle facilities with similar complexities. The manner in which NFS adopted use of the terms and methodologies is fully consistent with the regulatory approach used by those other fuel cycle facilities. NFS chose to follow the approach taken by those facilities primarily because the NRC had approved the methodology. Most notable are the qualitative methods for process operations involving the storage and downblending of High-Enriched Uranium that were approved by the NRC[2,3] under 10 CFR 70, Subpart H requirements based on an approved ISA Plan[4] (refer to Exhibit I attached to this response). In addition, these qualitative methods have also been approved (by the NRC) for future applications at other fuel cycle facilities[5] (refer to Exhibit II attached to this response). Since the NRC's approval of Reference 5 occurred after the final form of the SRP (issued on March 20, 2002), NFS believes that this approach is acceptable.

Therefore, the manner in which the terms "Unlikely" and "Highly Unlikely" are derived, are conservative and meet the intent of the rule and the SRP and revision to the definitions is not necessary. For purposes of nuclear criticality safety, sufficient justification will be provided (in the NCSE and/or the ISA Summary) to demonstrate that the likelihood of a criticality is sufficiently low. In addition, prior NRC approval of this approach for other NRC licensees supports the use of NFS' risk indexing approach as well as the selection of the -4 highly unlikely index.

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[2] Letter from NRC to A. F. Olsen, BWXT Amendment 82 (TAC NO. L31492) Application Dated March 22, 2001, Vault 7 Storage Facility and Supplement dated August 14, 2001, dated October 5, 2001.

[3] Letter from NRC to A. F. Olsen, BWXT Amendment 85 (TAC NO. L31534) Application Dated December 18, 2001, Metal Dissolution Facility, dated January 30, 2002.

[4] Letter from NRC to A. F. Olsen, BWXT Amendment 74 (TAC NO. L31493) Submittal Dated June 4, 2001, Integrated Safety Analysis Plan (ISAP), dated July 10, 2001

[5] Letter from NRC to N. B. Parr, Westinghouse Electric Company, LLC, Amendment 33 (TAC NO. L31601) Approval of Integrated Safety Analysis Plan Approach, page 7, dated August 8, 2002.

Table 1

Table A-10 of SRP	Type of IROFS	Table 4 of NFS' ISA Summary	NFS IROFS Failure Index
–6			
–4 or –5	Exceptionally robust passive engineered IROFS (PEC), or an inherently safe process, or two redundant IROFS, more robust than simple admin. IROFS (AEC, PEC, or enhanced admin.) robust	–4	Protected by an exceptionally robust passive engineered control (PEC). Exceptionally Robust Management Measures to ensure availability
–3 or –4	A single passive engineered IROFS (PEC) or an active engineered IROFS (AEC) with high availability	–3	Protected by an inspected single PEC or exceptionally robust AEC with a trained operator backup. Adequate management measures to ensure availability
–2 or –3	A single active engineered IROFS, or an enhanced admin, IROFS, or an admin. IROFS for routine planned operations	–2	Protected by a single functionally tested AEC. Protected by a trained operator performing a routine task with an approved procedure, an enhanced administrative control, or an administrative control with large margin. Adequate Management Measures to ensure availability.
–1 or –2	An admin. IROFS that must be performed in response to a rare unplanned demand	–1	Protected by a single administrative control or a trained operator performing a non-routine task with an approved procedure.
		0	No protection

NRC:

2. For the scenario descriptions provide justification in the ISA Summary as to why each scenario is deemed highly unlikely, unlikely, etc. and how it meets the double contingency principle.

In many of the scenario descriptions, a statement is made that a scenario is highly unlikely without adequate justification. For example, in Scenario 1.26.3 there is not adequate justification that contingency number one is unlikely. In general, a failure of a single administrative control does not constitute a contingency and may not be unlikely. Generally some type of independent verification or a large safety margin is required when relying on a single administrative control to make a contingency unlikely.

This information is required to determine if the likelihood of the scenarios are sufficiently low to meet the performance requirements of 10 CFR 70.61 and to ensure it meets the double contingency principle of 10 CFR Part 70.

NFS RESPONSE:

The NCSE will be revised to provide additional justification for each scenario description that explicitly states that each scenario is highly unlikely or unlikely and that it further meets the double contingency principle. This level of detail will be provided in the NCSE as opposed to the ISA summary. The revised NCSE will be provided to the NRC upon request.

NRC:

3. For Scenarios 1.251, 1.38.1, 1.54.1, 1.55.1, 1.59.1, 1.61.1, and 1.62.1 provide justification for the assumption that IROFS UNB-E and UNB-F can handle the maximum flow rate. Provide this flow rate. Can the maximum flow to TK-10 exceed the maximum flow of these IROFS? This information is also required to justify the conclusion that cases 5, 9, 10, 11, 12, 13 and 14 in the NCSE meet the double contingency principle.

