DISCUSSION TOPICS
NRC/NFS MEETING FEB. 4, 2003

- NATURAL PHENOMENA
- REMAINDER OF ITEMS RAI – NOV. 29, 2002
- DOUBLE CONTINGENCY – SRS SAMPLING
- LIKELIHOOD DEFINITIONS
- REMAINDER NCS – RAI – JAN. 10, 2003

IROFS for Natural Phenomena

IROFS Number	Initiating Event	Consequence & Category	Items Relied on For Safety	Failure definition
UNB-1	Earthquake Design basis: 2E-3/ yr return	Major earthquake could collapse building and cause rupture of multiple tanks, leading to high consequences.	Building design per SBC 1999 seismic requirements for Erwin, TN. Key features: - Structural steel components sized for acceleration loads - Concrete foundations sized to support steel	Conditions exist that could cause collapse of the building under less than design basis earthquakes. These conditions could be caused by modifications or damage to key structural components.
UNB-2	Earthquake (same as above)	Major earthquake could cause multiple storage tanks to move sufficiently to break connection nozzles and spill UN to floor, leading to high consequences.	Each storage tank is equipped with a seismic restraint system. Key features: - molded in restraint strap - anchor bolt and nut - attachment to concrete floor	Conditions exist such that the restraint systems for multiple tanks are compromised to the point that they would be functionally ineffective.
UNB-3	High winds (sustained winds > 70 mph)	Sustained high winds could collapse building and cause rupture of multiple tanks, leading to high consequences.	Building design per SBC 1999 wind load requirements for Erwin, TN. Key features: - Structural steel components sized for wind loads - Concrete foundations sized to support steel	Conditions exist that could cause collapse of the building under less than design basis wind loads. These conditions could be caused by modifications or damage to key structural components.

Compliance with Baseline Design Criteria for Natural Phenomena

New terms to be added to UNB ISA Summary for Baseline Design Natural Phenomena Events (Based on Phenomena Threshold)

- Seismic – 2E-3/yr return period, High consequence, 1999 Standard Building Code
- High Winds – 70 mph, High consequence, 1999 Standard Building Code
- Flooding – 100 year floodplain, no credible High or Intermediate consequences for the UNB
- Lightning – no credible High or Intermediate consequences for the UNB, NFPA 780
- Tornado – Not credible

Management Measures

- Protection is afforded by designing and constructing a facility to applicable sections of the Standard Building Code and by ensuring operational adherence to this code through a configuration management change control process.

Compliance w/ Baseline Design Criteria for Natural Phenomena

Baseline Design Natural Phenomena Event: A physically credible natural phenomena event not expected to occur during plant lifetime that has the capability to exceed the performance criteria specified in 10 CFR 70.61. Protection is afforded by designing and constructing a facility to applicable sections of the Standard Building Code and by ensuring operational adherence to this code through a configuration management change control process. Adherence to 10 CFR 62(c)(iv) and 10 CFR 70.64(a)(2) is demonstrated by eliminating potential high or intermediate consequences limited to a defined baseline design threshold. The UNB baseline design threshold for each natural phenomena event is as follows:

Seismic: The UNB facility is designed and constructed to seismic zone IIC criteria as specified in Section 1607 of the 1999 Standard Building Code and is equipped with a tank restraint system designed to withstand a 0.1 g horizontal and vertical ground acceleration. The threshold return period for which the facility is designed and constructed to is 2E-3/yr. The Effective Peak Velocity Related Acceleration Coefficient $A\nu$ and Peak Acceleration Coefficient Aa are defined as specified in Figures 1607.1.5A and 1607.1.5B of the Code respectively. Facility IROFS are assigned to prevent a high consequence event that may result from a seismic event within the specified threshold envelope. Management measures will be applied to ensure the facility is designed, constructed and operated through configuration change control management to prevent this consequence. Refer to the *IROFS for Natural Phenomena* table for IROFS UNB-1and UNB-2 descriptions.

High Winds The UNB facility is designed and constructed to withstand basic sustained wind speeds up to 70 miles per hour as specified in Section 1606 of the 1999 Standard Building Code. Facility IROFS are assigned to prevent a high consequence event that may result from high winds within the specified threshold envelope. Management measures will be applied to ensure the facility is designed, constructed and operated through configuration change control management to prevent this consequence from occurring. Refer to the *IROFS for Natural Phenomena* table for IROFS UNB-3 description.

Flooding The UNB facility is located above the 100-year flood plain base flood elevation threshold. As such, there is no physically credible accident scenario that could result in a flood of the facility.

