DOCKET: 70-143

LICENSEE: Nuclear Fuel Services,
Erwin, Tennessee

SUBJECT: SAFETY EVALUATION REPORT: NUCLEAR FUEL SERVICES, INC., AMENDMENT 39 (TAC NOS. L31688, L31739, L31721 AND L31748) - TO AUTHORIZE URANYL NITRATE BUILDING AT THE BLENDED LOW-ENRICHED URANIUM COMPLEX AND POSSESSION LIMIT INCREASE

## 1. EXECUTIVE SUMMARY

On February 28, 2002, Nuclear Fuel Services, Inc., (NFS) requested an amendment to its Special Nuclear Materials License SNM-124. In this amendment request, NFS asked for authorization to receive and store low-enriched uranyl nitrate solutions in a new storage building, the uranyl nitrate building (UNB) at its site in Erwin, Tennessee. The license amendment request included changed pages to NFS' license. NFS also submitted an Integrated Safety Analysis (ISA) Summary for the UNB. It's ISA Summary is required by 10 CFR Part 70, Subpart H - Additional Requirements for Certain Licensees Authorized to Possess a Critical Mass of Special Nuclear Material.

In subsequent submittals, most notably a revised ISA Summary, Nuclear Criticality Safety Evaluations, responses to NRC requests for additional information, and other correspondence on the docket, NFS supplemented the original amendment request. NRC staff reviewed the amendment request and supplemental information using the applicable regulations in 10 CFR Part 70, Domestic Licensing of Special Nuclear Material, NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility," and 10 CFR Part 20, "Standards for Protection Against Radiation." Specifically, the staff used 10 CFR 70.23 requirements for the approval of applications, and 10 CFR 70.66 containing additional requirements for approval of a license application, to determine whether to grant the amendment request.

As part of the UNB amendment request, but submitted separately on March 8, 2002, NFS requested changes to its emergency plan to include the proposed UNB. We reviewed the proposed emergency plan changes using 10 CFR 70.22(i)(3) and determined that they are adequate. We have documented the basis for this finding in Section 12 of this Safety Evaluation Report (SER).

As part of the UNB amendment request, but submitted separately on March 12, 2002, NFS requested changes to its Physical Protection Plan for Special Nuclear Material of Low Strategic Significance to address physical protection of the proposed UNB. We reviewed this plan using the regulations in 10 CFR Part 73, Physical Protection of Plants and Materials. We have documented in this SER, in Section 4, our evaluation of those plan changes.

As part of the UNB amendment request, but submitted separately on February 21, 2002, NFS requested changes to its Fundamental Nuclear Material Control (FNMC) Plan to support the UNB amendment request. We reviewed these plan changes using the regulations in 10 CFR Part 74, Material Control and Accounting of Special Nuclear Material. Our evaluation of the FNMC Plan is not in this SER; it was documented in a SER that supported Amendment 36 to NFS' SNM license, issued on August 30, 2002.

We have determined that the amendment request was complete and adequate to meet the regulatory requirements and that the request can be granted. This SER documents our technical review and the bases for that determination.

Also as part of the amendment request, NFS submitted a Supplement to Applicant's Environmental Report (ER) in November 2001. We reviewed this supplement and additional information requested from NFS, and the staff prepared an Environmental Assessment (EA) and a Finding of No Significant Impact (FONSI) for the UNB. The FONSI was initially published in the Federal Register on July 9, 2002 (67 FR 45555) and subsequently republished October 30, 2002, (67 FR 66172) to clarify the amendment application. A correction was published on November 12, 2002, (67 FR 68699).

## 2. BACKGROUND

On February 28, 2002, NFS requested an amendment to its Materials License SNM-124 to authorize the storage of low-enriched uranium-bearing materials at the UNB. This amendment application was the first of three license amendment applications that will support the Blended Low-Enriched Uranium (BLEU) project at NFS. The license amendment application included both proprietary and non-proprietary versions of its ISA Summary, a proprietary decommissioning cost estimate, changes to Parts I and II of its license, and proposed changes to its emergency plan.

NRC staff performed an on-site review of additional ISA documentation during the week of June 10-14, 2002. As a result of these reviews, NRC identified, in part, that additional accident sequence background information, and additional information concerning the reliability of Items Relied on for Safety (IROFS) was needed to complete the review. NFS provided additional information during the on-site review, and that additional information, including the revised ISA Summary, was submitted to NRC on August 23, 2002. NRC staff reviewed the revised ISA Summary and additional information. The staff then conducted a second on-site review, during the week of October 14, 2002. On November 29, 2002, NRC sent a letter to NFS requesting additional information to which NFS replied by letter dated December 23, 2002. On February 4, 2003, a meeting was held to discuss the application resulting in an NFS letter dated February 14, 2003, that documented additional NFS comments on its application. NRC staff also reviewed the proprietary decommissioning cost estimate and requested that NFS provide the basis used to estimate the costs. NFS provided this basis by proprietary letter dated October 18, 2002.

NFS' demonstration of double contingency, as required by 10 CFR 70.64, is documented in the Nuclear Criticality Safety Evaluation (NCSE) for the BLEU Complex UNB, NCS-07-02, Revision 2. To comply with the double contingency principle, administrative and engineered controls were developed to preclude conditions under which a criticality could occur. Additional supporting information was submitted in responses to NRC requests for additional information (RAI) dated, December 23, 2002, and February 10, 2003, as well as other submittals dated March 21, 2003.

NFS submitted a supplemental ER, dated November 9, 2001, and additional information letters dated January 15, 2002, March 15, 2002, and April 12, 2002. The NFS environmental documentation was used by NRC staff to prepare an EA pursuant to the NRC regulations [10 CFR Part 51] and guidance from the Council on Environmental Quality regulations [40 CFR Parts 1500–1508] that implements the requirements of the National Environmental Policy Act (NEPA) of 1969.

## 3. CONDUCT OF REVIEW

NRC reviewed the license amendment application for compliance with the requirements of 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material," and specifically for compliance with the requirements of Subpart H to Part 70, "Additional Requirements for Certain Licensees Authorized to Possess a Critical Mass of Special Nuclear Material." NRC staff also reviewed the ISA Summary for conformance with the commitments in NFS' Integrated Safety Analysis Plan, dated October 5, 2001, which was approved by license Amendment 31, dated October 30, 2001. NRC staff used the guidance in NUREG-1520, "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility," March 2002, to ensure the quality and completeness of the technical review.

The amendment application review used an integrated team approach. NRC review team members with expertise in the various areas of technical review such as chemical, electrical, mechanical, and fire protection engineering, occupational radiation protection, nuclear criticality safety, environmental protection, and other disciplines reviewed the amendment application and ISA Summary and participated in the on-site reviews.

This Safety Evaluation Report documents the results of the NRC staff review.

## 4. REGULATORY REQUIREMENTS

### 4.1 Contents of Applications, 10 CFR 70.22, and Requirements for the Approval of Applications, 10 CFR 70.23

In the February 28, 2002, license amendment request, NFS requested changes to Part I, License Conditions, of the license application. Specifically, NFS requested changes to Chapter 1, "Standard Conditions and Special Authorizations," and Chapter 5, "Environmental Protection."

NFS did not request a change to the identity of the licensee corporation, the state where it is incorporated, the location of the principal office, or the names, addresses, and citizenship of its principal officers. NFS is a privately held company with no alien, foreign corporation, or foreign control or ownership. NRC staff has determined that this information continues to be acceptable in accordance with 10 CFR 70.22(a)(1). NRC staff has determined that the existing information in Section 1.1, "Name, Address, and Corporate Information," is adequate to meet the requirements of 10 CFR 70.22(a)(1) as applied to the UNB.

In its ISA Summary and in revised Chapter 15 to the license, NFS described the activity for which it requested the license amendment and the general plan for carrying out the activity. Section 1.5 of the current license authorizes NFS to receive, possess, use, store, and ship authorized special nuclear material pursuant to 10 CFR Part 70. NRC staff has determined that no changes to this authorization are necessary for the UNB. NRC staff has also determined that the low-enriched uranyl nitrate (LEUN) to be stored in the UNB is to be used for activities licensed by the Commission under Section 103 of the Atomic Energy Act, in conformance with 10 CFR 70.23(a)(1). NFS requested a change to Chapter 1, Section 1.2, of the license application, titled "Site Location," to include the mailing address, 200 Oxide Lane, of the BLEU complex. This location is adjacent to NFS' existing plant in Erwin, TN. NRC staff has determined that this information is acceptable in accordance with 10 CFR 70.22(a)(2).

NFS did not specify the period of time for which the license amendment is requested, as required by 10 CFR 70.22(a)(3). NFS' current license was renewed in July 1999 for a 10-year period. The activities authorized by this amendment will expire at the same time that the current license expires, unless the license is otherwise amended, renewed, or terminated in accordance with 10 CFR 70.38.

In the license amendment request, NFS requested a change to Chapter 1, Section 1.4.1, of the license application, titled, "Uranium Enriched in the $^{235}U$ Isotope," to increase the U-235 possession limit from [redacted] to [redacted] to support the BLEU complex. The NRC staff has determined that this change is in conformance with 10 CFR 70.22(a)(4) and is acceptable. NRC staff considered this possession limit increase in its review of NFS' safety programs and determined, as documented in the safety program discussions in Sections 7 through 15 of this SER, that NFS' safety programs are adequate to meet the requirements of 10 CFR 70.22(a)(6), (7), and (8) and 10 CFR 70.23(a)(2), (3), and (4) for this additional enriched uranium material.

In the license amendment request, NFS requested a change to Chapter 5, Section 5.1.2 of the license application titled, "Liquid Effluents," to clarify that the BLEU complex treated process wastewater will be discharged to the sanitary sewer under NFS' wastewater discharge permit issued by the City of Erwin. Other changes describe the storm water drainage system. The storm water from NFS' main plant site discharges to Banner Spring Branch; storm water from the BLEU complex will be discharged directly to Martin Creek. The effluent discharge changes did not require any changes to the environmental sampling program because NFS' current license commits NFS to sampling Martin Creek. As discussed in Section 13 of this SER, NRC staff reviewed these changes to the liquid discharges and determined that they are acceptable.

NFS did not request changes to Chapter 2 of the license, titled, "Organization and Administration," that describes the technical qualifications of NFS staff to engage in the UNB activities, in accordance with 10 CFR 70.22(a)(6). As part of its 1999 license renewal, the staff reviewed NFS' management organization and minimum technical qualifications. The staff determined that NFS is qualified, by reason of training and experience, to use SNM for the manufacture and development of uranium fuel. Based on similarities between the management organization, administration, and fuel processes reviewed during the license renewal and the management organization, administration, and fuel processes in this UNB amendment, the NRC staff concluded that NFS' management organization and administration are sufficient to safely manage operation of the UNB, in accordance with 10 CFR 70.23(a)(2).

NFS provided a description of the UNB equipment and facilities which will be used to protect health and minimize danger to life or property in changes to Chapters 9, 10, 12, 13, and 15 of Part II, "Safety Demonstration," of the license and in its ISA Summary submitted with the amendment application. As discussed in Sections 5 through 13 of this SER, NRC staff reviewed this description and determined that the description addresses the requirements of 10 CFR 70.22(a)(7) and is acceptable in accordance with 10 CFR 70.23(a)(3).

NFS provided a description of the UNB procedures to protect health and minimize danger to life or property in its ISA Summary and in subsequent responses to NRC requests for additional information. NRC staff reviewed these procedures submitted by NFS and additional procedures during on-site reviews in June and October 2002 and determined that these procedures address the requirements of 10 CR 70.22(a)(8) and are acceptable in accordance with 10 CFR 70.23(a)(4).

NFS provided a decommissioning cost estimate and financial assurance instrument to cover the cost of decommissioning the UNB. As discussed in Section 14 of this SER, NRC staff has determined that this cost estimate and instrument satisfy the requirements of 10 CFR 70.22(a)(9).

In the license amendment request, NFS also proposed changes to Part II, "Safety Demonstration," Chapters 9, 10, 12, 13, and 15 of the license application. NRC staff used this safety demonstration information to support review of the license conditions. NFS proposed no other changes to Part I of their license.

NFS proposed revisions to its Emergency Plan to address the UNB, as required by 10 CFR 70.22(i). As discussed in Section 12 of this SER, NRC staff reviewed the revised Emergency Plan and determined that it meets the requirements of 10 CFR 70.22(i) and satisfies the requirement of 10 CFR 70.23(a)(11).

## 4.2 Material Control and Accounting, 10 CFR 70.22(b)

This section requires that an application for a license to possess special nuclear material contain a full description of the applicant's program for control and accounting of SNM to show how compliance with 10 CFR 70.58 and 10 CFR 74.31 will be accomplished. NFS provided proposed revisions to sections of its FNMC Plan to address the BLEU complex, which includes the UNB, in a license amendment application dated February 21, 2002. NRC staff reviewed the revised plan and found it to be acceptable and adequate. NRC issued license Amendment 36, dated August 30, 2002, approving the revised FNMC Plan.

## 4.3 Physical Security Plan for SNM of Low Strategic Significance, 10 CFR 70.22(k)

### 4.3.1 Discussion

By letter dated March 12, 2002, NFS submitted a revised Physical Security Plan (PSP) for Special Nuclear Material (SNM) of Low Strategic Significance to address the UNB and the Industrial Park Facility (the Industrial Park Facility is not a subject of this license amendment). NRC staff reviewed the PSP and performed a site visit on June 15, 2002. During the site visit, NRC staff noted a number of concerns with the security of the Industrial Park Facility. By letter dated December 17, 2002, NFS submitted a second revised Physical Security Plan for Special Nuclear Material of Low Strategic Significance, Revision 0 (NFS-SEC-C3-PSP, Revision 0); this second revision addressed only the Blended Low Enriched Uranium (BLEU) complex.

In addition to the site visit, NRC staff reviewed the PSP using guidance published in NUREG-1615, "Physical Protection Requirements for Categories I, II, and III Materials at Fuel Cycle Facilities," and Regulatory Guide 5.59, "Standard Format and Content for a Licensee Physical Security Plan for the Protection of Special Nuclear Material of Moderate or Low Strategic Significance."

### 4.3.2 Evaluation Findings

The NFS PSP stated how NFS will comply with the criteria in 10 CFR 73.67(f) and (g), which require the licensee to: (1) store the material in a controlled access area, (2) monitor the area and detect unauthorized penetrations or activities, (3) assure that a watchman or an offsite response force will respond to unauthorized penetrations or activities, (4) establish and maintain response procedures for dealing with threats of thefts or thefts of this material, and (5) comply with in-transit requirements for SNM of low strategic significance. The staff has reviewed this plan and concludes that it adequately satisfies the regulatory requirements of 10 CFR 73.67(f) and (g).

The staff concludes, after reviewing the NFS PSP, Revision 0, for SNM of low strategic significance dated December 17, 2002, that the plan reflects the standard content and format necessary to adequately satisfy the regulatory requirements in 10 CFR 73.67(f) and (g).

## 4.4 Controlled Area, 10 CFR 70.61(f)

This section requires the licensee to establish a controlled area, as defined in 10 CFR 20.1003, and to retain the authority to exclude or remove personnel and property from the area. In Figure 1 of its ISA Summary, as modified by letter dated, February 14, 2003, NFS identified the Controlled Area as the fenced and security controlled area located on the owner controlled area. NFS has chosen to define the Controlled Area to be the same as the Restricted Area for the purposes of compliance with 10 CFR 20.1003. NRC staff reviewed the boundaries of this controlled area against the regulatory requirements and determined that it was acceptable.

## 4.5 Baseline Design Criteria, 10 CFR 70.64(a)

This section requires NFS address the ten baseline design criteria in the design of new facilities or new processes at existing facilities. NFS must maintain the application of these criteria unless the ISA demonstrates that a given item is not relied on for safety or does not require adherence to the specified criteria.

**Quality Standards and Records**

10 CFR 70.64(a)(1) requires that the design, "be developed and implemented in accordance with management measures to provide adequate assurance that items relied on for safety will be available and reliable to perform their function when needed. Appropriate records of these items must be maintained by or under the control of the licensee throughout the life of the facility." NFS committed to maintain records of the IROFS under the Configuration Control program described in Section 4.8.1 of its ISA

Summary. In its ISA Summary, NFS provided a list of the UNB IROFS; however, since the facility design was not complete at the time of license amendment application, it did not provide quality standards or specifications for the IROFS.

Based on the staff's review of the ISA Summary, the supporting information provided by the licensee, and the applicable licensee commitments, the staff concludes that the design of the UNB meets the requirements of 10 CFR 70.64(a)(1).

**Natural Phenomena Hazards**

10 CFR 70.64(a)(2) requires that the, "design must provide for adequate protection against natural phenomena with consideration of the most severe documented historical events for the site." Based on historical and geological records, this translates into a design for a 2000 year earthquake return frequency. NFS has identified seismic activity (0.1g horizontal and vertical accelerations per the 1999 Standard Building Code, approximately a 2E-3/year magnitude) and high winds as credible natural phenomena hazards for the facility. In its February 14, 2003, letter, NFS committed to a 70 mph [31 m/s] wind speed as the facility design bases in accordance with the 1999 Standard Building Code. See Section 7 of this SER for further discussion and evaluation.

Based on the staff's review of the ISA Summary, the supporting information provided by the licensee, and the applicable licensee commitments, the staff concludes that the design of the UNB meets the requirements of 10 CFR 70.64(a)(2).

**Fire Protection**

10 CFR 70.64(a)(3) requires that the design, "provide for adequate protection against fires and explosions." See Section 11 of this SER for the staff's discussion and evaluation.

Based on the staff's review of the ISA Summary, the supporting information provided by the licensee, and the applicable licensee commitments, the staff concludes that the design of the UNB meets the requirements of 10 CFR Part 70.64(a)(3).

**Environmental and Dynamic Effects**

10 CFR 70.64(a)(4) requires that the design, "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." NFS stated in its December 23, 2002, letter that the UNB design must provide for protection from environmental conditions and dynamic effects associated with normal operations, maintenance, testing, and postulated accidents that could lead to the loss of a safety function. In that letter it expanded the environmental and dynamic effect design basis to minimize problems from variations (both normal and credible upsets) in the ambient and process conditions in which IROFS are expected to operate. NFS has included in the design of the UNB and process equipment, consideration for:

1. protection of pipes and vessels from vehicles and forklifts,
2. protection of fitting from external impact,
3. corrosion protection,
4. vibration from pumps, fans, etc.,
5. water discharge from sprinkler systems (or other splashes),
6. weather, and
7. other facility siting factors such as proximity to railways, air traffic patterns, and nearby commercial facilities.

NFS stated that specific design requirements and procurement specifications ensure that IROFS can perform their safety functions under the environmental and dynamic service conditions and for the length of time they are required to function.

Based on the staff's review of its ISA Summary, the supporting information provided by NFS, and NFS' commitments mentioned above, the staff concludes that the design of the UNB meets the requirements of 10 CFR 70.64(a)(4).

**Chemical Protection**

10 CFR 70.64(a)(5) requires that the design, "provide for adequate protection against chemical risks produced from licensed material, facility conditions which affect the safety of licensed material, and hazardous chemicals produced from licensed material." See Section 10 of this SER for the staff's evaluation and conclusion.

Based on the staff's review of the ISA Summary, the supporting information provided by the licensee, and the applicable licensee commitments, the staff concludes that the design of the UNB meets the requirements of 10 CFR Part 70.64(a)(5).

**Emergency Capability**

10 CFR 70.64(a)(6) requires that the design, "provide for emergency capability to maintain control of: (i) licensed material and hazardous chemicals produced from licensed material, (ii) evacuation of on-site personnel, and (iii) onsite emergency facilities and services that facilitate the use of available offsite services."

NFS has stated that its design basis for emergency management at the BLEU complex, includes Category III security requirements, an evacuation system in accordance with applicable sections of ANSI Standard 8.23, "Nuclear Criticality Accident Emergency Planning and Response," an emergency response organization in accordance with ANSI Standard 8.23, and a criticality accident monitoring system in accordance with the requirements of 10 CFR 70.24.

The Category III security requirements for NFS are described in Chapter 2 of NFS Security Plan and have been found acceptable by the NRC staff. The criticality monitoring system is described in Section 4.3 of the NFS license was evaluated in Section 9 of this SER, and was found to be acceptable by the NRC staff.

An evacuation system, in accordance with ANSI Standard 8.23, including the following elements:

1. timely evacuation,
2. equipment and personnel are available for radiological assessment of the assembly location and evacuated personnel,
3. sufficient exits from the immediate evacuation zone are provided to enable rapid and unobstructed evacuation of personnel,
4. evacuation route and assembly area are clearly posted,
5. evacuation route minimizes the total risk considering all potential hazards.

Onsite emergency facilities and services that facilitate the use of available offsite services, based on ANSI Standard 8.23, include the following elements:

1. an emergency response organization and support teams with appropriate expertise and experience,
2. appropriate monitoring equipment, emergency response documents, and protective clothing/equipment housed in the emergency facilities,
3. letters of agreement for support by off-site agencies present,
4. training and orientation to off-site agencies occurring on an annual basis, and,
5. an emergency message information system for timely notification to off-site agencies established.

NFS has stated that its design basis for selection of offsite emergency facilities includes:

1. its ability to have a timely response,
2. sufficient trained personnel,
3. hospitals with level one trauma center capabilities,
4. hospitals equipped for radioactive contaminated persons.

Based on the staff's review of NFS emergency plan and supporting information provided by NFS, the staff concludes that NFS has provided for emergency capability to maintain control of licensed material and hazardous chemicals produced from licensed material, has provided for the evacuation of on-site personnel, and has provided sufficient onsite emergency facilities and services that facilitate the use of available offsite services. Accordingly the emergency management program meets the requirements for baseline design criteria (BDC) set forth in 10 CFR 70.64(a)(6).

**Utility Services**

10 CFR 70.64(a)(7) requires that designs, "provide for continued operation of essential utility services." Offsite electrical power to the facility is supplied from a 12.5 kilovolt (kV) pole line via an underground feeder. Emergency electrical power is provided by a 300 kilowatt (kW), 480 volt (V) diesel generator which receives an automatic start signal when an automatic transfer switch detects the loss of offsite power. The automatic transfer switch transfers the load to the generator when the generator's output voltage

reaches an appropriate level and transfers the load back to the offsite power when it has been restored for a predetermined time.

Additionally, a 30 kilovolt-ampere (kVA) uninterruptible power supply (UPS) for Building 540 and a 20 kVA UPS for Building 510 provide power for security, fire alarm system, and criticality alarms. Both UPSs are fed from the offsite power or diesel generator and have battery backup to prevent power interruptions during transients. A manual bypass switch is also provided.

NFS concluded in the ISA that the electrical systems are not IROFS based on the fail-safe design of active engineered controls and the functional requirements of IROFS which minimize their dependence on electrical power. Also NFS has stated that the continued operation of the facility's only essential utility, the water supply to the fire suppression system, does not depend on electrical power. However, in response to a staff concern and to ensure the reliability and availability of the electrical systems, NFS (in the February 14, 2003, letter) has committed to apply the following measures:

1. for the diesel generator - periodic functional testing, periodic battery checks, and configuration control,
2. for the automatic transfer switch - periodic functional testing and configuration control,
3. for the UPS - periodic functional testing, periodic battery checks, and configuration control.

Based on the staff's review of its ISA Summary, the supporting information provided by NFS, and NFS' commitments mentioned above, the staff concludes that the electrical systems adequately support IROFS in satisfying the performance requirements of 10 CFR 70.61(e). Also the staff concludes that the electrical systems are not essential utility services pursuant to 10 CFR 70.64(a)(7). With regard to the water supply, the staff concludes that the municipal water system provides for continued operation of the water supply.

**Inspection, Testing, and Maintenance**

10 CFR 70.64(a)(8) requires that the design of IROFS, "provide for adequate inspection, testing, and maintenance, to ensure their availability and reliability for perform their function when needed." See Section 15 of this SER for the staff's discussion and evaluation.

Based on the staff's review of the ISA Summary, the supporting information provided by the licensee, and the applicable licensee commitments, the staff concludes that the design of the UNB meets the requirements of 10 CFR Part 70.64(a)(8).

**Criticality Control**

10 CFR 70.64(a)(9) requires that the design, "provide for criticality control including adherence to the double contingency principle." See Section 9 of this SER for the staff's discussion and evaluation.

Based on the staff's review of the ISA Summary, the supporting information provided by the licensee, and the applicable licensee commitments, the staff concludes that the design of the UNB meets the requirements of 10 CFR Part 70.64(a)(9).

**Instrumentation and Controls**

10 CFR 70.64(a)(10) requires that the design, "provide for inclusion of instrumentation and control systems to monitor and control the behavior of items relied on for safety." The UNB includes instrumentation and controls for measuring volume, density, flow, pH, and temperature and for functioning as interlocks, monitors, and alarms. In Table 9 of the revised ISA Summary, NFS has listed several safety interlocks which, as active engineered controls, are classified as IROFS for the prevention of specific hazardous events. Also, as part of administrative controls (included as enhanced administrative controls in revised Table 8 contained in NFS' letter dated December 23, 2002), several alarms are discussed in Section 3.1.4 of the revised ISA Summary as IROFS.

The interlocks (active engineered controls) are single independent instrument channels that are used separately or combined into a redundant pair with no common failure modes except loss of electrical power which results in a fail-safe condition. Setpoints for the interlocks and alarms (enhanced administrative controls) are selected using conservative engineering analyses which account for safety limits, instrument and system accuracies, response times, and instrument drift. The analysis for each safety setpoint will be a formal calculation following good engineering practice and will be documented for each applicable IROFS. Calibration and functional test frequencies are also based on the data used in the setpoint determinations.

The central control system

In its February 14, 2003, letter, NFS stated that the CCS performs

Based on the staff's review of its ISA Summary and supporting information provided by NFS, the staff concludes that the instrumentation and controls meet the BDC set forth in 10 CFR 70.64(a)(10).

## 4.6 Defense-in-Depth, 10 CFR 70.64(b)

10 CFR 70.64(b) requires that the facility and system design and facility layout be based on defense-in-depth practices. The design must incorporate, to the extent practicable, a preference for the selection of engineered controls over administrative controls to increase overall system reliability, and features that enhance safety by reducing challenges to IROFS.

### 4.6.1 Discussion

The UNB ISA Summary Appendix A, Part B, lists the considerations made for facility and system design based on defense-in-depth practices. In general, NFS has given the following order of preference for controls:

1. passive engineered controls (listed as the most preferred control),
2. active engineered controls,
3. enhanced administrative controls, and
4. administrative controls (listed as the least preferred control)

NFS stated in the license application that administrative controls are appropriately enhanced through the use of postings, procedures, and computer programs that act as aids for the operator. These controls will have the appropriate safety margins. NFS stated that because of the defense-in-depth practices and as a result of the ISA process for the UNB facility, no scenarios have been identified that challenge IROFS.

