BWXT
Nuclear Fuel Services, Inc.

~~OFFICIAL USE ONLY~~

21G-21-0092
GOV-01-55-04
ACF-21-0153

November 18, 2021

Director
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

References:
1) Docket No. 70-143; SNM License 124
2) Pre-Application NRC Presentation, April 8, 2021
3) Letter from NFS to NRC, Proposed Uranium Conversion and Purification Services, Transmittal of Performance Work Statement, dated May 25, 2021 (21G-21-0089)
4) Pre-submittal Meetings, September 13/14, 2021
5) Letter from NFS to NRC, License Amendment Request for U-Metal at the NFS Site – UCNI Document Submittal, dated November 18, 2021 (21G-21-0187)

Subject: License Amendment Request for U-Metal at the NFS Site

Dear Sir:

BWXT Nuclear Fuel Services, Inc. (NFS) hereby requests an amendment to the referenced license to authorize Uranium Purification and Conversion Services (U-Metal Project) at the NFS Site pursuant to contract 89233121CNA000175 with the U.S. Department of Energy's National Nuclear Security Administration (NNSA) (Reference 3).

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1. Background and Submittal Scope

NNSA awarded the U-Metal Project contract to bridge the gap between Y-12 legacy uranium processing equipment shutdown and a new facility startup utilizing electrorefining technology to purify high enriched uranium (HEU) metal. NNSA

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contracted NFS to design and license a process for uranium purification and conversion to uranium metal that not only provides the oxide conversion, but hedges against the risk associated with the new electrorefining technology.

NFS is submitting this License Amendment Request (LAR) due to the new types of accident scenarios introduced by the addition of the U-Metal Project to existing NFS licensed activities. Reference Section 4 for additional discussion on the regulatory basis for change.

The LAR submittal includes the following documents (markups or in whole) as Attachment 1 through Attachment 5:

a) ATTACHMENT 1: SNM-124, Chapter 1

Materials License SNM-124, Chapter 1, *General Information*, updates the general process description to account for U-Metal operations; additionally, the update includes a few other minor corrections. For convenience, the mark-up copy denotes affected license page changes with blue underlined lettering for insertions and red strikethrough for deletions.

b) ATTACHMENT 2: Integrated Safety Analysis (ISA) Summary

The Integrated Safety Analysis (ISA) Summary addresses the U-Metal project scope and its specific safety related impacts, along with applicable, updated portions of the Site ISA Summary. The Site ISA Summary is not submitted in whole as the facility description, described ISA methodologies, and other portions that are applicable to the NFS site processes, as a whole, have not changed and apply to the U-Metal process the same as any other process at NFS.

The U-Metal ISA Summary identifies, when applicable, deviations from the Site ISA Summary. **This document will be submitted under separate cover as it is classified as Unclassified Controlled Nuclear Information (Reference 5).** A redacted Official Use Only version of the U-Metal ISA Summary will be submitted under separate cover when it is available.

c) ATTACHMENT 3: Emergency Plan

The Emergency Plan includes applicable, updated portions that address two (2) new emergency scenarios related to the release of anhydrous hydrogen fluoride (AHF) and anhydrous ammonia, proposed modifications to the Protective Action Recommendations (PARs) related to chemical toxicity and various other related changes, such as updates to process descriptions and accident mitigations.

d) ATTACHMENT 4: Supplemental Environmental Report

NFS prepared an Environmental Report (ER) for the 2009 license renewal application. In order to provide information for an NRC Environmental Assessment for this proposed licensing action, a Supplemental ER was prepared that evaluates the environmental impacts associated with the addition of the U-Metal Project and documents changes to key information between 2009 and this submittal.

e) ATTACHMENT 5: Decommissioning Cost Estimate

The decommissioning cost estimate for the U-Metal process, including the addition of the Utilities Building external to the MAA is included as Attachment 5.

2. Proposed Change

The majority of the operations comprised within the U-Metal Project are processes NFS has extensive experience with and create no new hazards that would require NRC prior approval. These processes may be referenced within LAR supporting documents or the applicable ISA Summary; however, these processes are not within the submittal scope.

