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NUCLEAR FUEL SERVICES, INC.
a subsidiary of The Babcock & Wilcox Company

21G-11-0157
GOV-01-55-04
ACF-11-0244
September 9, 2011

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

Reference:
1) Docket No. 70-143; SNM License 124
2) Letter from B. Marie Moore to the NRC, dated June 30, 2009, (21G-09-0104), Renewal of Special Nuclear Material (SNM) License 124
3) Letter from B. Marie Moore to the NRC, dated September 18, 2009, (21G-09-0141), Response to Request for Additional Information Concerning Section 11.8 of SNM-124 License Renewal Application
4) Letter from NRC to Mark P. Elliott dated June 15, 2010, (TAC No. L32830), Request for Additional Information Concerning License Renewal
5) Letter from Mark P. Elliott to NRC, dated August 12, 2010, (24Y-10-0006), Response to NRC Request for Additional Information (RAI) Concerning Security Portions of License Renewal
6) Letter from Mark P. Elliott to NRC, dated August 16, 2010, (21G-10-0163), Response to the Request for Additional Information Concerning License Renewal for SNM-124
7) Letter from Mark P. Elliott to NRC, dated May 27, 2011, (21G-11-0109), Revised Chapter 5 for Renewal of SNM License 124
8) Letter from Mark P. Elliott to NRC, dated August 1, 2011, (21G-11-0145), Revised Chapters 2, 7, 10, and 11 for Renewal of SNM License 124

Subject: Revisions for Chapter 1, Addendum, Chapter 2, Chapter 5, Chapter 10, and Chapter 11 for Renewal of SNM License 124

Nuclear Fuel Services, Inc. (NFS) hereby submits the following revisions for the renewal of SNM License 124:

- Chapter 1 – General Information
- Addendum – Sensitive Information

OFFICIAL USE ONLY
May be exempt from public release under the Freedom of Information Act (5U.S.C. 552). Exemption number 2
Nuclear Regulatory Commission review required before public release.

R. Shackelford/NFS
Name and organization of person making determination
Date of Determination: 9/9/11

NMSS01

- Chapter 2 – Organization and Administration (Pages 2-8, 2-10, and 2-12 only)
- Chapter 5 – Nuclear Criticality Safety (formatting correction only)
- Chapter 10 – Decommissioning (Pages 10-2 and 10-3 only)
- Chapter 11 – Management Measures (Pages 11-6 and 11-18 only)

Attachments 1 and 2 contain proposed changes to incorporate responses to the Request for Additional Information (References 5 and 6). Changes are denoted with lines in the right hand margin of the pages.

Attachment 2 contains sensitive information and is marked "Official Use Only" in accordance with U.S.C. 552. As such, Attachment 2 is not suitable for public release.

A brief summary of the changes for Chapter 1 and the Addendum is included below.

<u>Chapter 1</u>

- Section 1.2.3.4 and 1.2.3.5 – added in response to RAI 1.2.
- Section 1.2.5.3 – deleted Section referencing Incinerator Operations, as discussed with your staff during a public meeting held on January 13, 2011, and renumbered remaining sections under 1.2.5
- Section 1.2.5.4 – updated in response to RAI 1.5.
- Section 1.2.5.5 – updated in response to RAI 1.6.
- Section 1.2.5.6 – added in response to RAI 14.2.
- Section 1.2.5.7 – added in response to RAI 4.19.
- Section 1.3.2 – updated in response to RAI 1.7.
- Section 1.3.4 – updated in response to RAI 1.8.
- Section 1.3.5 – updated in response to RAI 1.10.

Although the response to RAI 12.1 indicated that a new Section 1.2.5.8 would be added, it is now NFS' understanding that the NRC plans to include these MC&A items in the License Conditions.

<u>Addendum</u>

- Chapter 1, Figure 1-1 – updated to reflect the most recent version of the drawing.
- Chapter 1, Section 1.2.3.4 and 1.2.3.5 – added in response to RAI 1.2.

Due to a recent organizational change involving the Quality Assurance discipline, Figure 2-1 has changed. In addition, a minor update was made to the qualifications regarding the manager responsible for the fire protection program. Finally, a formatting error was discovered on Page 2-10. Attachment 3 contains Pages 2-8, 2-10, and 2-12, and is intended to replace the three pages previously provided on August 1, 2011, for Chapter 2, Revision 1 (Reference 8).

A formatting error was discovered on page 5-17 in Chapter 5, Revision 1, as previously submitted on May 27, 2011 (Reference 7). Correcting the formatting error affected the pagination for the remaining pages in Chapter 5; therefore, Attachment 4 contains a full replacement for Chapter 5, Revision 1. No content changes were made.

During a public meeting held on January 13, 2011, a minor change to Section 10.5 was discussed to address an open issue with RAI 1.6. This change was inadvertently omitted from Chapter 10, Revision 1, as previously submitted on August 1, 2011 (Reference 8). Attachment 5 contains Pages 10-2 and 10-3, and is intended to replace the two pages previously provided.

Formatting errors were discovered on Pages 11-6 and 11-18 in Chapter 11, Revision 1, as previously submitted on August 1, 2011 (Reference 8). Attachment 6 contains Pages 11-6 and 11-8, and is intended to replace the two pages previously provided.

Finally, Attachment 7 contains supplemental information regarding the response to RAI 1.1.

If you or your staff have any questions, require additional information, or wish to discuss this, please contact me, or Ms. Jennifer Wheeler, Licensing and ISA Manager, at (423) 743-5429. Please reference our unique document identification number (21G-11-0157) in any correspondence concerning this letter.

Sincerely,

NUCLEAR FUEL SERVICES, INC.

R. Shackelford /MPE

Mark P. Elliott, Director
Quality, Safety, and Safeguards

DML/pdj

21G-11-0157
GOV-01-55-04
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ATTACHMENTS:
Attachment 1: SNM-124, Chapter 1, Revision 1, dated September 9, 2011
Attachment 2: SNM-124, Addendum, Revision 1, dated September 9, 2011
Attachment 3: SNM-124, Replacement for Pages 2-8, 2-10, and 2-12, Revision 1, dated August 1, 2011
Attachment 4: SNM-124, Replacement for Chapter 5, Revision 1, dated May 27, 2011
Attachment 5: SNM-124, Replacement for Pages 10-2 and 10-3, Revision 1, dated August 1, 2011
Attachment 6: SNM-124, Replacement for Pages 11-6 and 11-18, Revision 1, dated August 1, 2011
Attachment 7: RAI 1.1 (Additional Information Discussed at 1/13/2011 Meeting)

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Attachment 1

SNM-124, Chapter 1, Revision 1

dated September 9, 2011

(25 pages to follow)

GENERAL INFORMATION
Table of Contents

GENERAL INFORMATION

1.1 Facility and Process Information

1.1.1 General Facility Description

The Nuclear Fuel Services, Inc. (NFS) site is located at 1205 Banner Hill Road, within the limits of the City of Erwin. The fenced Protected Area of approximately 24 acres is located within 70 acres of NFS-owned land, the remainder of which is either devoted to vehicle parking areas, is undeveloped, or is undergoing decommissioning. Additional information describing the NFS facility, including its location with respect to geographic features, roadways, population centers, industrial facilities, and public facilities, is provided in Section 1.3, "Site Description."

1.1.2 Facility Buildings and Structures

The facilities within the NFS site consist of numerous buildings, the majority of which are located within the Protected Area fencing. The buildings and structures include the major SNM-processing production facilities, SNM-handling support facilities (storage, waste treatment, etc.), and a large number of non-SNM-handling support facilities (materials warehouses, maintenance shops, office buildings, etc.).

Buildings within the plant have been designated with numbers and names as shown in Figure 1-1. The major site features and descriptions of their current primary function(s) are provided below for informational purposes and are not intended to be restrictive of future potential activities in those facilities.

High Enriched Uranium (HEU) Fuel Production Facilities (Bldgs. 302, 303, 304, 306, & 307)

Unit operations which produce a classified product containing high enriched uranium, as well as uranium recovery operations. Receipt, handling, and shipment of feed and product materials.

Blended Low Enriched Uranium (BLEU) Production Facilities

1. **Uranyl Nitrate Building (UNB) (Bldg. 510)**
   Receipt, handling, and storage of liquid uranyl nitrate.

Figure 1-1: Plant Layout and Property Boundaries

This drawing is "Official Use Only" and has been moved to the "Sensitive Information" ADDENDUM.

2. **Commercial Development Line (CDL) Facility (Bldg. 301)**
   Conversion of HEU materials to uranium oxides or to uranyl nitrate solution for subsequent purification and downblending in the adjacent BLEU Preparation Facility.

3. **BLEU Preparation Facility (BPF) (Bldg. 333)**
   Conversion of HEU materials to pure HE uranyl nitrate solution, preparation of blendstock (N uranyl nitrate solution), subsequent mixture of the HE uranyl nitrate and blendstock solution to form a LE uranyl nitrate solution (product), and uranium recovery operations.

4. **Oxide Conversion Building (OCB) (Bldg. 520)**
   Conversion of low enriched uranyl nitrate liquids into uranium oxides. Loading of powder for shipment.

5. **Effluent Processing Building (EPB) (Bldg. 530)**
   Treatment of process waste streams generated at the OCB (Bldg. 520) prior to discharge and/or disposal.

6. **LEU Dilution and Loading Facility (Bldg. 440)**
   Dilution of LEU produced by the BLEU Preparation Facility (Bldg. 333) to customer specifications. Loading of diluted LEU for shipment.

Laboratories

1. Building 220 – analytical laboratory.
2. Building 100 – NDA laboratory.
3. Research and Development (R&D) Laboratories (Buildings 105, 110, & 131)
   Facilities for conducting engineering studies and R&D of chemical and radioactive material processing, manufacturing, and treatment technologies in support of ongoing production efforts or new business development.
4. Central Analytical Laboratory (Building 105, Building 110, and the northwest portion of Building 303)
   Receipt and handling of samples from all plant processing facilities (HEU, LEU, natural U, and depleted U), scrap recovery facilities, waste water treatment facilities, and select environmental monitoring programs.

Waste Water Treatment Facility (WWTF) (Buildings 330 and 335)

Treatment and discharge of liquid effluents generated by the process facilities, R&D laboratories, laundry, decommissioning activities, and analytical laboratory.

Other Support Facilities

Warehousing

Warehouse and material storage facilities include the Industrial Park Facility (IPF) Warehouse, Buildings 300, 310, 311, southeast portion of 304, south and east sections of 306, 135, 136, 133, 132, and the UNB (Bldg. 510). Non-nuclear supply storage; nuclear materials storage in sealed containers while awaiting processing, treatment, or shipment off-site; rail siding and intermodal container transfer area.

Maintenance

The maintenance facilities reside in Buildings 110B, 120, 121, and the east section of 306. The plant's primary maintenance facility is located in Buildings 120 and 121.

Respirator Facility (Building 104)

Respirator laundry; an inspection, testing, and quality assurance area; and a fit-test facility.

Materials Staging and Medical Facility (Building 350)

Multi-function facility which includes medical facilities (e.g., medical records, examining rooms, Fitness-for-Duty testing facility, and emergency decontamination), the in vivo counting facility, and the shipping/receiving staging area.

Building 111

Storage and staging of decommissioning materials in support of ongoing decontamination and decommissioning activities. The facility may also be used for the receipt, storage, and handling of materials separately licensed by the State of Tennessee.

Administration Buildings

Buildings 105, 130 (east annex), 120 (north end), 305, 320, and 345 house offices and computer facilities.

Plant Utilities (Bldg. 130)

Non-radioactive plant utility services (compressed air, deionized water, and steam). This building contained uranium processes in the past, and covered fixed radioactive contamination exists.

Emergency Electrical Power

Emergency electrical power is provided for the Criticality Accident Alarm System and other surveillance systems from uninterruptible power supply (UPS) systems. Automatic transfer switches detect loss of off-site power, send a start signal to diesel engine generators, transfer the load to the generators when an appropriate output voltage has been reached, and transfer back to utility power after off-site power has been restored for a predetermined time. The automatic transfer switches then allow the generators to operate for a predetermined cool-down period prior to shutdown. This automatic switchover with UPS provides for continuous criticality detection and other surveillance functions during the absence of off-site power. Emergency power generators, transfer switches, and UPS systems are periodically functionally tested.

1.1.3 General Process Description

There are two primary operations at the NFS site involving licensed material: 1) the manufacture of a classified product containing high enriched uranium and 2) the downblending of surplus DOE high enriched uranium (HEU) to low enriched uranium (LEU).

High Enriched Uranium Fuel Production Facilities

Uranium is received in various forms and then processed to make a classified product. The product is tested to verify that it meets the customer specifications and then grouped into lots. The lots are packaged and then shipped to a fabricator for manufacture into reactor fuel components. Product that does not meet customer specifications is returned to the uranium recovery area of the facility for further processing.

Blended Low Enriched Uranium (BLEU) Production Facilities

Uranyl nitrate solution is produced at the BPF by downblending HEU to LEU. The HEU consists of, but is not limited to, feed materials such as uranium oxide, uranium-metal buttons, uranium-aluminum ingots, reactor elements, and UF_6. Incoming uranium feed materials to CDL or BPF may be converted into uranium oxide or processed as received for subsequent dissolution into uranyl nitrate solution. The HEU solutions are processed in CDL or BPF and downblended with natural uranium in the BPF. The LE uranyl nitrate solution is transferred to the UNB (Bldg. 510), to the LEU Dilution and Loading Facility (Bldg. 440), or loaded directly into a shipping package at the BPF after verification that the solution meets the product specifications. Uranyl nitrate solution transferred to Bldg. 440 is diluted to meet customer specifications, loaded into shipping containers, and shipped to a fabricator for further manufacturing. Product that does not meet customer specifications is returned to the uranium recovery area of the facility for further processing.

Uranyl nitrate solution is received at the UNB from an off-site supplier via shipping containers or via pipeline from the BPF. The solution is transferred to the OCB for conversion into uranium oxide powder. The uranium oxide powder is loaded into shipping containers and shipped to a fabricator for manufacture into commercial reactor fuel bundles for ultimate transport to utility customers.