### 4.6.2 Evaluation Findings

The NRC staff has reviewed the defense-in-depth features specified to support the function of IROFS and concludes that the design of the UNB facility, and the IROFS in particular, meets the defense-in-depth provisions and the preference to engineered controls over administrative controls stated in 10 CFR 70.64(b).

## 4.7 Additional Content of Applications, 10 CFR 70.65

### 4.7.1 Safety Program

10 CFR 70.65(a) requires that the application, "include a description of the safety program established under 10 CFR 70.62." NFS' plant-wide safety program is

described in Part I, Chapters 1-8 of the license. The UNB amendment application included changes to the Environmental Safety Program, Chapter 5 of the license, to address the management of treated process wastewater and storm water drainage from the BLEU complex. NFS application dated April 14, 2003, clarified that sewer discharge samples would not be collected from the UNB because no radioactive materials would be discharged to the sewer from the UNB. NFS did not propose any other changes to its plant safety programs to accommodate the UNB operations, and NRC staff agree that the current safety programs described in the license are adequate for UNB operations. Although most of its current license remains the same, NFS requested changes to the liquid effluents and sampling in its safety program, which are evaluated in Section 13 of this SER. The NRC staff concluded, in Section 13 of this SER, that NFS' conformance to the application and license conditions provides adequate assurance of the protection of the health and safety of the workers and public, is adequate to protect the environment, and complies with the regulatory requirements imposed by the Commission in 10 CFR Parts 20, 51, and 70.

### 4.7.2 ISA Summary

10 CFR 70.65(b) requires that an ISA Summary be submitted with the license amendment application. 10 CFR 70.65(b)(1) requires that the ISA Summary contain a general description of the site with emphasis on those factors that could affect safety (i.e., meteorology, seismology). NRC staff has reviewed the site description for the NFS UNB according to Section 1.3 of the SRP. In Section 1.0 of the amendment application and in the Environmental Report, NFS adequately described and summarized general information pertaining to 1) site geography, including its location relative to prominent natural and man-made features; 2) population information to show population distribution as a function of distance from the facility; 3) meteorology, hydrology, and seismology for the site, and 4) applicable design basis events. NRC staff verified that the site description is consistent with the information used as a basis for the environmental report, emergency management plan, and ISA Summary. Based on staff review of the submitted information and direct observation of the site, the NRC staff concludes that the general description of the site is acceptable.

10 CFR 70.65(b)(2) requires that the ISA Summary contain a general description of the facility with emphasis on those areas that could affect safety, including an identification of the controlled area boundaries. Section 2.0 of the amendment application described the BLEU complex, which includes the UNB, and showed the location of the controlled area boundaries. Based on the staff review of submitted information against the SRP and based on the NRC staff's direct observation of the site, the NRC staff concludes that this general facility description is acceptable.

10 CFR 70.65(b)(3) requires that the ISA Summary contain a description of each process (defined as a single reasonable simple integrated unit operation within an overall production line) analyzed in the integrated safety analysis in sufficient detail to understand the theory of operation; and for each process, the hazards that were identified in the ISA pursuant to 10 CFR 70.62(c)(1)(i)-(iii) and a general description of the types of accident sequences. Section 3.0 of the ISA Summary included a

description of the UN receipt process and equipment and of the UN storage process and equipment, and the ISA identified several accident scenarios that could lead to unacceptable safety consequences. Based on the staff's review of its ISA Summary and supporting information provided by NFS, the staff concludes that its ISA Summary descriptions of the process, hazards, and accident sequences are acceptable.

10 CFR 70.65(b)(4) requires that the ISA Summary contain information that demonstrates compliance with the performance requirements of 10 CFR 70.61, including a description of the management measures; the requirements for criticality monitoring and alarms in 10 CFR 70.24, and the requirements of 10 CFR 70.64 (baseline design criteria). NRC staff review of the ISA Summary, including management measures applied to IROFS at the UNB, is in Section 7 of this SER. NRC staff review of criticality monitoring and alarms commitments is in Section 9 of this SER. NRC staff review of the baseline design criteria is in Section 4 of this SER. Based on the staff's review of its ISA Summary and supporting information provided by NFS, the staff concludes that the licensee is in compliance with the performance requirements of 10 CFR 70.61(b)(4).

10 CFR 70.65(b)(5) requires that the ISA Summary contain a description of the team, qualifications, and methods used to perform the integrated safety analysis. Sections 4 and 5 of the ISA Summary describe the ISA team, its qualifications, and the method used to perform the ISA. NRC staff review of the team, qualifications, and method is in Section 7 of this SER. Based on the staff's review of its ISA Summary and supporting information provided by NFS, the staff concludes that the descriptions of the ISA team, its qualifications, and methods are acceptable.

10 CFR 70.65(b)(6) requires that the ISA Summary contain a list briefly describing each item relied on for safety which is described in sufficient detail to understand their functions in relation to the performance requirements of 10 CFR 70.61. NFS provided a list of the items relied on for safety in Table 8 of the ISA Summary. This list included an IROFS identification code, a description of the item, its type, whether administrative, active engineered, or passive engineered, its failure index, and the management measures NFS will apply to assure its reliability. NRC staff has determined that this list is complete and acceptable.

10 CFR 70.65(b)(7) requires that the ISA Summary contain a description of the proposed quantitative standards used to assess the consequences to an individual from acute chemical exposure to licensed material or chemicals produced from licensed materials which are on site or expected to be on site as described in 10 CFR 70.61(b)(4) and (c)(4). In Table 2 of its ISA Summary, NFS provided criteria for high consequence, intermediate consequence, and low consequence categories. These categories conform to the high and intermediate consequences specified in 10 CFR 70.61 and the staff finds that these categories are acceptable.

10 CFR 70.65(b)(8) requires that the ISA Summary contain a descriptive list that identifies all items relied on for safety that are the sole item preventing or mitigating an accident sequence that exceeds the performance requirements of 10 CFR 70.61.

Section 8.0 of the UNB ISA Summary states that there are no sole IROFS in the UNB. As discussed in Section 7 of this SER, the licensee identified that there are no sole IROFS. The staff reviewed the licensee's sole IROFS and determined that they are acceptable.

10 CFR 70.65(b)(9) requires that the ISA Summary contain a description of the definitions of unlikely, highly unlikely, and credible, used in the evaluations in the ISA. Section 9.0 of the ISA Summary provided these definitions; NRC staff review is discussed in Section 7 of this SER. The NRC staff concluded that the licensee's application of the terms is acceptable.

## 5. GENERAL INFORMATION

This section requires NFS to describe the activity for which the SNM is requested, the place at which the activity will be performed, and the general plan for carrying out that activity. NFS provided this information in the amendment application. The activity is receipt and storage of low-enriched uranyl nitrate solution, the place will be 200 Oxide Lane in Erwin, TN, and the general plan is described in the amendment application and ISA Summary. NRC staff has determined that these activities are licensable by the Commission under Section 103 of the Atomic Energy Act, in accordance with 10 CFR 70.23(a).

### 5.1 Facility and Process Description

#### 5.1.1 Discussion

The BLEU complex is intended to be built in Erwin, Tennessee. This is located in Unicoi County in the northeast portion of the state. The NFS site is located in a long, narrow valley located in the Appalachian range. The valley is oriented in a south-west to north-east direction.

The proposed site is adjacent to the current NFS processing area. The property lies near the Nolichucky River. The property is bounded by Carolina Avenue to the east, the CSX rail yard to the west, NFS to the north and the Studsvik processing area to the south.

The closest industrial areas are the Studsvik processing facility and the CSX railroad yard. The Studsvik facility is a licensed low level radioactive waste processing facility. The Studsvik facility processes low level contaminated ion exchange resins for the nuclear power industry.

The CSX railroad yard starts approximately one-half mile [800 meters] south of the proposed NFS UNB site and extends several miles [thousands of meters] north into the main yard in downtown Erwin. The yard consists of 7 sets of tracks near the proposed NFS UNB site expanding to 30 sets in the main yard. The speed in the yard is limited to 10 mph [4.4 m/s]. Trains stored or passing through the yard may contain various types of hazardous materials, in addition to railroad refueling operations.

The Tri-cities Regional Airport is approximately 40 miles [65 km] north of the proposed NFS UNB. The airport has an 8,000 foot [2400 meter] primary runway and a smaller secondary runway. The airport is relatively small and a significant distance from the site. Other local airports are in Johnson City and Elizabethton, approximately 25 miles [40 km] from the site. These are small airports.

Carolina Avenue is the local road that may serve the proposed UNB facility and that serves the current NFS facilities. Carolina Avenue runs parallel to the east property boundary.

Uranyl nitrate (UN) solution is proposed to be transported from the U.S. Department of Energy's Savannah River Site in Augusta, Ga., for storage in the UNB. specially designed shipping containers will be carried on a flatbed trailer between the Savannah River Site and NFS. UN solution will be transferred outside the UNB via a flexible piping system. In case of a spill, the transfer area has a minimum [redacted] spill basin.

The BLEU complex property is located in Erwin, Tennessee, that is in the northeast portion of the state. The complex is on NFS owned property and is approximately acres [ hectares] in size. The closest BLEU complex property boundary is approximately feet [ meters] from the UNB exhaust stack and feet [ meters] from the UNB. The closest residence is approximately feet [ meters] from the site boundary. The prevailing wind direction is in the same direction as the orientation of the valley in which the proposed facility is to be located; that is in a southwesterly orientation. The controlled area encompasses the UNB and is surrounded by an access control fence. The UNB is approximately feet [ meters] from the boundary of the BLEU site and feet [ meters] from the edge of the owner controlled area in the direction of the prevailing winds.

The BLEU complex is located on approximately acres of land adjacent to NFS' current processing area. The UNB amendment describes two buildings; the UNB building and the security office. The proposed UNB will be a single story metal building with the approximate dimensions of feet [ meters] by feet [ meters] at the floor and feet [ meters] and feet [ meters] high at the peak of the roof and the eaves, respectively. The UNB is proposed to contain the load/download area, UN storage area, mechanical and electrical rooms, and office area. The building is proposed to be protected by fire alarms and automatic sprinkler systems. In addition to the UNB, the site is to include a perimeter fence, security building, parking area, and areas for the future proposed Oxide Conversion Building (OCB) and associated structures.

NFS has installed 24 UN storage tanks, arranged in four banks of six tanks each. Each UN storage tank is [redacted] A recirculation system will serve each bank. The purpose of this system is to recirculate UN solution within the tanks to maintain a well-mixed solution and to handle transfer of UN solution between the tanks and for sampling. A separate transfer system will pump the UN solution to a future

OCB. The OCB was not a part of the NFS license amendment request and is not a part of this SER. The OCB will be reviewed in a separate future NRC SER.

The UNB storage system performs five operations. They are: filling of the storage tanks from the receiver tank, recirculating UN solution within the storage tanks, transfer of the UN solution between storage tanks in one bank, and transfer of UN solution to the OCB, as discussed previously. During transfer and storage operations, the UN solution will be transferred from the receipt tank to a single bank of six storage tanks. No operations will be carried out on the UN solution other than receipt, sampling, transfer, recirculation, sampling, and spill cleanup. In case of spill in the UN storage area, the UNB has a gallon [ liter] spill basin sized to hold the contents of one full UN storage tank plus 30 minutes of fire water.

### 5.1.2 Evaluation Findings

The staff has reviewed the general facility description for the proposed NFS UNB according to Section 1.1 of the Standard Review Plan. NFS has adequately described (1) the facility and processes so that the staff has an overall understanding of the relationships of the facility features and (2) the function of each feature. NFS has cross-referenced its general description with the more detailed descriptions elsewhere in the application. The staff concludes that NFS has complied with the general requirements of 10 CFR 70.22, "Contents of Applications," 10 CFR 70.60, "Applicability," and 10 CFR 70.65(b)(1), (2), and (3), "Additional Content of Applications," as applicable to this section.

## 5.2 Institutional Information

The staff has reviewed the institutional information for the proposed NFS UNB according to Section 1.2 of the Standard Review Plan. NFS has provided all institutional information necessary to understand the ownership, financial qualifications, location, planned activities, and nuclear materials to be handled in connection with the requested license. On the basis of the review, the NRC staff has determined that NFS has adequately described and documented the corporate structure and financial information, and is in compliance with those parts of 10 CFR 70.22 and 10 CFR 70.65 related to other institutional information.

### 5.2.1 Discussion

#### 5.2.1.1 Corporate Identity

This section concerns the identification of NFS and its corporate ownership. Although Framatome, a corporation with some foreign ownership, is the prime contractor to TVA for the BLEU project, and NFS is a subcontractor to Framatome ANP Richland, Inc., the contract between them does not convey any control or ownership of NFS to Framatome ANP Richland, Inc. Section 1.1 of the license application describes NFS corporate ownership, and NFS' letter dated August 23, 2002, stated that no changes are necessary to Chapter 1, Organization and Administration, of the referenced license with respect to the requirements of 10 CFR 70.22(a)(1). NRC staff finds this acceptable.

### 5.2.1.2 Financial Qualifications

NFS provided a cost estimate for decommissioning of the UNB in the license amendment application and provided a letter of credit to assure that decommissioning funds will be available. NRC staff reviewed the cost estimate and the letter of credit and determined that they were adequate to assure that funds will be available to decommission the UNB at any time during or after its operation. Decommissioning financial assurance is further discussed in Section 14 of this SER.

NFS has been licensed since 1957 to produce highly-enriched fuel for U.S. Government programs. NRC considers that the contract with TVA and Framatome, as documented in the TVA Record of Decision (66 FR 57997, November 19, 2001), and the decommissioning financial assurance instrument demonstrate sufficient financial strength to provide reasonable assurance that NFS is financially qualified to conduct the business activities described in the UNB license amendment application.

### 5.2.1.3 Type, Quantity, and Form of Licensed Material

NFS proposed to increase its possession limit from [redacted] to [redacted] of U-235 to support the BLEU complex. NFS also revised the material description to clarify that the limits specified in License Condition 6.A. for allowable concentrations of contaminants (e.g., plutonium, transuranic materials, and fission products) are based on an average value for the uranium materials in possession. NFS' current authorization to possess highly-enriched uranium and its contaminants is sufficient to bound the low-enriched uranium material and its associated contaminants, therefore the staff concludes that the allowable concentration of low-enriched uranium contaminants is acceptable. The staff finds that NFS has adequately described the types, forms, quantities, and proposed authorized uses of licensed materials to be permitted at this facility, in accordance with 10 CFR 70.22(a)(2) and (4).

### 5.2.1.4 Authorized Uses

NFS requested authorization for receipt and storage of low-enriched uranyl nitrate solution.

### 5.2.1.5 Special Exemptions or Special Authorizations

NFS did not request any special exemptions or authorizations as part of its license amendment request.

### 5.2.2 Evaluation Findings

The staff has reviewed the institutional information for the NFS UNB according to Section 1.2 of the SRP. On the basis of the review, the NRC staff has determined that NFS has adequately described and documented the corporate structure and financial information, and is in compliance with those parts of 10 CFR 70.22 and 10 CFR 70.65 related to other institutional information. In addition, in accordance with 10 CFR

70.22(a)(2) and (4), NFS has adequately described the types, forms, quantities, and proposed authorized uses of licensed materials to be permitted at this facility.

NFS' proposed activities are consistent with the Atomic Energy Act. NFS has provided all institutional information necessary to understand the ownership, financial qualifications, location, planned activities, and nuclear materials to be handled in connection with the requested license.

## 5.3 Site Description

NFS provided a description of the proposed UNB site in its supplement to the Environmental Report and in its ISA Summary.

### 5.3.1 Discussion

The site description is a summary of information, presented in greater detail, in NFS' environmental report, emergency plan, and ISA Summary. The description included geography, population information, meteorology, hydrology, and geology. The staff reviewed NFS' information to confirm that it provided a complete, up-to-date, and consistent description of the site.

#### 5.3.1.1 Site Geography

Erwin, Tennessee, is located in Unicoi County in the northeast portion of the state. The NFS site is approximately 65 acres [26 hectares] of land located in a long, narrow valley located in the Appalachian range, whose peaks have a maximum elevation of 2480 feet [756 meters]. The valley is oriented in a south-west to north-east direction. The site is located at an elevation between 1638 to 1680 feet [499 to 512 meters] above sea level.

#### 5.3.1.2 Population Information

The NFS facility is located approximately fifty miles north-northwest of Asheville, NC and twenty miles south of Johnson City, Tennessee near the southwest boundary of Erwin, Tennessee, in Unicoi County. The 2000 U.S. Census recorded a population in Erwin of 5,610 persons and 17,667 in Unicoi County. A one mile [1.4 km] radius of the site includes residential neighborhoods of Banner Hill, Love Station, and Evergreen. The estimated population within a one mile radius is approximately 2,800 people.

#### 5.3.1.3 Meteorology

The climate in the vicinity is characterized by warm, humid summers and relatively mild winters. Cooler, drier weather in the area is usually associated with polar continental air masses, whereas warmer, wetter weather is generally associated with gulf maritime masses. The average annual temperature in 2000 was 55.1°F [12.8°C]. The average daily minimum temperature was 23.8°F [-4.6°C] in January and 83.4°F [28.6°C] in July.

The average annual precipitation in the Erwin area is 41 inches [104 cm] and the average snowfall is 16 inches [41 cm]. Prevailing winds tend to be from the southwest following the orientation of the valley. The 30 year average wind speed is 6.9 mph [3.1 m/s].

Severe storm conditions are rare in the Erwin, TN area. This area is east of the center of tornado activity, south of blizzard areas, and too far inland to be affected by hurricane activity. The National Oceanic and Atmospheric Administration (NOAA) regional data recorded a maximum wind speed of 50 mph [22 m/s] in 1951, and a peak wind gust of 86 mph [38 m/s] in 1995. Wind data from the NFS site collected over the last three years indicate a maximum sustained wind speed of 29 mph [13 m/s].

Only one tornado has been recorded in the county since 1950. Two adjacent counties have reported two tornados each over the same period. The topography of the area provides a measure of protection against tornados. For Unicoi County, data indicate a probability of 2 tornados per 100 years over 186 sq. miles [48,174 hectares] or a probability of 2.5E-6 per year for a tornado striking a site the size of the NFS controlled area (     sq. miles [     hectares]).

### 5.3.1.4 Hydrology

The majority of the information reviewed by the staff was provided in the NFS' environmental report for the renewal of its license dated December 1996. There are four major surface water bodies: Banner Spring Branch, North Indian Creek, Martin Creek, and the Nolichucky river. Banner Spring Branch lies entirely within NFS property, North Indian Creek is north of the site, Martin Creek lies just north of the north site boundary, and the Nolichucky river is west of the site boundary. Surface water runoff from the NFS site and BLEU complex will be directed into Martin Creek via local branch streams and site drainage structures. Martin Creek empties into North Indian Creek and then into the Nolichucky River. Groundwater flows in a generally northwest direction towards the Nolichucky river. Groundwater quality is generally good with principal dissolved constituents being calcium, magnesium carbonate, and bicarbonate. The 100-year flood plain for Martin Creek is at an elevation of 1,640 feet [500 meters] above sea level. The floor of the UNB is 1,655 feet [504 meters] above sea level, well above the 100-year flood plain. The NFS site is not within the 100-year flood plain for the Nolichucky river. Recent developments have had the additional effect of protecting the site from flooding. These developments include the construction of US Routes 19/23 and the related re-channeling of the Nolichucky and re-routing of Martin Creek. The NFS site northern boundary is within the 100 year flood plain for Martin Creek. Recent changes in a drainage culvert by the CSX railroad may have a positive effect on the 100 year flood elevation.

### 5.3.1.5 Geology

The site is located in Southern Appalachian Tectonic Province, extending from central Virginia to central Alabama and from the western edge of the Piedmont Province to the Cumberland Plateau Province. This area has a moderate level of historical earthquake activity. The NFS site is designated as Seismic Zone IIC. There is no evidence of capable faults (defined in 10 CFR 100) in the immediate area of NFS. NFS has done a seismic analysis of the site and determined that there is no evidence of geologically recent fault displacements on the site associated with capable faults in the region. The analysis concluded that an effective peak horizontal ground acceleration of 0.06 gravity may be expected to occur at a 1000-year return period. The environmental review concluded that a maximum of 0.18 gravity earthquake could occur once every 2000 years.

In its environmental report, NFS provided additional information on the physiography and geology of the site. Three dolomite formations underlying the valley are associated with a large band of sandstone, siltstone, shale, dolomite, and limestone. Large areas of these formations are covered by deep soils originating from adjacent mountains and from stream flooding. Consolidated bedrock underlying the site either provides firm foundations for buildings or for building footings. Structures constructed on unconsolidated alluvium in the former flood plains and terraces of the Nolichucky river are subject to settlement during the first 2-3 years following construction. The NFS site is not likely to experience slope failure or erosion or river bank slope failures due to its location on the former flood plain and its setback from the river.

### 5.3.2 Evaluation Findings

The staff has reviewed the site description for the NFS UNB according to Section 1.3 of the SRP. NFS has adequately described and summarized general information pertaining to (1) site geography, including its location relative to prominent natural features and infrastructure such as mountains, rivers, airports, population centers, schools, and commercial and manufacturing facilities; (2) population distribution as a function of distance from the facility; (3) meteorology, hydrology, and geology for the site; and (4) applicable design basis events. The reviewer verified that the site description is consistent with the information used as a basis for the environmental report, emergency management plan, and ISA Summary.

## 6. ORGANIZATION AND ADMINISTRATION

This chapter of the SER reviews the organization and administration information presented in NFS' license amendment request. The objective of the review was to determine whether NFS qualified by reason of training and experience to use the material for the purpose requested in accordance with the regulations in 10 CFR Part 70. This review also ensures that the qualifications for key management positions are adequate.

NFS' current organization and administration is described in its Materials License, SNM-124, Part I, Chapter 2. The NFS license amendment request, dated February 28, 2002, did not propose changes to the NFS organization and administration. In the 1999 license renewal, the NRC staff reviewed the management organization and minimum technical qualifications. The NRC staff determined that NFS is qualified, by reason of training and experience, to use SNM for the manufacture and development of uranium fuel. Based on similarities between the management organization, administration, and fuel processes reviewed during the license renewal and the management organization, administration, and fuel processes in this UNB amendment, the NRC staff concluded that NFS' management organization and administration are sufficient to safely manage operation of the UNB.

## 7. SAFETY PROGRAM AND INTEGRATED SAFETY ANALYSIS (ISA)

10 CFR 70.62 requires the licensee to establish and maintain a safety program, including performance of an ISA. The ISA must demonstrate that all credible high and intermediate consequence events meet the performance requirements specified in 10 CFR 70.62(c). The regulations also require the licensee to maintain the ISA and related documentation to reflect changes made to the site, structures, processes, systems, equipment, components, computer programs, and personnel activities.

### 7.1 Safety Program

This chapter of the SER contains the staff's review of the ISA Summary submitted by NFS to support the license amendment request for the UNB. The objective of this review is to determine whether the performance requirements of 10 CFR 70.61 are met. The staff evaluated the information provided in the NFS request, supplementary information provided by NFS, and relevant documents available at NFS' offices. The review of IROFS and strategies was closely coordinated with the review of evaluations performed in other chapters of this SER.

The staff reviewed how the ISA Summary addressed:

- 10 CFR 70.61 requires compliance with the performance requirements (e.g., consequences and associated likelihoods and the risk of nuclear criticality accidents).
- 10 CFR 70.62 requires a safety program, process safety information, an ISA, and management measures demonstrating compliance with the above.
- 10 CFR 70.64 requires BDC and defense-in-depth practices be incorporated into the design of new facilities.

The staff used Chapter 3.0 in the SRP as guidance in performing the review. The review focused on the hazard assessment and other information. The review also included consideration of IROFS features such as redundancy, independence, reliability, and quality. The staff reviewed descriptions of the systems to assure that the facility will be designed to meet the performance requirements of 10 CFR 70.61 during operation of the facility. Much of the review was directed at NFS' consequence analysis (including natural phenomena and external events) and the formulation of a strategy and identification of IROFS to meet the performance requirements.

The safety assessment review used an integrated team approach. Team members with expertise in the various areas of technical review such as chemical, electrical, mechanical, fire protection engineering, radiation protection, nuclear criticality safety and other disciplines reviewed their respective chapters as well as the ISA methodology and ISA Summary.

## 7.2 Process Safety Information

10 CFR 70.62(b) requires the licensee maintain process safety information enabling the performance and maintenance of an ISA. This process safety information must include information pertaining to the hazards of the materials used or produced in the process, information pertaining to the technology of the process, and information pertaining to the equipment in the process. In the NRC-approved ISA Plan, NFS committed to maintain process safety information for all processes for which an ISA is required. The NRC staff finds this commitment to be acceptable.

By letter, dated August 23, 2002, NFS committed to establishing and maintaining records that demonstrate compliance with 10 CFR 70.62, Safety Program and Integrated Safety Analysis, requirements. The NFS ISA Summary specifies the records-keeping requirements for the management measures designed to maintain the reliability of IROFS. Current licensing requirements in the license (SNM-124, Section 2.11.2) are credited to meet this requirement. NRC staff concludes that this meets the acceptance criterion of the SRP and is therefore, acceptable.

NFS' Configuration Management Program is credited with identifying and controlling plant equipment, structures, systems, and components. Proposed changes to these items, are submitted to the safety discipline manager for review to determine if a license amendment is required or if the change can be made under NFS' internally authorized change process. NFS' current License Condition S-25 meets 10 CFR 70.72. NRC staff concludes that this meets the acceptance criterion of the SRP and therefore finds this to be acceptable.

## 7.3 Integrated Safety Assessment

In its ISA Summary, dated August 2002, NFS stated that it took the following steps in the performance of its analysis: 1) individual and specific hazards analyses were performed to identify hazards and accident sequences, 2) consequence assessment and risk categorization of all accident sequences, and 3) IROFS were identified. See Figure 7-1 for a graphical depiction of the ISA process.