For defense in depth the above listed cases state that this ductwork is inspected each time a HEPA filter is changed and in addition that the drains are inspected. Provide the frequency of the filter changeouts and drain inspections and why they can be relied upon.

This information is required to determine if these IROFS are sufficient to perform their intended function for all credible flow rates such that the postulated accident scenario will be highly unlikely and meet the performance requirements of 10 CFR 70.61.

NFS RESPONSE:

Engineering evaluation demonstrates that IROFS [redacted] and [redacted] can handle the maximum flowrate from TK-10. The maximum flowrate from TK-10 into the vent line leading to the HVAC exhaust duct is 65 gpm (assuming all high level interlocks fail). The 65 gpm maximum flowrate was calculated based on the hydraulic performance of the UNB pumps and the fluid dynamics of the related piping systems used for transfer of UN solutions in the UNB. The vent line drain could in fact handle at least 130 gpm without allowing liquid into the HVAC duct, which is far beyond the capability of the pumps in the UNB. The TK-10 vent line enters the side of a vertical 20" circular duct, which rises 9 feet before running horizontally to the HEPA filter housing. The open lower end of this duct forms drain UNB-F. There is no credible scenario in which more liquid than a mist or droplets could be carried into the horizontal ductwork leading to the HEPA filter. The facility configuration control program will ensure that the flowrate and configuration will not change. Therefore, both of these passive control IROFS are extremely reliable and unlikely to fail.

Furthermore, HEPA filters and ductwork will be inspected on an annual basis and changed out based on pressure differential values. Periodic inspections will identify potential holdup with continued inspection frequencies determined based on findings. These activities will be conducted in accordance with written approved procedures. These additional details will be incorporated into the revised NCSE.

NRC:

4. **Define limiting condition of operation and show that this was the initial concentration used in the calculations for Scenarios 1.26.2 and 1.76.1 in the ISA summary and cases 6, 18 and 20 in the NCSE. If the criticality safety limit is actually the LCO rather than the routine operating limit, then this is the value that should be used for these calculations.**

   Also provide additional description of the sampling credited in contingency #2 in the NCSE. Describe how this will reduce the likelihood to unlikely since as discussed, it does not include dual independent sampling.

   This information is required to determine whether this control is adequate to meet the performance requirements of 10 CFR 70.61.

NFS RESPONSE:

The Limiting Condition of Operation (LCO) is defined as 231 g U/l in the NCSE (Reference Table 5). The calculations for scenarios 1.26.2 and 1.76.1 and Cases 6, 18 and 20 will be revised using the LCO limit. For scenarios 1.26.2 and 1.76.1, the duration using the LCO limit is 372 days. For Case 6, the duration using the LCO limit is 22.6 days. For Cases 18 and 20, the duration using the LCO limit remains unchanged. These revised calculations will be provided to the NRC upon request.

With regard to Case 6, contingency #2, the only potential source of spilled solution is from one or more of the large receipt/storage tanks or the shipping containers. Once the source of the spill is confined (i.e., from the receipt/storage tanks or the shipping containers), the solution will be sampled at multiple locations. Once the solution is confirmed to be acceptable, the solution can then be transferred back into the tanks.

NRC:

5. **For scenario 1.26.3 justify why the value specified at UNB-L was used. At what value can precipitation become a problem? How much can safely precipitate out and not be a criticality safety concern? For this case what would be the total change in value? Demonstrate why this value will ensure that a minimum critical mass will not precipitate out before this value is reached for all credible uranyl nitrate solutions in the UNB.**

This information is needed to ensure that the pH monitor and the limit chosen are adequate IROFS for this scenario and meet the performance requirements of 10 CFR 70.61.

NFS RESPONSE:

It should be noted that the pH monitor is located in the transfer line to TK-10. Therefore, it will prevent transfer of any basic precipitants from being transferred into TK-10 by shutting down a pump. The value of pH 9 was selected because it is above the normal solution transfer pH (UN has a pH around 1 and water has a pH of 6 to 8) and because material with a pH of 9 is not basic enough to precipitate uranium (pH 9 represents 0.00001 M hydroxyl ion concentration). [redacted] gallons of a sodium hydroxide or 32 million gallons of ammonium hydroxide solution at pH 9 is necessary to precipitate 36 kg of uranium (a subcritical mass) in an initial solution of 231 g U/l with no free acid (which is a minimum of 0.3M). The value of pH 9 will also detect and prevent the transfer of ammonium or sodium hydroxide solutions (ammonium hydroxide has a pH of 10.6-11.5 and sodium hydroxide has a pH of 12-14). Therefore, the value of pH 9 provides a large margin to prevent precipitation. At a pH of 10, [redacted] gallons of sodium hydroxide or 750 thousand gallons of ammonium hydroxide solution is necessary to precipitate 36 kg of uranium.