1.1.4 Raw Materials, Products, By-Products and Wastes

Various forms of uranium are used as feed materials for the classified process in the HEU Fuel Production facilities. The feed materials for the BLEU Production facilities include uranium oxide, uranium-metal buttons, uranium-aluminum ingots, reactor elements, and UF_6. The production, support, and waste processing activities are supported by a number of non-radiological chemical materials, such as bulk quantities of ammonium hydroxide, hydrogen, nitric acid, sodium hydroxide, sodium hydrosulfide, and sulfuric acid. A significant number of chemicals are used on site in lesser quantities.

Finished products containing licensed material include a classified product, uranyl nitrate solution, and uranium oxide powder.

There are no by-products produced or recovered at the NFS site that are sold for commercial use.

Liquid process wastes are collected in tanks in or near the various process buildings. Prior to pumping these wastes to the Waste Water Treatment Facility (WWTF), they are analyzed and must show levels below internal action guide limits. Waste water is treated in the WWTF on a batch basis, and the average discharge is approximately 15,000 gallons. Treatment typically involves adjustment of pH, and precipitation and removal of fluoride ions and uranium. The precipitate is de-watered, and the solids are packaged for land burial. The solutions may undergo ammonia removal by use of a stripping tower or by break-point chlorination prior to neutralization for discharge. The treated water is discharged directly to the Nolichucky River. A sample from each batch is collected and analyzed prior to discharge to assure compliance with 10 CFR 20 and applicable State of Tennessee regulations.

Plant sanitary wastes are discharged through piping which goes to the City of Erwin publicly owned treatment works (POTW). The inputs for the sanitary sewer system from the NFS site include bathrooms, showers, and water from the Groundwater Treatment Facility, where groundwater is collected and treated as part of ongoing site decommissioning and remediation activities. Non-contact cooling water, treated process waste water, and sanitary sewage from the BLEU Complex (Bldgs. 510, 520, 530) facilities are also discharged to the POTW.

The NFS site produces a variety of regulated solid wastes (obsolete equipment, used ventilation filters and personal protective equipment, waste treatment residues/filter cakes, demolition debris, miscellaneous combustible wastes, etc.). Solid waste materials could be radiologically contaminated, non-contaminated, hazardous, or mixed (hazardous and radioactive). These wastes are typically containerized for shipment to a licensed disposal facility.

The site facilities discharge airborne effluents to the atmosphere via a number of process stacks. HEPA filtration and scrubber systems (i.e., venturi, demisting, packed-bed) are used as needed to remove radioactive particulates and chemicals from airborne effluents to assure compliance with 10 CFR 20 and applicable State of Tennessee regulations prior to discharge to the atmosphere.

1.2 Institutional Information

1.2.1 Corporate Identity

The full name and address of the applicant and the facility are as follows:

Nuclear Fuel Services, Inc.
1205 Banner Hill Road
Erwin, Tennessee 37650-9718

The U.S. Nuclear Regulatory Commission (NRC) license number for this facility is SNM-124 (Docket Number 70-143).

The Nuclear Fuel Services, Inc., (NFS), facilities are located within the City of Erwin, in Unicoi County, Tennessee. At this site, NFS maintains buildings for administrative, laboratory, manufacturing, and support activities. The activities described in Section 1.2.4 are performed at 1205 Banner Hill Road, 1080 S. Industrial Drive, and 200 Oxide Lane. These locations are in Erwin, Tennessee.

The applicant, Nuclear Fuel Services, Inc., is incorporated in the State of Delaware, with its Corporate Offices located at 1205 Banner Hill Road, Erwin, Tennessee 37650-9718. NFS is a subsidiary of NFS Holdings, Inc., which is a subsidiary of NOG-Erwin Holdings, Inc., which is a wholly-owned subsidiary of Babcock & Wilcox Nuclear Operations Group, Inc., incorporated in Delaware. A summary listing of NFS affiliates is provided in Appendix 1A, along with a figure (Figure 1A-1) showing the reporting relationships.

1.2.2 Financial Qualifications

As a result of the indirect transfer of control in 2008 of Nuclear Fuel Services, Inc., from NFS Services, LLC, to NOG-Erwin Holdings, Inc., NFS was required to provide details to the NRC which demonstrate its financial capability to operate and decommission the Erwin facility. The financial arrangements to assure that decommissioning funds will be available are set forth in Chapter 10.

1.2.3 Type, Quantity, and Form of Licensed Material

1.2.3.1 Uranium Enriched in the ^{235}U Isotope

Maximum quantity on site – **This information is "Official Use Only" and has been moved to the "Sensitive Information" ADDENDUM.**

Isotopic content – any, up to maximum enrichment and up to an average of 10^{-6} grams of plutonium per gram of uranium, 0.25 millicuries of fission products per gram of uranium, and 1.5×10^{-5} grams of transuranic materials (including plutonium) per gram of uranium, as contaminants;

Chemical and physical forms – as described in Appendix 1B.

1.2.3.2 Uranium Enriched in the ^{233}U Isotope

1. Maximum quantity on site – **This information is "Official Use Only" and has been moved to the "Sensitive Information" ADDENDUM.**
   Isotopic content – any, up to maximum enrichment;
   Chemical and physical forms – any form, but limited to residual contamination from past operational activities.

2. Maximum quantity on site – **This information is "Official Use Only" and has been moved to the "Sensitive Information" ADDENDUM.**
   Isotopic content – any, up to maximum enrichment;
   Chemical and physical forms – any form, as received for analysis and/or for input into development studies.

1.2.3.3 Plutonium

1. Counting and Calibration Standards
   Maximum quantity on site – 10 millicuries as counting and calibration standards;

2. Residual Contamination and Mixed Oxide Process Holdup
   a. Buildings 110 & 234
      The possession limits, including quantity, isotopic content and chemical and physical forms, for plutonium residual contamination and mixed oxide holdups for Buildings 110 and 234 were previously described in letters dated October 17, 1988; and January 21, 1994. **This information is "Official Use Only" and has been moved to the "Sensitive Information" ADDENDUM.**

   b. Site-Wide Decommissioning
      NFS is authorized to possess residual plutonium contamination, as-is from former plutonium operations, in in-situ soil and debris, as well as waste and waste holdups that is generated during NFS plant site decommissioning activities, including Building 234.

3. Materials Input to R&D Studies
   Maximum quantity on site – **This information is "Official Use Only" and has been moved to the "Sensitive Information" ADDENDUM.**
   Chemical and physical forms – any form, received for analysis and/or for input into development studies.

4. Materials Received for Decontamination and Volume Reduction
   Maximum quantity on site – **This information is "Official Use Only" and has been moved to the "Sensitive Information" ADDENDUM.**
   Chemical and physical forms – any form, as contamination on equipment and materials received for decontamination and volume reduction.

1.2.3.4 Transuranic Isotopes

Maximum quantity on site – **This information is "Official Use Only" and has been moved to the "Sensitive Information" ADDENDUM.**
Chemical and physical forms – as waste resulting from processing enriched uranium.

1.2.3.5 Fission Products

Maximum quantity on site – **This information is "Official Use Only" and has been moved to the "Sensitive Information" ADDENDUM.**
Chemical and physical forms – as waste resulting from processing enriched uranium.

1.2.4 Authorized Uses

This application authorizes the use of special nuclear material (SNM) for operations involving enriched uranium pursuant to 10 CFR Part 70 as listed below. Typical support activities related to the production of these products include, but are not limited to, the receipt and storage of raw materials; the storage of finished products; the preparation and transport of these products off-site; SNM recycling/recovery operations; the processing/disposal of SNM-bearing waste materials, excluding on-site burial; process and product development activities; laboratory operations; and maintenance/repair of contaminated equipment and facilities.

1.2.4.1 Product Processing Operations

1. UF_6 Conversion
   Conversion of high enriched uranium hexafluoride to other uranium compounds.

2. Fuel Manufacturing
   Production of fuel containing high enriched uranium.

3. Uranium Recovery
   Recovery and purification of LEU and HEU from process scrap materials, either internally generated or generated at other facilities.

4. Enrichment Blending and Conversion
   Enrichment blending of high enriched liquid UNH to produce a low enriched UNH solution, and conversion of downblended UNH solution to uranium oxide (U_xO_x).

1.2.4.2 Laboratory Operations

Laboratories are equipped to perform wet chemical and instrumental analyses and a wide variety of physical tests on material consisting of and/or containing special nuclear materials.

1.2.4.3 General Services Operations

1. Storage of special nuclear material compounds and mixtures in areas with containers arranged specifically for maintenance of radiological and nuclear safety.
2. Maintenance and repair of special nuclear materials processing equipment and auxiliary systems.
3. Decontamination of equipment and materials, including personnel protective clothing and respiratory devices.

1.2.4.4 Research and Development Operations

Research and development work is performed on natural, source, and special nuclear material compounds and mixtures in areas with containers arranged specifically for maintenance of radiological and nuclear safety.

1.2.4.5 Waste Treatment and Disposal

1. Decontamination of materials and equipment.
2. Volume reduction, treatment, packaging and storage of both liquid and solid wastes contaminated with or containing non-recoverable uranium and plutonium.
3. Shipment of radioactive waste to licensed facilities or to licensed burial sites for disposal.
4. Treatment, packaging, and storage of hazardous or mixed waste for off-site disposal.

1.2.4.6 Period of License

This license application applies to the renewal of License No. SNM-124 (expiration date July 31, 2009) and meets the 30-day timely renewal criterion of 10 CFR 70.38. The requested renewal period is forty (40) years.

1.2.5 Special Exemptions and Special Authorizations

1.2.5.1 Criticality Monitoring

Special Nuclear Material stored in authorized shipping containers complying with the requirements of the Code of Federal Regulations, Title 10, Part 71, and which are in isolated arrays or on a transport vehicle and which are no more reactive than that approved for transport are exempt from criticality monitoring requirements of 10 CFR 70.24.

1.2.5.2 Posting and Labeling

Pursuant to the requirements of 10 CFR 20.1904(a), each entrance into the plant security fence will be posted "Caution, Radioactive Materials, Every container or vessel within this area may contain Radioactive Materials." This is in lieu of the requirement to have a "Caution, Radioactive Material," or "Danger, Radioactive Material," label affixed to each container of licensed material. See Chapter 4 for additional details.

1.2.5.3 Contamination-Free Articles

NFS is authorized to use the limits specified in "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," U.S. Nuclear Regulatory Commission, April, 1993, (See Chapter 4) for determining contamination levels on facilities released to uncontrolled areas, and on equipment released for unrestricted use.

1.2.5.4 Decommissioning Funding Plan

NFS is exempt from the requirements in 10 CFR 70.25(e) specifying that one of the listed methods in 10 CFR 70.25(f) must be used for financial assurance. The financial arrangements to assure that decommissioning funds will be available are set forth in Chapter 10. This exemption is limited to the use of a statement of intent (or an equivalent contract clause) from a government agency, as outlined below.

1. The exemption stated above is applicable to the decommissioning activities for which the U.S. Government has assumed liability per Appendix 10A of Chapter 10. The NFS/USDOE Contract language in said Appendix 10A also makes it necessary for NFS to establish a cost

estimate and a financial assurance plan for those decommissioning activities not covered by the Government.

2. The exemption stated above is also applicable to the decommissioning activities for which the U.S. Government has assumed liability per the U.S. Department of Energy and Tennessee Valley Authority Interagency Agreement described in Appendix 10B of Chapter 10.

1.2.5.5 Decommissioning-Related Activities Performed Prior to the End of Plant Life

Facilities or grounds may be remediated/decontaminated on a project-by-project basis prior to the end of plant life. These projects will address portions of the facility no longer in use or in need of decontamination to protect the environment. The portions of the NFS plant subject to these operations may be used for future licensed activities, require clean-up to protect the environment, or be conducted as a precursor to decommissioning an area under a NRC approved final status survey and release plan. Decommissioning-related activities, including associated procedures, are reviewed against the criteria in 10 CFR 70.38(g)(1) to determine if a decommissioning plan is required and the results of the review are documented. If required, the plan must be submitted to NRC for review and approval prior to starting the activities. Such operations are described further in Chapter 10.

1.2.5.6 Transportation of SNM

NFS is authorized to ship SNM up to and exceeding a formula quantity using physical protection measures for SNM of low strategic significance under 10 CFR 73.67(g) when certain conditions are met. The conditions are contained in the NFS Category III Physical Protection Plan. This exemption is limited to material in transit; fixed site security requirements remain unchanged.

1.2.5.7 Use of ICRP 68 DAC and ALI Values

Notwithstanding the requirements, the derived air concentration (DAC) values and the annual limit on intake (ALI) values listed in Appendix B of 10 CFR Part 20, NFS may use adjusted DAC values and adjusted ALI values specified in Publication 68 of the International Commission on Radiation Protection (ICRP-68). Additional information can be found in Section 4.7.9.1 of this application.

1.2.6 Security of Classified Information

NFS has been issued a facility security clearance in accordance with 10 CFR 95.

1.2.7 Terminology/Definitions

Definitions for terms specific to a particular safety function may be given in the corresponding chapter on that function. The following definitions apply to terms used in this license:

Term	Definition
^{235}U Enrichments	"Low enriched uranium" is defined as any compound of uranium in which the enrichment in the isotope uranium-235 is less than 20 percent by weight. "High enriched uranium" or "highly enriched uranium" is defined as any compound of uranium in which the enrichment in the isotope uranium-235 is equal to or greater than 20 percent by weight.
Nuclear Safety	Nuclear criticality safety
Will, Shall	A requirement.
Should	A recommendation.
May	Permission (optional), neither a requirement nor a recommendation.
Are	An existing practice for which there is a requirement to continue.
Monthly	An interval not to exceed 35 days.
Quarterly	An interval not to exceed 4 months.
Semi-Annually	An interval not to exceed 7 months.
Annually	An interval not to exceed 14 months.
Biennially	An interval not to exceed 28 months.
Triennially	An interval not to exceed 42 months.
Criticality Control	The administrative and technical requirements established to minimize the probability of achieving inadvertent criticality in the environment analyzed.