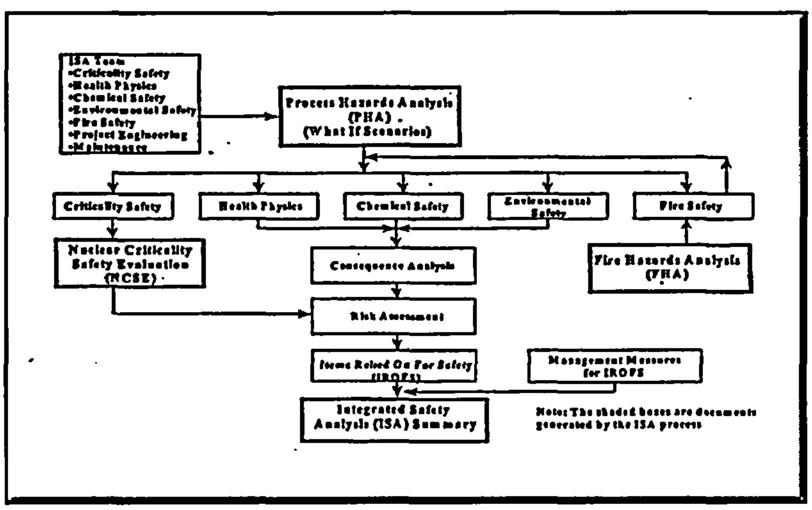

Figure 7-1

### 7.3.1 Discussion

10 CFR 70.65(b) requires that the ISA Summary be submitted with the license amendment application. The ISA Summary must contain the elements discussed below.

#### 7.3.1.1 Site

10 CFR 70.65(b)(1) requires, "a general description of the site, with emphasis on those factors that could affect safety (*i.e.,* meterology, seismology)." NFS described the site in the license amendment request, specifically in the environmental report and in the ISA Summary supporting the request. NFS provided detailed site information in its environmental report for renewal of its license, dated December 1996.

The BLEU complex is intended to be built in Erwin, Tennessee. This is located in Unicoi County in the northeast portion of the state. The NFS site is approximately acres [ hectares] of land located in a long, narrow valley located in the Appalachian range, whose peaks have a maximum elevation of 2480 feet [756 meters]. The valley is oriented in a south-west to north-east direction. The site is located at an elevation between 1638 to 1680 feet [499 to 512 meters] above sea level.

Nearby features include the Studsvik Processing Facility, IPF Warehouse, Impact Plastics Poly Pipe, Georgia Pacific, A B Plastics, Bear Mountain Outfitters, Southside Volunteer Fire Department, Love Chapel Elementary School, a high school stadium, Erwin Modular Structures, Holiday Inn Express, Erwin Health Care Center, Erwin State Fish Hatchery, Red Cap Industries, a public housing project, Whites Shopping Center, the Tri-cities Regional Airport, Carolina Avenue, Jackson Love Highway, Chestoa Pike, State Route 23, and the CSX Transportation railroad yard.

The NFS facility is located approximately fifty miles north-northwest of Asheville, North Carolina, and twenty miles south of Johnson City, Tennessee, near the southwest boundary of Erwin, Tennessee. The 2000 U.S. Census recorded a population in Erwin of 5,610 persons and 17,667 in Unicoi County. A one mile [1.6 km] radius of the site includes residential neighborhoods of Banner Hill, Love Station, and Evergreen. The estimated population within a one mile radius is approximately 2,800 people.

The licensee has considered the natural phenomena and external events in its ISA Summary. These phenomena and events include factors that could effect process equipment and operability of equipment, or be hazardous to on-site personnel. The NRC considered the following off-site phenomena and events: earthquake, flooding, windstorm, snow loading, heavy rain, high and low ambient temperatures, hurricane, tornado, lightning, nearby industrial accidents, aircraft and traffic accident, offsite fire, and site evacuation. The staff considered the following on-site events and site layout analyses: on-site accidents (including credible fire and explosion events), location of on-site personnel, locations of critical systems, potential interactions with adjacent systems, on-site traffic patterns, evacuation routes and emergency exits and gathering places, and access for fire-fighting and other emergency services.

The site is located in Southern Appalachian Tectonic Province, extending from central Virginia to central Alabama and from the western edge of the Piedmont Province to the Cumberland Plateau Province. This area has a moderate level of historical earthquake activity. The NFS site is designated as Seismic Zone IIC specified in Section 1607 of the 1999 Standard Building Code. There is no evidence of capable faults (defined in 10 CFR 100) in the immediate area of NFS. NFS has done a seismic analysis of the site and determined that there is no evidence of geologically recent fault displacements on the site associated with capable faults in the region. The analysis concluded that an effective peak horizontal ground acceleration of 0.06 gravity may be expected to occur at a 1000-year return period. The environmental review concluded that a maximum of 0.18 gravity earthquake could occur once every 2000 years.

The climate in the vicinity is characterized by warm, humid summers and relatively mild winters. Cooler, drier weather in the area is usually associated with polar continental air masses, whereas warmer, wetter weather is generally associated with gulf maritime masses. The average annual temperature in 2000 was 55.1°F [12.8°C]. The average daily minimum temperature was 23.8°F [-4.6°C] in January and 83.4°F [28.6°C] in July.

The average annual precipitation in the Erwin area is 41 inches [104 cm] and the average snowfall is 16 inches [41 cm]. Prevailing winds tend to be from the southwest following the orientation of the valley. The 30 year average wind speed is 6.9 mph [3.1 m/s].

Severe storm conditions are rare in the area. This area is east of the center of tornado activity, south of blizzard areas, and too far inland to be affected by hurricane activity. NOAA regional data recorded a maximum wind speed of 50 mph [22 m/s] in 1951, and a peak wind gust of 86 mph [38 m/s] in 1995. Wind data from the NFS site collected over the last three years indicate a maximum sustained wind speed of 29 mph [13 m/s]. A risk analysis of the site indicated a moderate to severe risk of facility damage due to lightning strike.

Only one tornado has been recorded in the county since 1950. Two adjacent counties have reported two tornados each over the same period. The topography of the area provides a measure of protection against tornados. For Unicoi County, data indicate a probability of two tornados per 100 years over 186 sq. miles [48,174 hectares], or a probability of 2.5E-6 occurrences per year for a tornado striking a site the size of the NFS controlled area (      sq. miles [      hectares])

Based on the staff review of submitted information against the SRP and based on the NRC staff's direct observation of the site, the NRC staff concludes that this description is acceptable.

**7.3.1.2 Facility**

10 CFR 70.65(b)(2) requires that NFS submit, "a general description of the facility with emphasis on those areas that could affect safety, including an identification of the controlled area boundaries." For a complete description of the facility, refer to Section 5.1.1 of this SER.

In the revised ISA Summary, NFS stated, "The Controlled Area encompasses the UNB, which encloses the tanker load and unload areas. The Controlled Area is surrounded by an access control fence line patrolled by armed guards." NFS also showed in its Figure 1 that a "Controlled Access Area" surrounds the BLEU complex. Due to the ambiguity created by the use of terms, "Radiation Controlled Area," and "Controlled Access Area," NFS committed to revise the figure in its ISA Summary Revision 2, to identify the "Controlled Area Boundary," and "Owner Controlled Area." NFS stated that for the purposes of this license amendment request, the "Controlled Area Boundary" is equivalent to a "Restricted Area" as defined in 10 CFR 20.1003 and its current license. NFS' revised figure is given in Figure 7-2. The NRC staff has reviewed both the facility description and the revised "controlled area boundary," "radiation controlled area," and "owner controlled area," boundaries and finds the facility description and identified boundaries to be acceptable.

Figure 7-2, NFS Site Area Boundaries

**7.3.1.3 Processes, Hazards, and Accident Sequences**

10 CFR 70.65(b)(3) requires a description of each process analyzed in the ISA in sufficient detail to understand the theory of operation; and for each process, the hazards that were identified in the ISA, pursuant to Section 70.62(c)(1)(i)-(iii) and a general description of the types of accident sequences.

### 7.3.1.3.1 Processes

**Uranyl Nitrate Receipt Process**

UN solution is proposed to be transported from the U.S. Department of Energy's Savannah River Site, in Augusta, Georgia, for storage in the UNB.

. Following receipt and acceptance of the delivery at NFS, the UN solution will be transferred via a flexible piping system equipped with special fittings designed to mate only with the containers. In addition, the flexible piping and fittings will be installed so that they will not be easily connected to containers at ground level. In case of a spill, the transfer area is proposed to have a minimum gallon [ liter] spill basin sufficient to handle a "worst-case" spill plus fire suppression water.

Once connected to the container, compressed air is used to force the UN solution from the container into the transfer line. The compressed air addition to the Liqui-Rad container will be terminated and vented, and the transfer line closed, if the temperature of the UN solution is below °F [ °C]. If the temperature of the UN solution is greater than or equal to °F [ °C], the solution will be transferred to a receiver tank in the UNB. The receiver tank is a [redacted] [redacted] seismically designed stainless steel pressure vessel. This tank is equipped with instrumentation for measuring volume, density, and temperature of its contents.

The UNB is

, mechanical and electrical rooms, and office area. The building is protected by fire alarms and automatic sprinkler systems. In addition to the UNB, the site is to include a perimeter fence, security building, parking area, and areas for the future proposed OCB and associated structures. A [redacted] utility storage tank is connected to the receiver tank for the storage and recycling of solutions from spills and other miscellaneous sources. This tank is equipped with instrumentation for measuring volume, density, and temperature of its contents.

. See the complete discussion on the proposed instrumentation and control system in Section 4.6 SER.

**UN Storage Process**

NFS has installed 24 UN storage tanks, arranged in four banks of six tanks each. Each UN storage tank is [redacted] A recirculation system will serve each bank. The purpose of this system is to recirculate UN solution within the tanks to maintain a well-mixed solution and to handle transfer of UN solution between the tanks and for sampling. A separate transfer system will pump the UN solution to a future proposed OCB. The OCB is not a part of this SER. The OCB will be reviewed in a separate future NRC SER. Instrumentation will monitor storage tank solution density, volume, and temperature.

The UNB storage system has five operations. They are: filling of the storage tanks from the receiver tank, recirculating UN solution within the storage tanks, transfer of the UN solution between storage tanks in one bank, and transfer of UN solution to the OCB, as discussed previously. During transfer and storage operations, the UN solution will be transferred from the receipt tank to a single bank of six storage tanks. Approximately one-sixth of the solution will go into each of the six tanks in turn. No operations will be carried out on the UN solution other than receipt, sampling, transfer, recirculation, sampling, and spill cleanup.

In case of spill in the UN storage area, the UNB is proposed to have a gallon [ liter] spill basin sized to hold the contents of one full UN storage tank plus 30 minutes of fire sprinkler water.

The only chemicals used in the UNB related to the process are Uranyl Nitrate and distilled water. Other standard industrial chemicals are likely to be used (e.g., solvents, cleaners, paint, paint thinners, etc.). Basic and acidic waste solutions will be collected separately and treated at the NFS waste water treatment facility using precipitation and ion exchange processes. Press cake and other solid waste will be packaged and transported for disposal at a licensed facility. Water collected from evaporation will be stored and sampled before discharge to the sanitary sewer after verification of compliance with the pretreatment permit. Radioactive wastes will be volume reduced by evaporation and/or compaction and will be shipped to licensed burial sites for disposal.

### 7.3.1.3.2 Hazards

The primary hazard identified in this facility is an inadvertent criticality, a high consequence event. Natural phenomena hazards have the potential to lead to intermediate (environmental) consequences. No chemical or radiological hazards were identified to exceed the performance requirements of 10 CFR 70.61. These hazards are discussed in subsequent sections.

NFS submitted an ISA Summary for the UNB, as required by 10 CFR 70.65, with the license amendment application. NFS identified the radiological, chemical and facility hazards related to the possession of large quantities of licensed material in the UNB. NFS identified the radiological, chemical, and facility hazards related to the receipt of licensed material from shipping containers into the receiver tank TK-10 in the UNB. NFS also evaluated the radiological, chemical, and facility hazards related to the storage of licensed material in the UNB.

**Criticality Event**

NFS performed a process hazards analysis to identify potential accident conditions, including both process upsets and natural phenomena events. The NFS team then identified accident sequences using a hazard and operability (HAZOP) methodology.

For each credible accident sequence a consequence category was assigned, as described in Section 4.7.1 of the ISA Summary. For those with undesirable consequences, controls were identified to prevent or mitigate consequences. Accident sequences with intermediate or high consequences are documented in Section 3 of the NFS ISA Summary. The criticality accident scenarios identified are considered high consequence events due to potential impact to workers.

NFS has chosen to treat high and low temperature events in its ISA Summary as process hazards instead of natural phenomena hazards. NFS has further broken down the hazard into 1) a low temperature event during UN receipt, 2) a low temperature event during UN storage, and 3) a high ambient temperature event during UN storage. For these events, NFS has identified IROFS as appropriate to reduce the risk of an accident that may have high or intermediate consequences. NFS stated, in its December 23, 2002, letter, that the design basis of the building temperature control system and backup system are given in IROFS Table 9 of the UNB application and the design specifications and performance calculations will be in permanent records for each of these systems. The staff concludes that NFS' evaluation of these hazards is acceptable.

**Natural Phenomena Hazards**

The facility design must provide for adequate protection against natural phenomena with consideration of the most severe documented historical events for the site. NFS provided in its ISA Summary analyses of 30 events including: earthquake, high winds, tornado, flood, bulk chemical storage accident, adjacent industrial facility accidents and explosions, criticality accident, railroad accident, plane crash, freeway traffic accident, meteorite impact, fire, explosion, electrical short circuit, and lightning strike.

NFS has identified natural phenomena hazards including estimated frequency and severity, consequences, IROFS, and associated management measures, and has committed to address credible natural phenomena hazards in its ISA.

Earthquake - NFS has specified a seismic design basis for the UNB of 0.1g horizontal and vertical effective peak acceleration. Based on historical and geological records, this translates into a design for a 2000 year earthquake return frequency. This shaking level is in accordance with Seismic Zone IIC specified in Section 1607 of the 1999 Standard Building Code. This is an industry code that gives accepted design values for new construction. This code-specified shaking level is greater than the NFS analysis that concluded the 1000-year earthquake yielded a 0.06g effective peak horizontal ground acceleration. The licensee has met the NRC's SRP Section 1.3.4.3(4) guidance for a summary description of the geology and seismicity of the area and exceeds earthquake accelerations associated with 250-year and 500-year earthquakes. The staff finds this design basis to be acceptable.

Explosions - During the evaluation of consequences, the staff reviewed likely sources of flammable/explosive materials listed by NFS in the ISA. Examples of such sources are diesel fuel, gasoline, propane, hydrogen, and natural gas contained in rail cars, on trucks, in an underground pipeline, or located on the site. The staff evaluated the likelihood of a rail car accident in the CSXT rail yard adjacent to the site. The staff reviewed the August 2002, Safety and Compliance Program Report for CY 2001, from the Federal Railroad Administration (FRA). The staff used the data presented in the report to arrive at an estimate of the likelihood of an accident in the CSXT rail yard that could initiate the evaluated explosion scenario. For the year 2001, the train accident rate was 4.17 accidents per million train-miles [2.6 accidents per million train-kilometers] (on 265,000 miles [426,000 kilometers] of track). The FRA also states that the number of hazardous material releases was 31 in more than 2 million shipments. The staff assumption that the total length of rail in the CSXT yard is 1 mile [1.6 km] gives a likelihood of approximately 3.8E-6 of occurring on a train in the rail yard in one year. This accident rate is extremely low. Therefore, the staff finds the likelihood of this type of accident occurring at the rail yard adjacent to the proposed NFS UNB building is not credible.

NFS stated in its December 23, 2002, letter that explosions, such as those mentioned previously, would most likely be bounded by a hydrogen storage tank scenario. NFS stated that liquid hydrogen, gaseous hydrogen, and liquified propane gas are stored on the site. In addition, NFS stated that a hydrogen vapor cloud explosion is not a credible event due to the dispersion characteristics of hydrogen. Based on the NRC staff's review of the industry codes and standards (such as NFPA 58), historical accounts of these types of explosions, the design and operation of the storage facilities in accordance with industry standards, and the out-of-doors location of the tanks, the staff finds that this type of accident is not credible for this facility.

The staff also reviewed the licensee's assessment of controls related to the use of natural gas on the site. NFS' original application stated that for the purposes of preventing and mitigating a fire caused by the natural gas heaters, a 12" [.3 meter] concrete block wall and the natural gas supply system were IROFS. As a result of additional study of the process hazard analysis (PHA) by NFS, the hazard and engineering and administrative controls were changed. By letter dated December 23, 2002, NFS stated that the PHA deemed the natural gas fire event to be a low consequence event and a natural gas explosion in the UNB Mechanical Room to be a high consequence event resulting in a loss of uranium containment from multiple tank failures. As a result, NFS has changed to a prevention strategy for the postulated explosion event, and has identified 2 active engineered IROFS and a defense-in-depth measure to reduce the likelihood of the event. These IROFS are two independent active double block and bleed isolation valves working in concert with two independent combustible gas detectors inside [redacted]. These valves and interlocks will fail safe to a closed position on loss of power. Included in this system is one low pressure switch on the gas line that activates the block and bleed system as well. Defense in depth consists of the natural gas burner system internal controls (such as a flame detector) and an automatic fire suppression system designed to limit the growth of a fire and the extent of damage. The staff finds this revised description of the explosion hazard, the evaluation of the consequences, and identification of the IROFS and defense-in-depth controls to be acceptable.

Lightning Strike Event - NFS stated in its ISA Summary that the UNB has a moderate to severe risk of being damaged by lightning. NFS stated in its August 2002 submittal that the design of the UNB facility includes lightning strike. The UNB will be built to applicable portions of NFPA-780, "Standard for the Installation of Lightning Protection Systems," 2000 edition. However, NFS stated, in its February 14, 2003, letter, that it has not identified any credible lightning strike scenarios that would result in a high or intermediate consequence event. Therefore, no IROFS have been identified for this postulated event. The staff finds the analysis of this event to be acceptable.

Flooding - The majority of the information reviewed by the staff was found in the NFS' environmental report for the renewal of its license, dated December 1996. There are four major surface water bodies: Banner Spring Branch, North Indian Creek, Martin Creek, and the Nolichucky river. Banner Spring Branch lies entirely within NFS property, North Indian Creek is north of the site, Martin Creek lies just north of the north site boundary, and the Nolichucky river is west of the site boundary. Surface water runoff from the NFS site and BLEU complex will be directed in to Martin Creek via local branch streams and site drainage structures. Martin Creek empties into North Indian Creek and then into the Nolichucky River. Groundwater flows in a generally northwest direction towards the Nolichucky river. Groundwater quality under the UNB is generally good with principal dissolved constituents being calcium, magnesium carbonate, and bicarbonate. The 100-year flood plain for Martin Creek extends to an elevation of 1,640 feet [500 meters] above sea level. The floor of the UNB is proposed to be 1,655 feet [504 meters] above sea level, well above the 100-year flood plain. The NFS site is not within the 100 year flood plain for the Nolichucky river. Recent developments have had the additional effect of protecting the site from flooding. These developments include the construction of US Routes 19/23 and the related re-channeling of the Nolichucky and re-routing of Martin Creek. The NFS site northern boundary is within the 100 year flood plain for Martin Creek. Recent changes in a drainage culvert by the CSX railroad may have a positive effect on the 100 year flood elevation.

The lowest proposed floor elevation for the UNB located in the flood plain is 15 feet [4.5 meters] above the Base Flood Elevation. NFS has stated that its PHA has found no credible accident scenarios resulting from local area flooding because the storage tanks are bolted in place and the facility is above the 100 year flood plain Base Flood Elevation. Due to the not-credible nature of a flooding event that would lead to offsite consequences, IROFS are not required. The staff has reviewed the use of the 100 year flood design basis against the acceptance criteria given in the SRP and finds this design basis and hazard evaluation to be acceptable. The staff also finds that the licensee has adequately described the hydrology for the area, has adequately described the design basis flood event, and has adequately provided descriptions that are consistent with the more detailed information submitted in other documents, e.g., the environmental report.

High Wind/Hurricane/Tornado - The licensee discussed high wind occurrences at the proposed facility. NOAA data indicates that the maximum sustained wind speed and peak gust for the regional airport are 50 mph [22 m/s] (recorded in 1951) and 86 mph [38 m/s] (recorded in 1995), respectively. High wind speeds are postulated to result in a high consequence event. In its February 14, 2003, letter, NFS committed to a 70 mph [31 m/s] wind speed as the facility design bases in accordance with the 1999 Standard Building Code. As a result, NFS has identified the structural steel components and building foundations as IROFS to prevent the postulated event. The NRC staff reviewed NFS' analysis of high winds and finds the hazards, consequences, and IROFS to be acceptable.

Based on a review of historical data and due to the location of the facility far inland, NFS stated in its December 23, 2002, letter, that the risk of a hurricane was not credible. The staff has reviewed NFS' analyses of hurricanes, and finds the hazards, consequences, and IROFS to be acceptable.

NFS stated, in its December 23, 2002, submittal, that there has been only one recorded tornado in Unicoi County, Tennessee in the last 50 years. The last tornado was recorded on July 10, 1980. The adjacent counties of Washington and Carter reported two tornados each in the last 50 years. This information supports the frequency information for Unicoi County. NFS estimated the likelihood of a tornado striking the NFS controlled area at 3.0E-7 occurrences per year. No intermediate or high consequence events or IROFS have been identified. This estimate results in NFS finding the likelihood of a tornado striking the facility to be not credible. NRC staff has reviewed the licensee's analysis of tornados and finds the hazards, consequences, and IROFS to be acceptable.

Heavy Rain/Heavy Snow - In a Request for Additional Information (RAI), dated November 28, 2002, NRC requested additional information regarding the hazard that a maximum expected rain event may pose to the proposed facility. NFS stated that the PHA determined that damage to the UNB roof would be unlikely due to its design; sloping roof with no parapets. The maximum sustainable roof load would occur during snow loading and maintenance/construction. These design loads are specified by the Southern Building Code (SBC). NFS' facility roof design is a slope of approximately 1 foot [0.3 meter] rise/fall for every 3.3 foot [1 meter] run, or a 17 degree pitch on the roof. The staff has reviewed NFS' evaluation. Based on the building roof design and applicable codes and standards for snow loading, the staff agrees that the hazard would not have consequences meeting or exceeding 10 CFR 70.61.

Off-Site Fires - In its application, NFS described in accident Scenario 12, Studsvik bulk chemical storage accident resulting in explosion or fire. Due to the design of the UNB facility for internal fires, the likelihood that an external fire would result in a high or intermediate consequence event was judged to be not credible. Other mitigating factors include the distance from the site boundary to the UNB, a 50 foot [15 meter] fire break located around the property, the UNB construction with non-combustible materials, and fire response groups from both NFS and the Erwin Fire District within close proximity to any offsite fires. The staff has reviewed NFS' assessment and based on industrial codes and standards and standard industry practices, finds it to be acceptable.

**Non-Process Hazards**

These hazards are primarily classified by NFS to be fires. Fire hazards and accident scenarios are discussed in Section 11 of this SER.

### 7.3.1.3.3 Accident Sequences

In its ISA Summary, NFS provided a list of potential accident sequences that could be caused by process deviations or other events internal to the facility and credible external events, including natural phenomena, that can exceed the performance requirements of 10 CFR 70.61. The hazards are discussed in the previous section. The staff also reviewed NFS' list of IROFS for the UNB. The following table gives the accident sequences, hazards, and associated IROFS:

**Table 7-1 NFS Proposed IROFS and Accident Sequences[1]**

| # | IROFS ID. | IROFS Description | Accident Sequence | Hazard |
|---|---|---|---|---|
| 1 | UNB-A | | | Criticality |
| 2 | UNB-B | | | Criticality |
| 3 | UNB-C | | | Criticality |
| 4 | UNB-D | | | Criticality |
| 5 | UNB-E | | | Criticality |

[1-4]Note to readers: This table does not list analyzed accident scenarios that were eliminated from consequence evaluation due to the conclusion that they were not credible.

| # | IROFS ID. | IROFS Description | Accident Sequence | Hazard |
|---|---|---|---|---|
| 6 | UNB-F | | | Criticality |
| 7 | UNB-G | | | Criticality |
| 8 | UNB-H | | | Criticality |
| 9 | UNB-I | | | Criticality |
| 10 | UNB-J | | | Criticality |
| 11 | UNB-K | | | Criticality |
| 12 | UNB-L | | | Criticality |
| 13 | UNB-M | | | Criticality |
| 14 | UNB-N | | | Criticality |
| 15 | UNB-O | | | Criticality |
| 16 | UNB-P | | | Criticality |
| 17 | UNB-Q | | | Criticality |
| 18 | UNB-R | | | Criticality |

| # | IROFS ID. | IROFS Description | Accident Sequence | Hazard |
|---|---|---|---|---|
| 19 | UNB-S | | | Criticality |
| 20 | UNB-T | | | Environmental |
| 21 | UNB-U | | | Environmental |
| 22 | UNB-V | | | Environmental |
| 23 | UNB-W | | | Criticality |
| 24 | UNB-1* | | | Environmental |
| 25 | UNB-2* | | | Environmental |
| 26 | UNB-3* | | | Environmental |

** These IROFS were identified in the NFS letter dated December 23, 2002.*

The staff has reviewed NFS' identification of accident sequences against the acceptance criteria of the SRP. The staff finds that NFS used an acceptable hazard identification methods and process hazard analysis, the methods were correctly applied, NFS did not overlook any credible accident sequences and identified all processes, therefore the staff concludes that the licensee's analysis of accident sequences is acceptable.

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

10 CFR 70.61(a) requires NFS to, "evaluate, in the ISA performed in accordance with 10 CFR 70.62, its compliance with the performance requirements in (b), (c), and (d)." 10 CFR 70.61(b) requires that credible high-consequence events, as defined, are limited by engineered and administrative controls, such that, upon implementation of the

controls, the events are highly unlikely. 10 CFR 70.61(c) requires, in part, that credible intermediate consequence events, are limited by engineered and administrative controls, such that, upon implementation of the controls, the events are unlikely. 10 CFR 70.61(d) requires that nuclear criticality accidents are limited such that, "under normal and credible abnormal conditions, all nuclear processes are subcritical, including use of an approved margin of subcriticality for safety." NRC reviewed the accident sequences described in its ISA Summary that NFS determined could result in an accidental criticality. NRC staff also reviewed other accident sequences, during the on-site reviews, that NFS concluded did not result in intermediate or high consequences. During these reviews, NRC staff identified additional accident initiators, such as an explosion external to the UNB, e.g., at the neighboring nuclear facility or railroad, that NFS had not considered, NFS agreed to analyze the likelihood and consequences of these events, and concluded that the consequences of an accident were low. The NRC staff's independent evaluation concluded that, although these types of accidents could meet or exceed intermediate consequences, as defined in 10 CFR 70.61, these accidents were not credible. Therefore, the staff concluded that no engineered or administrative controls are required to meet 10 CFR 70.61(b).