Lightning Lightning protection is installed in the UNB facility per the applicable portions of NFPA 780. There are no credible UNB accident scenarios that result in an intermediate or high consequence event as a result of a lightning strike.

Tornado There are no credible accident scenarios that result in an intermediate or high consequence event as a result of a direct tornado strike on the UNB facility.

BLEU Project

Remaining UNB License Matters from Nov 29 RAI

Definition of IROFS

NRC Staff Requirement

NFS should use the verbatim definition cited in 10 CFR 70.4 in the ISA Summary. NFS can then add a separate paragraph to address the functionality of "systems" that are listed as IROFS in the ISA Summary.

NFS Compliance Response

The IROFS definition will be revised ISA Summary to include the following from the regulation:

"Item Relied on for Safety:

Means structures, systems, equipment, components and activities of personnel that are relied on to prevent potential accidents at a facility that could exceed the performance requirements of 10 CFR 70.61 or to mitigate their potential consequences."

Concept of IROFS as Function – see handout.

Definition of IROFS

"Item Relied on for Safety:
Means structures, systems, equipment, components and activities of personnel that are relied on to prevent potential accidents at a facility that could exceed the performance requirements of 10 CFR 70.61 or to mitigate their potential consequences."

Accordingly, an IROFS provides a safety function that serves to reduce the risk associated with a specific accident scenario. The components of an IROFS function may include operator actions, equipment, control logic, and elements such as time or margin of safety (see example below). In addition, utility subsystems required to maintain the reliability and availability of an IROFS are bounded within the IROFS function. Utilities not required to meet the performance criteria, such as in fail-safe controls or equipment, do not require inclusion in the IROFS functional boundary.

Equipment, actions, or controls within the IROFS functional boundary equipment and subsystems must be:

- Designed to prevent or mitigate specific, potentially hazardous events. Each identified potential hazard will have corresponding, specific protection strategies.

- Independent so that there is no dependence on components of other protective layers associated with an identified hazard. There must also be no linkage between the initiating event and the ability of the IROFS to perform as required.

- Dependable so that they can be relied on to operate in the prescribed manner. Both random and specific failure modes will be considered in the assessment if there is a probability of protection layers failing on demand or failing during their mission. If human intervention is included as an IROFS, the response time and corresponding human error probability must be considered.

- Auditable in that they are designed to facilitate regular validation (including testing) and maintenance of their protective functions.

Example: an administrative control may require a spill be cleaned up with 8 hours and only if it exceeds 5 gallons (because it is safe if cleaned up in less time or if the volume is below 5 gallons).

This definition will be incorporated into Revision 2 of the UNB ISA Summary.

Instrumentation and Control of IROFS

Baseline Design Criteria Requirement:

***"Instrumentation & Controls**: The design must provide for inclusion of instrumentation and control systems to monitor and control the behavior of IROFS.*

Extract from NFS RAI Response

"Active engineered controls are used extensively for safety purposes in the UNB facility. Section 4.8 of the ISA Summary addresses the requirements for inspection, periodic functional checks, and maintenance to ensure the effectiveness of IROFS. This type of IROFS is typically implemented through the Central Control System (CCS). The CCS provides extensive internal diagnostic checks that will detect component failures and trigger alarms and in appropriate cases will send the outputs to a safe state. This is true for individual field instruments up through the controllers themselves and all communication links in between."

Amplification

"In general, equipment systems that will be used as enhanced administrative or active engineered control IROFS will have means for verification that key components of the IROFS are functional. Applicable information about monitoring each individual IROFS of these types will be contained in the ISA."

Environmental and Dynamic Effects

Baseline Design Criteria Requirement:

<u>Environmental & Dynamic Effects:</u> The design must provide for adequate protection from environmental conditions and dynamic effects associated with normal operations, maintenance, testing, and postulated accidents that could lead to loss of safety functions.

<u>Extract from NFS RAI Response</u>

"The UNB facility is designed to minimize problems from variations (both normal and from credible upsets) in the ambient and process conditions under which the IROFS equipment is expected to operate. Consideration in the design of the facility and equipment is given to the following to prevent loss of safety functions:

- Protection of piping and vessels from vehicles and forklifts.
- Protection of fittings from external impact.
- Corrosion protection.
- Vibration from pumps/fans etc.
- Water discharge from sprinkler systems (or other splash).
- Weather
- Other facility siting factors including the railway, air traffic patterns, and the nearby commercial facilities."

<u>Amplification</u>

As such, IROFS will be qualified to demonstrate that they can perform their safety functions under the environmental and dynamic service conditions in which they will be required to function and for the length of time their function is required.