Term	Definition
Work Area Air Samplers	Stationary air samplers demonstrated to be representative of workers breathing air. If stationary air samplers have not been demonstrated to be representative, the results of lapel air samplers will constitute work area air samples.
Equivalent Experience	For the purpose of meeting educational requirements, two (2) years experience is considered to be equivalent to one (1) year of post-secondary education. For example, two (2) years of post-secondary education (associate degree) in a relevant field and four (4) years experience will satisfy the requirement for a B.S. degree (4 years of post-secondary education).
U-233 Action Levels	The action levels used for U-233 shall be those used for highly enriched uranium (HEU).
Protected Area	A site area bounded by a double fence, separated by an exclusion zone, designed to provide physical security. The area contains radioactive material processing, storage, and laboratory areas, as well as support functions.
Restricted Area	A site area in which individuals may be exposed to radiation or radioactive material at levels or concentrations in excess of that allowed for the general public (see definition in 10 CFR 20.1003). This could include any location at the NFS Erwin facility, depending upon activities conducted and the exposure potential as evaluated by the safety function.
Radiologically Controlled Area	A site area where uncontained radioactive material is present, such that contamination levels are likely to be encountered in excess of acceptable levels for unrestricted use. This type of area, designated for contamination control purposes, requires various levels of protective clothing and other personnel protective actions. It could include any location within the Restricted Area, either on a permanent or temporary basis.
Uncontrolled Area	A site area where radioactive materials may be handled in the form of sealed sources, in packages or closed containers, in small amounts (air samples, bioassay samples, etc.), or not at all. This type of area is designated for contamination control purposes and is not likely to have contamination at levels in excess of those acceptable for unrestricted use.

1.3 Site Description

1.3.1 Site Geography

The NFS site is located at 1205 Banner Hill Road, inside the city limits of Erwin, in Unicoi County, Tennessee. The fenced Protected Area of approximately 24 acres lies within 70 acres of land owned by NFS. The property is situated at approximately latitude 36°07'47"N and longitude 82°25'57"W.

The facility is bounded on the north by Martin Creek; on the south by residential properties; on the east by Banner Hill Road, an asphalt roadway providing access to the NFS site; and on the west by CSX Railroad. Interstate 26 is located just west of the NFS property, within one (1) mile of the site boundary.

There are four (4) bodies of surface water adjacent to or in the immediate vicinity of the plant. The site contains a natural spring (Banner Spring), which originates on the NFS property. Banner Spring forms Banner Spring Branch, which is routed through an underground pipe across the site and empties into Martin Creek at the site boundary. Martin Creek empties into North Indian Creek approximately 3,500 feet north of the NFS site, and North Indian Creek empties into the Nolichucky River approximately one (1) mile from the site boundary.

The site is located in a southwest-to-northeast oriented valley, bounded on both sides by the Blue Ridge Mountains of the Appalachian Mountain chain. The surrounding mountains have a maximum elevation of approximately 2,480 feet above sea level. The topography of the NFS property is relatively level, with site elevations ranging from approximately 1,640 to 1,680 feet above sea level.

1.3.2 Demographics

The NFS site is located inside the Erwin city limits. Based on the 2000 U.S. Census, the city of Erwin, the seat of Unicoi County, has a population of approximately 5,600 people, and the population of Unicoi County is approximately 17,700 people. Approximately 2,713 people live within one (1) mile of the NFS site.

Erwin Health Care Center, a nursing home, and Love Chapel Elementary School are the only public facilities within one (1) mile of the NFS site. Two other schools, Unicoi County Middle School and Unicoi County High School, are approximately 1.3 miles northeast of the NFS site. The nearest hospital, Unicoi County Memorial Hospital, and and an adjacent nursing home, Center for Aging and Health, are approximately 1.2 miles northeast of the NFS site.

Land use within one (1) mile of the NFS site is a mixture of residential and agricultural activities, as well as several industrial facilities. The industrial facilities, including Studsvik, a low-level radioactive waste processing facility located adjacent to the southern NFS site boundary. A railroad yard owned by CSX Transportation is located adjacent to the western NFS site boundary.

The Nolichucky River, located approximately one (1) mile from the site boundary, is used primarily for recreational purposes (white water rafting, canoeing, fishing, etc.) and serves as irrigation water for agricultural activities. The Nolichucky River also serves as a source of drinking water the for Town of Jonesborough, and the water treatment plant intake is located approximately 8 miles downstream of the NFS site.

1.3.3 Meteorology

Prevailing winds at the NFS site tend to be from the southwest following the orientation of the valley, southwest to northeast. The 30-year average wind speed is 6.9 mph.

The East Tennessee region has a climate with warm, humid summers and relatively mild winters. The average annual rainfall in the Erwin area is 39 inches, and the average annual snowfall is 15 inches. The average annual temperature is 55°F, with a monthly average minimum temperature in January of 25°F and a monthly average maximum temperature in July of 87°F.

Severe storm conditions are infrequent in the Erwin area, due to the fact that the area is east of the center of tornado activity, south of most blizzard conditions, and too far inland to be affected by hurricane activity. Maximum sustained wind speeds measured in the region include 50 mph in 1951 and 40 mph in 1962.

The only tornado reported in Unicoi County in the last 50 years occurred in 1980. Adjacent Washington and Carter Counties reported two tornadoes each in the last 50 years. Due to the low frequency of tornadoes in this region, no specific design criteria relative to tornadoes are required in the International Building Code.

Lightning risk at the NFS site has been addressed by evaluating facility operations and the potential for damage due to lightning strikes. See Chapter 7 for additional details.

1.3.4 Hydrology

There are four (4) bodies of surface water adjacent to or in the immediate vicinity of the plant. The site contains a natural spring (Banner Spring), which originates on the NFS property. Banner Spring forms Banner Spring Branch, which is routed through an underground pipe across the site and empties into Martin Creek at the site boundary. Martin Creek empties into North Indian Creek approximately 3,500 feet north of the NFS site, and North Indian Creek empties into the Nolichucky River approximately one (1) mile from the site boundary.

Based on the 2008 National Flood Insurance Map published by FEMA for the Erwin area, the NFS site is located outside of the 100-year floodplain of the Nolichucky River. However, the northern portion of the NFS site is located within the 100-year floodplain of Martin Creek. The culvert that allows Martin Creek to pass under the CSX Railroad was enlarged in 1990, and NFS has constructed a berm along the northern site boundary, both of which effectively lower the potential for flooding of the NFS site due to Martin Creek. The floodplain elevation mapping has not been updated to take these factors into account. Potential impacts due to flooding in facilities located in the northern portions of the NFS site are further minimized by early warning and associated mitigative efforts (removal/relocation of materials and equipment susceptible to water damage, sandbagging, etc.) during potential flooding conditions.

Depth to the water measurements taken at wells in the vicinity of the NFS site range from 5 to 19 feet below land surface, with an average of 11 feet. Groundwater elevation measurements and modeling indicate that groundwater generally flows in a northwest direction toward the Nolichucky River, which is a major discharge zone for the groundwater flowing under the NFS site, at an average rate of 0.5 to 114 feet/day, with an average of 22 feet/day. There are no known household, public, or industrial users of groundwater downgradient of the NFS site. A potentiometric surface map for the groundwater under the NFS site is included in Chapter 9.

The uppermost aquifer at the NFS site is the alluvial aquifer. This alluvial aquifer is limited in areal extent and is found mainly in the lowland areas. The alluvial aquifer pinches out just north and south of the site due to the presence of shallow bedrock. Alluvial deposits are generally very heterogeneous in sediment size, composition, and depositional pattern, causing varying degrees of anisotropy throughout these deposits. The presence of large amounts of clay in suspended and mixed-load stream deposits commonly causes the vertical hydraulic conductivity to be orders of magnitude less than in a horizontal direction.

1.3.5 Geology

The NFS site lies in the Valley and Ridge physiographic province of northeastern Tennessee. The area topography consists of a series of alternating valleys and ridges that have a northeast-southeast trend, with the NFS site located in a valley. The present topography of the valley is the result of stream erosion of softer shales and limestones. The bedrock strata at the NFS site are consolidated, providing firm foundations for buildings that lie directly on the strata or that are supported by footings. Foundations for buildings that house licensed activities are supported by soil which meets the bearing capacities required by the building design.

Although common in the mountainous terrain surrounding the NFS site, slope failures are not common on the former flood plain where slopes are flat. Structures are set back sufficiently from the Nolichucky River and Martin Creek to avoid destabilization due to erosion or slope failures along the waterway banks.

The NFS site is located in the moderately active Appalachian Tectonic Belt, Seismic Zone 2, indicating that moderate damage could occur as the result of earthquakes. There is no evidence of capable faults as defined by 10 CFR 100 in the immediate vicinity of the NFS site. A seismic analysis of the NFS site conducted in 2001 determined that the horizontal component of ground motion for a safe shutdown earthquake with a 1000-year return period has a peak ground acceleration of 0.06 gravity, and the vertical acceleration is two-thirds of the horizontal, or 0.04 gravity.

APPENDIX 1A

NUCLEAR FUEL SERVICES, INC.
AFFILIATES

1. **The Babcock & Wilcox Company** is a corporation that owns 100% of the stock of BWX Technologies, Inc.

2. **BWX Technologies, Inc.**, is a corporation that owns 100% of the stock of Babcock & Wilcox Nuclear Operations Group, Inc.

3. **Babcock & Wilcox Nuclear Operations Group, Inc.**, is a corporation that owns 100% of the stock of NOG-Erwin Holdings, Inc.

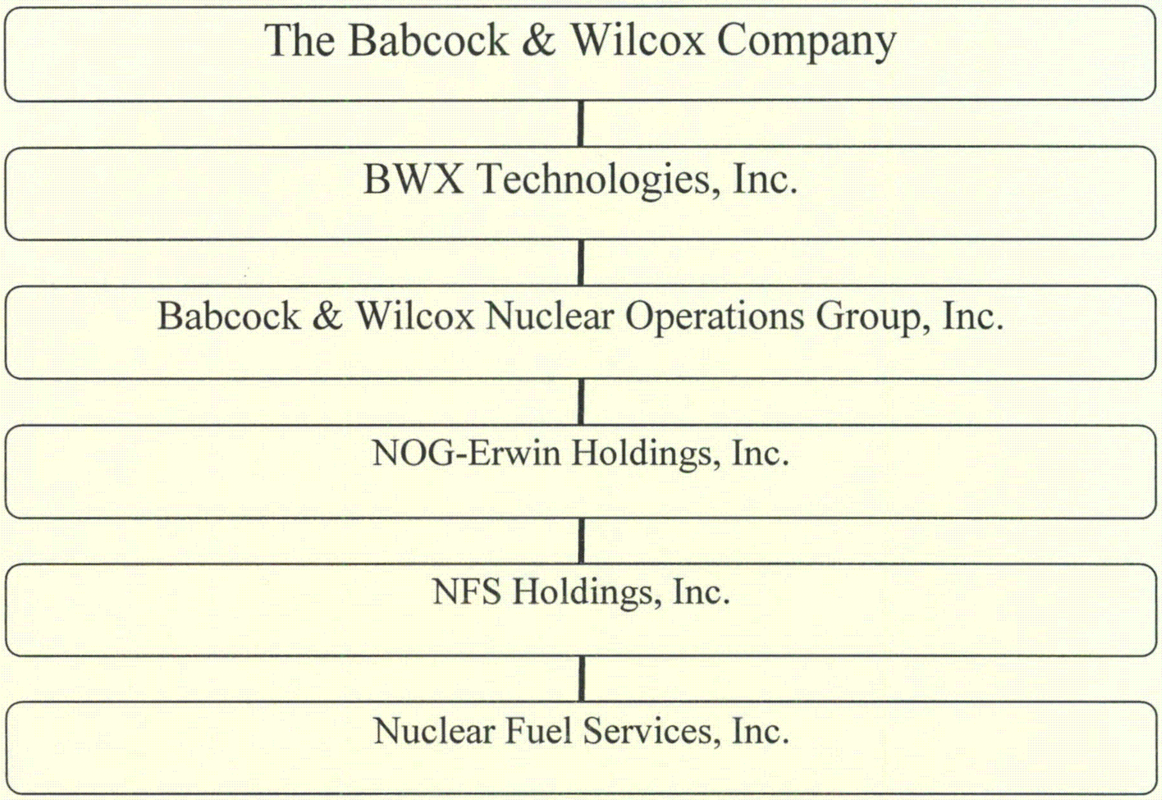
4. **NOG-Erwin Holdings, Inc.**, is a corporation which owns 100% of the stock of NFS Holdings, Inc.

5. **NFS Holdings, Inc.**, is a corporation which owns 100% of the stock of Nuclear Fuel Services, Inc.

6. **Nuclear Fuel Services, Inc. (NFS)**, is a manufacturer and processor of specialty nuclear fuels which is also engaged in decontamination, decommissioning, and remediation services for the chemical and nuclear industry. These services are performed both at NFS' Erwin, Tennessee, location and at other facilities.

NOTE: This listing does not include certain affiliate companies that are not relevant to licensed activities.

Figure 1A-1
NFS Corporate Structure



NOTE: This chart is a simplified organization chart and does not include certain affiliate companies that are not relevant to licensed activities.

APPENDIX 1B

LISTING OF CHEMICAL AND PHYSICAL FORMS OF URANIUM AUTHORIZED

The physical forms of uranium which may be used in licensed operations are:

Solid Forms,
Liquid Forms, and
Gaseous Forms.