#### 7.3.1.4.1 Compliance with 10 CFR 70.61 for Accident Sequence Evaluation and IROFS Designation

The NRC staff has reviewed its ISA Summary, based on the acceptance criteria in the SRP, to verify that NFS provided sufficient information demonstrating that 1) credible high-consequence events are highly unlikely and 2) credible intermediate-consequence events are unlikely. The SRP criteria for acceptance are based on the ISA Summary's presentation of completeness, consequences, and likelihood.

**Completeness**

NFS used a process hazards analysis method (Figure 7-3) to identify undesirable consequences for a process or activity. As part of this analysis for process hazards, NFS applied the HAZOP method to the NFS UNB process that included all UNB operations, solution unloading from transport containers, natural uranium nitrate (NUN) solution transfers from the OCB building (an as-yet unlicensed facility) and NUN loading to tanker trucks.

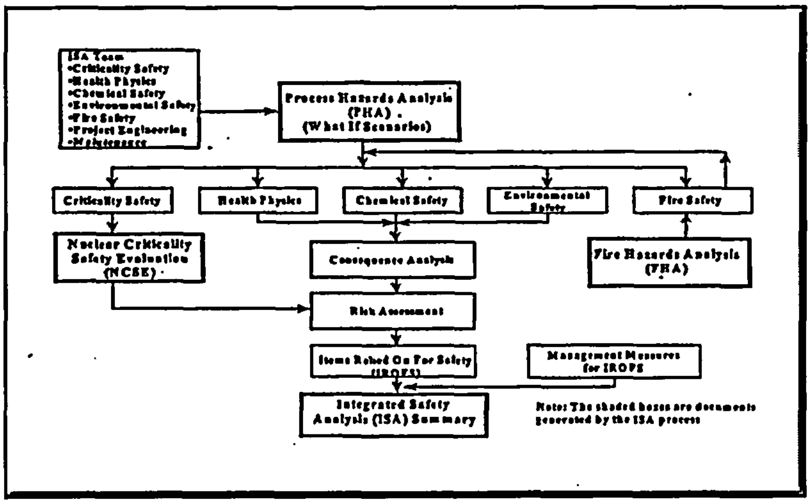


Figure 7-3

NFS also analyzed natural phenomena hazards, external events and site layout issues. NFS looked at the likelihood and/or consequences of these hazards and eliminated hazards deemed to be non-credible. The remaining credible hazards included: earthquake, high winds, snow loading, site evacuations, bulk chemical storage accidents, criticality accidents and radiological releases, off site explosions or fires, diesel generator fire, other storage tank fires, vehicle fires, maintenance, electrical short circuit, administrative processes, plane crash, freeway traffic accidents, meteorites, and lightning. NFS excluded the following hazards due to its not-credible (NC) nature or the low consequence (LC) of their occurrence: tornado striking facility (NC), hurricane (NC), flood (LC), NFS bulk liquid/vapor release accident (NC), NFS bulk chemical storage accident resulting in explosion or fire (bounded by hydrogen storage vessel accident), Studsvik bulk chemical storage accident resulting in release of liquids or vapor (NC), Studsvik criticality accident or radiological release (LC), railroad accident resulting in release of bulk liquids or vapor (NC), standing rainwater on roof (NC), and off-site fires (LC).

Based on its independent review of facility hazards and accident sequences, against the acceptance criteria of the SRP, and the ISA guidance provided by NUREG-1513, the NRC staff finds that, 1) NFS has used an acceptable method of hazard identification and process hazard analysis, 2) the method was correctly applied, 3) NFS did not overlook any accident sequences for which consequences could exceed the performance requirements of 10 CFR 70.61, and 4) NFS used a method that identified all facility processes. Therefore, the staff finds NFS analysis of accident sequences to be complete and therefore acceptable.

**Consequence**

NFS analyzed the consequences of the process accident scenarios and natural phenomenon events and the results are given in Table 7-2.

Table 7-2 - Credible Accident Sequences, Hazards, Consequences and Defense-in-Depth

| Accident Sequence | Process Haz./ Nat. Phen. | Assumed Conseq. Level* | Defense-in-Depth |
|---|---|---|---|
| 1.5.1 High U conc. or %U235 | Receipt Process | Criticality | |
| 1.5.2 UN Receipt High U in TK-10 | Receipt Process | Criticality | |
| 1.7.1 UN Receipt High U in TK-10 | Receipt Process | Criticality | |
| 1.12.1 UN Receipt High U in TK-10 | Receipt Process | Criticality | |

| Accident Sequence | Process Haz./ Nat. Phen. | Assumed Conseq. Level* | Defense-in-Depth |
|---|---|---|---|
| 1.14.1 High U conc. in TK-10 | Receipt Process | Criticality | |
| 1.18.1 UN Receipt High U in TK-10 Feed Line | Receipt Process | Criticality | |
| 1.25.1 U in Ductwork from TK-10 | Receipt Process | Criticality | |
| 1.26.1 TK-10 High U. Conc. | Receipt Process | Criticality | |
| 1.26.2 TK-10 High U Conc. from TK-10U | Receipt Process | Criticality | |
| 1.26.3 TK-10 High U due to Precip. | Receipt Process | Criticality | |
| 1.38.1 U in Ductwork from TK-10 | Receipt Process | Criticality | |
| 1.54.1 U in Ductwork from TK-10 | Receipt Process | Criticality | |
| 1.55.1 U in Ductwork from TK-10 | Receipt Process | Criticality | |
| 1.59.1 U in Ductwork from TK-10 | Receipt Process | Criticality | |
| 1.61.1 U in Ductwork from TK-10 | Receipt Process | Criticality | |
| 1.62.1 U in Ductwork from TK-10 | Receipt Process | Criticality | |
| 1.76.1 TK-10U High U conc. | Receipt Process | Criticality | |
| 1.106.1 Storage Tank High U conc. | Storage Process | Criticality | |

| Accident Sequence | Process Haz./ Nat. Phen. | Assumed Conseq. Level* | Defense-in-Depth |
|---|---|---|---|
| 1.109.1 Storage Tank High U conc. by freezing | Storage Process | Bounded by 1.106.1, 1.106.2, 1.111.1, 1.121.1, and 1.121.2 | |
| 1.111.1 & 1.120.1 Storage Tank High U conc. | Storage Process | Criticality | |
| 1.115.1 Storage Tank High U conc. | Storage Process | Criticality | |
| 1.121.1 High U Conc. in HVAC duct | Storage Process | Criticality | |
| 1.121.2 High U Conc. in HVAC duct | Storage Process | Criticality | |
| 1.132.1 & 1.132.2 High U Conc. in Storage Tank | Storage Process | Criticality | |
| Fire Scenario 29: Natural Gas Fire/Explosion | Natural Phenom. | Intermed. Conseq. - environ. damage | |
| Fire Scenario A: FRP Tank Fire | Natural Phenom. | Intermed. Conseq. - environ. damage | |
| Earthquake | Natural Phenom. | High Conseq. Event | |

| Accident Sequence | Process Haz./ Nat. Phen. | Assumed Conseq. Level* | Defense-in-Depth |
|---|---|---|---|
| Storm - High Winds | Natural Phenom. | High Conseq. Event | |
| Plane Crash** | External Event | High Conseq. Event | |
| Freeway Traffic Accident** | External Event | High Conseq. Event | |
| Others - Meteorites, etc.** | External Event | High Conseq. Event | |

* All nuclear criticality accidents are considered to be high consequence events because the radiation exposure that an individual could receive exceeds the acute 1 Sv (100 rem) dose established by 10 CFR 70.61(b)(1).
** Although the three external event accident scenarios are identified in this table as credible, high consequence events, no additional administrative or engineered controls are necessary to reduce the likelihood of the event to highly unlikely. The basis events themselves are highly unlikely.

Based on the staff's review of the ISA Summary against the acceptance criteria contained in the SRP, the staff found that NFS:

1. included information in the ISA Summary for each accident with consequences exceeding the performance requirements,
2. the consequences were calculated using conservative methods that were justified by NFS during the NRC review,
3. all consequences have been evaluated, including accident sequences with ranges of consequences,
4. the ISA Summary correctly assigned each type of accident to one of the consequence categories.

Therefore, the staff finds this analysis of consequences to be acceptable.

**Likelihood**

NRC staff reviewed NFS' identified likelihoods for each general accident sequence that could exceed the performance requirements of 10 CFR 70.61, the methods used to derive the likelihoods, and NFS' compliance with acceptable definitions of "unlikely," and "highly unlikely," as defined in the SRP. NFS derived its likelihood for accident sequences in a conservative manner. Criticality accident sequences were assumed to be a certainty, thereby resulting in a conservative application of IROFS and management measures. Natural phenomena hazards likelihoods were based on a thorough review of historical records. Based on this review, the staff concludes that NFS' application of likelihoods and its definition of "unlikely," and "highly unlikely," is acceptable.

#### 7.3.1.4.2 Compliance with 10 CFR 70.61 for Management Measures

See detailed evaluation of management measures in Section 15 of this SER.

#### 7.3.1.4.3 Compliance with 10 CFR 70.61 for Criticality Monitoring

NFS has committed to installing two detector nodes in the UNB which can detect a nuclear criticality in accordance with its current license commitments. The detectors and audible alarms will be connected to the UNB uninterruptible power supply, as described in correspondence between NFS and the NRC on December 16, 2002. NFS license Section 3.2.4.3 states that these detectors will meet the detector criteria required by 10 CFR 70.24. Figure 12.1 in the license amendment shows the location of the detectors.

NRC staff reviewed NFS' criticality alarm system coverage for the UNB and concurs that it meets the requirements of 10 CFR 70.24. NFS will shut down any operations in the UNB if the criticality accident alarm system coverage has been lost as required by the NFS license.

### 7.3.1.5 Compliance with 10 CFR 70.64 for New Facilities or New Processes at Existing Facilities

Refer to previous evaluations in Section 4.6, "Baseline Design Criteria," and 4.7, "Defense in Depth," of this SER.

### 7.3.1.6 ISA Team Qualifications and ISA Methods

#### 7.3.1.6.1 ISA Team Qualifications

NFS provided a list of the ISA team members and their qualifications in its license amendment request. NRC staff reviewed the request for the training, qualifications, and specialties of the ISA Summary team. The NRC staff found that the team leader has the appropriate formal training and knowledge of the ISA methods and an adequate understanding of the process operations to lead the ISA Summary team. The staff also found that the ISA met the NRC SRP guidelines for ISA team qualifications.

### 7.3.1.6.2 ISA Methods

10 CFR 70.62(c)(2) requires that the ISA be, "performed by a team with expertise in engineering and process operations. The team shall include at least one person who has experience and knowledge specific to each process being evaluated, and persons who have experience in nuclear criticality safety, radiation safety, fire safety, and chemical process safety. One member of the team must be knowledgeable in the specific ISA methodology being used."

In Section 4.7 of its ISA Summary, NFS described the qualitative risk categorization method used to determine the consequence categories and likelihood categories of the accident sequences. In Section 5.0 of its ISA Summary, NFS described the qualifications of the team that prepared the UNB ISA. The team consisted of personnel from Framatome-ANP and NFS. The team leader was a senior chemical engineer from Framatome who had received ISA team leader training, HAZOP training, and Layer of Protection Analysis training. The ISA team had 11 additional members, including 3 criticality safety specialists, a chemical operations technician, an industrial hygienist, 2 industrial safety specialists, one with fire protection expertise, 3 health physicists, and an environmental scientist. The UNB ISA was performed using the HAZOP methodology. The NRC staff has determined that this ISA team is qualified to assure the adequacy of the ISA.

#### 7.3.1.6.2.1 Process Hazard Analysis Method

NFS used the HAZOP method to perform the analysis on the process design, equipment, and operations. The analysis also included natural phenomena and external events. The PHA considered hazards and accident conditions that could result in undesirable consequences for a process or activity. The PHA considered hazards were radiological, criticality, fire, and chemical hazards. The NRC staff has determined that this is an acceptable method for the processes analyzed.

#### 7.3.1.6.2.2 Consequence Analysis Method

In the February 28, 2002, license amendment application, as supplemented, NFS listed in Table 1, Column 8 of its submittal, that the only high-consequence process hazards/accident scenario events were possible criticality accidents. NFS also concluded that there were non-process hazards including natural phenomena-related accident sequences with potential intermediate environmental consequences. NFS stated, "Consequence Category is assigned based on hazards analysis(es) results, past experience, industry standards, engineering judgement, analytical data, and/or other applicable information. In addition, the potential consequences are compared against bounding accident sequences."

In addition, NFS provided "Table 2: Consequence Severity Categories Based on 10 CFR 70.61," in its ISA Summary. The table defines high, intermediate, and low consequence categories specifically for workers, offsite public, and the environment as follows:

| | Limit for Workers | Limit for Offsite Public | Limit for Environment |
|---|---|---|---|
| Consequence Category 3 (High Consequence) | 1) TEDE ≥ 100 rem<br>2) Chemical Release ≥ ERPG3 | 1) TEDE ≥ 25 rem<br>2) Chemical Release ≥ EPRG2<br>3) ≥ 30mg sol. Uranium Intake | See Intermediate Consequence Category 2 |
| Consequence Category 2 (Intermediate Consequence) | 1) TEDE is ≥ 25 rem and ⟨ 100 rem<br>2) Chemical Release ≥ EPRG2 and ⟨ EPPG3 | 1) TEDE is ≥ 5 rem and ⟨ 25 rem<br>2) Chemical Release ≥ EPRG1 and ⟨ EPPG2 | Radioactive release 24-hour average ⟩ 5000 * Table 2 Appendix B of 10 CFR Part 20 |
| Consequence Category 3 (Low Consequence) | Accidents with lower consequences than Cat. 2 above | Accidents with lower consequences than Cat. 2 above | Releases with lower conseq. than Cat 2 above |

The consequence categories NFS defined in Table 2 of its ISA Summary are identical to those specified in 10 CFR 70.61 and are acceptable.

During the evaluation of consequences, the staff reviewed likely explosion sources listed by NFS in the ISA. Examples of such sources are propane and natural gas contained in rail cars, on trucks, in an underground pipeline, or located on the site. The staff first employed the ALOHA 5.2.3 code to estimate the extent of flammability of a large leak of explosive material on the NFS site. The staff also employed a classical approach to estimate the overpressures generated from a subsequent explosion of that material. The staff's evaluation showed that an explosion of a rail car leaking propane, located on the CSXT rail yard within 150 feet [52 meters] of the facility, would generate overpressures sufficient to disable site personnel and disrupt facility structures and equipment. An explosion of a propane delivery truck located on Carolina Avenue (approximately 500 feet [152 meters] distant) or an explosion of the propane storage tank on the UNB site (250-300 feet [76-91 meters] distant) may develop sufficient overpressures to do damage (minor or light damage for the case of the 250 gallon [946 liter] propane storage tank) to the site but would not be likely to develop sufficient overpressures to harm facility personnel or cause catastrophic loss of equipment that may injure personnel. Underground pipelines are designed, installed, and maintained per national codes and standards and a failure leading to unacceptable consequences is not credible.

The basis for the conclusion that an accident related to the propane-related equipment would not radiologically endanger facility personnel is due to the large size and mass of UN piping and tanks, their design and construction, historical performance, and their seismic qualification. The staff concludes that NFS' consequence evaluation method is acceptable.

### 7.3.1.6.2.3 Likelihood Evaluation Method

In Section 4.7.2 of the amendment application, NFS described its qualitative method for determining likelihoods in the accident sequences.

For each credible accident sequence, NFS identified the initiating event leading to the accident. NFS assigned an Initiating Event Frequency Index to each credible accident scenario based on past experience, engineering judgement, analytical data, industry acceptable values, and/or any other applicable information. Initiating Event Frequency is defined as the probability of occurrence of the initiating event or initiating set of conditions. The index assignments are defined in Table 3 of the ISA Summary. NFS then identified Failure Frequency Index numbers for IROFS in Table 4 of its ISA Summary.

NFS assigned Failure Duration Index Numbers to each IROFS based upon an average failure duration in Table 5 of its ISA Summary.

In Sections 4.7.4 and 4.7.5 of the application, NFS described how it determined whether credible accidents were highly likely, unlikely, or not likely, based upon this likelihood category. NFS calculated a Controlled Likelihood and an Uncontrolled Likelihood for each accident sequence to demonstrate the relative importance of the IROFS in preventing or mitigating the accident sequence to meet the performance requirements. A Controlled Likelihood Index, (T), was calculated by summing the Initiating Event Failure Frequency Index with the IROFS Failure Frequency Index. If the initiating event is an IROFS failure, then the Controlled T is calculated by summing the IROFS Failure Frequency Indexes and the Failure Duration Index. An Uncontrolled T is calculated by using the Initiating Event Failure Frequency Index or the IROFS Failure Frequency Index as applicable. Controlled and Uncontrolled Likelihood Categories are then assigned from Table 6 of the ISA Summary based on the respective Likelihood Index.

**Table 7-3 NFS Total Risk Likelihood Category**

| Likelihood Category | Likelihood Index (T) (sum of Index numbers) |
|---|---|
| 1 | $T \leq -4$ |
| 2 | $-4 < T \leq -3$ |
| 3 | $T > -3$ |

NFS assigned a consequence category to each identified accident sequence, then assigned the likelihood of occurrence of each of these sequences to an appropriate likelihood category. NFS provided valid bases for assigning the controlled and mitigated sequences to likelihood categories. The NRC staff has determined that this likelihood evaluation method is acceptable.

### 7.3.1.7 Items Relied On for Safety

This section requires that each engineered or administrative control or control system that is necessary to comply with the performance requirements of 10 CFR 70.61(b), (c), or (d) shall be designated IROFS. The safety program established and maintained pursuant to 10 CFR 70.62 shall ensure that each IROFS will be available and reliable to perform its intended function when needed and in the context of the performance requirements.

#### 7.3.1.7.1 Descriptive List of all Items Relied On For Safety

NFS identified the IROFS in Section 4.7 3 of its ISA Summary. Applicable IROFS are identified and assigned to all High or Intermediate consequence accident scenarios.

In Section 6, Table 9, of its ISA Summary, as supplemented, NFS provided a list of the IROFS, a description of each, its type, whether active engineered control, passive engineered control, administrative control or enhanced administrative control, its failure index, and its risk reduction level. NRC staff reviewed this table and determined that it included all the IROFS and that they were adequately described and identified as active or passive engineered or administrative controls.

#### 7.3.1.7.2 Description of all Management Measures for IROFS

The details of NFS' proposed management measures were described in its ISA Summary and in NFS' submittal dated March 7, 2003.

Management Measures for IROFS

| CONTROL TYPE / Measures | RISK REDUCTION LEVEL | |
|---|---|---|
| | A<br>IROFS credited with a high level of Risk Reduction for High or Intermediate consequence events | B<br>IROFS credited with a moderate level of Risk Reduction for Intermediate consequence events |
| **ACTIVE ENGINEERED CONTROLS** | | |
| Periodic Functional Test | x | |
| Verification After Maintenance | x | |
| Calibration | x | x |
| Controlled Listing Identification | x | |
| Drawing Identification | x | |
| Procedural Identification | x | x |
| Pre-operational Audits or Tests | x | x |
| Periodic Audits | x | x |
| Training and Qualifications | x | |
| Records Management, Investigations, and QA | x | |
| **PASSIVE CONTROLS** | | |
| Verification After Maintenance | x | |
| Controlled Listing Identification | x | |
| Procedural Identification | x | x |
| Pre-operational Audits or Tests | x | x |
| Independent Installation Verification | x | |
| Periodic Audits or Inspections | x | x |
| Vendor Specifications | x | |
| Training and Qualifications | x | |
| Records Management, Investigations, and QA | x | |
| **ADMINISTRATIVE CONTROLS** | | |
| Procedural or Posting Identification | x | x |
| Pre-operational Audits | x | x |
| Periodic Audits | x | x |
| Training and Qualification | x | |
| Testing of Training Effectiveness | x | |
| Records Management, Investigations, and QA | x | |
| **ENHANCED ADMINISTRATIVE CONTROLS** | | |
| Periodic Functional Test | x | |
| Verification After Maintenance | x | |
| Controlled Listing Identification | x | x |
| Drawing Identification | x | x |
| Procedural or Posting Identification | x | x |
| Pre-operational Audits | x | x |
| Periodic Audits | x | x |
| Training and Qualification | x | |
| Testing of Training Effectiveness | x | |
| Records Management, Investigations, and QA | x | |

Note: The Management Measures identified for each risk reduction level are minimum if applicable. For example, it is not possible to calibrate certain types of active engineering controls. The controls may be increased based on the specific IROFS involved, the credited risk reduction, industry standards, vendor specifications, or engineering recommendations.

The NRC staff also reviewed the management measures, described under the safety program evaluated in Section 4.8 and 7.1 of this SER, and determined that they were adequate to ensure that each IROFS will be available and reliable to perform its intended function when needed and in the context of the performance requirements.

#### 7.3.1.7.3 Chemical Consequence Standards

Although NFS stated in its August 2002 submittal that no high, intermediate, or low consequence chemical accidents have been identified, NFS used values for nitric oxide developed by the U.S. Department of Energy Subcommittee on Consequence Assessment & Protective Actions.

#### 7.3.1.7.4 Sole IROFS

Section 8.0 of the ISA Summary stated that there are no sole IROFS in the UNB. As discussed in Section 7.2.1.3, Processes, Hazards, and Accident Sequences, above, NRC staff reviewed the list of accident sequences and IROFS and determined that no accident sequence is dependent on a sole IROFS.

### 7.3.1.8 Definitions of "Credible," "Unlikely," and "Highly Unlikely"

NFS gave definitions of "highly unlikely," "unlikely," and "credible" in its ISA Summary. NFS provided a qualitative analysis of the risk of plant operations in its ISA Summary. In its evaluation, NFS identified 2 types of events, "credible" and "not credible." Table 3 of the ISA Summary, titled, "Initiating Event Frequency," assigns a Frequency Index of -5 to a failure frequency of 1 failure in 100,000 years, and describes that frequency as "not credible." These initiating event frequencies were based on past experience, engineering judgement, analytical data, industry accepted values, and other information, if available.

NFS also applied qualitative criteria for its use of the terms, "highly unlikely" and "unlikely." Similar to NFS' application of qualitative criteria for "credible," they defined the likelihood of "highly unlikely" to be an index of -4 and "unlikely" an index of -3, instead of a frequency per accident per year. These initiating event frequencies were based on past experience, engineering judgement, analytical data, industry accepted values, and other information, if available. When an accident scenario resulted from a failure of an IROFS, NFS applied a failure duration index number for the failure frequency index number.

NFS applied a qualitative method for evaluating the likelihood of an accident sequence by assigning a failure frequency index number to an IROFS, depending on whether it was a passive engineered control, active engineered control, administrative control, or an enhanced administrative control. NFS did not give credit for additional IROFS characteristics such as defense-in-depth, diversity and vulnerability to common-cause failure.

On the basis of NFS' qualitative methods and definitions for evaluating compliance with 10 CFR 70.61, NRC staff applied the qualitative acceptance criteria of the SRP. NFS has identified reasonably clear, objective criteria in its definitions, and the use of these definitions can reasonably be expected to consistently distinguish between accidents that are highly unlikely and those that are merely unlikely.

### 7.3.2 Evaluation Findings

Many hazards and potential accidents can result in unintended exposure of people to radiation, radioactive materials, or toxic chemicals incident to the processing of licensed materials. The NRC staff finds that NFS has performed an ISA to identify and evaluate those hazards and potential accidents as required by the regulations. The NRC staff has reviewed the ISA Summary and other information, and finds that it provides reasonable assurance that NFS has described the process and identified hazards, accident sequences, IROFS, and established engineered and administrative controls to ensure compliance with the performance requirements of 10 CFR 70.61. Specifically, the NRC staff finds that the ISA results, as documented in its ISA Summary, provide reasonable assurance that the IROFS, management measures, and NFS' programmatic commitments will, if properly implemented, make all credible intermediate consequence accidents unlikely and all credible high consequence accidents highly unlikely.

## 7.4 Management Measures

NFS has committed to establish management measures to maintain the reliability of IROFS. These management measures are discussed in detail in NFS' ISA Summary. Please refer to Section 15 of this SER for the NRC staff review and evaluation of the proposed management measures for the UNB amendment.

NFS has committed to maintain the ISA and continue to be in compliance with its license and therefore, 10 CFR 70.72. NFS has also committed to maintain the training programs and use qualified personnel in its ISA team. This information will be maintained in NFS' Records Management program and will be audited, inspected and will be in compliance with NFS' Quality Assurance program. NFS has committed to maintain written procedures on site. The NRC staff finds these commitments acceptable.

### Evaluation Findings

The NRC staff concludes that NFS' safety program, if established and maintained pursuant to 10 CFR 70.62, is adequate to provide reasonable assurance that IROFS will be available and reliable to perform their intended safety functions when needed and in the context of the performance requirements of 10 CFR 70.61.

# 8. RADIATION PROTECTION

NFS' request for a license to store low-enriched uranium-bearing materials at the UNB has a low radiological risk due to the low dose rate from the storage facilities. The staff reviewed the potential radiological accidents for the facility while on-site from October 21-23, 2002, and concluded that all the radiological effects for all non-criticality accidents would result in a low dose to workers and members of the public. The staff concluded during license renewal in July

1999 that NFS' radiation safety program was adequate to meet the requirement of 10 CFR Part 20, therefore, no changes to the radiation program are required for this amendment.

## 9. NUCLEAR CRITICALITY SAFETY

The staff reviewed the information submitted by the licensee for the UNB amendment which consisted of the ISA Summary, the nuclear criticality safety evaluation (NCSE), and other information on the docket. The staff only reviewed those areas of the NFS NCS program that have changed or are impacted due to this license amendment. Therefore, staff did not review the overall management of NFS' nuclear criticality safety (NCS) program as well as its administration and organization. Also, only those management measures and technical practices and methodologies specific to the UNB were reviewed. The staff's review of the changes to NFS' NCS program to support the UNB amendment are discussed below.

### 9.1 Discussion

#### 9.1.1 Description of NFS Submittal

By letter dated February 28, 2002, as revised, NFS submitted for NRC review and approval an amendment request in accordance with 10 CFR Part 70 to store low enriched uranium-bearing materials (≤5 wt% U-235) at the UNB. This submittal contained an ISA Summary for the UNB which identified potential accident sequences, IROFS, definitions of highly unlikely, unlikely, and credible, and the management measures needed to provide reasonable assurance of the availability and reliability of the IROFS, as required by 10 CFR 70.65(b). NFS' demonstration of double contingency, as required by 10 CFR 70.64, is documented in the NCSE for the BLEU Complex Uranyl Nitrate Building, NCS-07-02, Revision 2. Administrative and engineered controls were developed to preclude conditions under which a criticality could occur. Additional supporting information was submitted in responses to NRC RAI, dated December 23, 2002, and February 10, 2003, as well as other submittals dated March 21, 2003.