Precipitating agents will not be allowed in the UNB. There are no piping connections to a source of precipitant in the UNB. IROFS [redacted] and [redacted] also protect the storage tanks. These IROFS prevent backflow from [redacted] in the Oxide Conversion Building (OCB) that may contain precipitant. Configuration management will also be applied to the design to prevent unauthorized changes. In addition, operators will be trained to restrict precipitating agents from the UNB and there are no chemical additions associated with normal UNB operations. The procedural requirements that FRA/NFS rely on as IROFS have management measures applied to them as described in Section 4 of the ISA Summary to achieve the required level of risk reduction. Unique connectors are used to ensure that only the Liqui-Rad containers are connected to the storage tanks. This alone will restrict the entry of a precipitant into TK-10. The connection point of the flexible UNB transfer line leading to TK-10 is approximately 8' above ground level, making connection to a container of liquid at ground level impossible without reengineering. Configuration control requirements ensure that the system remains as designed to further guarantee the inability of a precipitant to enter the tanks.

A precipitation study (submitted to NRC during a previous licensing action) was performed by NFS in which uranium solutions ranging from 150 to 349 g U/l were precipitated with a peroxide solution to form a pure UO_4 precipitate (hydrogen peroxide precipitation forms this pure compound and water). This study concluded that the uranium concentration in the precipitate did not increase by more than 10%. The resultant precipitate concentrations were 164 and 323 g U/l, respectively. This precipitate is more reactive (higher k_{eff} as a function of the uranium concentration) than the precipitates obtained when using other precipitants such as sodium or ammonium hydroxide. Both sodium and ammonium hydroxide precipitants will precipitate sodium and ammonium nitrates in addition to the sodium or ammonium diuranate compounds. The diuranate compounds contain a lower percentage of uranium due to the presence of sodium and ammonia. Therefore, the precipitates obtained with the use of sodium or ammonium hydroxide will be less dense and contain less uranium than the pure UO_4 compound. The UO_4 precipitant obtained with the use of hydrogen peroxide is bounding of the precipitates obtained with either sodium or ammonium hydroxide. This study demonstrates that essentially the entire tank's contents can precipitate without leading to a criticality.

Calculations further suggest that 18 gallons of a 50% sodium hydroxide solution (pH = 14) is necessary to precipitate 36 kg U from a uranyl nitrate solution at 231 g U/l with no free acid. UNB operations do not use precipitants nor are precipitants directly piped to any UNB operations. Precipitants such as ammonium or sodium hydroxide solutions are the only precipitants remotely available to the UNB. Operators are trained to restrict the entry of basic solutions into the UNB and further prevent their entry into a tank within the UNB. The pH monitor with a set point of 9 will detect and prevent the entry of this precipitating agent into TK-10 from the sump basin. There are no means to add precipitants (or any other chemicals) directly into the storage tanks. Therefore, a large margin exists to preclude the entry of a precipitating agent into the UNB.

The precipitation study and the additional calculations indicate that a large margin exists relative to the precipitation of uranium in a storage tank. Based on the NFS precipitation study, an entire tank's contents can precipitate and remain subcritical. An operator, trained to exclude precipitating agents, will not bring 18 gallons of sodium hydroxide solution into the UNB and will not add the solution to a tank. Training, exclusion of precipitants, pH monitor with a set point of 9 and configuration control ensure that a precipitating agent will not be inadvertently added to TK-10 or any storage tank.

The above discussions will be included in the revised NCSE and the precipitation studies and calculations will be referenced.

NRC:

6. **Since concentration is a controlled parameter, justify why the density monitor in the recirculation system is not designated as IROFS. Since density is the controlled parameter, the density monitor should be an IROFS.**

This information is required to demonstrate compliance with the performance requirements 10 CFR 70.61 as items relied on for safety are to be designated as an IROFS.

NFS RESPONSE:

The density measurement in the recirculation piping will be designated as part of new IROFS UNB-S.

NRC:

7. **In the NCSE the term "failure limit" is used in Table 5 and appears to be where keff=1.0. However, in the NFS license, the term "failure limit" appears to be used to describe NFS's subcritical limit. Please clarify this discrepancy.**

This information is needed to ensure that the request is in agreement with the NFS license.

NFS RESPONSE:

The k_{eff} value reported as the "safety limit" in Table 5 of the NCSE is the "failure limit" as defined by the license. The NCSE will be revised to use limit descriptions that are consistent with the license.

NRC:

8. **Provide a table of operating control limits for enrichment that is similar to that for concentration (Table 5 of the NCSE). The NCSE only gives the operating limits for the parameter of concentration but enrichment is also a controlled parameter.**

This information is necessary to evaluate the limits for enrichment to ensure that these limits will maintain operations subcritical and to ensure that this operation meets the double contingency principle of 10 CFR Part 70.