The following listing contains the chemical compounds of uranium which may be present in licensed operations. Other compounds may be present as transitory compounds. This listing does not include materials in which uranium may be present as a mixture:

LISTING OF URANIUM COMPOUNDS	
Compound Name	**Compound Formula**
Acid deficient uranyl nitrate	$UO_2\ (NO_3)_x$ where x is less than 2
Ammonium diuranate	$(NH_4)_2U_2O_7$
Ammonium uranyl carbonate	$(NH_4)_4UO_2(CO_3)_3$
di-Ammonium uranylcarbonate	$2(NH_4)_2CO_3UO_2CO_32H_2O$
Ammonium pentauranylfluoride	$(NH_4)_3UO_2F_5$
Potassium metauranate	K_2UO_4
Potassium uranyl acetate	$KUO_2(C_2H_3O_2)_3H_2O$
Potassium uranyl carbonate	$2K_2CO_3UO_2CO_3$
Potassium uranyl sulfate	$K_2SO_4UO_2SO_42H_2O$
Sodium metauranate	Na_2UO_4
Sodium uranyl acetate	$NaUO_2(C_2H_3O_2)_3$
Sodium uranyl carbonate	$2Na_2CO_3UO_2CO_3$
Uranium (metal)	U
Uranium diboride	UB_2
Uranium tetrabormide	UBr_4
Uranium tribromide	UBr_3
Uranium dicarbide	UC_2
Uranium carbide	UC_x, where x is less than 2
Uranium pentachloride	UCl_5
Uranyl hydroxide	$UO_2(OH)_2$
Uranium tetrachloride	UCl_4
Uranium trichloride	UCl_3
Uranium hexafluoride	UF_6
Uranium tetrafluoride	UF_4

LISTING OF URANIUM COMPOUNDS	
Compound Name	**Compound Formula**
Uranium trifluoride	UF_3
Uranium hydride	UH_3
Uranium tetraiodide	UI_4
Uranium mononitride	UN
Uranium dioxide	UO_2
Uranium peroxide	UO_42H_2O
Uranium trioxide	UO_3
triUranium octoxide	U_3O_8
Uranium sulfate	$U(SO_4)_24H_2O$
Uranium sulfate	$U(SO_4)_28H_2O$
Uranium sulfate	$U(SO_4)_29H_2O$
Uranium disulfide	US_2
Uranium monosulfide	US
Uranium sesquisulfide	U_2S_3
Uranyl acetate	$UO_2(C_2H_3O_2)_22H_2O$
Uranyl benzoate	$UO_2(C_7H_5O_2)_2$
Uranyl bromide	UO_2Br_2
Uranyl carbonate	UO_2CO_3
Uranyl perchlorate	$UO_2(ClO_4)_26H_2O$
Uranyl chloride	UO_2Cl_2
Uranyl fluoride	UO_2F_2
Uranyl formate	$UO_2(CHO_2)_2H_2O$
Uranyl iodate	$UO_2(IO_3)_2$
Uranyl iodate	$UO_2(IO_3)_2H_2O$
Uranyl iodide	UO_2I_2
Uranyl nitrate hexahydrate	$UO_2(NO_3)_26H_2O$
Uranyl nitrate	$UO_2(NO_3)_2$
Uranyl nitrate hydrate	$UO_2(NO_3)_2XH_2O$, where X is less than 6
Uranyl oxalate	$UO_2(C_2O_4)_23H_2O$
Uranyl mono-H phosphate	$UO_2HPO_44H_2O$
Uranyl potassium carbonate	$UO_2CO_32K_2CO_3$
Uranyl sodium carbonate	$UO_2CO_32Na_2CO_3$
Uranyl sulfate	$UO_2SO_43H_2O$
Uranyl sulfate	$2(UO_2SO_4)7H_2O$
Uranyl sulfide	UO_2S
Uranyl sulfite	$UO_2SO_34H_2O$

21G-11-0157
GOV-01-55-04
ACF-11-0244

Attachment 3

SNM-124, Replacement for Pages 2-8, 2-10, and 2-12, Revision 1

dated August 1, 2011

(3 pages to follow)

fire protection and licensing, regulatory compliance, safety, or safety analysis in the nuclear or another highly regulated industry.

2.3.6 Material Control and Accountability

The Material Control and Accountability (MC&A) Discipline maintains programs to assure that SNM is received, processed, stored, and transferred in accordance with federal regulations, and implements these functions through the areas of SNM safeguards, SNM accountability, shipping, receiving, and warehousing.

The minimum qualifications for an MC&A discipline manager are a BS/BA degree and at least five years experience in MC&A-related activities, two years of which have been in the nuclear fuel cycle.

2.3.7 Security

The Security Discipline provides on-site security forces which control access to protected and material access areas; administers facility and personnel security clearance programs and protects against material and equipment theft and unauthorized personnel entry.

The minimum qualifications for a security discipline manager are a BS/BA degree and at least five years experience in security-related activities, two years of which have been in the nuclear fuel cycle.

2.3.8 Quality Assurance

The Quality Assurance Discipline assesses systematic programs for indoctrination and training of personnel performing quality-related safety activities; for specifying during the design phase the extent of quality assurance or confidence necessary for quality-related safety structures, systems, and components; and for performing audits, surveillances, and assessments of quality-related safety activities. The quality assurance program is based on, but is not limited to, applicable requirements and guidance such as ASME NQA-1, MIL-Q-9858A, or other similar guidance. The quality assurance discipline is administratively independent of operations, and has no other duties or responsibilities unrelated to quality assurance that would interfere with carrying out the duties of this discipline.

The qualifications for a quality assurance discipline director are a BS/BA degree in science or engineering and ten years of experience in industry or nuclear

- Reviewing all violations of regulations or license conditions having safety significance.

The committee will meet at the following frequencies:

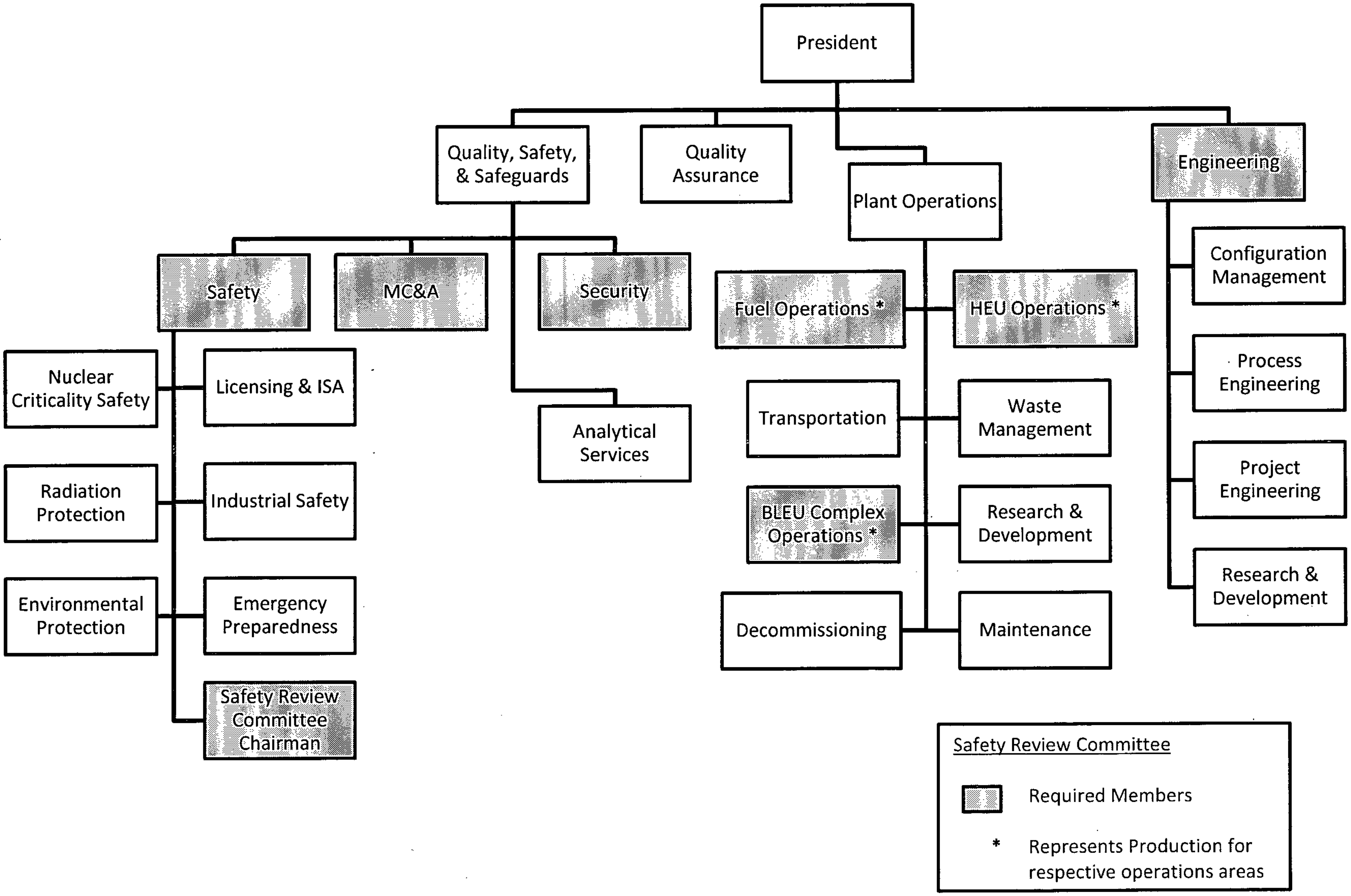
- to discuss topics such as proposed license changes – as needed;
- to discuss ALARA considerations – at least semiannually;
- to review license-required safety inspections, audits, investigations, and violations of regulations or license conditions – at least quarterly.

Its proceedings, findings, and recommendations will be documented in writing and made available to the president, discipline directors, and discipline managers. Such reports will be retained for at least five years.

The chairman of the safety review committee, with concurrence of the remaining committee members, is authorized to select individual committee members to review and approve new or revised operating and general safety procedures. However, the review and approval of such procedures, as described herein, include at a minimum the initiating discipline manager, the safety discipline manager, and the appropriate safety review committee members, as selected by the safety review committee chairman. If an active procedure has not been revised within a three-year period, the chairman may select individual committee members to review the procedure to ensure it remains current and relevant. Records of procedural changes will be maintained for a minimum of five years.

Committee review of matters other than the bulleted items above may be conducted by either individual review or collectively at a meeting; however, individual members of the committee have the authority to request a meeting of the entire committee on any given matter.

Figure 2-1


President
Quality, Safety, & Safeguards
Quality Assurance
Plant Operations
Engineering
Safety
MC&A
Security
Analytical Services
Nuclear Criticality Safety
Licensing & ISA
Radiation Protection
Industrial Safety
Environmental Protection
Emergency Preparedness
Safety Review Committee Chairman
Fuel Operations *
HEU Operations *
Transportation
Waste Management
BLEU Complex Operations *
Research & Development
Decommissioning
Maintenance
Configuration Management
Process Engineering
Project Engineering
Research & Development
Safety Review Committee
Required Members
* Represents Production for respective operations areas

21G-11-0157
GOV-01-55-04
ACF-11-0244

Attachment 4

SNM-124, Replacement for Chapter 5, Revision 1

dated May 27, 2011

(30 pages to follow)

NUCLEAR CRITICALITY SAFETY
Table of Contents

SPECIAL NUCLEAR MATERIAL LICENSE
SNM-124
CHAPTER 5

NUCLEAR CRITICALITY SAFETY

5.1 Nuclear Criticality Safety Program Management

5.1.1 Nuclear Criticality Safety Program and Philosophy

NFS provides an adequate and effective nuclear criticality safety (NCS) program, including methodologies and technical practices, to support safe operation of the facilities. Controls and barriers that are designated as Items Relied on for Safety (IROFS) to prevent an inadvertent nuclear criticality are documented in NCS Evaluations and the Integrated Safety Analysis (ISA) Summary as appropriate.

NFS provides for the appropriate management of the NCS program. The responsibilities and authorities of individuals that develop and implement the NCS program are also provided. In addition, facility management measures are provided that support implementation and maintenance of the NCS program.

Subcriticality is maintained for all normal and credible abnormal conditions. To support this overarching requirement, process designs incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible. Sufficient redundancy and diversity should be implemented on changes in one process condition such that at least two unlikely, independent, and concurrent errors, accidents, or equipment malfunctions must occur before a criticality accident is possible. The focus should be on understanding each credible change in process conditions and implementing the best overall controls to maintain subcriticality such that no single credible event or failure will result in a criticality accident. When considering NCS accident sequences, guidance from ANSI/ANS-8.1-1998, Appendix A is used.

NFS relies on passive, active, enhanced administrative, and simple administrative controls to maintain subcriticality. Where practicable, reliance is placed on equipment design in which "favorable" geometry is used rather than on administrative controls.

5.1.2 Management of the Nuclear Criticality Safety Program

NFS provides effective management of the NCS program as well as sufficient resources to implement an effective NCS program. The NFS NCS program includes the following commitments:

1) NFS shall develop, implement, and maintain an NCS program that meets the regulatory requirements of 10 CFR 70.

2) NFS shall establish NCS program objectives (refer to the NCS program objectives below).

3) NFS shall establish and maintain NCS safety limits, controls, and procedures.

4) NFS shall outline an NCS program structure and define the responsibilities and authorities of key program personnel.

5) NFS shall keep the plant configuration current and consistent with the NCS-established safety limits and IROFS by means of the configuration management function.

6) NFS shall use the NCS program to establish and maintain NCS safety limits and NCS operating limits for IROFS in fissile material processes and NFS shall maintain adequate management measures to ensure the availability and reliability of the IROFS.

7) NFS shall prepare NCS postings, provide NCS training, and provide NCS emergency procedure training.

8) NFS shall adhere to the NCS baseline design criteria requirements in 10 CFR 70.64(a).

9) NFS shall use the NCS program to evaluate modifications to operations, to recommend process changes necessary to maintain the safe operation of the facility, and to select appropriate IROFS and management measures.