Specific requirements for each IROFS will be contained in the ISA.

Electrical Power Reliability

NRC Staff Requirement

NFS should make a license commitment to maintain/test the UPS, the diesel backup generator, and the transfer switch.

NFS Compliance Response

Revise license SNM-124, 6.3 Emergency Utilities as follows:

"...The electrical power supply system for the BLEU Conversion Complex (UNB, OCB, EPB and related facilities) includes backup power generation and uninterruptible power supply equipment to ensure key systems remain functional. To ensure system availability, the following measures (as described in written procedures) are applied to the specified systems:

- diesel backup generator: periodic functional testing; periodic battery checks; configuration control
- transfer switch: periodic functional testing; configuration control
- UPS: periodic functional testing; periodic battery checks; configuration control".

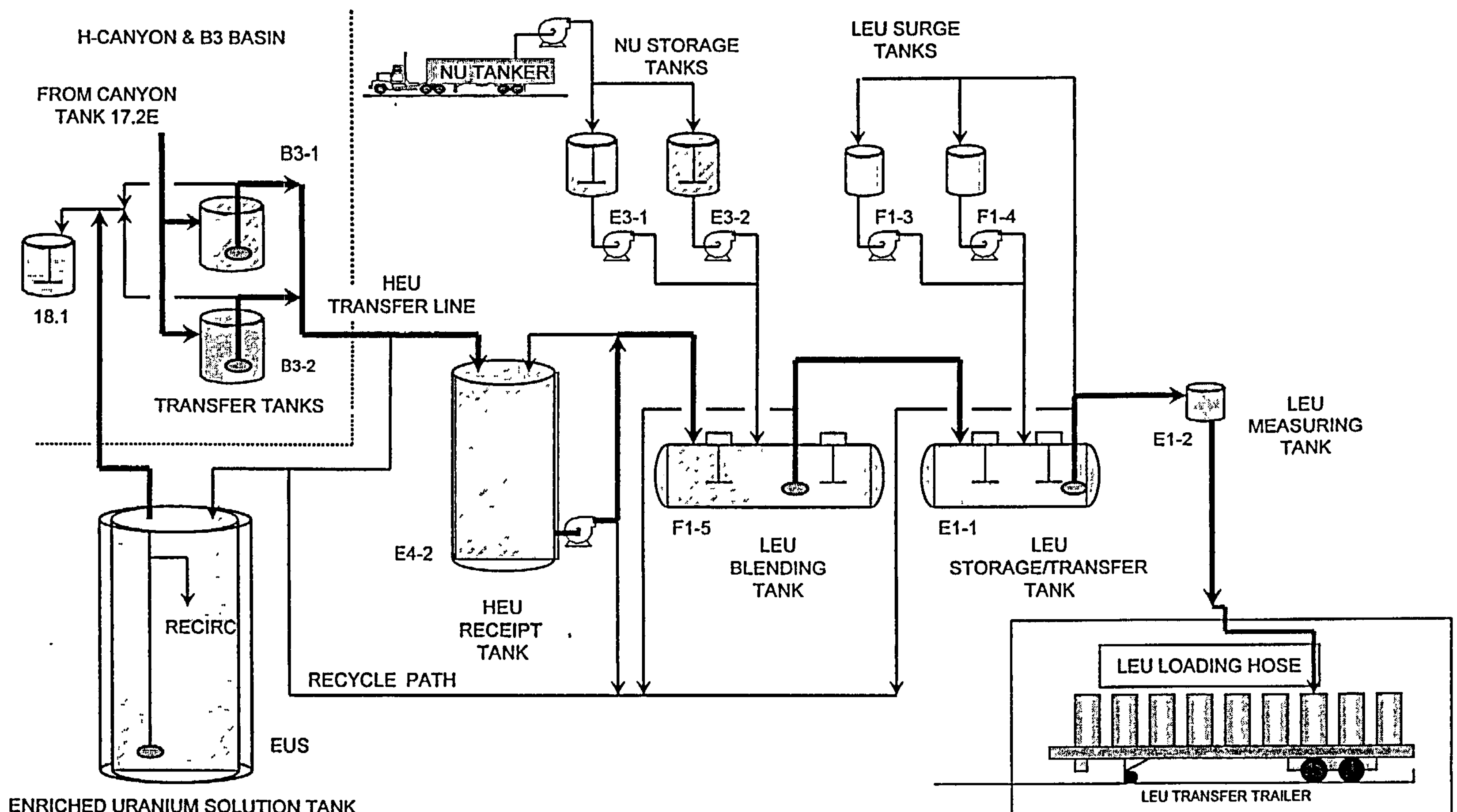
BLEU Project

UNB License Amendment Criticality Safety

Shipper enrichment verification discussion:

- NFS proposed criticality controls for double contingency
- NRC's questions regarding sampling at SRS
- Discussion of path forward

HEU BLEND DOWN PROJECT



A-LINE BASIN AREA

Sufficiency of Proposed Criticality Controls

- UN solutions from SRS are safe by concentration controls at SRS
  - No means to change composition after sampling in E1-1 tank
    - Exception is freezing in shipping container

- Sampling at SRS is independent and both legs of double contingency are reliable.

- Precedents for meeting double contingency in similar situations:
  - UF_6 receipt in Richland, for >4.70% enriched
    - Basis is 1) sample results from shipper and 2) pinch tube sample sent with cylinder & analyzed at Richland.
    - Both samples are taken from the master cylinder.
    - UF_6 is received from Europe in addition to NRC licensees

Propose On-Receipt Assay Option

- Framatome has conducted successful tests on UN with portable assay system
- Can use same system to assay U-235 g/l for each shipment before unloading
  - Cannot verify <5% enrichment
  - Can distinguish between 5 g/l nominal and unsafe concentrations > 10 g/l
  - Shoot one container per shipment
- In-line system not possible at this time
- Can use first shipments to develop simpler system

Why not sample upon receipt?

- An NRC proposal is to sample multiple times each shipment before/during transfer to unsafe geometry
- Receipt sampling is overly conservative
  - UN is safe as received as per previous discussion
  - No chance of container to container variations
- Receipt sampling is unworkable
  - Highly probable receiving schedule could not be met, jeopardizing the entire program
  - Extremely expensive: have to go to 3 shift operation, plus high analytical costs

LIKELIHOOD DEFINITIONS

Qualitative Risk Assessment incorporates the recommendations set forth in NUREG 1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility."

10 CFR 70.65(b)

The integrated safety analysis summary must contain:
(9) A description of the definitions of unlikely, highly unlikely, and credible as used in the evaluations in the integrated safety analysis.

SRP Chapter 3, p. 3-24, "Acceptance Criteria for Qualitative Definitions of Likelihood"

If the applicant's definitions are qualitative, they are acceptable if they meet the following criteria:

a) are reasonably clean and based on objective criteria
b) can reasonably be expected to consistently distinguish accidents that are highly unlikely from those that are merely unlikely…

…Objective criteria are needed to provide consistency.

Table A-10	Based on Type of IROFS	Table A-9	Based on Evidence and Type of IROFS	Table 4	NFS IROFS Failure Index	Licensee 1	Licensee 2
-6		-6	External event with freq,. < 10^{-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, PÉC, or enhanced admin.) robust	-4	No failures in 30 years for hundreds of similar IROFS in industry, exceptionally robust passive engineered IROFS (PEC), or an inherently safe process, or two independent active engineered IROFS (AECs), PECs, or enhanced admin IROFS	-4	Protected by an exceptionally robust passive engineered control (PEC). Exceptionally Robust Management Measures to ensure availability	Protection by two independent, redundant methods or systems each functionally tested (consistent with double contingency and control acceptability described in Chapter 4)	Protection by two independent, redundant methods or systems each functionally tested (consistent with double contingency protection)
-3 or –4	A single passive engineered IROFS (PEC) or an active engineered IROFS (AEC) with high availability	-3	No failures in 30 years for tens of similar IROFS in industry, a single IROFS with redundant parts, each a PEC or AEC	-3	Protected by a inspected single PEC or exceptionally robust AEC with a trained operator backup. Adequate management measures to ensure availability	Protection by an inspected passive safety device, or a functionally tested hardware system	Protection by an inspected passive safety device, or a functionally tested active safety device with trained operator backup
-2 or –3	A single active engineered IROFS, or an enhanced admin, IROFS, or an admin. IROFS for routine planned operations	-2	A single PEC	-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	Protection by a trained operator performing a routine task, or a functionally tested hardware system	Protection by a trained operator performing a routine task, or a functionally tested active safety device

					to ensure availability.		
-1 or –2	An admin. IROFS that must be performed in response to a rare unplanned demand	-1	A single AEC, or enhanced admin IROFS with large margin, or a redundant admin IROFS	-1	Protected by a single administrative control or a trained operator performing a non-routine task with an approved procedure.	Protection by a trained operator performing a non-routine task	Protection by a trained operator performing a non-routine task
		0	A single admin IROFS	0	No protection	No protection or extremely weak protection	No protection or extremely weak protection
		1	Frequent event, inadequate IROFS				
		2	Very frequent event, inadequate IROFS				

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.