##### 9.1.1.1 Identification of Potential Criticality Accidents

NFS performed a process hazards analysis to identify potential accident conditions, including both process upsets and natural phenomena events. The NFS team then identified accident sequences using a HAZOP methodology.

For each credible accident sequence a consequence category was assigned, as described in Section 4.7.1 of the ISA Summary. For those with undesirable consequences, safeguards were identified to protect against the consequences. Accident sequences with intermediate or high consequences are documented in Section 3 of the NFS ISA Summary. The criticality accident scenarios identified are considered high consequence events due to potential impact to workers.

An initiating event frequency index was assigned as described in Section 4.7.2 of the ISA Summary. The initiating event frequencies are defined as the probability of occurrence of the initiating event or initiating set of conditions. These are generally based on past experience and engineering judgment, or analytical data.

Because criticality accidents are high consequence, they are required to be controlled to "Highly Unlikely." NFS' definition of highly unlikely is given in Section 9 of its ISA Summary, and is discussed in further detail below.

#### 9.1.1.1.1 UN Receipt

For the receipt of the low enriched uranyl nitrate (UN) from the Savannah River Site (SRS), sixteen criticality accident sequences were identified and are summarized in Table 1 of the ISA Summary. These include high U-235 enrichment or uranium (U) concentration due to shipper error, high U concentration due to freezing, high U concentration due to precipitation, U in ductwork due to overflows from receipt operations, and high U concentration due to evaporation.

Scenario 1.5.1 addresses transferring unsafe UN solution (uranium that is greater in enrichment or concentration than what is allowed in the license) into receipt tank TK-10 during transfer from the shipping containers. The initiating event is supplier error.

Scenarios 1.5.2, 1.7.1, and 1.18.1 address transferring unsafe UN solution (uranium that is greater in concentration than what is allowed in the license) into receipt tank TK-10 during transfer from the shipping containers. The initiating event is freezing of the UN solution due to low outside temperatures.

Scenario 1.14.1 addresses transferring unsafe UN solution (uranium that is greater in concentration than what is allowed in the license) into receipt tank TK-10 during transfer from the shipping container. The initiating event is precipitation of the UN solution due to supplier error.

Scenarios 1.25.1, 1.38.1, 1.54.1, 1.55.1, 1.59.1, 1.61.1, and 1.62.1 address UN solution in ductwork from receipt tank TK-10 that then concentrates to an unsafe concentration. The initiating event is an overflow of the UN tank or failure of the de-entrainment system.

Scenario 1.26.1 addresses transferring unsafe UN solution (uranium that is greater in concentration than what is allowed in the license) into receipt tank TK-10 from the spill basin. The initiating event is a spill that is not detected and cleaned up before it concentrates to an unsafe concentration.

Scenario 1.12.1 addresses unsafe UN solution (uranium that is greater in concentration than what is allowed in the license) in receipt tank TK-10. The initiating event is precipitation due to introduction of a precipitating agent into the area.

Scenarios 1.26.2 and 1.76.1 address unsafe UN solution (uranium that is greater in concentration than what is allowed in the license) in tank TK-10U. The initiating event is evaporation caused by high temperatures.

Scenario 1.26.3 addresses transferring unsafe UN solution (uranium that is greater in concentration than what is allowed in the license) into receipt tank TK-10 from the spill basin. The initiating event is introduction of a precipitating agent into the sump or sink.

#### 9.1.1.1.2 UN Storage

For UN storage, nine different criticality accident sequences were identified and summarized in Table 1 of the ISA Summary. These include high U concentration due to evaporation, high U concentration due to freezing, high U concentration in HVAC ductwork due to overflows from storage tanks, and high U concentration due to precipitation in storage tanks.

Scenarios 1.106.1, 1.106.2, and 1.115.1 address unsafe UN solution (uranium that is greater in concentration than what is allowed in the license) in storage tanks due to concentration. The initiating event is evaporation due to high temperatures and/or high flow through the tanks.

Scenario 1.111.1 and 1.109.1 address unsafe UN solution (uranium that is greater in concentration than what is allowed in the license) in receipt tank TK-10 due to crystallization. The initiating event is low ambient temperature.

Scenarios 1.121.1 and 1.121.2 address UN solution in ductwork from the storage tanks that then concentrates to an unsafe concentration. The initiating event is an overflow of the UN solution.

Scenarios 1.132.1 and 1.132.2.1 address getting unsafe UN solution (uranium that is greater in concentration than what is allowed in the license) into storage tanks. The initiating event is introduction of a precipitating agent due to overflows from the Oxide Conversion Building.

### 9.1.1.2 Designation of Criticality Safety IROFS

The licensee has committed to the double contingency principle as required by 10 CFR 70.64(a)(9). In Table 9 of its ISA Summary, NFS identified the IROFS necessary to control the criticality accident sequences such that they are highly unlikely as required by 10 CFR 70.61. These include both engineered and administrative IROFS. The IROFS were assigned an IROFS failure index. NFS' IROFS failure indices by category are given in Table 4 of its ISA Summary. However, more conservative indices may be assigned to an IROFS as appropriate. The index is based on the expectation that IROFS will not fail outside the bounds established by the assigned index with the applied management measures. NFS states that these are based on industry accepted values, past experience, engineering judgment, or analytical data. If failure of an IROFS is the initiating event, a duration index is assigned as specified in Table 5.

The ISA Summary states that setpoints for interlocks or alarms used in controls will consider safety limits, instrument and system accuracy, response time, anticipated drift, and other performance factors as appropriate. Calibration and functional test frequencies will also be based on this data.

Controlled likelihood and uncontrolled likelihood indices are calculated for each accident sequence to demonstrate the relative importance of the IROFS in preventing the accident sequence. An uncontrolled likelihood index is simply the initiating event likelihood index. The controlled likelihood index is calculated by summing the initiating event failure frequency index with the IROFS failure index.

**9.1.1.3 Identification of Management Measures**

NFS management measures are described in Section 4.8 and Table 8 of its ISA Summary, as well as in the NFS license. The type of IROFS control, along with the risk reduction level credited in the ISA, determines the specific management measures applied to a particular IROFS. IROFS credited with a high level of risk reduction (level A) require a high level of management measures to ensure a high level of reliability. All criticality safety IROFS given in the ISA Summary are considered Level A. Thus, they require a high level of management measures. These management measures include configuration management, maintenance, training and qualification, procedures, audits and assessments, incidents and investigations, records management, and other quality assurance elements.

**9.1.1.4 Definitions of Credible, Unlikely, and Highly Unlikely**

In Section 9 of the ISA Summary and NFS' RAI response dated December 23, 2002, NFS gave definitions for highly unlikely, unlikely, and not unlikely. As noted in the RAI response, since NFS' analysis is qualitative in nature, the definitions were changed to be qualitative. For highly unlikely the definition was changed from $10^{-4}$/accident per year to -4 which generally corresponds to $10^{-4}$/accident per year for each accident sequence. As discussed in Section 9.1.5, below, NRC staff does not agree with all of the NFS definitions with respect to criticality safety. However, given that the ISA is qualitative and that only 5 of the 25 identified criticality scenarios have a controlled likelihood index of -4 with the rest of the scenarios more unlikely, the NRC staff has reasonable assurance that these operations will meet the criticality safety requirements of 10 CFR Part 70.

**9.1.1.5 Criticality Accident Alarm System Requirements**

NFS committed to installing two criticality detector nodes (4 detectors) in the UNB. The detectors and audible alarms will be connected to the UNB uninterruptible power supply, as described in correspondence between NFS and the NRC on December 16, 2002. NFS license Section 3.2.4.3 states that these detectors will meet the detector criteria required by 10 CFR 70.24. Figure 12.1 in the license amendment shows the location of the detectors.

### 9.1.1.6 Criticality Calculations

NFS also performed criticality calculations for the UNB. The models used in the criticality calculations assume that for normal conditions the uranium is all U-235 and U-238 at the maximum allowed enrichment of 5.0 wt. % U-235. The models also assumed full water reflection on all sides of the tanks with concrete reflection where appropriate. NFS' calculations show that the calculated $k_{eff}$ + 2 sigma is less than the subcritical limit of 0.97, as described in license condition S-10, under both normal and credible abnormal conditions.

## 9.1.2 Review of Potential Criticality Accidents

The NRC staff reviewed the potential criticality accidents for the UNB to ensure that the requirements of 10 CFR 70.61(b), 10 CFR 70.61(d), and 10 CFR 70.64(a)(9) are met. All potential criticality accidents are considered high consequence events as defined in 10 CFR 70.61(b) and thus must be controlled such that they are highly unlikely. Additionally, the double contingency principle (10 CFR 70.64(a)(9)) must be met.

Meeting the double contingency principle (10 CFR 70.64(a)(9)) does not necessarily constitute meeting the highly unlikely requirement of 10 CFR 70.61(b). These are two distinct regulatory requirements. While the staff found that each of the scenarios is highly unlikely as well as doubly contingent as required by 10 CFR Part 70, the staff in some cases did not agree with the justification provided by NFS. In addition, the NFS submittals initially indicated that if a scenario met the double contingency principle, then it was highly unlikely. The staff disagrees.

The NCSE provides the in-depth justification for the assignment of the indices for the initiating event and IROFS for each scenario as well as the demonstration that the double contingency principle was met. These scenarios are referred to as cases in the NCSE. As a result of NRC's RAI, changes were made to the scenarios which required changing some of the IROFS as noted in the revised NCSE. The staff's review and acceptance of the individual scenarios is discussed in this section and in Section 9.1.3, "Criticality IROFS."

For Case 7 (Scenario 1.26.3 in the ISA Summary), the initiating event frequency index was -1, in part, based on its being unlikely that an operator would add precipitants into the tank and that precipitants are not allowed in the area by procedure. Contingency #2 (IROFS UNB-K) is

. The staff finds that the initiating event frequency index is acceptable because there are no process requirements for precipitating agents in the UNB. The staff has reasonable assurance that this accident sequence is rendered highly unlikely given the initiating event frequency index and the two IROFS which are

. These dual controls are independent and sufficiently robust such that the NRC staff has determined that the double contingency principle was met.

For Cases 15, 16, and 19 (Scenarios 1.76.1, 1.106.1, and 1.115.1 in the ISA Summary), the initiating event frequency index was set at -2 partially based on the loss of tank sealing for a long time. Contingency #1 (IROFS UNB-I) was

. NFS has revised this scenario such that the initiating event frequency index is set at -1 (based on high temperature and/or high airflow concentrating the solution due to inadequate tank sealing) and has included

as IROFS. These will be included as IROFS in the updated ISA Summary. The staff finds that this accident sequence is rendered highly unlikely given the initiating event frequency index and the two IROFS which are the tank design including the airflow monitor, routine inspections, and the density monitors in the storage tanks. These dual controls are independent and sufficiently robust such that the NRC staff has determined that the double contingency principle was met.

For Cases 24 and 25 (Scenarios 1.5.1 and 1.14.1 in the ISA Summary), as described in the NCSE, the initiating event frequency index was initially set at -3, in part, based on the fact that SRS provides dual sampling of the solution. Contingency #1 (IROFS UNB-R) was

. NFS revised the initiating event such that the frequency index (unlikely) is based on the processes used by SRS to control and isolate the UN from other material. The revised initiating event description and the robustness of the SRS process provides reasonable assurance that this initiating event is controlled such that it is unlikely. The staff finds that this accident sequence is rendered highly unlikely given the initiating event frequency index and the two IROFS which are

. Additionally, these dual controls are independent and sufficiently robust such that the NRC staff has determined that the double contingency principle was met.

The NRC did not review Cases 22 and 23 (Scenarios 1.131.2 and 1.132.2 in the ISA Summary) because they involve the Oxide Conversion Building (OCB) which is not connected to the UNB at this time. These two cases will be evaluated during the license amendment review for the OCB.

The NRC staff's review of Cases 1, 2, 4, and 6 are described below. Also, Cases 8 and 17 are bounded by other scenarios as described in the NCSE and are not evaluated separately.

For Case 3, the initiating event is the transfer of a precipitating agent into TK-10 due to hooking up a wrong container to the transfer line. The event frequency index is set at -1. IROFS #1 is and IROFS #2 is the . The staff finds that this accident sequence is rendered highly unlikely given the initiating event frequency index and the two IROFS. These dual controls are independent and sufficiently robust such that the NRC staff has determined that the double contingency principle was met.

For Cases 5, 9, 10, 11, 12, 13, 14, and 21 the initiating event is overflow into the ductwork from either TK-10 or the storage tanks, or failure of the off-gas demister. The initiating event frequency index is set at -1. IROFS #1 is and IROFS #2 is the , and defense in depth is provided by . The staff finds that this accident sequence is rendered highly unlikely given the initiating event frequency index and the two IROFS. These dual controls are independent and sufficiently robust such that the NRC staff has determined that the double contingency principle was met.

For Cases 18 and 20, the initiating event is precipitation due to crystallization in the storage tanks due to low temperatures. The initiating event frequency index is set at -2. IROFS #1 is a and IROFS #2 consists of . The staff finds that this accident sequence is rendered highly unlikely given the initiating event frequency index and the two IROFS. These dual controls are independent and sufficiently robust such that the NRC staff has determined that the double contingency principle was met.

For Case 26, the initiating event is precipitation due to supplier error. The initiating event frequency index is set at -3. Contingency #1 is and IROFS #2 is . The staff finds that this accident sequence is rendered highly unlikely given the initiating event frequency index and the two IROFS which are . Additionally, these dual controls are independent and sufficiently robust such that the NRC staff has determined that the double contingency principle was met.

While the staff does not always agree with the indices assigned to the initiating events in Table 1 of the ISA Summary, the NRC staff finds that the licensee adequately identified all accidents for which the consequences could exceed the performance requirements of 10 CFR 70.61. In addition, the NRC staff finds the licensee has adequately identified each scenario and the associated IROFS. The NRC staff found that each accident sequence was rendered highly unlikely and meets the double contingency principle.

### 9.1.3 Criticality IROFS

The staff reviewed the licensee's submittal to ensure that controls necessary to comply with the requirements of 10 CFR 70.62 shall be designated as IROFS and that the IROFS were appropriately credited in the ISA Summary. The licensee has committed to the double contingency principle as required by 10 CFR 70.64(a)(9).

Although NFS did not justify the IROFS failure indices (revised Table 4 in its ISA Summary), the NRC staff finds that the IROFS were described in sufficient detail to understand their safety function. Table 1 in its ISA Summary and the NCSE describe which IROFS are applicable to which accident sequences. Based on technical judgement and the staff's understanding of the processes described in the application and RAI responses, as well as the fact that the management measures for the UNB will assure the IROFS are available and reliable, the staff finds that the IROFS are identified, are sufficiently independent and provide reasonable assurance that the criticality safety requirements of 10 CFR Part 70 are met such that each accident is controlled to highly unlikely.

Based on the NFS submittal, the NRC staff identified that Scenario 1.5.1 did not meet the double contingency principle and was not highly unlikely due to inadequate IROFS. This scenario involves getting unsafe solution (uranium that is greater in enrichment or concentration than what is allowed) into receipt tank TK-10. The initiating event was supplier error. NFS originally proposed that both legs of double contingency consist of . One leg of double contingency would be and the other leg of double contingency would be a . NRC staff determined that NFS had not adequately demonstrated that the IROFS were independent and unlikely to fail, conditions necessary to meet the double contingency principle.

In response to NRC staff RAIs and discussions at meeting on December 19, 2002, NFS has committed to installing an in-line monitor to verify U-235 concentration within six months of startup. In the interim, as the second leg of double contingency, NFS will either perform nondestructive assay (NDA) of each of the shipping containers and sample the solution once it is in TK-10, or sample each of the shipping containers. The staff finds that the in-line monitor or the proposed interim measures are independent of the IROFS at SRS and are unlikely to fail. Thus, the staff finds these revised IROFS acceptable since the IROFS are independent and each is unlikely to fail. Additionally, because these dual controls are independent and sufficiently robust, the NRC staff has determined that the double contingency principle was met.

### 9.1.4 Management Measures

The staff's review of the management measures is discussed in Section 15 of this SER. The specific quality assurance commitments provided by NFS on February 24, 2003, and March 21, 2003, are reviewed here as they pertain specifically to criticality safety. These commitments were made to provide reasonable assurance that the IROFS relied on for the accident sequences that involve operations performed at SRS will be reliable and available as required by 10 CFR Part 70.

NFS committed to performing a criticality Quality Assurance (QA) evaluation under the NFS QA plan, at least semi-annually of SRS downblending and shipping container loading activities. After some operating experience with these audits has been gained, the audit frequency may be adjusted based on experience, track record, and performance, and if justified go to an annual basis.

The licensee has committed to having the SRS audits on the QA audit schedule as a supplier, and that the audit will be conducted by a certified QA lead auditor and technical experts as appropriate (criticality, MC&A, measurements). These QA activities are part of the contract between NFS and SRS. Additionally, an interagency agreement is in place to formalize the QA/audit agreement. The QA activities include the following: organization of the program, description of the SRS activities included in the QA evaluation, design control of the downblending and loading operations, procurement document control, process (operations) document control, documentation of instructions, procedures, and drawings, control of purchased material, equipment, and services, identification and controls of materials, parts, and components, inspection, test control, control of measuring and test equipment, handling, storage, and shipping of LEUN, identification of inspection, test, and operating status, control nonconforming LEUN product, corrective actions, quality assurance records, and audits.

The NRC staff reviewed the licensee's QA commitments of the SRS downblending and loading activities, and found that the licensee has committed to adequate facility management measures as required by 10 CFR 70.62(d). Therefore, the NRC staff has reasonable assurance that the licensee can implement and maintain an effective NCS program for the receipt of LEUN from SRS.

### 9.1.5 Definition of Credible, Unlikely, and Highly Unlikely

NRC staff reviewed the NFS definition of highly unlikely, unlikely, and not unlikely. By the NFS definition, highly unlikely requires a controlled index of -4 or less, in contrast to the guidance in the SRP of -5 or less. The SRP definitions are based on the NRC's goal of no inadvertent nuclear criticality at a fuel cycle facility during the lifetime of the facility.

NFS stated that NFS has used the more conservative failure indices of those given as examples in the SRP for their IROFS. The NRC staff stated in the RAI dated January 10, 2003, it is not acceptable to shift the definitions of highly unlikely and unlikely based solely on choosing the most conservative value of IROFS failure indices given in the SRP. The IROFS failure indices are independent of the indices chosen for the definition of highly unlikely. Also, when the SRP gives a range of failure indices the most conservative value should be used unless there is justification for using the less conservative values. NFS did not provide any justification to use the less conservative values. Index numbers should be justified as appropriate for each situation because an

IROFS failure index may be different depending on the use of the IROFS and the management measures applied.

The NRC staff has determined that of the 25 criticality scenarios in the ISA Summary, only 5 of these scenarios (discussed below) have a controlled index of -4, with the remaining 20 scenarios more unlikely (assigned a controlled index of -5 or less). These 5 scenarios are identified in the ISA Summary as 1.5.2, 1.7.1, 1.18.1, 1.26.1, and 1.26.3 and are discussed below.

Scenarios 1.5.2, 1.7.1, and 1.18.1 (Cases 1, 2 and 4 in the NCSE) all concern receipt of abnormally high U concentrations due to UN freezing in the shipping containers. For these scenarios, NFS assumed an initiating event frequency 0 (once per year) and an IROFS failure index of -2 for each of the . This resulted in a controlled index of -4. The design of the shipping containers is such that material will not easily freeze (they are heavily insulated and temperature changes would be slow). In addition, the receipt line is located inside the building thus providing heat to the UN before it reaches the receiving tank. This, along with the fact that the material is packaged at SRS with a minimum temperature of 55°F [13°C], provides additional layers of protection beyond that provided by the . The NRC staff finds that these additional layers of protection, along with the IROFS, provide adequate protection against an inadvertent criticality and that the accident sequence is rendered highly unlikely.

Scenario 1.26.1 (Case 6 in the NCSE) concerns abnormally high U concentration due to a spill which evaporates and is then transferred into TK-10. For this scenario the controlled likelihood index, based on an initiating event frequency -2 and an IROFS failure index of -1 for each of two administrative controls ( ), is only a -4. However, for this scenario to lead to a criticality safety concern, the spill would have to be very large and left unmitigated for almost 40 days in order to concentrate to unsafe levels. Given the scenario required for this to be a criticality concern, the staff finds that there is adequate protection against an inadvertent criticality due to a large spill concentrating before it is remediated.

Scenario 1.26.3 (Case 7) concerns abnormally high U concentration due to precipitation caused by an operator transferring a precipitating agent into TK-10 from the sump or sink. For this scenario the controlled likelihood index is a -4, based on an initiating event frequency -1 and an IROFS failure index of -1 for the administrative control in the area and an IROFS failure index of -2 for the . For this scenario, there are additional layers of protection against criticality. The TK-10 recirculation line has a filter and pressure monitor that will stop the feed into receipt tank TK-10 if there is presence of solids or a missing filter. The NRC staff finds that these additional layers of protection, along with the IROFS, provide adequate protection against an inadvertent criticality.

The staff finds that these scenarios have adequate defense in depth which enables the UNB facility to exhibit a greater tolerance to failures and external challenges. Since most of the scenarios for the UNB are controlled to an index of -5 or less and there is additional margin of safety for the 5 scenarios which are controlled to a -4, the NRC staff has reasonable assurance that the receipt and storage operations scenarios for the UNB will be highly unlikely as required by 10 CFR Part 70.

### 9.1.6 Criticality Accident Alarm System Requirements

NRC staff reviewed NFS' criticality accident alarm system coverage for the UNB and concurs that it meets the requirements of 10 CFR 70.24. NFS has committed to installing two detector nodes in the UNB which can detect a nuclear criticality in accordance with its current license commitments. NFS will shut down any operations in the UNB if the criticality accident alarm system coverage for the UNB has been lost.

### 9.1.7 Criticality Calculations

The NRC staff reviewed the licensee's calculational models and agreed that they are consistent with the description of the operation. NFS utilized the SCALE 4.4 CSAS25 computer code using the 238 and 44-group cross-section libraries for the NCS calculations. The staff agreed that the codes and cross-section sets used are appropriate for this type of application.

The staff performed confirmatory analyses using the information provided in the amendment and the NCSE. The staff's results were comparable with those of the licensee. Specifically the NRC staff performed calculations to verify that the UN with the proposed enrichment and concentration limits would be subcritical in the UNB. The staff also performed calculations to find the critical concentrations and enrichments in the UNB. For the shipping containers, the staff performed calculations to ascertain the concentration and enrichment at which the shipping containers would be critical. The staff's calculations verified the licensee's results.

## 9.2 Evaluation Findings

The staff evaluated those portions of the ISA Summary and associated documentation that pertained to criticality safety of the UNB receipt and storage operations described above. The staff reviewed this information to ensure that the criticality safety requirements of 10 CFR Part 70, specifically 10 CFR 70.24, 10 CFR 70.61(b) and (d), 10 CFR 70.62 and 10 CFR 70.64(a)(9) were met.

The staff finds that the licensee's controls in the UNB will ensure that fissile material will be possessed, stored, and used safely according to the requirements in 10 CFR Part 70. Based on this review, the staff concluded that the licensee's NCS program meets the requirements of 10 CFR Part 70 and provides reasonable assurance for the protection of public health and safety, including workers and the environment.

## 10. CHEMICAL PROCESS SAFETY

### 10.1 Discussion

The NRC is concerned with chemical hazards derived from radioactive materials and plant conditions that can affect nuclear material processing that would result in an increased radioactive risk. Chemical hazards could result from operational failure, fire, or explosions resulting in a release of radioactive materials.

NRC recognizes that hazardous chemicals are also regulated by other Federal and State agencies. At the Federal level, the Occupational Safety and Health Administration (OSHA) has promulgated 29 CFR 1910.119, titled, "Process Safety Management of Highly Hazardous Chemicals (PSM) Standard," and the Environmental Protection Agency (EPA), under requirements of the, "Clean Air Act of 1990," has published 40 CFR Part 68, known as the "Risk Management Plan (RMP)." NRC's objective is to ensure safe operations involving chemicals and licensed radioactive material as codified in 10 CFR Part 70, Subpart H.

In accordance with OSHA requirements, NFS trains all persons at the facility who handle or could be exposed to hazardous chemicals. This OSHA requirement also provides personnel access to material safety data sheets.

NFS has stated that the only chemicals that will be used in the UNB are de-ionized water and UN solution (which should contain less than 1 molar nitric acid). This UN solution is considered a weak nitric acid solution.

Based on NRC modeling, the catastrophic failure of one fiberglass reinforced plastic storage tank would result in the release of approximately [redacted] of UN solution. This would result, ultimately, in an airborne release of nitrogen oxide(s). At an airborne temperature of 80°F [27°C], the partial pressure from a spill of UN would be extremely low and would not be considered a significant chemical hazard. The NRC staff concludes that during normal operations, the handling and storage of this LEUN would require the normal precautions necessary for handling acidic-radioactive solutions.

### 10.2 Evaluation Findings

The staff has evaluated the application using the criteria listed in the SRP. Based on the review of the license application, the NRC staff has concluded that the applicant has adequately reviewed chemical accident consequences and effects that could result from the handling, storage, or processing of licensed materials. The applicant has performed an adequate hazard analyses that provided reasonable assurance of safe facility operation.

The staff concludes that the applicant's plan for managing chemical process safety meet the requirements of 10 CFR Part 70, Subpart H, and provides reasonable assurance that the health and safety of the public will be protected.

## 11. FIRE SAFETY

The NRC staff reviewed NFS' submittals on February 28, August 23, and December 23, 2002, for amendment to Materials License No. SNM-124 for storage of UN solutions in the UNB. During NRC staff's site visit from June 10 to 14, 2002, NFS provided the NRC staff with additional information related to the facility, processes, related hazards analyses, safety evaluations, plant procedures, and other supporting technical information related to fire protection for the demonstration of reasonable assurance that the risks and/or consequences of fires for the UNB are minimized.

The potential fire risks at the UNB are fires that could involve low-enriched nuclear material and fires that could cause loss of safety controls that may lead to an accident of a different type (e.g., a chemical or radiological release, a nuclear criticality). NFS plans to implement the safety controls and defense-in-depth protection required to prevent or minimize the risk of unacceptable consequences and assure safe operations at the UNB.

### 11.1 Discussion

#### 11.1.1 Process Fire Hazards and Risks

NFS' plans to store LEUN and NUN solutions in the UNB at the BLEU complex, adjacent to the main NFS facility in Erwin, TN. The UNB is a single story metal building, approximately feet [ meters] by feet [ meters] at the floor and feet [ meters], with a peak roof height of approximately feet [ meters]. The UNB can be divided into two nuclear operations areas (loading/downloading and storage of UN solutions) and support areas (mechanical and electrical room and office).