The objectives of the NFS NCS program include the following:

1) Preventing an inadvertent nuclear criticality;

2) Protecting against the occurrence of an identified accident sequence in the ISA Summary that could lead to an inadvertent nuclear criticality;

3) Complying with the NCS performance requirements of 10 CFR 70.61;

4) Establishing and maintaining NCS safety limits, controls, and procedures;

5) Establishing and maintaining NCS safety limits and NCS operating limits for IROFS;

6) Conducting NCS evaluations to assure that under normal and credible abnormal conditions, all nuclear processes remain subcritical, and maintaining an approved margin of subcriticality for safety;

7) Establishing and maintaining NCS IROFS based on current NCS determinations;

8) Providing training in emergency procedures in response to an inadvertent nuclear criticality;

9) Complying with the NCS baseline design criteria requirements in 10 CFR 70.64(a);

10) Complying with the NCS ISA Summary requirements in 10 CFR 70.65(b);

11) Complying with the NCS ISA Summary change process requirements in 10 CFR 70.72; and

12) Complying with the reporting requirements in 10 CFR 70, Appendix A.

5.2 Organization and Administration

Information regarding general organization and administration is described in Chapter 2. Chapter 2 also includes the organizational positions, functional responsibilities, experience, educational requirements, and authorities of NCS management and staff who develop, organize, implement, and administer the NCS program.

The NCS organization and administration includes the following commitments:

1) NFS shall comply with the requirements of ANSI/ANS-8.1-1998 and ANSI/ANS-8.19-2005 as they relate to organization and administration.

2) NFS shall use personnel, skilled in the interpretation of data pertinent to NCS and familiar with the operation of the facility, as a resource in NCS management decisions. These specialists should be independent of operations supervision (Refer to Section 4.1.1 of ANSI/ANS-8.1-1998).

3) NFS shall provide NCS postings in areas, operations, work stations, and storage locations, as appropriate.

4) NFS personnel shall report defective NCS conditions to the NCS function and perform response/corrective actions only in accordance with written,

approved procedures. Unless a specific procedure deals with the situation, personnel shall report defective NCS conditions to the NCS function and take no action until the NCS function has evaluated the situation and provided recovery directions.

5) NFS shall describe organizational positions, experience and qualifications of personnel, functional responsibilities, and organizational relations among the individual positions (Refer also to Chapter 2).

6) NFS shall designate an NCS function manager who will be responsible for implementation of the NCS program.

7) NFS shall adequately staff the NCS program with suitably-trained personnel and provide sufficient resources for its operation.

5.3 Management Measures

5.3.1 General Management Measures

Information regarding management measures programs is described in Chapter 11. These programs include the management measures identified in 10 CFR 70.62 and are used to implement and maintain the NCS program.

5.3.2 Employee Training

NFS complies with the requirements of ANSI/ANS-8.19-2005 and ANSI/ANS-8.20-1991 as they relate to training. NFS also provides training to all personnel to recognize the Criticality Accident Alarm system (CAAS) signal and to evacuate promptly to a safe area. In addition, NFS employees receive instruction training regarding the NCS Policy.

5.3.3 Training and Qualifications of NCS Staff

A formal training and qualification program is developed and maintained for NCS staff. Elements of the program include the following: on-the-job training, off-site NCS-related training courses, and mentoring by senior NCS engineers.

5.3.4 Auditing, Assessing, and Upgrading the NCS Program

NFS complies with the requirements of ANSI/ANS-8.19-2005 as it relates to audits and assessments. NCS inspections of selected site operations involving special nuclear material are performed weekly by NCS Engineers to determine if activities are being conducted in accordance with nuclear criticality safety requirements and limits.

Quarterly NCS audits of selected plant activities are conducted such that SNM processing or storage facilities are audited biennially. The purpose of the audits is to determine that: (a) site operations are conducted in compliance with license conditions, operating procedures, and posted limits; (b) administrative controls and postings are consistent with NCSEs; (c) equipment and operations comply with NCSEs; and, (d) corrective actions relative to findings of NCS inspections are adequate.

An independent assessment of the nuclear criticality safety program is conducted every three (3) years.

Findings and observations from NCS audits, inspections, and assessments are entered into the corrective action program and tracked until closure. Refer to Chapter 11 for a discussion of the corrective action program.

5.3.5 Procedures

NFS commits to the requirements of ANSI/ANS-8.19-2005 as it relates to procedures and to the policy that no single, inadvertent departure from a procedure could cause an inadvertent nuclear criticality.

Operating procedures are provided for activities involving special nuclear material; and, the procedures incorporate safety limits and controls as appropriate. These procedures are reviewed and approved by the nuclear criticality safety function. During the review and approval process, the NCS staff may recommend or require modifications (to the procedures) to reduce the likelihood of occurrence of an inadvertent nuclear criticality.

5.3.6 NCS Reviews of New or Modified Equipment

Each proposed addition of new equipment or change to existing equipment used in the processing or storage of SNM, and any procedure changes resulting therefrom, are reviewed and approved by the nuclear criticality safety function. During the review and approval process, the NCS staff may recommend or require modifications (to the design and/or to the procedures) to reduce the likelihood of occurrence of an inadvertent nuclear criticality.

5.3.7 Posting of Nuclear Criticality Safety Limits

Nuclear criticality safety requirements issued by the nuclear criticality safety function for each process system are available at each work area in the form of operating procedures. Clear, visible signs or notices may be posted at work stations, as appropriate, to supplement the procedures by emphasizing specific limits and controls.

Posted nuclear criticality safety requirements are defined by the nuclear criticality safety function and include, as appropriate:

- Limits on material types and forms;
- Allowable quantities by mass or number of items/containers;
- Allowable enrichments;
- Limits on reflecting materials;
- Required spacing between units;
- Control limits (when applicable) on quantities such as moderation, concentration/density and the presence of additives.

5.3.8 Integrated Safety Analysis (ISA) Summary Revisions

Refer to Chapter 3 for a discussion of ISA Summary revisions.

5.3.9 Corrective Action Program

A corrective action program is implemented to document and manage NCS-related problems, observations, findings, investigations, corrective actions, and any unacceptable NCS-related performance deficiencies. Refer to Chapter 11 for a discussion of the corrective action program.

5.3.10 Records Retention

Records of the NCS program are retained in accordance with the regulatory retention program. These records include NCS analyses and documentation of corrective actions taken.

5.4 Criticality Accident Alarm System (CAAS) and Emergency Management

5.4.1 Criticality Accident Alarm System (CAAS)

A criticality accident alarm system (CAAS) is designed and installed to provide prompt detection and annunciation of an inadvertent nuclear criticality. The system satisfies the requirements of 10 CFR 70.24. A documented evaluation will be maintained that demonstrates that the CAAS meets the requirements of 10 CFR 70.24. The system is also designed to remain operational during credible events or the system will alarm during credible failure modes. Refer to Chapter 4 for a discussion of the CAAS.

Exemptions from the CAAS monitoring requirements include the following: 1) materials and/or containers that satisfy the fissile material exceptions in 49 CFR; or 2) materials packaged in authorized shipping containers which are in isolated arrays or on a transport vehicle and which are no more reactive than that approved for transport.

Whenever the criticality alarm system is out of service, in storm-watch mode, or being tested or repaired, compensatory measures are established (e.g., stop movement and/or monitoring of the criticality alarm panel). Periods when the criticality alarm system is out of service are minimized to the extent practical.

Emergency power is provided for the CAAS (e.g., uninterruptible power supply).

5.4.2 Emergency Management

With regard to emergency management, refer to Chapter 8 for a discussion of the emergency management program and emergency plan. With regard to accident dosimetry, refer to Chapter 4. Guidance from ANSI/ANS-8.23-2007 is also used for nuclear criticality accident emergency planning and response.

5.5 Methodologies and Technical Practices

5.5.1 Means of Control

The relative effectiveness and reliability of controls are considered during the nuclear criticality safety analysis process. Engineered controls or design features are preferred over administrative controls. Passive engineered controls or design features are preferred over all other system controls and are utilized when practicable and appropriate. Active engineered controls are the next preferred method of control. Administrative controls are the least preferred method of control; however, when administrative controls are deemed necessary, enhanced administrative controls are preferred over simple administrative controls.

1) Passive engineered controls (most preferred) use fixed design features or devices to maintain safe process conditions. No human intervention or action is required. Assurance is maintained through initial verification prior to operation and/or periodic inspections as appropriate. Assurance is also maintained through the configuration management program.

2) Active engineered controls use add-on, active hardware (e.g., electrical, mechanical) or moving parts to maintain safe process conditions. No human intervention or action is required during operation. Assurance is maintained through initial and periodic inspection, functional testing, and/or calibration as appropriate. Active engineered controls detect an undesirable change in process conditions and automatically secure the system to a safe condition. Active engineered controls are designed to be "fail safe," meaning they are designed to place the system in a safe state due to signal loss or power failure.

3) Enhanced administrative controls rely on human judgment, training, and personal responsibility for implementation and are augmented by warning devices (visual or audible) which requires human action according to procedure. A visual or audible alarm alerts the operator to an undesirable change in process conditions, which requires human action or intervention in accordance with approved procedures to maintain or return the process to a safe condition. Alarm integrity and reliability is ensured by initial and periodic inspection or functional testing as appropriate.

4) Simple administrative controls (least preferred) rely on human judgment, training, and personal responsibility for implementation when the control function is needed. The control is a procedural human action that is required to maintain safe process conditions. Assurance is maintained through periodic verification, audit, or training.

5.5.2 Methods of Control

The following recognized control methods are also referred to as parameters which may be controlled for nuclear criticality safety purposes (i.e., controlled parameters). When evaluating an SNM-bearing system for criticality safety, each of these parameters will be assumed to be at its optimum credible condition (i.e., most reactive credible condition) unless acceptable controls are specified and implemented to limit the parameters to certain values. When computer codes are used to determine the safety of a system, the values meet the k_{eff} limits of this chapter. Criticality safety may also be based on data provided in handbooks, reference documents, experimental data or the values listed in Tables 5A-1 thru 5A-6 of this chapter. The safety factors as presented for Tables 5A-1 thru 5A-6 must be applied to critical values; or, maximum subcritical values may be used as provided in handbooks or standards (e.g., maximum subcritical values provided in ANSI/ANS-8.1).

1. **Geometry** – Geometry control is achieved by increasing neutron leakage by limiting the dimensions of defined geometrical shapes. Equipment relying upon favorable geometry for control include adequate factors of safety to ensure reliability under credible accident conditions. Before beginning an operation, all dimensions relied upon for geometry control are verified. The facility configuration management program is used to maintain these dimensions. Periodic inspections are performed on those systems where credible changes in equipment dimensions may occur that could result in the inability to meet established nuclear criticality safety limits. Standard buckling equations may also be used to determine the geometric limits for finite units.

2. **Spacing (or Unit Interaction)** – Spacing (or Unit Interaction) control is a method of limiting the introduction of neutrons leaked from one SNM unit into a neighboring SNM unit by controlling the separation distance between units. Where spacing control is required, a passive engineered device (e.g., a spacer or bumper) is the preferred method of control and is used where practicable. The structural integrity of any spacers/racks should be sufficient for normal and credible abnormal conditions. If not practicable, administrative controls may be utilized and should include such items as procedural instructions, postings, and visual indicators, as appropriate.

   Equipment, facilities, and individually subcritical units may be considered to be effectively non-interacting or neutronically isolated when their surfaces are separated by any of the following:

- A 12-inch-thick layer of water, or by the distance which is equivalent in isolational ability to a 12-inch-thick layer of water, or
- 12 feet of air, or
- Sub-arrays separated by not less than the smallest dimension of the facing surfaces of the sub-arrays, or
- The greatest distance across an orthographic projection of the largest of the fissile accumulations on a plane perpendicular to the line joining their centers, or
- 12 inches of solid concrete (block or poured) of density greater than or equal to 140 pounds per cubic foot.

The design conditions for interaction between multiple units or between arrays that experience neutron interaction will be based on values that can be demonstrated safe by one of the following methods:

- Unit Storage Criteria
- Solid Angle Method
- Surface Density
- Areal Density – When criticality safety is contingent only upon maintenance of a limited areal density of fissile material, controls will be implemented to ensure that the limit is not exceeded. The controls will limit the areal density to a safe value, which is defined to be no more than 45 percent of the minimum critical areal density.
- Monte-Carlo Calculations (Each application of Monte-Carlo calculations must comply with the requirements of this chapter).
- American National Standard, ANSI/ANS-8.7-1998, "Nuclear Criticality Safety in the Storage of Fissile Materials"
- NRC and/or DOT packaging or transportation regulations (e.g., staging of packages in accordance with the Criticality Safety Index)

With regard to the storage of SNM, NFS complies with the requirements of ANSI/ANS-8.7-1998.

3. **Volume** – Volume control is a method of limiting the volume of SNM to an acceptable value. Equipment relied upon for volume control includes adequate factors of safety to ensure that a safe volume is maintained under credible accident conditions. Prior to the equipment being released for use, the volume of the equipment is verified. The facility configuration management program is used to maintain the volume. Periodic inspections are performed on those systems where credible changes in equipment volume may occur that could result in the inability to meet established nuclear criticality safety limits. When the solution volume is measured (i.e., quantity of solution), appropriate instrumentation is used.

4. **Neutron Absorber (Fixed/Soluble)** – Neutron absorber control is a method of reducing the number of neutrons in a fissile material system available to cause a fission event, by introducing a parasitic neutron absorber (i.e., poison) into the system. This method of control includes use of fixed or soluble neutron absorbers. When evaluating absorber effectiveness, neutron spectra are considered (e.g., cadmium is an effective absorber for thermal neutrons, but ineffective for fast neutrons).

   Fixed neutron absorber control is a method of increasing neutron absorption in material by placing a solid absorber (i.e., poison) in the system that may include the use of "poison fixtures" as well as taking credit for the neutron absorption properties of structural materials. For fixed neutron absorbers, the thickness of the absorber is measured and documented prior to first use. The composition of the absorber will be verified unless the chemical properties of the materials consist of standard structural materials (e.g., stainless steel, carbon steel, etc.). Controls, as necessary, are exercised to maintain the continued presence and the intended distribution and contribution of the absorber. NFS complies with ANSI/ANS-8.21-1995 as it relates to fixed neutron absorbers.