The U-Metal Project has been broken into the following process nodes for design and safety analysis development:

Node 1: Uranyl Nitrate Solution Storage
Node 2: UO_4 & UO_3 Preparation Process
Node 3: Oxide Reduction and Hydrofluorination Process
Node 4: Reduction Vessel Preparation
Node 5: Calcium Metal Reduction Process
Node 6: Knockout and Packaging
Node 7: Waste/Slag Processing and Recovery
Node 8: Reserved for Future
Node 9: Utilities

The nodes were established based on clean break points between system processes; however, the relationships between the nodes and potential accident scenarios that could cross node boundaries or affect a process in a different node was recognized and evaluated within the process hazard analysis.

The U-Metal Project ISA Summary focuses on the processes with new accident sequences and IROFS introduced by the design of Node 3, Oxide Reduction and Hydrofluorination, Node 4, Reduction Vessel Preparation, and Node 5, Calcium Metal Reduction. The U-Metal ISA Summary, submitted under separate letter (Reference 5), provides a more detailed process description for each node.

3. Technical Overview

The process hazards evaluation indicates radiological impacts to the worker, public, and the environment are well within regulatory limits and performance requirements of 10 CFR 70.61. The proposed change represents a process currently performed at the Y-12 facility, with integrated process improvements focused on improved safety to the worker, public, and environment. For example, the Y-12 process utilizes a fluidized bed for the fluorination of UO_2 which is a large continuous process that uses excessive amounts of AHF. The proposed licensing action for NFS breaks the conversion processes down to batch operations to support the smaller, lab scale production of uranium metal. Additionally, design considerations have been made, incorporating MC&A measurement points and inventory, operability, and maintenance activities, as examples.

The Items Relied On For Safety (IROFS), identified for each Intermediate and High Consequence event, are further defined in Boundary Definition Documents (BDDs) that outlines failure modes, human factors applications, applicability and detailed safety function.

4. Regulatory Evaluation

The U-Metal process was evaluated against the 10 CFR 70.72(c) Facility Change and Change Process criteria to evaluate the proposed change and identify portions therein that may require prior NRC review and approval. Two of the criteria were identified that related to portions of three process nodes (Node 3, 4, & 5):

> (c)(1)(i) Create new types of accident sequences that, unless mitigated or prevented, would exceed the performance requirements of 10 CFR 70.61 and that have not previously been described in the ISA Summary.
>
> (c)(1)(ii) Use new processes, technologies, or control systems for which the licensee has no prior experience.

The Emergency Plan was included in the scope of this submittal to address proposed changes, however the updates to the Emergency Plan were not identified as a decrease in effectiveness as described in 10 CFR 70.32(i).

As a portion of the process was identified as a new type of process, the Baseline Design Criteria (BDC) identified in 10 CFR 70.64 applies. A significant portion, if not all, of the BDC is already addressed in the current framework of NFS and its implementation of facility design. Defense-in-depth practices for the facility and system design and layout have a preference for engineered controls over administrative controls and focuses on engineering features that reduce the potential for challenges to IROFS. This defense-in-depth design philosophy is applied from the outset and through completion of the design, that is based on successive levels of protection such that

health and safety will not be wholly dependent upon any single element of the design, construction, maintenance, or operation of the facility.

Not included in this submittal are minor changes to NFS' Security and Materials Control & Accountability Programs as the updates do not represent a substantive change that are needed for license amendment completeness. Additionally, NRC prior approval was determined to be not required per 10 CFR 70.32 as the updates do not represent a decrease in effectiveness. Subject to amendment of the NFS License, these minor program changes will be made and related documents submitted to the NRC in a timely manner coincident with the licensed activities of the U-Metal Project.

No changes were identified for the specific conditions listed in SNM-124 associated with the U-Metal process. Additionally, all the license chapters were reviewed and with the exception of Chapter 1 were found to not require modification to account for U-Metal operations.

The NFS Safety Safeguards and Review Council (SSRC) has reviewed and approved the proposed changes.

5. Environmental Considerations

In support of this LAR, NFS is providing a Supplemental Environmental Report (ER) (Attachment 4), which, in addition to addressing changes associated with the anticipated U-Metal Project, includes updates for NFS as a whole that have occurred since the 2009 ER. The Supplemental ER concludes that the potential environmental impacts associated with the addition of the U-Metal process are small, and outweighed by the socioeconomic benefits associated with the continued plant activities.