Uranyl Nitrate Solutions: The nuclear material involved in processes will be solutions of UN consisting of LEUN and NUN. The solutions have a water content of approximately 85% by weight. The solutions are a weak nitric acid and will not contribute as an oxidizing agent (i.e., enhance combustion of cellulosic material). The solutions and associated vapors are neither combustible nor flammable. On the basis that the solutions are not a source of ignition and do not contribute to potential fire hazards or severity of a fire, the NRC staff concludes that the handling and storage of LEUN and NUN solutions do not require special protection or controls for fire safety.

Loading and Downloading: The UNB will receive LEUN solution from -gallon [ liters] Type B shipping containers transported on a flatbed trailer. The NUN solution will be transferred by piping, stored at the UNB, and loaded into transport tankers with a capacity of approximately[redacted]. Because the solutions are water-based, there are no process fire hazards from operations of loading or downloading solutions. The combustibles expected in the UNB loading/downloading area are minimal. A tow vehicle, with a 50-gallon [189 liter] capacity diesel fuel tank, will be used to pull a flatbed trailer into the area for unloading and loading of LEUN solutions. NFS has committed to providing automatic sprinkler protection, a liquid containment system, and a [redacted] fire barrier system for fire safety. The containment system for the loading/downloading area will have the capacity to contain a spill of approximately gallons [ liter].

Storage: The LEUN solution will be stored in 24 fiberglass reinforced plastic tanks (FRP) arranged in 4 banks, with 6 tanks in each bank. The tanks are [redacted] in diameter and [redacted] high and each will hold approximately [redacted]. Initially, the LEUN solution will be transferred into a [redacted] diameter and [redacted] high stainless steel tank, prior to the FRP storage tanks. A smaller FRP tank of approximately [redacted] will be provided for storage of NUN solutions. Because the solutions are water-based, with no combustible or flammable vapor, there are no process fire hazards associated with the transfer and storage of LEUN or NUN solutions. In case of a spill in the storage area, the containment system in this area has a minimum capacity of gallons [ liters].

Chemicals and Gases: A natural gas air heating unit will be installed in the mechanical room of the UNB. NFS commits to installing natural gas piping and heating unit in accordance with industry requirements for fire safety (e.g., NFPA 54, National Fuel Gas Code). The natural gas heating unit will be equipped with internal controls to prevent leak and potential natural gas fires. NFS also commits to providing combustible gas monitoring systems with safety interlocks to isolate incoming natural gas supply.

Combustible Materials: The FRP tanks are the most significant combustible material found in the UNB. The FRP tanks will be constructed of a composition of styrene monomer and vinyl ester resin, with glass fiber reinforcement for chemical resistance and mechanical integrity properties. NFS' fire hazards analysis (FHA) has identified the decomposition temperature of the FRP material at approximately 650°F [343°C]. The ignition temperature for the material has been identified at approximately 925-932°F [496-500°C]. Similar to other FRP material, it will not easily ignite and requires the presence of a sufficiently high energy ignition source. Flame impingement or heat exposure would raise the temperature of material to begin decomposition and production of combustible vapors for burning. Once ignited, the FRP has a fast rate of flame spread and produces a significant amount of smoke. NFS plans to apply an intumescent fire-retardant latex coating on the exterior of the FRP tanks to improve fire resistance and reduce potential flame spread and smoke development.

### 11.1.2 Fire Accident Scenarios

NFS' FHA qualitatively evaluated the potential fire hazards and possible accident scenarios related to potential consequences and risks at the UNB. NFS' FHA evaluated the following potential fire scenarios involving nuclear processes or adjacent support areas:

1. diesel fuel fire involving standby generator
2. tow vehicle fire in load/download area
3. storage tank fire
4. HVAC duct/filter fire

5. electrical room fire
6. mechanical room fire

NFS also evaluated external fires to determine potential consequences of fire exposures to the processes in the UNB. The NRC staff concludes that the NFS' FHA was comprehensive and adequately evaluated the potential fire hazards related to the proposed operations at the UNB. The NRC staff also concludes that dominant risk of a fire at the UNB is a fire that potentially causes the loss of controls important to safety (i.e., containment). For the proposed operations at the UNB, a fire of sufficient energy and duration in the storage area could lead to damage of one or more storage tanks with potential loss of UN solution containment, resulting in chemical and radiological spill accidents. The key fire scenarios are discussed below:

Fire inside UNB - Storage Tank Area: NRC staff reviewed the postulated fire scenarios described in NFS' FHA for the UN solution storage area, along with the postulated consequences for accidental release of UN solutions in NFS' Environmental-Radiological ISA Consequences and Analysis. The NRC staff concludes that the unmitigated fire involving one or multiple empty FRP tanks would result in the most severe fire conditions within the UNB, with the likelihood of flashover conditions (i.e., raise of room temperature above 1,200°F [649°C], causing simultaneous ignition of all combustibles) in the storage area and fire spreading throughout the building.

In order for a fire to spread to storage tanks, an initial condition that must exist is a fire of sufficient energy, within close proximity to an empty FRP tank or unwetted portion of a tank, to cause the ignition and burning of the FRP material. As a result, an important safety control is the administrative control of combustibles that minimizes or prevents the accumulation of unacceptable quantities of combustibles leading to a fire igniting an empty or unwetted portion of FRP material. Because the expected ignition temperature for this FRP material is high, greater than 600°F [315°C], the risk of igniting storage tanks may be considered low or unlikely. Also, it is difficult to ignite wetted perimeter walls (i.e., tanks filled with UN solutions). NFS commits to controlling combustibles and controlling ignition sources to minimize the likelihood of a fire spreading to a storage tank.

The NRC staff determined that the fire damage of storage tanks will depend on whether they are filled (i.e., full or partially) or empty of UN solutions and the location of where the fire starts. For the unwetted tank perimeter wall and top above the UN solution, flame impingement or heat exposure will cause the FRP material to decompose, structurally weaken, collapse, ignite, and burn. In some cases, the fire exposed portions of the unwetted perimeter wall may collapse on top of the UN solutions, resulting in limited burning or self-extinguishment. Where flames or heat exposure affects the wetted perimeter wall, the UN solution serves as a heat sink (i.e., heat is transferred away from the FRP material). As a result, delays can be expected in temperature rise of the FRP material, structural failure, ignition, and burning. A localized failure of the heat exposed area can lead to loss of containment and spill of UN solution. Because the damage to storage tanks from a fire is dependent on a number of factors (i.e., where the fire starts, what is exposed, whether a tank is filled or empty, fire severity, and subsequent fire development), there are uncertainties associated with how many tanks may fail and how much UN solution would be spilled. It would be reasonable to assume a worst case location for a fire exposing up to eight tanks with the tanks simultaneously spilling their contents. This spill scenario would exceed the capacity of the spill containment system in the UN storage area that has a capacity of gallons [ liters]. This may result in UN solution release to the environment. For these reasons, NRC staff concludes that an unmitigated fire in the storage area involving an empty FRP storage tank will lead to environmental damage.

NFS has concluded in its ISA Summary that the failure of more than one FRP tank would result in intermediate consequences. NFS will install an automatic sprinkler system and train operators with approved procedures (designated as an IROFS) making the likelihood of fires resulting in multiple tank failures to be "highly unlikely." In addition to the IROFS, NFS will provide defense-in-depth protection to minimize the potential occurrence and the consequences of a fire in the UNB. They will implement the following engineered and administrative controls:

1. trained operators and approved procedures (identified as IROFS),
2. fire alarm system,
3. automatic sprinkler system (identified as an IROFS),
4. storage area containment systems,
5. emergency response (NFS' fire brigade and offsite fire department),
6. non-combustible building construction,
7. fire-rated barriers,
8. fire-retardant intumescent latex coating of FRP storage tanks.

The NRC staff concludes that trained operators and approved procedures, as they relate to implementing control of combustibles, control of ignition sources, and response, will be the first mitigating system in preventing or interrupting conditions required in the event of a fire involving an FRP storage tank. The second mitigating system is an automatic sprinkler system, designed and installed in accordance with applicable industry codes and standards. This system provides a high level of assurance that a fire in the UNB will be extinguished or contained prior to damage of more than one storage tank. The NRC found that these IROFS provide reasonable assurance that, in the event of a fire, the likelihood of a spill of UN solution greater than one storage tank is "highly unlikely."

The remaining features listed above are credited as defense-in-depth protection in safety basis assumptions for operations for minimizing the risk and consequences of fires within the UNB.

The NRC staff notes that NFS plans to provide an intumescent fire-retardant latex coating on FRP storage tanks as a defense-in-depth protection feature. The coating provides a barrier when exposed to heat and minimizes the severity of fire spread and smoke generation. The NRC staff's review of the manufacturer's data indicates that the intumescent fire-retardant latex coating is not intended for application on FRP material (i.e., intended for improving fire rating for structural steel). The improvement of fire resistance of the FRP material is not expected, as the FRP material degrades and loses structural integrity at lower temperatures than steel. Therefore, the only reasonable safety function that may be credited is increased ignition difficulty or ignition time delay and limited fire and smoke spread of the FRP material. NFS' assumption that the coating is an additional defense-in-depth protection is reasonable. The Table 11-1, below, "Safety Controls for Fire Inside UNB Storage Area," is a summary of administrative and engineered controls and the corresponding safety performance which the NRC staff considers important as IROFS and/or defense-in-depth fire protection.

**Table 11-1, SAFETY CONTROLS FOR FIRES INSIDE UNB STORAGE AREA**

| Administrative and Engineered Controls | Safety Performances |
|---|---|
| Control of fixed and transient combustibles and control of ignition sources | Minimize potential fire severity such that a fire originating at one location is not sufficient to cause flashover conditions.<br><br>Minimize or prevent fire propagation between fixed and/or transient combustibles and control ignition sources such that a fire originating at one location will not spread to adjacent combustibles and lead to flashover conditions. |
| Manual fire suppression by operators | Extinguish an incipient (small) fire by operators trained to respond to a fire, using appropriate fire suppressants. |
| Automatic fire alarm system | Provide automatic detection of a fire in the UNB and automatically initiate the plant fire alarm for emergency response. |
| Automatic fire suppression system | Minimize or prevent the potential of a fire spreading to FRP storage tanks in the storage area.<br><br>Minimize potential fire severity such that a fire involving combustibles or FRP storage tanks is contained or extinguished and prevent the occurrence of flashover conditions.<br><br>Minimize potential of fire exposure and spread into the storage area by containing or extinguishing fires in adjacent process and administrative/support areas. |
| Fire Rated Barriers | Minimize potential fire exposures to storage tanks from adjacent load/download and support areas. |

| Administrative and Engineered Controls | Safety Performances |
|---|---|
| UNB storage area liquid containment system | Contain the spill of -gallon [ liters] storage tank and the discharge of water from 6 sprinklers at a total flow rate of gallons-per-minute [ liters-per-minute] for a duration of 30 minutes. |
| Plant emergency team (and/or an offsite fire department) manual fire suppression | Contain and suppress a fire that has developed beyond the incipient stage or beyond the suppression capabilities of trained operators. |

Other Fires Inside the UNB: NFS' FHA postulated the following fire scenarios in support of the ISA for the proposed operations at the UNB:

1. tow vehicle fire in load/download area,
2. HVAC duct/filter fire,
3. electrical room fire,
4. office area fire,
5. mechanical room fire, and
6. mechanical room natural gas explosion.

With the exception of the postulated natural gas explosion, NFS has concluded these fire scenarios do not present significant fire exposures or fire severities that would challenge the bounding fire, and would not result in the failure of more than one storage tank. Likewise, NFS stated that these fire scenarios would not challenge the effectiveness of the automatic sprinkler system (i.e., overtax system performance) in the storage areas. NFS' ISA Summary and FHA concluded that the overall risk of fire (initiating frequency and unmitigated consequences) in the postulated fire scenarios are low and IROFS were not required. NFS will provid administrative controls (e.g., control combustibles, control ignition sources) and engineered fire protection systems (e.g., fire alarm system, automatic sprinklers, UL listed HEPA filters) for defense-in-depth fire protection of the UNB.

NRC staff's review determined that the postulated fire scenario in the load/download area represents the second highest risk where a fire could involve nuclear material (i.e., UN solutions in transportation containers) and where fire exposures could impact the adjacent tank storage area. On the basis of limited amounts of fuel, NFS' ISA Summary and FHA stated that an unmitigated fire involving 50-gallons [189 liters] of diesel fuel will have low consequences and a low likelihood of occurrence. NRC staff determined that these statements were reasonable. NRC's independent evaluation of the safety significance and risk of a fire in the load/download area is discussed below.

Fire in Load/Download Area: The NRC staff determined that a postulated combustible liquid pool fire, assuming diesel fuel, in the containment basin of the load/download area will have a high heat release for a short duration (e.g., range from between 3-7 minutes), with generation of a significant amount of smoke. The development of flashover conditions that could involve other combustibles (e.g., tires, transient combustibles) within the process areas is not expected in this scenario. As a result, the risk of significant fire exposure and fire spread to the adjacent tank storage area exceeding the performance capability of the automatic sprinkler system is minimal.

On the basis of approved shipping containers having a fire endurance of 30 minutes exposure to a liquid pool fire, the NRC staff concludes that the risk of fire induced failure of shipping containers leading to a spill of UN solution in the load/download area is highly unlikely. The NRC staff noted that the radiological consequences from loss of containment of all UN solutions (i.e., approximately [redacted] in this process area would be bounded by a [redacted] spill from loss of containment of an FRP storage tank, that is not expected to exceed performance criteria of 10 CFR 70.61 (i.e., low consequences).

The Table 11-2 below, "Safety Controls for Fire In UNB Load/Download Area," is a summary of NFS' administrative and engineered controls and safety performances which the NRC staff considers important as defense-in-depth fire protection in the load/down load process area of the UNB.

**Table 11-2, SAFETY CONTROLS FOR FIRES IN UNB LOAD/DOWNLOAD AREA**

| Administrative and Engineered Controls | Safety Performances |
|---|---|
| Control of fixed and transient combustibles and control of ignition sources | Minimize potential fire severity such that a fire originating at one location is not sufficient to cause flashover conditions.<br><br>Minimize or prevent fire propagation between fixed and/or transient combustibles such that a fire originating at one location will not spread to adjacent combustibles and lead to flashover conditions.<br><br>Minimize fire severity by limiting combustible liquid in load/download area to no more than 50-gallon of diesel fuel. |
| Approved transportation container | Minimize potential UN solution containment failure under severe fire exposures for a duration of 30 minutes. |
| Manual fire suppression by operators | Extinguish an incipient (small) fire by operators trained to respond to a fire, using appropriate fire suppressants. |
| Automatic fire alarm system | Provide automatic detection of a fire in the UNB and automatically initiates the plant fire alarm for emergency response. |

| Administrative and Engineered Controls | Safety Performances |
|---|---|
| Fire rated barriers | Minimize potential fire exposures to storage tank areas and fire exposure from adjacent process areas. |
| Automatic fire suppression system | Minimize potential fire severity such that a fire involving combustibles in the load/download area is contained or extinguished.<br><br>Minimize or prevent the potential of a fire spreading or involving FRP storage tank(s) in adjacent storage area. |
| Load/download liquid containment (curbing and sump) system | Contain the contents of approximately gallons [ liters] spill of UN solutions and the discharge of water from 4 sprinklers at a total flow rate of gallons-per-minute [ liters-per-minute] for a duration of 30 minutes. |
| Plant emergency team (and/or offsite fire department) manual fire suppression | Contain and suppress a fire that has developed beyond the incipient stage or beyond the suppression capabilities of trained operators. |

Explosions in the UNB Mechanical Room: NFS' ISA has identified IROFS as and to shut off natural gas to minimize the potential for a natural gas explosion in the mechanical room. Because of uncertainties related to potential damage from an explosion, NFS plans to thereby preventing the accumulation of natural gas above the lower explosive limit in the mechanical room. The IROFS prevent explosions that could potentially damage storage tanks for containment of UN solutions. The NRC staff notes that the proposed systems are in addition to NFS' to installing natural gas piping and equipment in accordance with established industry standards that minimize the risk of fire and explosions. Table 11-3 below, "Safety Controls for Explosion in UNB - Mechanical Room," is a summary of NFS' engineered controls and corresponding safety performance which the NRC staff considers important to minimizing the risk of explosions in the mechanical room of the UNB.

Table 11-3, SAFETY CONTROLS FOR EXPLOSION IN UNB - MECHANICAL ROOM

| Active or Passive Engineered Controls | Safety Performances |
|---|---|
| Natural gas piping and unit | Minimize potential fire or explosion by system design and installation in accordance with applicable codes and standards and certification by independent testing laboratories requirements (e.g., Underwriters Laboratories, Factory Mutual).<br><br>Minimize potential leaks of natural gas (low pressure interlocks to automatically fail safe block and bleed valves in gas supply piping). |
| | Minimize potential accumulation of natural gas above the lower explosive limit (i.e., ). |
| | Minimize potential accumulation of natural gas above the lower explosive limit (i.e., ) |

The NRC staff concludes that the proposed controls are adequate to minimize the risk of an explosion from operations related to a natural gas unit for heating, ventilation, and air conditioning in the UNB.

### 11.1.3 Potential Fire Hazard Exposures to UNB

NFS reviewed potential external fire or explosion hazards that could pose a risk to the proposed UNB. NFS' ISA and FHA considered a number of potential fire or explosion hazards external of the UNB. These hazards included possible fire or explosion at an adjacent industrial facility, flammable storage (i.e., a [redacted] propane tank) on premises of the BLEU complex, hydrogen and propane storage tanks at the NFS plant, wild fire, nearby railroad, and UNB standby diesel generator. Due to baseline design conditions such as the current siting of the UNB, the noncombustible construction of the UNB, the presence of fire breaks, and the very low likelihood of an initiating event (i.e., derailment of a railcar with hazardous cargo at 10 mph [4.5 m/s], propane tank failures), NFS stated that there are no external fire or explosion hazards that could significantly affect the safety of operations at the UNB. NFS commits to management measures to provide fire prevention, control of potential fire hazards, and emergency response for fire protection of the facility and plant site, minimizing the potential of external fire exposures to nuclear material and processes.

The NRC staff concludes that the separation distance between the UNB and potential flammable or combustible hazards, in accordance with the SBC and applicable industry standard (e.g., NFPA 58, 80A, 101), minimizes the potential exposure hazards from nearby fires or explosions. The potential heat and explosion pressure hazards that could damage the UNB diminish rapidly with an increase in distances between the source of the fire or explosion and its target (i.e., the UNB). The potential fire and explosion exposures to nuclear processes from adjacent areas are minimal, with no additional significant increase in risks or challenges to controls relied on for safety. The NRC staff has reviewed NFS' analyses of potential fire hazards and concludes that NFS' findings and conclusions are acceptable.

### 11.1.4 Facility Fire Protection

#### 11.1.4.1 Facility Passive Engineered Fire Protection Systems

The UNB will be designed and built in accordance with applicable fire protection requirements in the SBC, the Standard Fire Prevention Code, and the National Fire Protection Association standards for fire protection. The facility equipment will be installed in accordance with applicable industry standards and guidelines, including NFPA standards for fire protection.

Noncombustible Facility Construction: The UNB facility containing the nuclear processes will be designed to meet the minimum Type IV unprotected construction requirements (i.e., it will have noncombustible structural elements) and fire resistance requirements in accordance with Table 600 of the SBC. The UNB is not required to have fire-rated perimeter walls, floors, or roof. However, NFS will provide a fire-rated wall separating the tank storage area from adjacent areas (i.e., load/download, mechanical room, electrical room, and offices) as defense-in-depth protection minimizing fire spread between areas.

NFS will limit the amount of fixed combustibles that could increase fire severity or propagate a fire by using noncombustible materials to construct walls, floor, roof, and structural support systems of the building. As a result, a fire involving process equipment or a fire involving transient combustibles would not spread by means of the facility construction materials. NFS' ISA Summary and FHA credit the building construction, along with a lack of combustibles, as defense-in-depth protection for the UNB. NFS plans to maintain the noncombustible construction of the facility structural elements as a fundamental requirement of the design safety basis for providing an adequate level of fire protection within the facility.

Containment Systems: NFS will provide two containment systems; one in the tank storage area and the other in the load/download area to minimize the consequences from spills of UN solutions. The containment systems will be sized to accommodate limited discharge of sprinkler systems in the event of a fire. NFS' ISA Summary and FHA assume that the availability and reliability of the containment systems provides a defense-in-depth feature preventing unacceptable consequences that may result from accidental spills of UN solutions.

### 11.1.4.2 Facility Active Engineered Fire Protection Systems

Fire Alarm System: NFS will provide a fire alarm system in the UNB for automatic detection of a fire, automatic and manual initiation of a plant fire alarm, and audible and visual indication of a fire. The key safety function of the fire alarm system is to provide automatic detection and the means of automatic and manual initiation of a plant emergency response. As a result, the fire alarm system and components (including the secondary power supply) are important to initiate a response by the plant and off-site emergency response team, thereby suppressing a fire before conditions challenge the controls relied on for safety or increase the risk of an accident of a different type. The NRC staff determined that the fire alarm system, installed in accordance with industry standard (e.g., NFPA 72) and maintained to be available and reliable, will contribute to defense-in-depth fire protection of the facility and its operations.

Automatic Fire Suppression Systems: NFS will provide sprinkler protection throughout the UNB to minimize the risk of fire. The has been identified as an IROFS to minimize the risk of a fire resulting in a spill of UN solutions greater than [redacted] (i.e., one storage tank). The sprinkler system and its safety performance are defense-in-depth protection minimizing the risk of exposure fires that could affect the storage of UN solutions. NFS will install the in accordance with applicable industry standard (e.g., NFPA 13) to ensure that it is available and reliable. The NRC staff determined that the automatic sprinkler system, if maintained to be available and reliable, will serve as an IROFS and contribute to defense-in-depth fire protection of the facility and its operations.

Ventilation System HEPA Filters: NFS will provide high-efficiency particulate air (HEPA) filter ventilation systems to remove particulate material prior to exhausting air from the UNB. The presence of HEPA filters provides defense-in-depth protection against the release of radiological contamination from a small fire or during the early stages of a fire.

### 11.1.5 Plant Fire Protection Program

NFS committed, in Chapter 6 of the current license application, to provide and implement a fire protection program (e.g., through implementing procedures) that will minimize the occurrence, the potential fire severity, and the consequences of a fire. The fire protection program will assure the required level of safety through provisions to provide engineered and administrative controls, and emergency response. The program ensures a fire does not cause an unacceptable release of hazardous material and jeopardize public health, safety and the environment.

NFS fire protection procedures describe implementation of administrative controls such as the following to minimize the occurrences of fires and severity of fires: (1) training on, and communication of, fire safety requirements, (2) inspecting for fire safety performance, (3) controlling ignition sources to minimize the occurrence of fires, (4) controlling the accumulation of combustibles, (5) controlling the use and storage of flammable and combustible liquids and gases, and (6) investigating fire events to minimize the occurrence of future fires. In addition, NFS' fire protection program requires the maintenance of engineered safety features for fire detection and notification, automatic fire suppression for high fire hazard areas, and fire extinguishers for manual fire suppression to limit the severity and spread of a fire. The fire protection program contains procedures for maintaining an onsite emergency response capability and equipment (including an adequate water supply) and coordinating offsite fire department assistance.

NFS committed to management measures as described in its ISA Summary (e.g., configuration control, maintenance programs, corrective actions reporting program, safety review committees, procedures, audits and assessments, incident and investigations) and in accordance with license safety condition S-25 to ensure design basis requirements are maintained for safety of nuclear operations. These management measures will be applied to IROFS that prevent and mitigate potential fires.

In summary, the implementation of NFS' fire protection program and related management measures ensures the defense-in-depth protection and safety performance necessary to minimize the likelihood of major fires in the process facility and site areas adjacent to the process facility. These fire protection and management measures provide reasonable assurance of safety that nuclear operations will be performed safely and minimize the potential of a fire that could involve licensed material, or cause a loss of safety controls that could lead to an accident of a different type.

### 11.2 Evaluation Findings

NFS described reasonable administrative and engineered controls to minimize the risk of fires and protect against potential exposure to fires and explosion hazards for operation of the UNB. The NRC staff concludes that, if the IROFS and defense-in-depth protection in NFS' ISA Summary, along with the safety basis assumptions described in ISA supporting analyses (i.e., PHA, FHA, etc.), and the commitments currently in the license are adequately implemented to achieve their intended safety functions, a reasonable assurance is provided that the health and safety of workers, the public, and the environment is protected.

## 12. EMERGENCY MANAGEMENT

This section requires NFS to provide an emergency plan for responding to the radiological hazards of an accidental release of SNM and to any associated chemical hazards directly incident thereto. NFS provided proposed changes to its site emergency plan in a submittal dated March 8, 2002. NRC staff reviewed these proposed changes and determined that it is in conformance with the requirements of 10 CFR 70.22(i)(3). NFS submitted the emergency plan to offsite response organizations expected to respond in case of an accident, 60 days prior to submitting the emergency plan to NRC, and received no comments from the response organizations. NFS requested that the commitments in the emergency plan revision submitted with the UNB amendment request not be implemented until NFS actually received

NRC-licensed material into the UNB. NRC staff agrees that this is a reasonable commitment, and the following license condition will be incorporated into the license:

S-24: The licensee shall maintain and execute the response measures in the Emergency Plan, Revision 6, transmitted by letter dated July 5, 2002, and in the proposed revisions to the NFS Emergency Plan to support the Uranyl Nitrate Building at the BLEU complex, submitted by letter dated March 8, 2002, or as further revised by the licensee consistent with 10 CFR 70.32(i).

## 13. ENVIRONMENTAL PROTECTION

### 13.1 Discussion

The NRC staff evaluated the effects of the construction and operation of the UNB on the environment in accordance with the SRP. The results of the evaluation are summarized below.

#### 13.1.1 Environmental Report

NFS submitted a supplemental ER, dated November 9, 2001, and additional information letters dated January 15, 2002, March 15, 2002, and April 12, 2002. The NFS environmental documentation was used by NRC staff to prepare an EA pursuant to the NRC regulations [10 CFR Part 51] and guidance from the Council on Environmental Quality regulations [40 CFR Parts 1500–1508] that implements the requirements of the National Environmental Policy Act (NEPA) of 1969.