NFS RESPONSE:

The enrichment is controlled to less than or equal to 5.0 wt%. Enrichment sensitivity calculations were performed at the request of the NRC during a site visit and were incorporated into Revision 1 of the NCSE. Enrichment is a controlled parameter; however, it is not controlled within a range of values similar to the uranium concentration. Therefore, it is not necessary to provide a table associated with enrichment ranges.

NRC:

9. **The criticality analysis in the NCSE assumes the failure of one tank at a time due to reliance on the isolation valves of the storage tanks. Explain how human error was considered here and provide further details on whether there are independent checks on the opening and closing of these valves. Also justify why these are not designated as IROFS.**

This information is required to demonstrate compliance with the performance requirements of 10 CFR 70.61 as items relied on for safety are to be designated as an IROFS.

NFS RESPONSE:

Multiple valve or tank failures will not lead to a criticality since spill geometries (including the spill basin/dike) are less reactive than tank geometries. Because these failures do not lead to a criticality, the respective components are not designated as criticality IROFS. Human errors were not factors in this criticality determination.

NRC:

10. For the NCSE, cases 3 and 7, (both address a criticality due to U precipitation) provide details on why contingency #1 is considered unlikely in both cases. As described this contingency consists of only a failure of a single administrative control (trained operator using a procedure) which may not constitute a contingency as described above in question number 2.

Also, in Case 7, contingency #2 does not justify the limit chosen. This information is needed for question 5 above.

This information is required to determine if this control is adequate to meet the performance requirements of 10 CFR 70.61 and to determine if this scenario meets the Double Contingency Principle of 10 CFR Part 70.

NFS RESPONSE:

It should be noted that the pH monitor is located in the transfer line to TK-10. Therefore, it will prevent transfer of any basic precipitants from being transferred into TK-10 by shutting down a pump. The value of pH 9 was selected because it is above the normal solution transfer pH (UN has a pH around 1 and water has a pH of 6 to 8) and because material with a pH of 9 is not basic [redacted] to precipitate uranium (pH 9 represents 0.00001 M hydroxyl ion concentration). [redacted] gallons of sodium hydroxide or 32 million gallons of ammonium hydroxide solution at pH 9 is necessary to precipitate 36 kg of uranium (a subcritical mass) in an initial solution of 231 g U/l with no free acid (which is a minimum of 0.3M). The value of pH 9 will detect and prevent the transfer of ammonium or sodium hydroxide solutions (ammonium hydroxide has a pH of 10.6-11.5 and sodium hydroxide has a pH of 12-14). Therefore the value of pH 9 provides a large margin to prevent precipitation. At a pH of 10, [redacted] gallons of a sodium hydroxide or 750 thousand gallons of ammonium hydroxide is necessary to precipitate 36 kg of uranium.

Precipitating agents will not be allowed in the UNB. There are no piping connections to a source of precipitant in the UNB. IROFS UNB-O and UNB-P also protect the storage tanks. These IROFS prevent backflow from tanks in the Oxide Conversion Building (OCB) that may contain precipitant. Configuration management will also be applied to the design to prevent unauthorized changes. In addition, operators will be trained to restrict precipitating agents from the UNB and there are no chemical additions associated with normal UNB operations. The procedural requirements that FRA/NFS rely on as IROFS have management measures applied to them as described in Section 4 of the ISA Summary to achieve the required level risk reduction. Unique connectors are used to ensure that only the Liqui-Rad containers are connected to the storage tanks. This alone will restrict the entry of a precipitant into TK-10. The connection point of the flexible UNB transfer line leading to TK-10 is approximately 8' above ground level, making connection to a container of liquid at ground level impossible without reengineering.

Configuration control requirements ensure that the system remains as designed to further guarantee the inability of a precipitant to enter the tanks.

A precipitation study (submitted to NRC during a previous licensing action) was performed by NFS in which uranium solutions ranging from 150 to 349 g U/l were precipitated with a peroxide solution to form a pure UO_4 precipitate (hydrogen peroxide precipitation forms this pure compound and water). This study concluded that the uranium concentration in the precipitate did not increase by more than 10%. The resultant precipitate concentrations were 164 and 323 g U/l, respectively. This precipitate is more reactive (higher k_{eff} as a function of the uranium concentration) than the precipitates obtained when using other precipitants such as sodium or ammonium hydroxide. Both sodium and ammonium hydroxide precipitants will precipitate sodium and ammonium nitrates in addition to the sodium or ammonium diuranate compounds. The diuranate compounds contain a lower percentage of uranium due to the presence of sodium and ammonia. Therefore, the precipitates obtained with the use of sodium or ammonium hydroxide will be less dense and contain less uranium than the pure UO_4 compound. The UO_4 precipitant obtained with the use of hydrogen peroxide is bounding of the precipitates obtained with either sodium or ammonium hydroxide. This study demonstrates that essentially the entire tank's contents can precipitate without leading to a criticality.