   Borosilicate-glass Raschig rings are used according to the requirements of the American National Standard ANS/ANS-8.5-1996 with the following exceptions:

   - Rough-cut rings may be used. Accumulation of glass fines in the bottom of such vessels is inconsequential, and determining the vessel volume and loss of glass volume due to breakage and settling is unnecessary. Precautionary inspections are performed on an annual frequency to ensure that settling does not result in an accumulation of solution in a ring-free region near the top of the vessel.

- Vessels with open tops may be constructed so as to overflow at 100 percent of free volume, provided the vessel is filled with rings and inspected on an annual frequency.

- Analysis for boron content in a representative sample of rings is performed once every 2 years.

- The glass volume fraction of a vessel need not be determined, since such a value is only used as a basis for limiting the maximum solution concentration of fissile material.

- The drop test need not be performed. Breakage of Raschig rings is accounted for by periodic inspections of the level in the tank.

- The limits of 5% enrichment are used for up to 6% enriched uranium.

Soluble neutron absorber control is a method of increasing neutron absorption in material by placing a soluble neutron absorber (i.e., poison) in a liquid system. Soluble neutron absorbers are only used as secondary NCS control. When soluble neutron absorbers are used, appropriate measurements are taken to ensure their initial presence and their continuous presence at the correct concentration.

5. **Piece Count –** Piece count is a method of limiting fissile material mass and/or geometry by limiting the number of containers or components with known amounts of SNM and/or fixed geometries.

6. **Mass –** Mass control is a method of limiting the amount of SNM at a given location to an acceptable value. Mass control may be used on its own or in combination with other control methods. When a given mass of material has been determined, a percentage factor is used to determine the mass percentage of SNM in that material. When fixed geometric devices are used to limit the mass of SNM, a conservative process density is used. When the mass is measured, instrumentation is used (e.g., scales, non-destructive assay equipment, etc.).

7. **Moderation –** Moderation control is a method of limiting or excluding either interstitial (i.e., within the SNM) or interspersed (i.e., between SNM units) moderating materials or both. NFS complies with the requirements of ANSI/ANS-8.22-1997 as it relates to limiting and controlling moderators. The most common moderating materials contain hydrogen; however, moderating materials may also include materials such as carbon and beryllium. Nuclear criticality safety based on control of moderation

requires that sources of moderation be identified and controlled. When designing physical structures for moderation control, the design should preclude the ingress of moderation. When developing firefighting procedures for use in a moderation controlled area, restrictions should be placed on the use of moderator material. After evaluating all credible sources of moderation for the potential for intrusion into a moderation-controlled area/workstation, the ingress of moderation is precluded or controlled. When moderation is measured, the measurement is obtained by using instrumentation, calculation, or by visual inspection as appropriate. In addition, when the NCS organization requires samples to be taken and analyzed by the NFS laboratory (i.e., wt% H_2O) to determine compliance with moderation limits, dual independent sampling methods will be employed. Shipper information may also be used as a basis for moderation content.

8. **Concentration** – Concentration control is a method of measuring and controlling the concentration of SNM in hydrogenous liquids to an acceptable value. When concentration control is utilized, the concentration is determined by appropriate sampling and analysis techniques (e.g., dual independent sampling) or by instrumentation which has been properly maintained and calibrated (e.g., in-line monitor). The analysis will consider the solubility limits of the SNM composition and possible concentrating mechanisms (e.g., precipitation, evaporation, settling, chemical phase change) and controls are established, as necessary, to prevent such mechanisms. When a tank containing concentration-controlled solution is used, the tank is normally closed.

9. **Material Composition** – Material composition (e.g., material type, density, heterogeneity, etc.) control is based on consideration of the physical, chemical, and/or nuclear properties of a material such that the ^{235}U density and neutron absorption of other materials within the compound are identified and understood (e.g., metal versus oxide versus nitrate, etc.). Manufacturing variability and measurement uncertainty are considered when using material specification as a method of control. Possible misidentification is considered for feed materials when using the feed material specification as control. With regard to heterogeneity, heterogeneous effects are particularly relevant for low-enriched uranium processes, where, all other parameters being equal, heterogeneous systems are more reactive than homogeneous systems. With regard to density, when the density is measured, the measurement is obtained by the use of instrumentation.

10. **Enrichment** – Enrichment control utilizes the inherent differences in critical attributes (critical dimensions, mass, etc.) of uranium at different enrichments of ^{235}U. A method of segregating enrichments is used to

ensure differing enrichments will not be interchanged, or else the most limiting enrichment is applied to all material. When the enrichment needs to be measured, the measurement is obtained by using instrumentation (e.g., lab analysis, non-destructive assay equipment, etc.).

11. **Reflection** – Reflection control is a method of control which limits neutron return back into an SNM-bearing system. Refer to the following reflection requirements:

General Reflection Requirements

Conservative reflection conditions are established when evaluating the criticality safety of individual units or arrays. If reflection conditions are uncontrolled, the maximum credible amount of water reflection is considered when calculating system subcriticality. Under certain conditions, however, materials such as concrete, beryllium, carbon, and polyethylene may be more effective reflectors than water. The thickness and location of these types of reflectors are considered in the model. If it is credible for reflection conditions to exceed those used in the analysis of system subcriticality, then reflection controls are implemented to maintain conditions to within the bounds of the analysis. Where positive barriers are used to maintain reflection control, the barriers are maintained through the configuration management and maintenance programs.

Single or Individual Units

A single unit (e.g., vessel or container) is shown to be subcritical when reflected by at least 30 cm of close-fitting water unless:

1) reflector(s) more effective than water are within 30 cm of the unit, or
2) where 30 cm of close-fitting water reflection is not credible.

When reflectors more effective than water are within 30 cm of a single unit, the thickness and location of these reflectors are considered in the model. When a reflector is offset from a single unit, subcriticality will be demonstrated for the thickness and material of the reflector at no more than the offset distance. The efficacy of the controls implemented to maintain the offset spacing is considered in the analysis of unit subcriticality. Subcriticality for single unit reflection may be demonstrated with calculations or by reference to documented subcritical values (e.g., maximum subcritical values provided in ANSI/ANS-8.1).

Multiple Portable Containers

Unless controls are implemented to limit reflection, evaluation of multiple portable containers must be shown to be subcritical with at least a 10 cm thick, 180 cm tall, and 60 cm wide close-fitting water reflector on one side of the containers and at least 2.5 cm of tangential water reflection on the remaining sides of the containers. These reflectors are modeled as slabs or a box that is tangential to the group of containers, or as a tangential cylinder around the group of containers. Figures 5-1 and 5-2 show these configurations.

Figure 5-1
Tangential Cylinder and Slab Around Containers

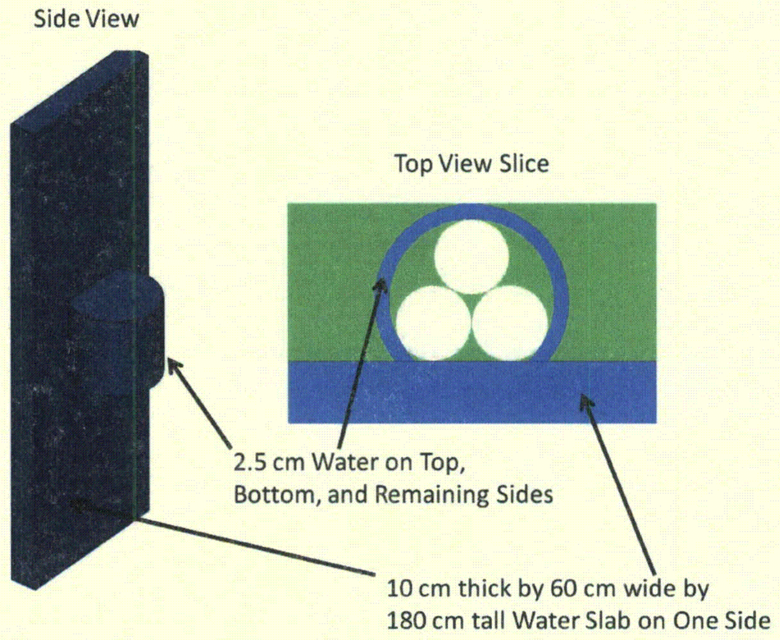
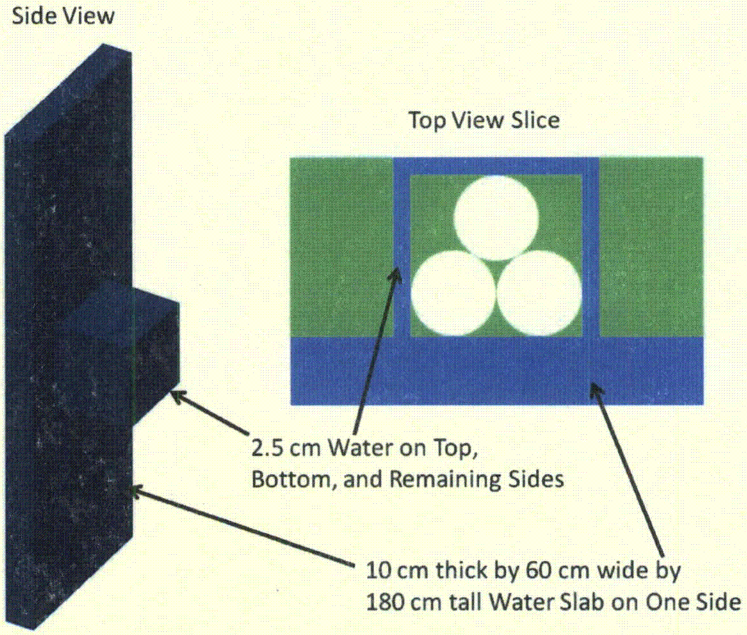


Figure 5-2
Tangential Box and Slab Around Containers

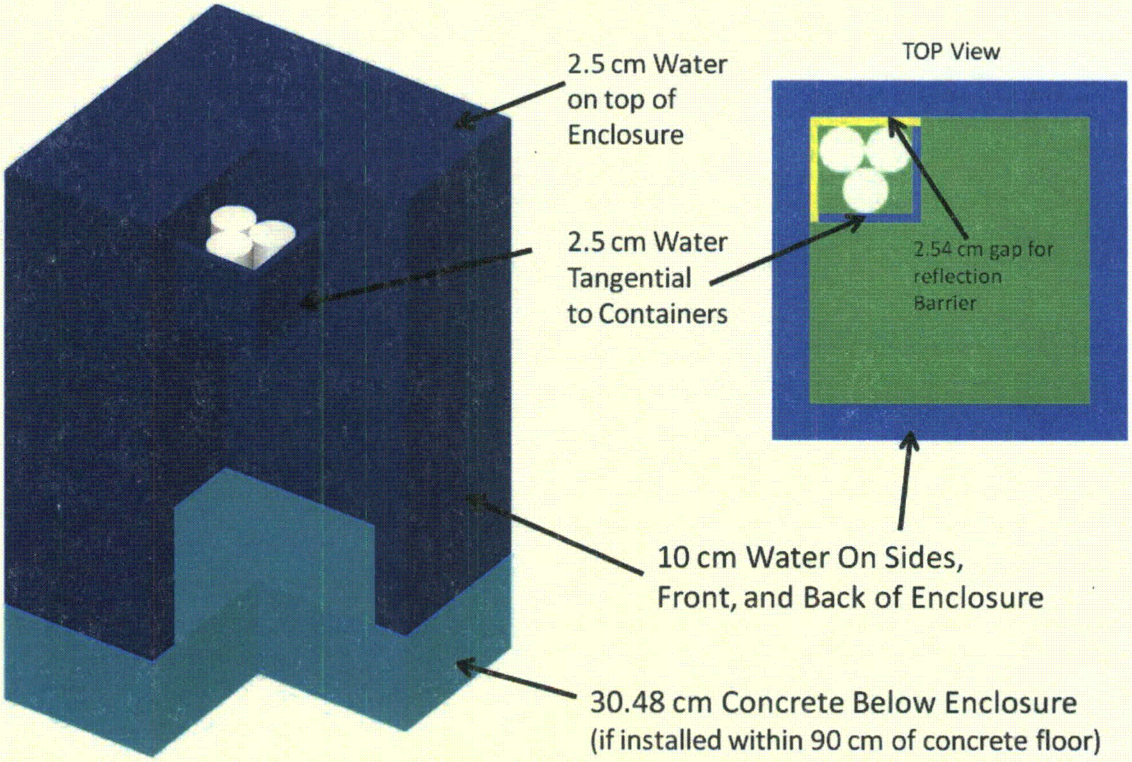


Enclosures/Gloveboxes

Subcriticality of enclosures is demonstrated with the accessible outer front, back, and sides of the enclosures reflected by 10 cm of close-fitting water and the outer top of the enclosures reflected by at least 2.5 cm of close-fitting water. The thickness and location of reflectors that may be more effective than water (e.g., concrete, beryllium, carbon, and polyethylene) must be considered in the model if they are located within 60 cm from the front, back, sides, and top of the enclosure or within 90 cm from the bottom of the enclosure.

Evaluation of overall enclosure reactivity is calculated with portable containers inside the enclosure positioned as close as possible to the outer water reflectors, taking into account any fixed spacing controls that may be present in the enclosure. At least 2.5 cm of water reflection is modeled on the remaining sides of the portable containers. This reflection is modeled as slabs or a box that is tangential to the group of containers, or as a tangential cylinder around the container or group of containers. Note that a larger calculated effective neutron multiplication might result when the portable containers are spaced farther away from the outer reflectors, but nearer to other fixed fissile units that are inside the enclosure. Figure 5-3 shows the configuration of the enclosure model containing a box that is tangential to the containers, whereas if a cylinder were used it would be similar to that shown in Figure 5-1.