#### 13.1.2 Environmental Protection Measures

The NRC staff assessed and evaluated the impacts from non-radiological contaminants to air, surface water, and groundwater. In order to protect air quality, the UNB will have a ventilation system that maintains the process area at negative pressure relative to the atmosphere. All tanks will be vented, and the tank vents and room exhaust will be passed through HEPA filtration prior to discharge to the atmosphere. The stack discharges will be monitored for gross alpha and gross beta radioactivity.

There will be no direct effluent discharges to surface water as a result of the construction and operation of the UNB. Surface water is expected to continue to be protected from site activities by enforcing release limits and monitoring programs, as required by the National Pollutant Discharge Elimination System (NPDES) permit, regulated by the State of Tennessee.

Previous operation of the plant has resulted in localized chemical and radiological contamination of groundwater. Groundwater monitoring conducted by NFS indicates that plumes of uranium, tetrachloroethylene, trichloroethylene, 1,2-dichloroethylene, and vinyl chloride, from past operations, could migrate offsite in the direction of the Nolichucky River. To address potential environmental impacts from this contamination, NFS has removed much of the source contamination through extensive remediation projects including excavation of contaminated areas in the North Site. In addition, NFS is decommissioning the radiological burial ground and the North Site to remove more of the source of this contamination. NFS also is working with the Tennessee Department of Environment and Conservation and the EPA to design remedial strategies and to investigate the off-site extent of existing plumes.

For normal operations, the proposed action will not discharge any effluents to the groundwater; therefore, no adverse impacts to groundwater are expected. Accidental releases of contaminants to groundwater appear unlikely due to design and control measures implemented by NFS. These controls include: robust tank design for storage and transfer tanks, tank berms for spill control and isolation, tank level controls for overfill protection, administrative controls on load/download operations, and safety interlocks with fail-safe design. NRC staff has determined that these environmental protection controls are acceptable.

### 13.1.3 Radiation Safety

The potential for increase in dose to workers at NFS due to the UNB was evaluated. Operation of the UNB is not expected to increase the dose to workers at the NFS facility, because the types and quantity of material, and the processing, will be similar to what is already licensed at the site. NFS has committed to keeping doses ALARA by maintaining a radiation protection program that minimizes radiation exposures and releases of radioactive material to the environment. In order to accomplish this, NFS has procedures for working with radioactive materials and monitoring programs to determine the doses received by employees. As discussed in Section 8 of this SER, NRC staff has determined that NFS' existing occupational radiation protection program provides reasonable assurance of compliance with 10 CFR Part 20 and is therefore acceptable.

The potential for increase in dose to the maximally exposed off-site individual due to the construction and operation of the UNB was evaluated. Because the types and quantity of material, and the processing, will be similar to what is already licensed at the site, the dose is not expected to increase significantly. NFS has controls and monitoring programs in place to minimize releases of radioactive material to the environment. In accordance with 10 CFR 70.59, they are required to submit a semi-annual effluent report which specifies the quantities of each of the principal radionuclides released to unrestricted areas in liquid and gaseous effluents. NRC staff has determined that these controls and monitoring programs provide reasonable assurance of compliance with the public dose limits of 10 CFR Part 20, and are therefore acceptable.

### 13.1.4 Effluent and Environmental Monitoring

Airborne, liquid, and solid effluent streams that contain radioactive material are generated at the NFS plant and monitored to ensure compliance with NRC regulations in 10 CFR Part 20. Each effluent is monitored at or just before the point of release. The results of effluent monitoring are reported on a semi-annual basis to the NRC in accordance with 10 CFR 70.59. Airborne and liquid effluents are also monitored for nonradiological constituents in accordance with state discharge permits.

Airborne effluents from process ventilation stacks and vents are sampled continuously for radioactivity during the processing of radioactive materials. Samples, representative of total discharge, are routinely collected at frequencies specified in NFS procedures. All airborne effluent samples are analyzed for gross alpha and gross beta radioactivity.

Ambient air is continuously monitored at onsite and offsite locations. All environmental ambient air samples are analyzed for gross alpha and gross beta radioactivity, and are composited and analyzed for specific radionuclides.

Liquid effluents from the UNB will exit the NFS plant by the sanitary sewer to the Erwin Publicly Owned Treatment Works, and storm water run-off will exit to Martin Creek. The sanitary sewer line for the new BLEU complex (including the UNB) is separate from the sanitary sewer line collecting waste from the main NFS plant site. Sanitary sewer discharges from the UNB are not required to be monitored for radiological constituents because no process waste will be discharged. Only UNB restroom waste will be discharged. Sanitary sewer discharges will be monitored for nonradiological constituents in accordance with a pre-treatment permit from Erwin Publically Owned Treatment Works. Storm water monitoring for the BLEU complex will be conducted in accordance with a general NPDES storm water discharge permit.

Solid wastes generated by UNB operations will be packaged into drums or boxes. Each container will be assayed for uranium content to verify that storage, shipment, and disposal requirements are met.

NFS conducts a sampling program of ambient soil, vegetation, surface water, and sediment to monitor impacts from the Erwin plant to the surrounding area. Details of the monitoring program are described in the license renewal EA. Also environmental dosimeters are at onsite and offsite locations to monitor ambient external dose rates and to assist with the assessment of potential accidents. NRC staff has determined that the environmental monitoring program, described in Chapter 5 of NFS' license, is adequate to assess impacts to the environment from the UNB and is therefore acceptable.

### 13.1.5 ISA Summary

The staff reviewed NFS' ISA Summary which identified three process accident sequences and three natural phenomenon hazards that have the potential to cause environmental damage. The process accident sequences are initiated by a fire or explosion in the building. The IROFS in place to prevent these accidents are as follows: natural gas system safety controls, block wall between heater and UNB tanks, fire suppression and automatic sprinkler systems, and trained operators. The natural phenomenon hazards are initiated by either an earthquake or high winds that could result in building failure causing the UN tanks to release their contents to the environment, or by direct failure of the UN tanks or supports due to ground motion. NFS identified IROFS to reduce the environmental consequences of a design basis event to less than 10 CFR 70.61(c)(3) and (c)(4). The IROFS for natural phenomena hazards include:

, and

. The staff has reviewed the safety features of the building and finds that these IROFS are appropriate to prevent environmental consequences exceeding the performance requirements and are therefore acceptable.

## 13.2 Evaluation Findings

NFS has committed to adequate environmental protection measures, including environmental and effluent monitoring and effluent controls to maintain public doses ALARA as part of the radiation protection program. The NRC staff concludes that NFS' conformance to the application and license conditions provides adequate assurance of the protection of the health and safety of the workers and public, is adequate to protect the environment, and complies with the regulatory requirements imposed by the Commission in 10 CFR Parts 20, 51, and 70.

The basis for this conclusion is documented in an EA which was prepared in support of the proposed amendment. The EA and FONSI were initially published in the Federal Register on July 9, 2002 (67 FR 45555) and subsequently republished October 30, 2002, (67 FR 66172) to clarify the amendment application. A correction was published on November 12, 2002, (67 FR 68699).

# 14. DECOMMISSIONING

## 14.1 Discussion

In accordance with 10 CFR 70.22(a)(9), NFS provided a cost estimate for decommissioning the UNB by letter dated February 28, 2002, to comply with 10 CFR 70.25. The estimate consisted of three tables that listed costs for labor, material, and services expected to be used for decommissioning. By letter dated July 11, 2002, the NRC requested that NFS provide the basis used to estimate the tabulated costs. NFS submitted that proprietary basis by letter dated October 18, 2002.

The NRC staff reviewed the cost estimate and basis according to NUREG-1757, NMSS Decommissioning Standard Review Plan, Section 15 (Financial Assurance for Decommissioning) and Appendix F (Standard Format and Content for Financial Mechanisms for Decommissioning).

The staff determined that NFS' submittals contained the three basic parts needed for a complete decommissioning cost estimate: 1) facility description, 2) estimated decommissioning costs, and 3) key assumptions.

The October 18, 2002, submittal included a description of the building, a process diagram, and a floor plan. Estimated costs were submitted in the February 28, 2002, letter. The October 18, 2002, submittal presented NFS' key assumptions for the estimated costs.

The staff's review of key assumptions found that NFS used appropriate contingency factors in their estimates of waste volume. The factors are based on historical data from other decommissioning projects performed by NFS. Labor staff-hours were estimated as a function of waste volume. The staff-hours were assigned rates and overhead charges to calculate labor costs. Similarly, materials costs were estimated as a function of waste volume.

The cost of disposal included container, preparation, transportation, and disposal costs. Thus, the estimate accounts for the major categories of disposal costs involved. The unit costs are based on contractual agreements. Because the waste volume includes a contingency factor, the total disposal costs also include a contingency factor.

The estimate included adjustments for contractor overhead and profit. This conforms to the NRC guidance that costs should be estimated to provide funds sufficient to permit an independent third party to assume completion of the decommissioning project. The contractor costs are calculated as a percentage of the labor, material and services cost. Because the underlying costs are themselves derived from waste volume estimates that have a contingency factor, the contractor overhead and profit costs have a contingency included.

The staff found the cost estimate to be reasonable, except for the reduction of the total by subtracting an "escalation adjustment" of approximately 6.4%. The licensee did not provide a basis for the reduction. NRC guidance does not recommend any reduction of the total estimated cost. NFS revised the cost estimate to remove the escalation adjustment. NFS provided a proprietary, irrevocable standby letter of credit dated May 5, 2003, to cover the total of all estimated costs. NFS provided a proprietary amendment to the letter of credit dated June 9, 2003.

### 14.2 Evaluation Findings

The NRC staff has evaluated NFS' decommissioning cost estimate and financial assurance instrument in accordance with the NUREG-1727, "Decommissioning Program Standard Review Plan." On the basis of this evaluation, the NRC staff determined that NFS' decommissioning cost estimate and financial assurance instrument comply with the NRC's regulations at 10 CFR 70.25 and provide reasonable assurance of protection for workers, the public, and the environment.

## 15. MANAGEMENT MEASURES

10 CFR 70.62(d) requires that each licensee establish management measures to ensure compliance with the performance requirements of 10 CFR 70.61. The measures applied to a particular engineered or administrative control or control system may be graded commensurate with the reduction of the risk attributable to that control or control system. Management measures ensure that engineered and administrative controls and control systems, identified as IROFS, are designed, implemented, and maintained, as necessary, to ensure they are available and reliable to perform their function when needed. Chapter 11 of the SRP, titled, "Management Measures," includes acceptance criteria for the following eight areas of management measures: configuration management (CM), maintenance, training and qualifications, procedures, audits and assessments, incident investigations, records management, and other QA elements.

NFS provided a new Section 2.12 to its license amendment application, titled, "Management Measures for Items Relied on for Safety," containing commitments addressing each of these eight areas. The NRC discussion and evaluation is provided below.

## 15.1 Discussion

### 15.1.1 Configuration Management

In new Section 2.12.1.1 of the license, NFS committed to maintain a CM program for IROFS in a manner consistent with SRP Chapter 11. The scope of the IROFS that are under CM, and management measures that shall be applied to maintain these safety controls reliable, are contained in Table 2.2. In addition, each IROFS and its associated management measures are specified in the ISA Summary in accordance with 10 CFR 70.62.

The design process shall rely on information supplied from a multi-disciplined team of engineers and safety personnel. This design process is initiated with a project definition wherein the baseline and safety design criteria are established and concludes with a detailed design wherein the safety criteria are incorporated. Information provided by the multi-disciplined team shall be used, as appropriate, to establish and implement the following CM functions for new facilities to ensure a baseline design meets the requirements specified in 10 CFR 70.64:

1. design requirements,
2. document control,
3. change control, and
4. assessments.

Changes to IROFS are managed and controlled as described in written procedures developed in conformance with guidance specified in the SRP. IROFS are identified in the ISA Summary, a controlled document.

In new Section 2.12.1.2, "Design Requirements," NFS committed to have documents establishing requirements for design of new facilities where special nuclear material is handled. Designs based on these requirements are reviewed in a graded manner through the NFS Internally Authorized Change (IAC) and the ISA process.

The design bases are established in accordance with procedures to meet regulatory requirements and to ensure that operations perform the desired function in accordance with requirements from individual safety functions. These design bases are developed by a multi-disciplined team comprised of engineering and safety personnel and are approved by the safety discipline manager (see Section 2.2.3 of the license application). Procedures used to establish design bases shall incorporate engineering, maintenance, and safety review interfaces used in support of the IAC and ISA processes. Through the IAC process, written approval of the recommended design bases shall be required from the safety review committee before startup of operations is permissible.

In new Section 2.12.1.3, "Document Control," NFS committed to establish a document control system for new facilities to create, control and track documents within the CM function. The document control system shall maintain control of procedures that are IROFS and those procedures related to training, quality assurance, maintenance, audits and assessments, emergency operations, emergency response, and change control documents associated with IROFS.

Other documents that shall be maintained under the document control system when relied on for safety include:

1. design requirements,
2. engineering drawings and/or sketches,
3. specifications for IROFS; and
4. the ISA Summary

The document control system will address cataloging the document databases, the informational content of the document databases, means to maintain and distribute documents, and document retention/retrieval policies. The document databases are used to control documents and track the document change status.
Documents are controlled in accordance with procedures developed by the appropriate functional disciplines (i.e., departments) until such time that the documents are transferred to Records Management for retention. Additional information concerning the document databases and records management system that shall be used to capture documents that are relevant and relied on for safety is provided in Section 2.12.7, "Records Management."

In new Section 2.12.1.4 "Change Control," NFS committed to establish a change control process as part of CM, that complies with requirements specified in 10 CFR 70.72. Proposed changes involving site structures, equipment, processes, systems, components, or procedures related to SNM operations and potentially affecting an IROFS are submitted to the safety discipline manager for review to determine if a license amendment is required or if the change requires using the IAC process. The criteria for exemption from a license amendment are specified in License Condition S-25 which implements the requirements of 10 CFR 70.72(a). The change control process, including requirements to update the necessary supporting safety basis documents (e.g., NCSE and ISA Summary), is specified in written procedures. This change control process provides the means to document and disseminate changes to the affected engineering, operations, maintenance, training and safety disciplines.

Staff members from individual safety functions are required to review, in accordance with written procedures, proposed changes that may affect design requirements, physical configurations and facility documentation. The safety review committee reviews and approves all proposed changes involving IROFS credited in the ISA Summary. Other committee responsibilities are set forth in Sections 2.4, 11.4, and 11.7, and License Condition S-25. In addition, IACs affecting an ISA Summary are reviewed by the safety discipline annually in support of requirements specified in 10 CFR 70.72 and License Condition S-25. Oversight of the change control process by the safety discipline manager and the safety review committee ensures consistency with these CM elements. The records management program described in Section 2.12.7 shall also be used to track and document implemented IACs.

In new Section 2.12.1.5, "Assessments," NFS committed to conduct an initial and a biennial assessment of the CM function to determine the program's effectiveness and to correct documented deficiencies. These assessments shall be performed in a systematic and planned manner and shall include both document assessments and physical assessments (i.e., facility walkdowns). The results of these assessments may provide a basis for future changes and, therefore, shall be documented and maintained in accordance with Sections 2.12.5, "Audits and Assessments," and 2.12.7, "Records Management."

The assessments shall be performed in accordance with the facility audit and assessment program as specified in Section 2.12.5, "Audits and Assessments." The staff's conclusion is given in Section 15.2.1.

### 15.1.2 Maintenance

NFS proposed a new Section 2.12.2 to its license amendment application titled, "Maintenance of IROFS." In the new section, NFS included commitments for maintenance of active and passive engineered controls and administrative controls, and committed to incorporate maintenance activities into written procedures.

NFS has established a program to ensure that active and passive engineered controls designated as IROFS are maintained in a manner so as to ensure the IROFS are capable of performing their intended function when called upon. An essential element of the maintenance program requires that all maintenance activities, including functional testing of IROFS during startup of new process operations, are authorized by written procedures and/or written instructions.

The maintenance program consists of several key program elements including a maintenance management system that provides the scheduling and documentation of the following maintenance elements when applied to IROFS:

1. surveillance and monitoring,
2. corrective maintenance,
3. preventive maintenance, and
4. functional testing.

Maintenance activities will be performed on IROFS in a manner to minimize the recurrence of unacceptable performance deficiencies. Maintenance, preventive maintenance, calibration, testing, and surveillance/monitoring of IROFS to ensure continued reliability and functional acceptability, IROFS will be authorized in accordance with written procedures and at frequencies approved by the safety review committee. These frequencies will be established based on manufacturer and industry guidance, risk assessment, feedback from surveillance and maintenance activities, or recommendations from NFS' corrective action program (see Section 2.12.6, "Incident Investigations and Corrective Actions").

Corrective maintenance shall be performed in a planned, systematic, integrated and controlled approach for the repair and replacement activities associated with identified unacceptable performance deficiencies of IROFS. Functional testing of the IROFS shall be performed to provide reasonable assurance that the safety control performs as designated and provides the safety action expected.

Preventive maintenance shall be performed in a preplanned and scheduled manner to refurbish or overhaul IROFS to ensure that they perform their intended function. Functional testing of the IROFS shall be performed to provide reasonable assurance that the safety control performs as designated and provides the safety action expected. Preventive maintenance will be appropriately balanced against the objective of minimizing unavailability of IROFS. A schedule for performing preventive maintenance on IROFS is maintained as specified in written procedures.

Functional testing of IROFS shall be performed prior to startup of new facilities or new process operations involving IROFS to provide reasonable assurance that the safety control performs as designated. Functional testing of IROFS shall be performed, prior to restart, if the process operation has been inactive for more than 120 days. During process operations, compensatory measures will be used as appropriate while functional testing is performed on IROFS. The results of functional testing shall be documented and maintained as specified in Section 2.12.7, "Records Management."

The maintenance system also provides instructions for specifying and documenting maintenance work activities and approvals. Maintenance skills training for mechanics involved in maintenance activities regarding IROFS is also required. Maintenance skills training is addressed in Section 2.12.3 "Training & Qualifications." Contractors working on IROFS will meet the same guidelines for IROFS training or will be under direct supervision by NFS-trained personnel that are qualified for the particular IROFS and knowledgeable of that IROFS.

Records for failures of IROFS shall be maintained in accordance with 10 CFR 70.62(a)(3). Maintenance records shall be maintained in accordance with written procedures as specified in Section 2.12.7, "Records Management."

NFS ensures that Administrative and Enhanced Administrative Controls designated as IROFS are functional and reliable over extended periods of operation by applying the Management Measures described throughout Section 2.12 and in Table 2.2, "Management Measures for IROFS."

The following methods/practices, as applicable, are incorporated into programs, systems, or written procedures regarding maintenance of IROFS:

1. authorized maintenance instructions with identification of the IROFS,
2. parts list for IROFS,

3. as-built or red-lined drawings,
4. pre-maintenance review of work to be performed on unique and complex IROFS, including procedure reviews to ensure accuracy and completeness,
5. notification before conducting repairs/maintenance or removing an IROFS from service, including notification instructions and the functional discipline(s) that shall be notified;
6. radiation work permit,
7. safe work practices (e.g., lock-out/tag-out; confined space entry; nuclear, radiation, environmental, fire, and chemical safety issues),
8. requirements for replacement of like-kind parts and control of new or replacement parts,
9. compensatory measures while performing work on IROFS,
10. procedural control of removal of components from service for maintenance and for return to service,
11. ensuring safe operations during removal of IROFS from service, and
12. notification to operations personnel that repair has been completed.

The staff's conclusion is given in Section 15.2.2.

### 15.1.3 Training and Qualification

In new Section 2.12.3, "Training and Qualification," NFS committed to provide a Training and Qualification Program that will provide all personnel on site with the knowledge and skills to safely perform their job function, effectively deal with the hazards of the workplace, and properly respond to emergency situations. The qualification aspect of this program ensures that operations are performed only by properly trained personnel. Requirements and methods for the training and qualification programs are approved by site management, who also provide ongoing evaluation of the effectiveness of the programs.

The NFS Training and Qualification Program requires that all personnel who are granted unescorted access to the restricted area(s) receive formal Safety Orientation Training. Safety Orientation Training covers plant safety rules, radiological, nuclear criticality, industrial, and environmental safety topics as appropriate to the job function of the individuals being trained. In addition, this training covers proper response to emergencies. Previously trained employees receive formal refresher training in Safety on an annual basis.

The NFS Training and Qualification Program provides a means to ensure that only qualified personnel are assigned to specific process operations involving handling of special nuclear materials. Exemptions from training are only authorized as described in written procedures.

The NFS Training and Qualification Program includes work training for operating personnel and others who directly handle greater than laboratory sample quantities of special nuclear material. Work training typically includes classroom, on-the-job and guided-work-experience training necessary to provide the desired knowledge and/or skill. It covers the operating procedures, alarms, emergency response actions, and radiological, nuclear criticality, industrial, and environmental safety controls and limits specific to the particular work assignment. NFS lesson plans and other training guides (for both class room and on-the-job training) developed for activities relied on for safety are based on learning objectives developed from specific job performance requirements. As such, information provided by various safety disciplines is included in the content of training elements with clearly defined objectives. The lesson plans also provide reasonable assurance that training is conducted in a reliable and consistent manner. The CM program (see Section 2.12.1.4, "Change Control") provides a means to assure that design changes and modifications to IROFS are accounted for in the training.

Work Training also includes appropriate re-instruction for previously qualified individuals prior to implementation of a process change or procedural modification. In addition, special "tool-box" training sessions are conducted when necessary to reinforce a particular requirement of the safety program or the operating procedure. Previously qualified individuals are required to undergo a re-qualification process for applicable work assignments every three years (maximum interval not to exceed 42 months). Additional details of the Work Training Program are provided in approved written procedures as described in Section 2.7, "Procedures."

The NFS Training Program provides for the instruction and training of mechanics involved in maintenance activities at NFS. Maintenance skills training may include such topics as basic math/precision instrument reading, laser alignment/vibration analysis, basic programmable logic controller (PLC), welding, industrial electricity (basic, intermediate, and advanced), and machine tool operation, as appropriate. The type and level of training will be commensurate with the job assignments.

The training records system includes a means to document training objectives, individuals trained, course content and other data necessary to satisfy requirements. Training records related to IROFS will be maintained for a minimum of two years in accordance with 2.12.7, "Records Management."

All training is conducted by, or under the supervision of, individuals recognized by NFS management as possessing the necessary knowledge and skills to conduct the training. As such, information provided by various safety disciplines is included in the content of training elements with clearly defined objectives.

The effectiveness of the training program and the individual comprehension of the subject matter are measured by appropriate assessment tools (e.g., written and/or oral examination, demonstration of skills, questionnaire, and feedback from NFS' corrective action program, etc.). Results from these assessment tools will be used to identify individuals that require special re-training, and to further enhance future training efforts and systems. The staff's conclusion is given in Section 15.2.3.

### 15.1.4 Procedures Development and Implementation

In new license Section 2.12.4, "Procedures," NFS committed to use several systems of operating and safety function procedures, as defined in license Sections 1.7.4, "Operating Procedures," and Section 1.7.5, "Safety Procedures," to conduct SNM operations and related support functions, including operations related to IROFS and their supporting management measures. NFS procedures address the following: design, CM, procurement, construction, radiation safety, maintenance, quality assurance, training and qualification, audits and assessments, incident investigations, records management, nuclear criticality safety, fire safety, chemical process safety, and reporting requirements. Procedures are further described in license Section 11.7, "Procedures."

Procedures shall be required for operator actions necessary to prevent or mitigate accidents defined in an ISA Summary. As such, operating procedures involving IROFS contain the following information, as applicable, to ensure that process activities and steps involving special nuclear materials are conducted safely and in compliance with regulatory and licensing requirements: initial and normal start-up, normal and off-normal operations, temporary operations, emergency operations or shutdown, startup following an emergency or extended downtime, types of hazards that may be encountered, operating limits (such as mass limits, double contingency measures and associated set points), precautions to prevent exposure to hazardous materials, and time-frame for which the procedure is valid. These procedures are applicable to workers, visitors, contractors, and vendors.

Verification of procedures involving IROFS is required to provide reasonable assurance that information is technically correct. In addition, procedures are validated through walk-downs. The verification/validation process provides reasonable assurance that the technical information, including formulas, set points, and acceptance criteria, is complete and is correct, and includes either a walkdown of the procedure in the field, or a tabletop walkthrough. The review process includes technical, cross-disciplinary reviews by affected organizations. This process includes both new procedures and revised procedures. The review provides reasonable assurance that the operating limits and IROFS are specified in the procedures and that QA requirements related to IROFS are identified and included in operating procedures. Approved temporary procedures are used when permanent procedures do not exist to:

1. direct operations during testing, maintenance, and modifications,
2. provide guidance in unusual situations not within the scope of permanent procedures, and,
3. provide assurance of orderly and uniform operations for periods of short duration.

Temporary procedures are controlled, reviewed, and approved as specified by a written procedure and shall not change an ISA except as authorized in License Condition S-25. The review and approval process required for temporary procedures is the same as for all other procedures.

In new license Section 2.12.4.1, "Developing Procedures," NFS stated that procedures for operations involving IROFS are prepared by the appropriate functional discipline. The operating procedures will incorporate criticality safety controls, radiation safety controls, environmental protection controls, and industrial safety controls as defined by the results contained in the ISA or ISA Summary. In addition, these operating procedures include provisions to place process operations in a safe condition if a step of the procedure cannot be performed as written. Procedures are also developed for all management measures supporting the IROFS (see license Section 2.12.4).

In new license Section 2.12.4.2, "Procedure Approval/Reviews," NFS stated that the safety review committee is responsible for reviewing and approving operating and emergency procedures. Procedures developed to support management measures shall be approved by the appropriate functional discipline manager and the safety discipline manager.

The operating procedures (including active temporary procedures) are reviewed at least every five years to assure they reflect current practice. Emergency procedures are reviewed annually. In addition, applicable procedures are reviewed as a corrective action after abnormal events.

In new license Section 2.12.4.3, "Personnel Qualification for Procedures," NFS stated that each NFS position involving personnel assigned to SNM process operations is evaluated to determine the specific procedures that apply to the defined job function. The procedural qualifications are defined in an on-line computer database. Personnel are notified of procedure revisions or new procedures and must update their qualification records within a defined time period. Personnel must remain current on the defined set of procedures to maintain job qualifications.

In new license Section 2.12.4.4, "Issuance of Procedures," NFS stated that operating procedures are controlled and made readily available to foremen, operators and other affected personnel. Additionally, workplace posting of limits and controls, training and other communication devices are used, if appropriate, to enhance comprehension and understanding of operating procedures. Once approved, new or revised operating procedures are distributed for personnel training and qualification, and outdated procedures are removed from use. The staff's conclusion is given in Section 15.2.4.