Calculations further suggest that 18 gallons of a 50% sodium hydroxide solution (pH = 14) is necessary to precipitate 36 kg U from a uranyl nitrate solution at 231 g U/l with no free acid. UNB operations do not use precipitants nor are precipitants directly piped to any UNB operations. Precipitants such as ammonium or sodium hydroxide solutions are the only precipitants remotely available to the UNB. Operators are trained to restrict the entry of basic solutions into the UNB and further prevent their entry into a tank within the UNB. The pH monitor with a set point of 9 will detect and prevent the entry of this precipitating agent into a tank from the sump basin by shutting down a pump. Therefore, a large margin exists to preclude the entry of a precipitating agent into the UNB.

The precipitation study and the additional calculations indicate that a large margin exists relative to the precipitation of uranium in a storage tank. Based on the NFS precipitation study, an entire tank's contents can precipitate and remain subcritical. An operator, trained to exclude precipitating agents, will not bring 18 gallons of sodium hydroxide solution into the UNB and will not add the solution to a tank. Training, exclusion of precipitants, pH monitor with a set point of 9 and configuration control ensure that a precipitating agent will not be inadvertently added to a storage tank.

The above discussions will be included in the revised NCSE and the precipitation studies and calculations will be referenced.

NRC:

11. **Cases 15, 16, and 19 in the NCSE rely on the tank being sealed. Provide the inspection frequency for the tanks and justify why this frequency is acceptable.**

This information is required to determine if this control is adequate such that it meets the performance requirements of 10 CFR Part 70.61.

NFS RESPONSE:

The tank manway consists of a thick reinforced material similar to the tank materials of construction. The manway is sealed with gasket and bolted (24 bolts) in place. The manway is provided in the unlikely event that the tank internals need to be accessed. Accessing the tank internals will be a controlled operation (e.g., work request, permits, etc.). The integrity of each tank seal is also monitored indirectly. The seal integrity on the tanks is verified by monitoring the vessel vent airflow in the control system, as described in the ISA Summary Table 9 description of UNB-I. Flowmeter FI-11V is part of this IROFS (enhanced administrative control). Routine facility inspections (Defense-in-Depth) conducted during the course of normal operations will also detect an open tank within the required 372-day duration necessary to concentrate the solution sufficiently to result in a criticality. Inspections will be conducted at least annually. Both the vent flowmeter and routine inspections will detect loss of the liquid seal in the common storage tank overflow line traps, which is the other route that tank sealing could be compromised.

NRC:

12. **For case 21 in the NCSE (U in ductwork from storage tank overflow), provide the flow rates to the tanks. Can the tank flow rates exceed the maximum drain flow rates? The description provided indicates that these may be different that those listed in question 3 above. Please state whether these are the same.**

This information is required to determine if these IROFS are sufficient to perform their intended function for all credible flow rates such that the postulated accident scenario will be highly unlikely and meet the performance requirements of 10 CFR 70.61.

NFS RESPONSE:

Engineering evaluation demonstrates that IROFS UNB-N and UNB-F can handle the maximum flowrate from a worst case tank overflow. For any of the storage tanks to overflow, all tank level controls would have to fail. The maximum flowrate into any of the storage tanks is 85 gpm. This then is the maximum flow into the 4" common overflow line, or if that were to somehow fail, into the vent line leading to the HVAC exhaust duct. The 85 gpm maximum flowrate was calculated based on the hydraulic performance of the UNB pumps and the fluid dynamics of the related piping systems used for transfer of UN solutions in the UNB. The storage tanks are equipped with 4" overflow lines that are designed to prevent liquid backing up into the vessel vent line at the top of the tank for the maximum credible flow of liquid into the tank (85 gpm). Designed for a very large margin of safety, the overflow could handle a flowrate up to 350 gpm without allowing liquid to backup into the vent line. The facility configuration control program will ensure that the pump and piping system will not change without appropriate review. The common storage tank vent line horizontally enters the same exhaust duct as the TK-10 vent, and therefore the tank overflow scenario shares IROFS UNB-F. Again, there is no credible scenario in which more liquid than a mist or droplets could be carried up more than 9' into the horizontal ductwork leading to the HEPA filter. The facility configuration control program will ensure that the flowrate and configuration will not change. Therefore, both of these passive control IROFS are extremely reliable and unlikely to fail.

NRC:

13. **For cases 24, 25, and 26, NFS is relying on actions by the shipper as a control. Provide further details on how the sampling is controlled at SRS such that the samples are representative of the material that arrives at NFS. Information is needed on how the tank at SRS is isolated, what parameters are controlled at SRS, what the tank limits are at SRS such that the material meets the shipping container limits and NFS limits, and how the sampling is done such that both samples are independent of each other, and the accuracy of the sampling. Explain how human error has been taken into the account during the sampling, the sample analysis, and the overcheck at NFS. Similar information is also required to justify the conclusion of cases 24, 25, and 26 in the NCSE.**

Provide details on how NFS will ensure that the Quality Assurance Process at SRS will ensure that the operation is not altered in a manner that is inconsistent with the details provided to the questions in the previous paragraph.