6. Conclusions

This license amendment request proposes changes to SNM-124, which would authorize NFS to conduct uranium purification and conversion services per the established safety basis. The safety analyses presented herein, as supported by the Supplemental ER and the technical supporting documents, confirm that the production of uranium metal will be implemented in a safe and acceptable manner in that radiological impacts to the worker, public and environment are well within regulatory limits and performance requirements of 10 CFR 70.61.

Amendment of NFS license to conduct the U-Metal Project supports the NNSA's nuclear material management strategy.

Information contained herein in Attachments 2 and 3 contains sensitive information, is marked as "Official Use Only," and is not suitable for public release. Information contained in Attachment 5 is considered proprietary information, as set forth in the enclosed affidavit; therefore, NFS requests that this information be withheld from public disclosure. A redacted version of this

submittal suitable for public disclosure will be provided under a separate cover letter, if requested.

If you or your staff have any questions, require additional information, or wish to discuss this, please contact me, or Danielle Rogers, Nuclear Safety and Licensing Section Manager, at (423) 735-5475. Please reference our unique document identification number (21G-21-0092) in any correspondence concerning this letter.

Sincerely,

NUCLEAR FUEL SERVICES, INC.

Tim Knowles, Director
Safety and Safeguards

TCH/smd
Attachments

copy:

Mr. James Downs
Senior Project Manager
Division of Fuel Management
Office of Nuclear Material Safety and Safeguards
US Nuclear Regulatory Commission
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Rockville, MD 20852-2738

Regional Administrator
U. S. Nuclear Regulatory Commission
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245 Peachtree Center Ave., NE
Suite 1200
Atlanta, GA 30303-1257

Mr. Larry Harris
U.S. Nuclear Regulatory Commission
Senior Resident Inspector

AFFIDAVIT

TRADE SECRETS OR COMMERCIAL INFORMATION

I, Tim Knowles, Director of Safety & Safeguards at Nuclear Fuel Services, Inc. (NFS), that to the best of my knowledge and beliefs, make the following representation contained herein:

A. The following document(s) which Nuclear Fuel Services, Inc. (NFS) wishes to have withheld from public disclosure is:

Attachment 2 "NFS Site Integrated Safety Analysis Summary"

Attachment 3 "Emergency Plan (Record of Revision, Chapters 1, 2 and 5)

Attachment 4 "Supplemental Environmental Report for the Amendment of Special Nuclear Material License No. SNM-124, Revision 0"

Attachment 5 "Decommissioning Cost Estimate"
to Letter
(21G-21-0092) dated November 18, 2021:
License Amendment Request for U-Metal at the NFS Site

B. The information contained in the document(s) cited in A above has been held in confidence by Nuclear Fuel Services, Inc. (NFS), in that it contains trade secrets or commercial information as specified in Title 10, Code of Federal Regulations, Part 2.390(a). The basis for requesting that this document(s) be withheld from public disclosure is explicitly marked on the cover page to each of the aforementioned documents and/or the top of each affected page, as appropriate, in accordance with 10 CFR 2.390(b)(i)(B).

C. The information contained in the document(s) cited in A above is the intellectual property of Nuclear Fuel Services, Inc. (NFS), and as such is customarily held in confidence by Nuclear Fuel Services, Inc. (NFS). As such, Nuclear Fuel Services, Inc. (NFS) has customarily submitted privileged and confidential information of this type to the Nuclear Regulatory Commission (NRC) and to its predecessor, the Atomic Energy Commission (AEC), in confidence.

D. The information contained in the document(s) cited in A above has not been made available to public sources by Nuclear Fuel Services, Inc. (NFS), nor has Nuclear Fuel Services, Inc. (NFS) authorized that it be made available. In accordance with Nuclear Fuel Services, Inc. (NFS) policies governing the protection and control of information, proprietary information contained herein has been made available, on a limited basis, to others outside NFS only as

required and under suitable agreement providing for nondisclosure and limited use of the information.