Figure 5-3
Enclosure Reflection Boundary Conditions



Arrays

Ordered arrays (more than two units evenly spaced in one or more dimension) of columns or storage racks are demonstrated to be subcritical using a 10 cm thick and 180 cm tall water boundary around the array (e.g., boundary framework). The thickness and location of reflectors that may be more effective than water (e.g., concrete, beryllium, carbon, and polyethylene) are also considered.

The density of water interspersed between units within the array is varied from 0.0 to 0.1 grams per cubic centimeter, to bound conditions that may exist during fire sprinkler activation or up to full density water if full flooding is credible. Where personnel may physically enter the array (e.g., storage vault), a 10 cm thick and 180 cm tall water slab must be modeled in each aisle, unless the array remains subcritical for any amount of interspersed water.

5.5.3 Transfers from Favorable to Unfavorable Geometry

Transfers from favorable geometry (e.g., column) to unfavorable geometry (e.g., tank) are controlled by one (1) of the following three (3) general provisions:

1) Multiple engineered hardware controls (e.g., in-line monitors) capable of preventing an unsafe transfer; or

2) At least one (1) engineered hardware control (e.g., in-line monitor) capable of preventing an unsafe transfer plus a determination of safe conditions (e.g., sampling) and actuation of transfer by an individual; or

3) A design requiring independent actions by two (2) individuals before transfer is possible, each action supported by independent measurements of material to be transferred, and a determination of safe conditions. In this case, physical impediments should be included in the system design which will prohibit either individual from performing both of the actions intended to be performed independently.

5.5.4 Computer Codes and Associated Safety Limits

Computer Codes

Computer codes may be used to calculate system reactivity (i.e., k_{eff}). NFS complies with ANSI/ANS-8.1-1998 as it relates to computer codes.

The calculational margin is determined for the computer code. As one acceptable method, the margin may be based on a validation against applicable benchmark experiments using a one-sided 95% tolerance limit at a 95% confidence level less an additional 0.015 Δk_{eff}.

Computer codes are validated to ensure that they calculate within acceptable ranges and that the assumptions are appropriate. The validation reports are incorporated into the configuration management program. NFS commits to the intent of the validation report statement in NRC Regulatory Guide 3.71, August 1998, which states that the following should be demonstrated: (1) the adequacy of the margin of safety for subcriticality by assuring that the margin is large compared to the uncertainty in the calculated value of k_{eff}; (2) that the calculation of k_{eff} is based on a set of variables whose values lie in a range for which the methodology used to determine k_{eff} has been validated; and (3) that trends in the bias support the extension of the methodology to areas outside the area(s) of applicability.

The validation report should have:

(a) A description of the theory of the methodology that is sufficiently detailed and clear to allow understanding of the methodology and independent duplication of results.

(b) A description of the area(s) of applicability that identifies the range of values for which valid results have been obtained. In accordance with the provisions in ANSI/ANS-8.1-1998, any extrapolation beyond the area(s) of applicability should be supported by an established mathematical methodology.

(c) A description of the use of pertinent computer codes, assumptions, and techniques in the methodology.

(d) A description of the proper functioning of the mathematical operations in the methodology (e.g., a description of mathematical testing).

(e) A description of the data used in the methodology, showing that the data were based on reliable experimental measurements.

(f) A description of the plant-specific benchmark experiments and the data derived therefrom that were used for validating the methodology.

(g) A description of the bias, uncertainty in the bias, uncertainty in the methodology, uncertainty in the data, uncertainty in the benchmark experiments, and margin of subcriticality for safety, as well as the basis for these items, as they are used in the methodology. If the bias is determined to be advantageous, a bias of 0.0 is used (e.g., in a critical experiment where the k_{eff} is known to be 1.00 and the code calculates 1.02, a bias of 0.02 cannot be used to allow calculations to be made above the value of 1.00).

(h) A description of the software and hardware that will use the methodology.

(i) A description of the verification process and acceptable results.

When modifications are made to the computer code system, the impact of the change is assessed to determine if the system needs to be revalidated. If there are changes to the computational platform, then the computer code system will be verified. As a minimum, verification is performed upon installation of a code package.

Safety Limits

When determining subcriticality based on computer code calculations, the following k_{eff} safety limits are not to be exceeded:

System	Safety Limit
High-enriched systems (uranium enriched in ^{235}U greater than 10 wt%)	$k_{eff} + 2\sigma \leq 0.95$
Low-enriched systems (uranium enriched in ^{235}U less than or equal to 10 wt%)	$k_{eff} + 2\sigma \leq 0.97$

The k_{eff} values of 0.95 and 0.97 above are exact limit values, and do not imply that compliance need only be shown to 2 significant figures. Compliance with these values allows for purely calculational inaccuracies, such as Monte Carlo variance, by meeting the limit with a margin in the conservative direction of at least two standard deviations. Any rounding is in the conservative direction.

Appendix 5A

Note: Criticality safety may be based on data provided in handbooks, reference documents, experimental data or the values listed in Tables 5A-1 thru 5A-6 of this chapter. The safety factors as presented for Tables 5A-1 thru 5A-6 must be applied to critical values; or, maximum subcritical values may be used as provided in handbooks or standards (e.g., maximum subcritical values provided in ANSI/ANS-8.1).

Table 5A-1

Limits for Fully Reflected Units of Homogeneous Low Enriched Materials

ENR WT% ^{235}U	MASS KG ^{235}U		CYL DIA INCHES	SLAB THICKNESS INCHES				VOLUME LITERS
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
10.0	.570	.950	7.9	1.7	2.9	3.3	3.7	14.8
9.0	.600	1.000	8.2	1.8	3.0	3.4	3.8	15.8
8.0	.625	1.040	8.4	1.9	3.2	3.6	4.0	17.3
7.0	.660	1.100	8.7	2.0	3.4	3.8	4.2	19.3
6.0	.720	1.200	9.0	2.1	3.5	4.0	4.5	22.0
5.5	.755	1.255	9.5	2.2	3.7	4.2	4.7	23.4
5.0	.800	1.340	10.1	2.3	3.8	4.4	4.9	25.3
4.5	.855	1.425	10.3	2.4	4.1	4.6	5.1	28.8
4.0	.935	1.560	10.5	2.6	4.4	5.0	5.6	33.2
3.5	1.040	1.735	11.3	2.9	4.8	5.4	6.0	38.1
3.0	1.210	2.015	12.4	3.2	5.4	6.1	6.8	46.4
2.5	1.510	2.515	13.9	3.8	6.4	7.2	7.8	61.5
2.0	2.165	3.605	16.5	4.6	7.7	8.7	9.2	98.6
1.5	4.500	7.500	22.0	6.6	10.9	12.4	13.9	210.7
1.0	6.840	11.400	--	--	--	--	--	--

Table 5A-2

Limits for Fully Reflected Units of Heterogeneous Low Enriched Materials

ENR WT% ^{235}U	MASS KG ^{235}U		CYL DIA INCHES	SLAB THICKNESS INCHES				VOLUME LITERS
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
10.0	.530	.885	7.1	1.5	2.5	2.8	3.0	6.0
9.0	.550	.915	7.2	1.6	2.6	3.0	3.1	6.6
8.0	.565	.945	7.3	1.6	2.7	3.1	3.3	7.5
7.0	.595	.995	7.5	1.7	2.9	3.2	3.5	8.5
6.0	.635	1.055	7.8	1.8	3.0	3.4	3.6	10.4
5.5	.660	1.100	7.9	1.8	3.1	3.5	3.7	10.8
5.0	.700	1.165	8.1	1.9	3.2	3.6	3.9	11.7
4.5	.735	1.230	8.3	2.0	3.3	3.7	4.1	13.0
4.0	.785	1.310	8.5	2.1	3.4	3.9	4.3	14.9
3.5	.850	1.415	8.9	2.2	3.6	4.1	4.6	16.8
3.0	.960	1.600	9.3	2.3	3.9	4.4	5.0	20.3
2.5	1.120	1.870	10.0	2.5	4.2	4.8	5.5	24.5
2.0	1.430	2.380	11.3	2.9	4.9	5.5	6.0	32.2
1.5	2.090	3.485	13.8	3.8	6.4	7.2	8.1	52.6
1.0	6.615	11.025	23.1	6.0	10.0	11.4	12.0	203.0

Table 5A-3

Limits for Fully Reflected Units of Homogeneous 100.0 WT% ^{235}U Compounds and Water

MAX. DENSITY (gU/cc)	MASS KG ^{235}U		CYL DIA INCHES	SLAB THICKNESS INCHES				VOLUME LITERS
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
4.0	0.365	0.610	4.7	0.7	1.2	1.3	1.4	4.2
5.8	0.365	0.610	4.5	0.6	1.1	1.2	1.3	3.7
8.0	0.365	0.610	4.3	0.6	1.0	1.1	1.2	3.3

Table 5A-4

Limits for Fully Reflected Units of Uranium Metal at 100.0 WT% ^{235}U for all Values of H/X

MASS KG ^{235}U		CYL DIA INCHES	SLAB THICKNESS INCHES				VOLUME LITERS
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
0.365	0.610	2.5	0.2	0.4	0.4	0.5	0.935

(A) Limit is ≤45% of minimum critical mass – double batching is credible
(B) Limit is ≤75% of minimum critical mass – double batching not credible
(C) Limit is ≤90% of minimum critical cylinder diameter
(D) Limit is ≤45% of minimum critical slab thickness
(E) Limit is ≤75% of minimum critical slab thickness
(F) Limit is ≤85% of minimum critical slab thickness
(G) Limit is ≤90% of minimum critical slab thickness
(H) Limit is ≤75% of minimum critical spherical volume

Table 5A-5

Critical and Safe Concentrations in Aqueous Solutions

ENRICHMENT (Wt% ^{235}U)	CRITICAL CONCENTRATION* (g ^{235}U/liter)	SAFE CONCENTRATION LIMIT (g ^{235}U/liter)
>5%	11.8	5.0
≤5%	14.1	6.1
≤4%	14.6	6.3
≤3%	15.6	6.7
≤2.5%	16.2	7.0
≤2%	17.6	7.6
* Reference: ARH 600, Volume II; Table III.B-2; Figures III.B.10(5)-2, III.B.10(4)-2, III.B.10(3)-2, III.B.10(2.5)-2, and III.B.10(2)-2 at K_∞=0.99.		

Dry ^{235}U Limit:

Safe dry mass = 10 kgs ^{235}U (hydrogen moderated only)
5.25 kgs ^{235}U (hydrogen and carbon moderated)

"Dry" mass limits meet the following criteria:

- $H/^{235}U \leq 4.0$ for uranium compounds at greater than 10% to 100% enriched (hydrogen moderated only).
- $H/^{235}U \leq 10.0$ for uranium compounds at 0.72% to 10% enriched (hydrogen moderated only).
- $H/U \leq 2.0$ and $C/U \leq 900$ for uranium compounds at 93.15% or less enrichment.

^{235}U Area Density Limits:

- 0.19 grams $^{235}U/cm^2$ for uranium compounds at ^{235}U enrichments greater than 5 wt% to 100 wt%.
- 0.25 grams $^{235}U/cm^2$ for uranium compounds at ^{235}U enrichments ≤ 5 wt%.

^{233}U Limit:

Because the form of the materials containing the ^{233}U isotope is restricted to residual contamination from past operations and small quantities for analysis and development studies, the nuclear safety limits are based primarily on the safe wet mass value of 250 grams ^{233}U. However, limits for geometry controls on individual units containing ^{233}U may be established and implemented.

Transuranic Limits:

Plutonium is generally present in small quantities, such as residual radioactivity from prior operations, samples received for laboratory analysis, materials received for development studies, and processing of materials containing trace amounts of plutonium as a contaminant. The maximum subcritical mass limit, as stated in ANSI/ANS-8.1-1998, will be applied for these limited operations.

If, based on analytical results or an engineering evaluation, multiple fissile isotopes are determined to be present at greater than 15 ppm (uranium basis) in scrap material received for storage or processing, the effect of the multiple fissile isotopes on nuclear criticality safety will be evaluated. A ^{235}U fissile gram equivalent (FGE) for each fissile nuclide present in the material will be determined using the maximum subcritical mass limits as stated in ANSI/ANS-8.1-1998 and ANSI/ANS-8.15-1981.

Enrichment Blending System

A system for performing the blending of a high-enriched uranyl nitrate (UN) solution with a natural, depleted, or slightly enriched UN solution to produce a low-enriched UN solution may be operated. The blended product may be discharged into a large geometry vessel. The system will implement at least one (1) in-line measurement of the ^{235}U concentration of the blended solution prior to discharge into the large geometry vessel (e.g., in-line monitor).

Engineering and procedural controls are utilized to prevent the solution in the tank from exceeding the criticality control limit for g^{235}U/liter. The controls meet the double contingency principle.

Limiting conditions are placed on certain parameters for the blending operation. These operational parameters are grams ^{235}U per liter for the high enriched feed solutions and volume of the two (2) feed solutions.

The limiting conditions of operation for the operational parameters are set based on Curve C of Figure 5A-1. Curve C defines the limiting condition of operation for the blend tank. It is derived by taking 85% of Curve B and limited to a maximum of 6% enrichment. Curve B depicts the conditions where $k_{eff} + 2\sigma = 0.95$. For a final enrichment greater than 6%, 85% of the concentration which has a k_∞ value of 0.95 will be applied per Table 5A-6.

UN Tanks

Uranyl nitrate (UN) solutions produced by an NFS process or received in authorized shipments may be transferred into large geometry vessels for storage or final blend adjustments. For any enrichment no greater than 20 wt% ^{235}U, limiting conditions corresponding to 85% of the concentration which has a k_∞ value of 0.95 will be applied. Concentration limits may be found in Table 5A-6.

The only authorized activities involving the UN solutions in these tanks (e.g., sampling, blending, and dilution) will not increase the ^{235}U concentrations above the limits in Table 5A-6.