This information is necessary to determine if these controls are adequate such that they satisfy the performance requirements of 10 CFR 70.61 and that the double contingency principle of 10 CFR Part 70 is met.

NFS RESPONSE:

Solutions at the Savannah River Site (SRS) associated with the downblending process are tightly controlled. Once the high-enriched uranium-bearing solution (HEU) in the form of UN is prepared, it is transferred to an HEU Receipt Tank ([redacted]) and stored safely under concentration control. Natural uranium-bearing solution (NU) in the form of UNH is safely stored in NU Storage Tanks (5,458 gallons each). The HEU (in the HEU Receipt Tank) and NU (in the NU Storage Tanks) are sampled for ^{235}U enrichment and uranium concentration. A blend is then proposed such that the ^{235}U enrichment is between 4.91 and 4.98 wt.% and the uranium concentration is less than 110 g U/liter. Appropriate amounts of NU and HEU are then transferred to the LEU Blending Tank (15,333 gallons) to achieve the desired U-235 enrichment and uranium concentration (i.e., ^{235}U enrichment is between 4.91 and 4.98 wt.% and the uranium concentration is less than 110 g U/liter). A batch adjustment can be made as necessary to achieve these targets. Nominal batch sizes are [redacted]. Prior to transfer of the LEU from the LEU Blending Tank to the LEU Storage/Transfer Tank, the LEU Blending Tank is isolated. The level of solution in the LEU Blending Tank is monitored to verify that no inadvertent solution additions or reductions have occurred. The solution in the LEU Blending Tank is then recirculated and sampled for ^{235}U enrichment, uranium concentration, and density. The recirculation and sampling is accomplished by an operator in the field opening manual valves and by another operator in a control room using the DCS to operate isolation valves and pump actions. It is not possible to sample the incorrect tank because the correct valves must be opened in the field, in addition to the DCS-operated isolation valves and pump actions, before a sample can be obtained at the LEU Blending Tank sampling station. The ^{235}U enrichment and uranium concentration results are then verified to be within the desired specifications and the laboratory density results are then compared to the on-line density monitor to verify that no changes have occurred in the solution density. Once all measurements are verified to be within the desired specifications, the solution is transferred to the LEU Storage/Transfer Tank ([redacted]. The transfer is accomplished by an operator in the field opening manual valves and by another operator in a control room using the DCS to operate isolation valves and pump actions.

Once the solution is transferred to the LEU Storage/Transfer Tank, the tank is isolated. The level of solution in the LEU Storage/Transfer Tank is monitored to verify that no inadvertent solution additions or reductions have occurred. The solution in the LEU Storage/Transfer Tank is then recirculated and sampled every 15 minutes for ^{235}U enrichment, uranium concentration, and density until a total of five (5) samples are taken using the SRS independent sampling protocol (a "dummy" sample, "dual' samples, an NFS/Framatome sample, and a retainer sample). The NFS/Framatome sample is sent to the Framatome facility in Richland, Washington for independent analysis. The recirculation and sampling is accomplished by an operator in the field opening manual valves and by another operator in a control room using the DCS to operate isolation valves and pump actions. It is not possible to sample the incorrect tank because the correct valves must be opened in the field, in addition to the DCS-operated isolation valves and pump actions, before a sample can be obtained at the LEU Storage/Transfer Tank sampling station. The ^{235}U enrichment and uranium concentration results are then verified to be within the desired specifications and the laboratory density results are then compared to the on-line density monitor to verify that no changes have occurred in the solution density. The sample results are also compared to the results obtained from the LEU Blending Tank. Each dual sample is split and analyzed separately in conjunction with the assay of control standards. The analysis of each of the split dual samples must be in agreement and confirm that the blended solution is within the specification requirements. If the blend does not meet specification requirements it is rejected and returned for subsequent adjustment. Adjustment does not occur in LEU Storage/Transfer Tank. Once all measurements are verified to be within the desired specifications for both the shipping containers and shipment to NFS, the solution is transferred through the LEU Measuring Tank prior to being transferred into the LR-230 shipping containers (total of nine per flatbed truck and four flatbeds per batch). After the sample results are obtained from SRS and the Framatome facility in Richland, Washington and the results are determined to be acceptable, the material from the LR-230 shipping containers are transferred into TK-10 at NFS.

The blended solution is analyzed in separate vessels at different times using multiple samples. Samples are analyzed for ^{235}U enrichment and uranium concentration. These measurements are sufficiently accurate to ensure that the LR-230 transportation limits are not exceeded. The shipping container limits are less than or equal to 5 wt.% ^{235}U and 125 g U/l.