### 15.1.5 Audits and Assessments

In new license Section 2.12.6, NFS committed to conduct audits and inspections (referred to as assessments in the SRP) as specified in license Section 2.8, "Audits and Inspections." In addition, audits and inspections will be performed to determine that site operations, as well as off-site operations, involving activities related to the IROFS are conducted in compliance with regulatory requirements, license conditions, and written plans and/or procedures.

Guidance and procedures used to perform these audit and inspection functions contain the following information:

1. activity to be audited,
2. audit frequency,
3. applicable guidance to be used in conducting the audit,
4. responsibilities for each phase of the audit and/or inspection,
5. procedure for recording the results, recommending and approving actions to be taken, and,
6. required distribution list of functional disciplines.

Audits and inspections will be performed in the following areas by qualified personnel for activities and operations involving IROFS:

1. radiation safety,
2. nuclear criticality safety,
3. industrial safety (chemical and fire),
4. environmental safety,
5. emergency preparedness,
6. quality assurance,
7. maintenance,
8. procedures,
9. CM,
10. training & qualification,
11. incident investigations, and
12. *records management.*

Each of the functional safety and quality-related disciplines and associated qualifications is described in license Sections 2.2, "Key Positions with Safety and Quality-Related Responsibilities," and Section 2.3, "Personnel Education and Experience Requirements."

In new license Section 2.12.5.1, "Safety Function Audits and Inspections," NFS stated that qualified members of the radiation safety, nuclear criticality safety, industrial safety, and environmental safety functions perform quarterly audits in accordance with written plans and/or procedures. Personnel responsible for performing these audits shall be qualified and shall not have direct responsibility for the area being audited. Guidance required to perform audits is specified in written procedures.

Monthly inspections for compliance with safety requirements are performed by personnel appointed by the appropriate safety functional manager in accordance with written procedures. Personnel responsible for performing these inspections shall be qualified and shall not have direct responsibility for the area being inspected (i.e., safety is independent of operations).

In addition, external audits of these safety programs are performed at least every three years by an appropriate function outside of the NFS Erwin organization as specified in license Section 2.8.2, "External Audits." Personnel responsible for performing these external audits shall be appropriately qualified and shall not have direct responsibility for the program being audited.

Results from the audits and inspections are integral to ensuring that IROFS are available and reliable to perform the required functions when needed. As such, these results are evaluated (see license Section 2.8, "Audits and Inspections") to determine the effectiveness of the associated management measures as part of the NFS corrective action program described in license Section 2.12.6, "Incident Investigations and Corrective Actions."

In new license Section 2.12.5.2, "Audits of Management Measures and the Emergency Plan," NFS stated that members of the Quality Assurance function conduct audits of management measures in accordance with written procedures to determine compliance with license requirements and NFS procedures. Reviews of operating procedures and equipment are performed as part of these audits to determine that approved procedures and equipment are available to the users. The emergency plan is audited on an annual basis. Audits of the following management measures elements are conducted on a biennial basis:

1. quality assurance,
2. maintenance,
3. procedures,
4. CM,
5. training & qualification,
6. incident investigations, and,
7. records management.

Audit results are evaluated as part of the NFS corrective action program. Members of the Quality Assurance function periodically audit safety programs as directed by the NFS president and/or vice president of safety & regulatory.

In new license Section 2.12.5.3, "Audit and Inspection Reports," NFS stated that audit and inspection results, including findings and observations, are captured in the NFS corrective action program. Personnel assigned the responsibility for preparing corrective action responses are identified. Corrective actions to prevent recurrence will be documented and tracked to completion in accordance with the requirements specified in the corrective action program.

Results of the audits and inspections are documented in written reports and distributed to NFS management as specified in license Section 2.8, "Audits and Inspections." These written reports are maintained in accordance with license Section 2.12.7, "Records Management." The staff's conclusion is given in Section 15.2.5.

### 15.1.6 Incident Investigations and Corrective Actions

NFS maintains procedures and programs to investigate, document, and report abnormal events to comply with reporting requirements of 10 CFR 70.50, 10 CFR 70.62, and 10 CFR 70.74. NFS investigates, tracks, and reports abnormal events with corrective actions assigned through the corrective action program. Events, investigations, and corrective actions are tracked, trended, and documented in a database. Procedures require that all documentation relating to events be auditable and maintained for two years or for the life of the operation, if longer, and require that original investigation reports be made available to NRC on request.

Abnormal events are reviewed by a multi-disciplinary committee using a graded, risk-based approach to assign a level of investigation with the level varying from that requiring no investigation to a full team investigation depending on the severity of the event. Levels of management involved in the review and approval of the corrective actions increase with the levels of investigation, including review, approval, and possible imposition of additional corrective actions by the safety review committee for full team investigations.

NFS uses a documented plan for event investigations that is separate from the emergency plan. Once an event has been brought under control, the investigation will begin within 48 hours or sooner based on ensuring the safety of the investigation team and the safety significance of the event. Guidance for conducting an investigation will include a description of the functions, qualifications, and responsibilities of the team leader and team members. This includes the requirement that at least one team member is knowledgeable of the area being investigated and at least one member is trained in root cause analysis. The scope of the team's authority, the assurance of management cooperation, and the team's independence from line management and from responsibility for, or to, the functional area involved in the incident under investigation are included in the guidance. Team members are also assured that retaliation will not be taken for their participation in the investigation. Personnel on the event investigation team are provided guidance on how to apply a reasonable, systematic, and structured approach to root cause and problem implication determinations.

Reports documenting incidents investigated by full or small teams will include descriptions of the events, contributing factors, root cause analyses, findings, and recommendations. Corrective actions resulting from investigations are monitored to ensure they are taken within a reasonable period of time and are used for lessons learned to prevent or minimize single or common-mode failures. Details of the event's sequence are compared with accident sequences in the ISA and the ISA Summary modified to include an evaluation of the risk associated with the accident actually experienced. IROFS failure trends are reviewed to evaluate the effectiveness of safety systems and to provide feedback for prevention or minimization of event recurrence. The staff's conclusion is given in Section 15.2.6.

### 15.1.7 Records Management

In accordance with written procedures, NFS maintains records related to safety activities (nuclear criticality, radiation, chemical, fire, and environmental), occupational exposure of personnel to radiation, releases of radioactive materials to the environment, decommissioning, emergency preparedness, quality assurance, and other pertinent activities to satisfy license conditions and regulatory requirements. Records management procedures assign responsibilities for records management, specify the authority needed for records retention or disposal, specify which records must have controlled access, provide the access controls needed, provide protection of records from loss, deterioration, tampering, theft, or damage during or after an emergency, and ensure that the records management system remains effective.

NFS has a functional organization in place to ensure prompt detection and correction of records management system deficiencies. Instructions will ensure that records are prepared, verified, characterized, and maintained and that they are legible, identifiable, and retrievable for their designated lifetimes. NFS has procedures to specify the requirements and responsibilities for record selection, verification, protection, transmittal, distribution, retention, maintenance, and disposition. Records are categorized by their relative safety importance and/or regulatory compliance so that protection and storage requirements including retention periods can be identified.

Procedures are established to maintain the readability and usability of older computer codes and related data used for activities relied on for safety. The procedures include the transfer of information from older media forms such as punched cards or paper tapes and of older computing equipment codes to contemporary computing media and equipment. The staff's conclusion is given in Section 15.2.7

### 15.1.8 Other QA Elements

In new Section 2.12.8 of the license, NFS committed to establish a quality system consisting of the organizational structure, procedures, processes, and resources needed to implement quality management. The system is structured on ASME NQA-1 (Quality Assurance Program Requirements for Nuclear Facilities) under the overall responsibility of the Quality Assurance function manager (see NFS license Section 2.2.4, "Quality Assurance Manager"). The following elements, as appropriate, are applied on individual projects:

1. organization and responsibilities,
2. quality assurance program,
3. quality planning,
4. test and inspection personnel requirements,
5. graded quality assurance,
6. design control,
7. procurement document control,
8. instructions, procedures, and drawings,
9. document control,

10. control of purchased items and services,
11. identification and control of items,
12. control of special processes,
13. inspection,
14. test control,
15. control of measuring and test equipment,
16. item handling, storage, and shipping,
17. inspection, test, and operating status,
18. control of nonconforming items,
19. corrective action,
20. quality assurance records,
21. audits, and,
22. updates of QA documents.

The quality system for the design, construction and operation of IROFS is described in a quality assurance program document and is implemented by functionally specific procedures and/or specific quality assurance project plans. The staff's conclusion is given in Section 15.2.8.

## 15.2 Evaluation Findings

### 15.2.1 Configuration Management

The NRC staff has reviewed the CM function for NFS' UNB facility according to the acceptance criteria in Section 11.4.3.1 of the SRP. In new Section 2.12.1 of Attachment II to NFS' response to NRC RAI regarding management measures for IROFS at the UNB, dated April 16, 2003, NFS has suitably and acceptably described its commitment to a CM system, including the method for managing changes in procedures, facilities, activities, and equipment for IROFS. Management-level policies and procedures, including an analysis and independent safety review of any proposed activity involving IROFS, are described that will provide reasonable assurance that consistency among design requirements, physical configuration, and facility documentation will be maintained as part of a new activity or change in an existing activity involving licensed material. The management measures include the following elements of CM:

1. CM; commitments to the organizational structure, procedures, and responsibilities necessary to implement CM,
2. design requirements; the design requirements and bases are documented and supported by analyses, and the documentation is maintained current,
3. document control; documents, including drawings, are appropriately stored and accessible. Drawings and related documents captured by the system are those necessary and sufficient to adequately describe IROFS,
4. change control; responsibilities and procedures adequately describe how NFS will achieve and maintain strict consistency among the design requirements, the physical configuration, and the facility documentation. Methods are in place for suitable analysis, review, approval, and implementation of identified changes to

IROFS. This includes appropriate CM controls to assure configuration verification, functional tests, and accurate documentation for equipment or procedures that have been modified,

5. assessments; commitments to an adequate assessment function that includes both initial and periodic assessments that are expected to verify and assure the adequacy of the CM function.

The staff concludes, based on the discussion in this section and section 15.1.1, that the configuration management program meets the requirements of 10 CFR 70.62(d), and provides reasonable assurance that those functions protect the health and safety of the workers and the public, and the environment.

### 15.2.2 Maintenance

In the April 16, 2003, management measures amendment application, NFS committed to maintenance of IROFS. NFS' maintenance commitments contain the basic elements to ensure availability and reliability of IROFS: corrective maintenance, preventive maintenance, functional testing, equipment calibration, and work control for IROFS. NFS' maintenance function is pro-active, using maintenance records, preventive maintenance (PM) records, and surveillance tests to analyze equipment performance and to seek the root causes of repetitive failures.

The surveillance/monitoring, PM and functional testing activities described in the Management Measures amendment application provide reasonable assurance that IROFS, identified in the ISA Summary, will be available and reliable to prevent or mitigate accident consequences.

The maintenance function: (1) is based on approved procedures, (2) employs work-control methods that properly consider personnel safety, awareness of facility operating groups, QA, and the rules of CM, (3) ISA Summary identifies IROFS that require maintenance and at what level, (4) justifies the PM intervals in the terms of equipment reliability goals, (5) provides for training that emphasizes importance of ISA or ISA Summary identified controls, regulations, codes, and personal safety, and (6) creates documentation that includes records of all surveillance, inspections, equipment failures, repairs, and replacements of IROFS.

The staff concludes, based on the discussion in this section and section 15.1.2, that NFS' maintenance functions meet the requirements of 10 CFR 70.62(d), and provide reasonable assurance that those functions protect the health and safety of the workers and the public, and the environment.

### 15.2.3 Training and Qualification

Based on its review of new Section 2.12.3, "Training and Qualification," of NFS' license, NRC staff has concluded that NFS has adequately described and assessed its personnel training and qualification in a manner that satisfies regulatory requirements, is consistent with the acceptance criteria in Section 11.4.3.3 of the SRP, and is therefore acceptable.

There is reasonable assurance that implementation of the described training and qualification will result in personnel who are qualified and competent to design, construct, startup, operate, maintain, modify, and decommission the facility UNB safely. The staff concludes, based on the discussion in this section and section 15.1.3, that NFS' plan for personnel training and qualification meets the requirements of 10 CFR 70.23(a)(2).

### 15.2.4 Procedures

New Section 2.12.4 of NFS' license described a suitably detailed process for the development, approval and implementation of procedures. IROFS have been addressed, as well as items important to health of facility workers and the public and to the protection of the environment. The staff concludes, based on the discussion in this section and section 15.1.4, that NFS' plan for procedures meets the requirements of 10 CFR 70.62(d).

### 15.2.5 Audits and Assessments

Based on its review of the license application, the NRC staff has concluded that NFS has adequately described its audits and assessments. In new license Section 2.12.5, NFS has described the procedures covering the audit and assessment function, and committed to conduct internal audits and independent assessments. The audits will verify compliance with regulatory requirements and license commitments. Independent assessments will be performed by individuals outside the NFS Erwin organization. Audits and assessments will be performed in the areas of radiation safety, nuclear criticality safety, chemical safety, fire safety, environmental protection, emergency management, quality assurance, CM, maintenance, training and qualification, procedures, incident investigation, and records management. Qualified personnel without direct responsibility for the program being reviewed will perform the audits and assessments. The staff has reviewed NFS' plan for audits and assessments and finds it acceptable.

The staff concludes, based on the discussion in this section and section 15.1.5, that NFS' plan for audits and assessments meets the requirements of 10 CFR 70.62(d) and provides a reasonable assurance of protection of the health and safety of the workers and the public and for protection of the environment.

### 15.2.6 Incident Investigations

NFS has committed to establish an organization responsible for (1) performing incident investigations of abnormal operational events, (2) determining the root cause and generic implications of an event, and (3) recommending corrective actions for ensuring safe facility operations, in accordance with the acceptance criteria of Section 11.4 of the SRP.

NFS has committed to monitoring and documenting corrective actions. NFS has committed to the maintenance of documentation so that "lessons learned" may be applied to future facility operations. Accordingly, the staff concludes, based on the discussion in this section and section 15.1.6, that NFS' description of the incident investigation process complies with 10 CFR 70.62(d) and is adequate.

### 15.2.7 Records Management

The staff has reviewed NFS' records management system against the SRP's acceptance criteria and concluded that the system: (1) will be effective in collecting, verifying, protecting, and storing information about the facility and its design, operations, and maintenance and will be able to retrieve the information in readable form for the designated lifetimes of the records, (2) will provide a records storage area with the capability to protect and preserve health and safety records that are stored there during the mandated periods, including protection of the stored records against loss, theft, tampering, or damage during and after emergencies, and (3) will provide reasonable assurance that any deficiencies in the records management system or its implementation will be detected and corrected in a timely manner. The staff concludes, based on the discussion in this section and section 15.1.7, that NFS' records management functions meet the requirements of 10 CFR 70.62(d), and provide reasonable assurance that those functions protect the health and safety of the workers and the public, and the environment.

### 15.2.8 Other QA Elements

Based on its review of the license amendment application dated April 16, 2003, NRC staff has concluded that NFS has adequately described the application of other QA elements (and the applicable QA elements of its principal contractors). The staff concludes:

1. NFS has established and documented a commitment to an organization responsible for developing, implementing, and assessing the management measures for providing reasonable assurance of safe facility operations in accordance with the acceptance criteria in Section 11.4 of the SRP,
2. NFS has established and documented a commitment to QA elements and the administrative measures for staffing, performance, assessing findings, and implementing corrective actions are in place,
3. NFS has developed a process for preparation and control of written plant procedures, including procedures for evaluating changes to procedures, IROFS, and tests. A process for review, approval, and documentation of procedures will be implemented and maintained,
4. NFS has established and documented surveillances, tests, and inspections to provided reasonable assurance of satisfactory performance of IROFS. Specified standards or criteria and testing steps have been provided,
5. periodic independent audits are conducted to determine the effectiveness of the management measures. Management measures will provide for documentation of audit findings and implementation of corrective actions,

6. training requirements have been established and documented to provide employees with the skills to perform their jobs safely. Management measures have been provided for evaluating the effectiveness of training against predetermined objectives and criteria,
7. the organizations and persons performing QA element functions have the required independence and authority to effectively carry out their QA element functions without undue influence from those directly responsible for process operations,
8. QA elements cover the IROFS, as identified in the ISA Summary, and measures are established to prevent hazards from becoming pathways to higher risks and accidents.

Accordingly, the NRC staff concludes, based on the discussion in this section and Section 15.1.8, that NFS' application of other QA elements (and the applicable QA elements of its principal contractors) meets the requirements of 10 CFR 70.62(d) and provides reasonable assurance of protection of worker and public health and safety and of the environment.

## 16. LICENSE CONDITIONS

New and revised current license conditions for SNM-124 are as follows:

S-24: The licensee shall maintain and execute the response measures in the Emergency Plan, Revision 6, transmitted by letter dated July 5, 2002, and in the proposed revisions to the NFS Emergency Plan to support the Uranyl Nitrate Building at the BLEU complex, submitted by letter dated March 8, 2002, or as further revised by the licensee consistent with 10 CFR 70.32(i).

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SG-6.4: Notwithstanding the above Safeguards License Conditions (SG-6.1, SG-6.2, SG-6.3), upon possession of less than Category I levels of special nuclear material, the licensee shall follow the measures described in the physical protection plans titled, "Physical Security Plan for the Protection of Special Nuclear Material of Moderate Strategic Significance, Revision 5," dated June 23, 1994 (letter dated June 22, 1994), and Revision 6, dated February 6, 1996, and in the "Physical Security Plan for Special Nuclear Material of Low Strategic Significance, Revision 0," dated December 17, 2002, and as they may be further revised in accordance with the provisions of 10 CFR 70.32(e).

## 17. CONCLUSION

Based on the previous discussion, the staff concludes that there is reasonable assurance that the activities to be authorized by the issuance of an amended license to NFS will not constitute an undue risk to the health and safety of the public, workers, and the environment. Furthermore the staff determined that the license amendment request satisfies the requirements of 10 CFR 70.23, "Requirements for the Approval of Applications."

Approval of the amendment application is recommended.

NRC Region II inspection staff has no objection to this proposed action.

## 18. PRINCIPAL CONTRIBUTORS

Mary Adams, Senior Project Manager
Mike Lamastra, Radiation Protection & Emergency Management
Kevin Ramsey, Backup Project Manager
Billy Gleaves, Mechanical Systems & ISA
Fred Burrows, Electrical Systems & Instrumentation and Control
Sheena Whaley, Criticality Safety
Don Stout, Chemical Safety
Peter Lee, Fire Safety
Tom Fredrichs, Decommissioning
Julie Olivier, Environmental Protection
Ed Johanneman, Physical Protection

## 19. REFERENCES


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NFS Letter, "Proposed Revisions to the NFS Emergency Plan to Support the Uranyl Nitrate Building at the BLEU Complex," 21G-02-0050, dated March 8, 2002. ADAMS No. ML020720476

NFS Letter, "Physical Security Plan for SNM of Low Strategic Significance," 24G-02-0004, dated March 12, 2002. ADAMS No. ML020990511

NFS Letter, "Physical Security Plan for SNM of Low Strategic Significance, NFS-SEC-C3-PSP, Rev. 0" 24G-02-0020, dated December 17, 2002. ADAMS No. ML030020463

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NFS Letter, "Reply to Request for Additional Information Concerning the Revised Integrated Safety Analysis Summary for the Uranyl Nitrate Building," 21G-02-0409, dated December 23, 2002. ADAMS No. ML023650692

NFS Letter, "Revised Integrated Safety Analysis Summary for Uranyl Nitrate Building," 21G-02-0268, dated August 23, 2002. ADAMS No. ML022610016

NFS Letter, "Basis of Decommissioning Cost Estimate for Uranyl Nitrate Building," 21G-02-0336, dated October 18, 2002. ADAMS No. ML023010293

NFS Letter, "Reply to Request for Additional Information Concerning Nuclear Criticality Safety Analysis and Integrated Safety Assessment Summary for the Uranyl Nitrate Building," 21G-03-0039, dated February 10, 2003. ADAMS No. ML030450267

NFS Letter, "Additional Commitments Regarding Licensing of the Uranyl Nitrate Building," 21G-03-0043, dated February 14, 2003. ADAMS No. ML030570318

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NFS Letter, "Nuclear Criticality Safety Evaluation for the BLEU Complex Uranyl Nitrate Building, Revision 2 (Proprietary)," 21G-03-0069, dated March 10, 2003. ADAMS No. ML030720233

NFS Letter, "Nuclear Criticality Safety Evaluation for the BLEU Complex Uranyl Nitrate Building, Revision 2 (Non-Proprietary)" 21G-03-0074, dated March 13, 2003. ADAMS No. ML030780134

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NRC Safety Evaluation Report that supported Amendment 36 to NFS' SNM license, dated August 30, 2002. ADAMS No. ML022480108

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NRC Letter, "Nuclear Fuel Services, Inc., (TAC NOs. L31599 and L31614) - Acceptance of Application to Amend License to Support the Uranyl Nitrate Building (UNB) at the BLEU Complex, Proposed Emergency Plan Revisions to Support the UNB, and Physical Security Plan for Special Nuclear Material of Low Strategic Significance," dated April 15, 2002. ADAMS No. ML021080124

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ANSI Standard 8.23, "Nuclear Criticality Accident Emergency Planning and Response."

NFPA-58, "Standard on Liquified Petroleum Gas."

NFPA-780, "Standard for the Installation of Lightning Protection Systems," 2000 edition.

Department of Transportation, 49 CFR Part 179

Standard Building Code by Southern Building Code Congress, Inc., 1999 ed.

Copies of these references are available for inspection and copying for a fee from the NRC Public Document Room (PDR) at the U.S. NRC's Headquarters building located at 11555 Rockville Pike, Rockville, MD, 20852. The PDR's mailing address is U.S. Nuclear Regulatory Commission, Washington, DC, 20555-0001. Phone: 301-415-7000, 7 am to 4:15 pm (ET), Monday through Friday TDD: 301-415-5575.

## 20. ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| *AEGL* | *Acute Exposure Guideline Level* |
| *ALARA* | *As Low As Reasonably Achievable* |
| *ANS* | *American Nuclear Society* |
| *ANSI* | *American National Standards Institute* |
| *ASCE* | *American Society of Civil Engineers* |
| *ASME* | *American Society of Mechanical Engineers* |
| *ASTM* | *American Society for Testing and Materials* |
| *BDC* | *Baseline Design Criteria* |
| *BPF* | *Bleu Preparation Facility* |
| *BLEU* | *Blended Low-Enriched Uranium* |
| *BTP* | *Branch Technical Position* |
| *CAAS* | *Criticality Accident Alarm System* |
| *CCS* | *Central Control System* |
| *CCE* | *Configuration Control Equipment* |
| *CFR* | *Code of Federal Regulations* |
| *CM* | *Configuration Management* |
| *CMP* | *Configuration Management Program* |
| *CSE* | *Criticality Safety Evaluation* |
| *D* | *Dose* |
| *DAC* | *Derived Air Concentration* |
| *DOE* | *Department of Energy* |
| *EA* | *Environmental Assessment* |
| *EAL* | *Emergency Action Level* |
| *EIS* | *Environmental Impact Statement* |
| *EPB* | *Effluent Processing Building* |
| *ERDA* | *Energy Research and Development Administration* |

| | |
|---|---|
| ERPG | Emergency Response Planning Guidelines |
| FCSS | Fuel Cycle Safety and Safeguards |
| FHA | Fire Hazards Analysis |
| FMEA | Failure Modes and Effects Analysis |
| FNMCP | Fundamental Nuclear Material Control Plan |
| FONSI | Finding of No Significant Impact |
| FRA | Framatome ANP Richland, Inc. |
| FRP | Fiberglass Reinforced Plastic |
| HAZOP | Hazard and Operability methodology |
| HEPA | High Efficiency Particulate Air |
| HVAC | Heating, Ventilating, and Air-Conditioning system |
| I&C | Instrumentation and Control |
| IBC | International Building Code by International Code Council |
| ICRP | International Council on Radiation Protection |
| ID | Inventory Difference |
| IEEE | Institute of Electrical and Electronic Engineers |
| IROFS | Items Relied On For Safety |
| ISA | Integrated Safety Analysis |
| LEU | Low Enriched Uranium |
| LEUN | Low Enriched Uranyl Nitrate |
| MC&A | Material Control & Accounting |
| MOU | Memorandum of Understanding |
| NCS | Nuclear Criticality Safety |
| NCSE | Nuclear Criticality Safety Evaluation |
| NCRP | National Council on Radiation Protection |
| NDA | Non-Destructive Assay |
| NEPA | National Environmental Policy Act |
| NFPA | National Fire Protection Association |

| | |
|---|---|
| *NFS* | *Nuclear Fuel Services* |
| *NIOSH* | *National Institute for Occupational Safety and Health* |
| *NIST* | *National Institute of Standards and Technology* |
| *NMSS* | *Office of Nuclear Material Safety and Safeguards* |
| *NRC* | *Nuclear Regulatory Commission* |
| *NOAA* | *National Oceanic and Atmospheric Administration* |
| *NSI* | *National Security Information* |
| *NUN* | *Natural Uranyl Nitrate* |
| *OCB* | *Oxide Conversion Building* |
| *OSHA* | *Occupational Safety and Health Administration* |
| *PHA* | *Process Hazard Analysis* |
| *PM* | *Preventive Maintenance* |
| *PPE* | *Personnel Protective Equipment* |
| *PSI* | *Process Safety Information* |
| *QA* | *Quality Assurance* |
| *QC* | *Quality Control* |
| *RD* | *Restricted Data* |
| *RG* | *Regulatory Guide* |
| *RSO* | *Radiation Safety Officer* |
| *RWP* | *Radiation Work Permit* |
| *SBC* | *Southern Building Code by Southern Building Code Congress International Inc.* |
| *SEID* | *Standard Errors of Inventory Difference* |
| *SER* | *Safety Evaluation Report* |
| *SNM* | *Special Nuclear Material* |
| *SOP* | *Station Operating Procedure* |
| *SRD* | *Shipper-Receiver Differences* |
| *SRE* | *Safety Related Equipment* |
| *SRP* | *Standard Review Plan* |

| | |
|---|---|
| *SRS* | *Savannah River Site* |
| *SSC* | *Structure, System, and Component* |
| *SSNM* | *Strategic Special Nuclear Material* |
| *T* | *Likelihood Index* |
| *TEDE* | *Total Effective Dose Equivalent* |
| *TRT* | *Tactical Response Team* |
| *TVA* | *Tennessee Valley Authority* |
| *UBC* | *Uniform Building Code by International Conference of Building Officials* |
| *UL* | *Underwriters Laboratories Inc.* |
| *UN* | *Uranyl Nitrate* |
| *UNB* | *Uranyl Nitrate Building* |
| *V&V* | *Verification and Validation* |