Figure 5A-1
Curves for Defining Limiting Conditions of Operation for the Enrichment Blend

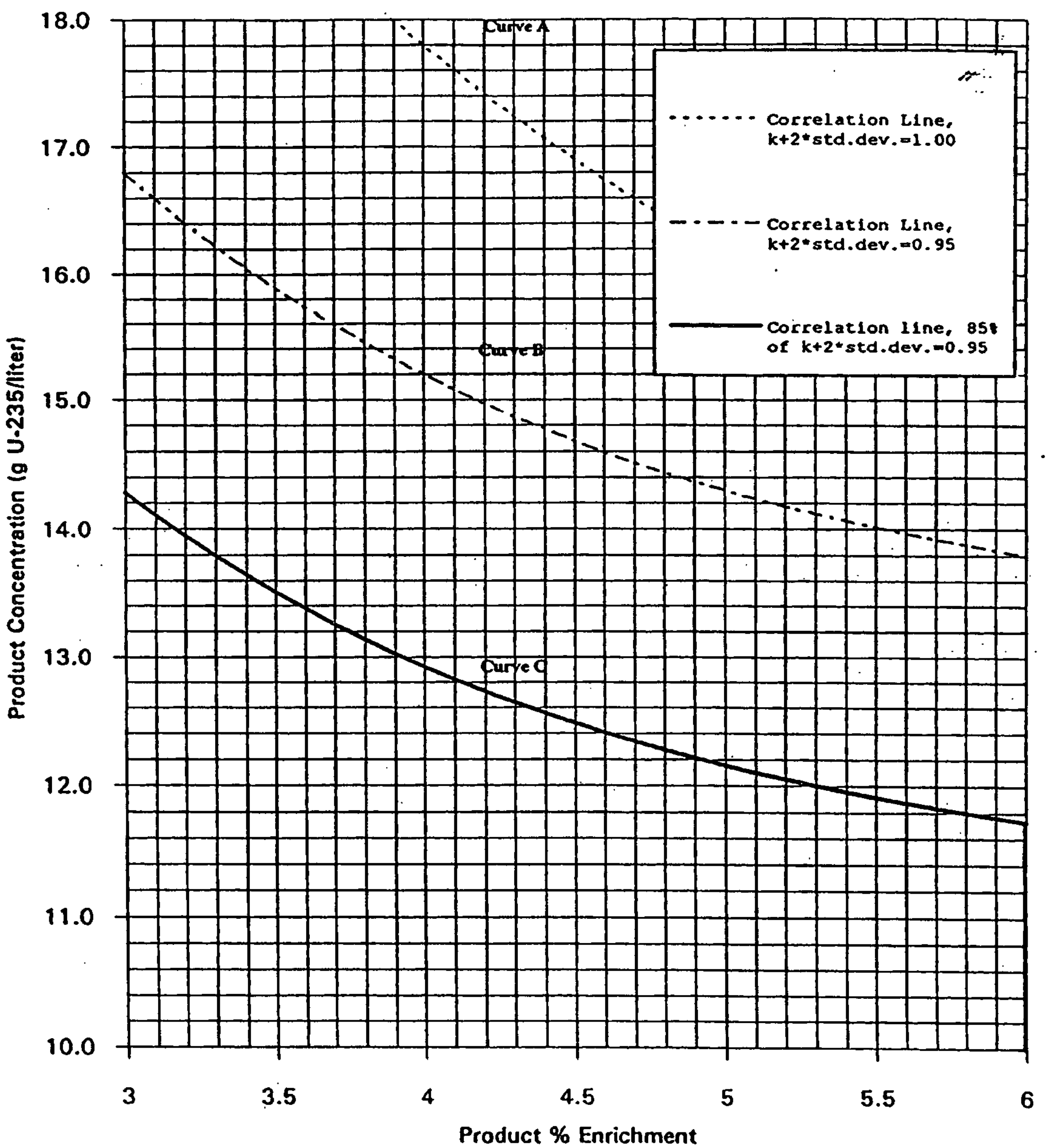


Table 5A-6
Limiting Conditions of Operations for UN Tanks

Enrichment (Wt% ^{235}U)	^{235}U Concentration at k_∞=1.0 (g/l)	^{235}U Concentration at k_∞=0.95 (g/l)	^{235}U Concentration at 85% of k_∞=0.95 Value (g/l)
1.96	There are no restrictions for UN solutions with enrichments ≤1.96 wt% ^{235}U (Reference Table 2, ANSI/ANS-8.1-1998).		
3	19.07	16.20	13.77
4	16.83	14.65	12.45
5	15.76	13.86	11.78
6	15.11	13.37	11.37
7	14.69	13.04	11.08
8	14.37	12.79	10.87
9	14.13	12.61	10.72
10	13.94	12.46	10.59
11	13.78	12.33	10.48
12	13.65	12.23	10.40
13	13.54	12.14	10.32
14	13.45	12.07	10.26
15	13.36	12.00	10.20
16	13.29	11.94	10.15
17	13.23	11.89	10.11
18	13.17	11.84	10.07
19	13.12	11.80	10.03
20	13.07	11.77	10.00

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Attachment 5

SNM-124, Replacement for Pages 10-2 and 10-3, Revision 1

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b. Due to NFS contracts to manufacture items containing radioactive materials, pursuant to the U.S. Department of Energy (USDOE) and Tennessee Valley Authority (TVA) Interagency Agreement, the U.S. Government has agreed to pay expenses incurred in decommissioning of certain NFS equipment and facilities related to the BLEU project. A copy of the relevant clauses from the USDOE/TVA Interagency Agreement which sets forth the U.S. Government assumption of liability for decommissioning NFS' equipment and facilities is included in Appendix 10B.

10.3.2 Surety Method – Letters of Credit

NFS has Letters of Credit and Standby Trust Agreements in place for decommissioning of the following facilities or portions thereof:

- Building 333 (BPF)
- Buildings 510, 520, 530 (BLEU Complex)
- Building 301 (CDL)
- Building 440 (LEU Dilution and Loading Facility)

10.4 Recordkeeping for Decommissioning

In accordance with 10 CFR 70.25(g), NFS will maintain records important to the decommissioning of the facilities on the site until the site is released for unrestricted use.

10.5 Decommissioning Plan (DP)

NFS will decommission plant facilities and grounds in a timely manner and in accordance with applicable NRC regulations and guidance. As part of the Change Control process described in Chapter 11, decommissioning-related activities, including associated procedures, are reviewed against the criteria in 10 CFR 70.38(g)(1) to determine if a decommissioning plan is required. If required, the plan must be submitted to NRC for review and approval prior to starting the activities. Release of a plant area from this license will require NRC review and approval.

Portions of the facility and grounds no longer in use, or in need of decontamination to protect the environment, may be decontaminated on a project-by-project basis prior to the end of plant life at NFS' discretion. The decommissioning-related decontamination is authorized by Chapter 1 of this license and activities may include:

- Dismantlement of contaminated buildings and equipment;
- Pumping and treatment of contaminated groundwater and surface water;
- Washing, spraying, stripping, vacuuming, or otherwise cleaning the surfaces of structures or equipment;
- Scabbling, scaling, or otherwise decontaminating structural and equipment surfaces;
- Characterization efforts; and,
- Source reduction measures, including removal of soil and debris.

The following DP was approved by the NRC and authorizes excavation of contaminated materials (primarily soil, debris, and waste materials) from the North Site:

> North Site Decommissioning Plan, Revision 3, March 2006 (as well as associated addendums, amendments, and revisions).

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Attachment 6

SNM-124, Replacement for Pages 11-6 and 11-18, Revision 1

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The Change Control Process assures that the following items are addressed prior to implementing the change:

1. Description and reason for the change;
2. The technical basis for the change;
3. Identification of all CI and FCI impacted by the proposed change;
4. Modifications to existing operating procedures including any necessary training or retraining before operation;
5. Impact of the change on safety and health, or control of licensed material;
6. Authorization requirements for the change;
7. For temporary changes, the requested duration (e.g., expiration date) of the change;
8. The impacts or modifications to the ISA, ISA Summary, or other safety program information developed in accordance with 10 CFR 70.62; and
9. An evaluation per 10 CFR 70.72 as to whether or not a license amendment must be approved by the NRC prior to implementation of the change.

Requests for proposed changes to CI and FCI are required to be effectively documented, and this is procedurally accomplished by use of formal change requests (CRs). The Change Control Process is applied in a graded manner which categorizes changes as administrative, minor, and major changes. Administrative changes include inconsequential changes to FCI and pre-approved equivalent replacements of CI. Minor changes include initial equivalent replacements of CI, and addition, deletion, and modification of CI in existing process systems where the design requirements, safety bases, and process function(s) are not affected. Major changes include substantial modifications to existing licensed facilities and/or processes, new licensed facilities, or new processes in existing licensed facilities. Any change requiring a license amendment is also considered a major change.

Each CR is reviewed for completeness and accuracy, and a review is conducted to assure it is properly categorized. Non-CM and administrative CRs are approved by the CM function and do not require CCB review. The Engineering discipline manager/designee may approve minor CRs on behalf of the CCB, provided the change does not impact the safety or design bases. All major CRs are reviewed by the CCB.

The CCB may request review by other organizations as required, e.g., Security, QA, Decommissioning, MC&A, etc., depending on the level (minor or major) of change(s) to assure appropriate reviews are obtained. The need for safety reviews, e.g., radiological, nuclear criticality, industrial, fire, and environmental, for a proposed change is determined using a graded approach based on the type of CI(s) involved, associated risks, and type and extent of the proposed change.

11.4.5 Temporary Procedures

Approved temporary procedures (i.e., Letter of Authorization (LOA)) 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; or,

3) Provide assurance of orderly and uniform operations for periods of short duration when the plant, a system, or a component is performing in a manner not covered by existing permanent procedures, or has been modified or extended in such a manner that portions of existing procedures do not apply.

Temporary procedures are controlled, reviewed, and approved as specified by a written procedure and will not change an ISA except as authorized under 10 CFR 70.72. The review and approval process required for temporary procedures is the same as for other procedures, and a timeframe is defined for which the procedure is valid.

11.4.6 Periodic Reviews of Procedures

If an active operating or general safety procedure has not been revised within a three-year period, the procedure will be reviewed to ensure it remains current and relevant. The chairman of the safety review committee may select individual members to perform the review, rather than the entire committee. The selection process is described in Section 2.4. Any general safety procedure meeting this condition will also be reviewed by the appropriate safety function manager(s). Support group procedures are periodically reviewed in accordance with the Audits and Assessments program (see Section 11.5). Emergency procedures are reviewed per the Emergency Plan required in Chapter 8.

The corrective action program includes provisions to assess the role of procedures in adverse conditions or events evaluated within the program. Corrections of procedural deficiencies are tracked to completion within the system.

11.5 Audits and Assessments

NFS has a program for conducting audits and assessments of activities significant to facility safety and environmental protection that identifies responsibility for:

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Attachment 7

RAI 1.1

(Additional Information Discussed at 1/13/2011 Meeting)

(2 pages to follow)

RAI 1.1

(Additional Information Discussed at 1/13/2011 Meeting)

RAI 1.1

The existing license excludes authority to possess uranium in pyrophoric forms. The application removes this restriction. Explain the basis for this change and why the U.S. Nuclear Regulatory Commission (NRC) should find that Nuclear Fuel Services, Inc. (NFS) can handle pyrophoric forms of uranium safely.

This information is required to verify compliance with Title 10 of the Code of Federal Regulations (10 CFR) 70.22 which requires, in part, that each application contain information on the activity for which the special nuclear material (SNM) is requested, the equipment and facilities which will be used to protect health and safety, and the procedures which will be used to protect health and safety.

NFS Response

During the 1992 renewal of SNM-124, NFS was not authorized by NRC to possess uranium in pyrophoric forms because NFS did not propose fire protection requirements for such materials. Since that time, the safety bases for the NFS site have been upgraded to meet the 10 CFR 70, Subpart H, Integrated Safety Analysis (ISA) requirements. Changes to plant operations are evaluated under 10 CFR 70.72 to determine whether or not a license amendment must be approved by NRC prior to implementation of a change. The ISA Program, the Fire Safety Program, and the Configuration Management Program are described in SNM-124, Chapters 3, 7, and 11, respectively.

The ISA includes initiating events for various types of accident scenarios that could result in a fire, including potential fires in glovebox operations where the fire is initiated by a generic ignition source such as transient combustible materials or electrical sources. The ISA also includes the controls necessary to prevent or mitigate the consequences of potential fires.

A glovebox operation is most likely where a fire involving pyrophoric material would occur because this is the first work station where the material would be exposed to air. Upon exposure to air, pyrophoric material could react instantly; however, combustible materials inside gloveboxes are limited to only those materials necessary for processing. Therefore, the material would quickly self extinguish due to lack of available fuel to propagate the fire. Appropriate extinguishing agents are provided inside gloveboxes if deemed necessary due to the material properties. Industry references such as DOE-HDBK-1081-94, "Primer on Spontaneous Heating and Pyrophoricity," would be consulted for other safe handling practices. In addition, if literature cannot be located that defines the fire properties of the material when subjected to chemical processing, lab testing is conducted to establish or confirm the processing plans.

For information, the bounding glovebox fire scenario currently in the ISA analyzes radiological consequences due to uranium oxide (a finely divided metal powder similar in some ways to pyrophoric material) involved in a fire. The resulting radiological consequence to either the worker or the public is Low, and IROFS are not required.

At NFS, adding material into a glovebox is a manual operation performed by an operator physically picking up a container and putting it into the glovebox. Glovebox operations are controlled via Standard Operating Procedure instructions and individual Station Limit Cards that specify the quantity and/or type of materials that are allowed to be added to a given glovebox.

Before processing pyrophoric materials, an evaluation would be conducted to determine whether the processing plans (how much material is planned for each addition to the glovebox) is bounded by current analyses. If the answer is yes (it is bounded), then SOP instructions/Station Limit Cards will specify the glovebox limits with no further controls necessary. If the answer is no (it is not bounded), then design changes and/or additional procedural controls would be required prior to any processing to ensure the performance requirements are maintained.

As described above, NFS has the appropriate experience, and programs are in place to evaluate potential hazards in order to protect health and safety; therefore, NFS should be authorized to possess uranium in pyrophoric forms.