Human error was considered in the design and layout of the SRS process. Sampling occurs in separated vessels that are not commingled with each other or other vessels. Each vessel is appropriately labeled and has separate locked and labeled analysis collection stations located on a platform above each respective vessel. The use of multiple samples, both in time and space, with each dual sample being subsequently split for analysis in conjunction with control standards ensures that human error regarding the sampling, analysis and verification processes is minimized. Confirming agreement between the density analysis and on-line density assay systems further ensures that the correct tanks are sampled and that the uranium concentrations are also acceptable. The overcheck sample analyzed by NFS provides additional assurance that the blended solution is within NFS safety limits for storage in the UNB.

NFS will provide oversight of the SRS operations (for Quality Assurance of NCS-related activities) through initial qualification and periodic surveillance. Changes to the process described above at SRS will be reviewed by NFS prior to implementation. Additional details of these activities will be provided to the NRC upon request.

NRC:

14. **The validation report referenced implies that it is only valid for up to 5wt % enriched U material. The NCSE has calculations up to 7.5wt % enriched material. Justify why it is acceptable to use a validation methodology which is limited to 5wt % enriched material for calculations for 7.5wt % material.**

This information is necessary in order to verify that the methodology used is acceptable and that operations will be maintained subcritical as required by 10 CFR Part 70.

NFS RESPONSE:

The validation report supports enrichments up to 10 wt%. Specifically, the validation report contains 24 experimental benchmarks specific to uranyl nitrate solutions ranging in enrichments from 5.0 to 10.0 wt%. The title of the validation report, and the title of the reference to the validation report in the NCSE, will be revised to be consistent with the study.

NRC:

15. **Justify the assumption in the demister calculations that the material is a homogenous mixture rather than a heterogeneous mixture. It is not clear that U would accumulate in such a manner as to be bounded by assuming a homogenous mixture. This is necessary since heterogeneous uranium mixtures are typically more reactive than homogenous mixtures.**

NFS RESPONSE:

Based on previous NRC/NFS licensing actions regarding heterogeneous versus homogeneous systems, the uranyl nitrate and demister geometry represents a homogeneous system as opposed to a heterogeneous system. Heterogeneous effects are attributed to configurations containing dense particles such as dry pellets and fuel rods with interstitial moderation; uranyl nitrate is a moderated low dense material that is homogeneous.

NRC:

16. **Justify why not following an approved procedure is always assumed to be unlikely. Explain how the training programs and procedures will prevent or mitigate human errors from occurring which could cause the performance requirements of 10 CFR 70.61 to be exceeded.**

This information is needed to determine that the performance requirements of 10 CFR 70.61 are being met.

NFS RESPONSE:

Not all administrative controlled IROFS are assumed to be unlikely to fail. All administrative control IROFS claimed as unlikely have management measures (including training programs and procedures) applied to them as described in Section 4 of the ISA Summary to achieve the level of risk reduction. For these controls the margin of safety is a consideration in the unlikely determination and all controls are properly justified for the specific application.

NRC:

17. For Scenario 1.5.1 in the ISA summary and Cases 24, 25, and 26 in the NCSE contingency number 2 is not independent and thus not acceptable. Provide details of the second contingency and justify why it is independent and unlikely.

This information is needed to determine that the double contingency principle of 10 CFR Part 70 is met.

NFS RESPONSE:

To replace the function of the NFS/Framatome sample as the second leg of double contingency for accident scenario 1.5.1 (transfer of unsafe UN solution into TK-10), NFS proposes that a qualified assay system will be used to verify the fissile concentration (g ^{235}U/l) in each LR-230 shipping container prior to the contents being transferred into TK-10. Once TK-10 is filled, the material will be sampled (fissile and uranium concentration from which the enrichment is inferred or measured). The assay and sampling will provide additional controls that are unlikely to fail and assurance of independence with Contingency #1. The inline density measurement in the recirculation line of TK-10 will also be used to verify the uranium concentration. The NCSE will be revised, as appropriate, to incorporate the requirements for this option. The NCSE will be provided to the NRC upon request.

NFS commits to design, install, and place in operation an in-line monitor with an automatic closure valve on the input line to TK-10 within 180 days after start-up of the UNB operations (i.e., when LEU is first introduced into the UNB). TK-10 will also be sampled to qualify the in-line monitor. The in-line monitor will provide an additional control that is unlikely to fail and assurance of independence with Contingency #1. The in-line monitor will be used in lieu of the NDA device after a confirmation period for the in-line monitor.

These controls, in addition to the controls at the SRS (see response to question 13), provide exceptionally robust controls for double contingency.