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)

RAI#2 Matters dated January 10, 2003
Outline of Draft Response

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.**

- Engineering evaluation demonstrates that IROFS can handle the maximum flowrate.
- Maximum flowrate from TK-10 into the vent line leading to the HVAC exhaust duct is 65 gpm.
- Design of ventilation duct (formed by a horizontal vent line entering the side of a vertical 20" circular duct, which rises 9 feet before running horizontally to the HEPA filter housing) designed to accommodate the maximum flowrate of 65 gpm.
- Flowrate cannot exceed the maximum and no liquid from any of the vent lines will enter the horizontal section of the duct.
- HEPA filters and ductwork will be scanned on an annual basis.
- HEPA filters will be changed-out based on pressure differential or NDA scan values.
- Periodic inspections will identify potential holdup. Frequencies determined based on findings. These activities will be conducted in accordance with written approved procedures.

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.**

- Limiting Condition of Operation (LCO) is defined as 231 g U/l in the NCSE.
- The calculations for scenarios 1.26.2 and 1.76.1 and Cases 6, 18 and 20 will be revised using the LCO limit.

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.**

   - Precipitating agents will not be allowed in the UNB.
   - Operators will be trained to restrict precipitating agents in the UNB.
   - pH monitor prevents transfer of basic solutions (transfer line).
   - pH set point of 9 is significantly below the pH of any precipitating agents of concern.

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.**

- The solution density is monitored directly in each of the storage tanks. These density monitors are designated as IROFS.
- The solution density measurement in the recirculation piping is a confirmatory, defense-in-depth monitor. Since recirculation monitoring is not used to establish the double contingency it is not designated as an IROFS.

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.**

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

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.**

- The enrichment is controlled to less than or equal to 5.0 wt%.
- Enrichment sensitivity calculations were performed at the request of the NRC.
- Enrichment is a controlled parameter however it is not controlled within a range of values similar to the uranium concentration.
- It is not necessary to provide a table associated with enrichment ranges.

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.**

- Multiple valve or tank failures will not lead to a criticality; spill geometries are less reactive than tank geometries.
- These failures do not lead to a criticality and the respective components are not designated as criticality IROFS.
- Human errors were not factors in this criticality determination.

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.

Case 3, numerous logistical and practical issues enhance the reliability of this administrative control to the point where it can conservatively termed "unlikely to fail".

- Requirements within procedures 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 claimed level risk reduction.
- The connection point of the flexible UNB transfer line leading to tank 10 is approximately 8' above ground level, making connection to a container of liquid at ground level impossible without some sort of reengineered connection.
- No precipitating agents are allowed in the UNB by procedure, nor are there any credible reasons for an operator to intentionally or inadvertently bring such a container of precipitant into the facility.

Any container that might be connected to the transfer line would also either have to be equipped with its own pump or have special design features that would allow connecting the motive air line that is used to transfer the UN.

Case 7, there are several considerations, which support this control as "unlikely to fail":

- The procedures 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 claimed level risk reduction. Administrative controls with appropriate management measures are commonly used in industry as one leg of double contingency.
- No precipitating agent is allowed in the UNB by procedure, nor is there a credible reason for operating personnel to intentionally or inadvertently bring such material into the facility. It would take more than 5 gallons of concentrated

sodium hydroxide added to TK-10 under worst-case scenarios to precipitate enough uranium to begin to approach an unsafe condition.

- pH set point of 9 is significantly below the pH of any precipitating agents of concern.

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.**

- Routine facility inspections conducted during the course of normal operations will detect an open tank within the required 2.2-year duration necessary to concentrate the solution sufficiently to result in a criticality

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.**

- 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 (65 gpm).

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.**

- 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 will be revised to be consistent with the study.

15. **Justify the assumption in the demister calculations that the material is a homogenous mixture rather than a heterogenous 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 heterogenous uranium mixtures are typically more reactive than homogenous mixtures.**

- Based on previous NRC/NFS licensing actions regarding heterogeneous versus homogeneous systems, uranyl nitrate and demister geometry represent 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.

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.**

- Not all administrative controlled IROFS are assumed to be unlikely to fail.
- All administrative control IROFS claimed as unlikely have management measures applied to them as described in section 4 of the ISA Summary to achieve the level of risk reduction.
- For these controls there is a large margin of safety.