21G-03-0039
GOV-01-55-04
ACF-03-0045

Exhibit I

Letter from NRC to A. F. Olsen, BWXT Amendment 74 (TAC NO. L31493) Submittal Dated June 4, 2001, Integrated Safety Analysis Plan (ISAP), dated July 10, 2001

(1 page to follow)

Mr. Arne F. Olsen
Licensing Officer
BWX Technologies, Inc.
Naval Nuclear Fuel Division
P.O. Box 785
Lynchburg, VA 24505-0785

SUBJECT: BWXT AMENDMENT NO. 74 (TAC NO. L31493) SUBMITTAL DATED JUNE 4, 2001, INTEGRATED SAFETY ANALYSIS PLAN (ISAP)

Dear Mr. Olsen:

This refers to your submittal dated June 4, 2001, in which you submitted your Integrated Safety Analysis Plan (ISAP). We have completed our review of your submittal and have determined that your ISAP is acceptable. Accordingly, pursuant to Part 70 to Title 10 of the Code of Federal Regulations, Materials License SNM-42 is hereby amended to include the date of June 4, 2001, in Safety License Condition S-1 of License SNM-42. It should be understood, however, that further review of your integrated safety analysis (ISA) methods and the content of your actual ISA summaries will be done when they are submitted to the NRC.

Table 15.2-4

Risk Assessment Table

Overall Likelihood of Accident

Severity of Consequences		Highly Unlikely	Unlikely		Not Unlikely		
		≤-4	-3	-2	-1	0	1
High	6						
	5						
Intermediate	4						
Site-Specific Intermed.	3						
Low	2	BELOW SEVERITY THRESHOLD					
	1						
	0						

= Risk Zone 1 (Does not meet performance criteria, immediate corrective action required)

= Risk Zone 2 (Does meet performance criteria, corrective action required within time limited waiver)

= Risk Zone 3 (Meets performance criteria, no corrective action required or acceptable for startup of new operation)

Exhibit II

Letter from NRC to N. B. Parr, Westinghouse Electric Company, LLC, Amendment 33 (TAC NO. L31601) Approval of Integrated Safety Analysis Plan Approach, page 7, dated August 8, 2002

(2 pages to follow)

August 8, 2002

Ms. Nancy B. Parr
Licensing Project Manager
Westinghouse Electric Company, LLC
Commercial Nuclear Fuel Facility
Drawer R
Columbia, SC 29250

SUBJECT: WESTINGHOUSE ELECTRIC COMPANY, LLC - AMENDMENT 33 - APPROVAL OF INTEGRATED SAFETY ANALYSIS PLAN APPROACH (TAC NO. L31601)

Dear Ms. Parr:

In accordance with your application dated February 28, 2002, and pursuant to Part 70 to Title 10 of the Code of Federal Regulations, Materials License SNM-1107 is hereby amended to approve your Integrated Safety Analysis (ISA) Plan approach. Accordingly, Safety Condition S-1 has been revised to include the date of February 28, 2002.

All other conditions of this license shall remain the same.

Enclosed are copies of the revised Materials License SNM-1107 and the Safety Evaluation Report, which includes the Categorical Exclusion.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

If you have any questions regarding this licensing matter, please contact me at (301) 415-5269 or by e-mail at DES1@NRC.GOV.

Sincerely,

/RA/

Daniel M. Gillen, Chief
Fuel Cycle Facilities Branch
Division of Fuel Cycle Safety
and Safeguards, NMSS

Docket 70-1151
License SNM-1107
Amendment 33

Enclosures: 1. Materials License SNM-1107
2. Safety Evaluation Report

Table 2.3 Failure Probability Scores for Protective Mechanisms

Index Score	Failure Probability	Qualitative Description or Example of Protection Mechanism
0	1	No protection or extremely weak protection
-1	0.1	Protection by a trained operator performing a non-routine task
-2	0.01	Protection by a trained operator performing a routine task, or a functionally tested active safety device
-3	0.001	Protection by an inspected passive safety device, or a functionally tested active safety device with trained operator backup
-4	0.0001	Protection by two independent, redundant methods or systems each functionally tested (consistent with double contingency protection)

Table 2.4 provides accident sequence risk acceptance criteria. Accident sequences with unacceptable Risk zone equal to 1 is considered unacceptable for continued operation. Risk zone 2 is unacceptable for long term operation and senior management will determine timely corrective actions needed to achieve risk zone 3 or 70.61 defined acceptable risk.

Table 2.4 Risk Analysis Table

			Overall Likelihood of an Accident					
Severity of Consequences			Highly Unlikely	Unlikely		Not Unlikely		
			-4	-3	-2	-1	0	1
	High	6						
		5						
	Intermediate	4						
		3						
	Low	2	Below Severity Threshold					
		1						
		0						

	Risk Zone 1 (Unacceptable for operation)
	Risk Zone 2 (Unacceptable for long term operation)
	Risk Zone 3 (Meets 70.61 - Acceptable)