E. The public disclosure of the information contained in the document(s) cited in A above is likely to cause substantial economic harm to the competitive advantage held by Nuclear Fuel Services, Inc. (NFS). The basis for withholding said information is that it contains distinguishing aspects of a process, methodology, or component(s), the exclusive use of which provides a competitive advantage for NFS in product optimization or marketability.

F. The proprietary information that Nuclear Fuel Services, Inc. (NFS) requests to be withheld from public disclosure is contained in the entire document(s) as so marked.

Tim Knowles 11/18/2021

Tim Knowles Date
Director, Safety & Safeguards
Nuclear Fuel Services, Inc.

I certify the above named person appeared before me and executed this document on this the 18 day of November 2021.

SUSAN M. DOMAN
NOTARY PUBLIC
STATE OF TENNESSEE
COFFEE COUNTY

Susan Marie Doman
State of Tennessee Notary Public

My commission expires: February 27, 2024

NFS to Dir., NMSS

21G-21-0092
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ATTACHMENT 1

SNM-124, Chapter 1, General Information

(26 Pages)

SPECIAL NUCLEAR MATERIAL LICENSE
SNM-124
CHAPTER 1

GENERAL INFORMATION
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SPECIAL NUCLEAR MATERIAL LICENSE
SNM-124
CHAPTER 1

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 TownCity of Erwin. The Protected Area of approximately 18 acres is located within approximately 8270 acres of NFS-owned land, the remainder of which is either devoted to vehicle parking areas, warehouse, training or office buildings, or 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. 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
(Buildingldgs. 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.

Figure 1-1: Plant Layout and Property Boundaries

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

~~Blended Low~~ Enriched Uranium ~~(BLEU) Production~~ Recovery and Purification Facilities

~~1. 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.~~

~~2.~~1. **Blended Low Enriched Uranium (BLEU) Preparation Facility (BPF) (Building~~Bldg~~. 333)**
Conversion and purification of impure HEU materials to ~~pure~~ HE uranyl nitrate solution, preparation of blendstock (natural~~N~~ uranyl nitrate solution), subsequent mixture of the purified HE uranyl nitrate and blendstock solution to form a low enriched ~~LE~~ uranyl nitrate solution (product), and uranium recovery operations.

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

3. Enriched Uranium Purification and Conversion (Building 301)

~~3.~~ Conversion of purified HE uranyl nitrate through various process steps to produce uranium metal and oxides, as well as recovery of process scrap/slag.

Laboratories

1. Building 220 – analytical laboratory.
2. Building 100 – NDA laboratory.
3. Research and Development (R&D) Laboratory~~ies~~ (Building~~s 105,~~ 110B)~~, & 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 110D, 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 234B, 250, 300, 310, 311, southeast portion of 304, south and east sections of 306, 135, 136, 133, and 132. 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, 300B, 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; and an inspection, testing, and quality assurance area.

Medical Facility (Building 350)

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 a respirator fit-test facility.

Buildings 111 and 131

~~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.~~ Facilities undergoing decontamination and decommissioning.

Administration Buildings

Buildings 105, 130 (east annex), 120 (north end), 260, 305, 320, and 345 house offices and computer facilities.

Plant Utilities (Building~~Idg.~~ 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.

Utility Services Building (Building 389)

Key utility subsystems that support the processes for purification and conversion of uranium in Building 301 (e.g. process off-gas and scrubber system, gaseous utility feed system (s), waste discard tanks, etc.) This building is planned for installation inside the NFS footprint, west of Building 301.

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)~~ conversion and purification of HE uranium materials into various forms meeting customer specifications (e.g. HE metal/oxides, downblended low enriched uranium, etc.).

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)~~ Recovery and Purification ~~Production~~ Facilities

Uranyl nitrate solution is produced at the BPF ~~by~~ for either purification and conversion to oxide, metal, or downblending ~~HEU~~ to LEU. The HEU consists of, but is not limited to, feed materials such as uranium oxide, uranium-metal buttons, uranium bearing residues, uranium alloys ~~aluminum ingots~~, reactor elements, and UF_{4}~~$_6$~~. Incoming uranium feed materials to ~~CDL or~~ BPF may be converted into uranium oxide or processed as received for subsequent dissolution and purification into uranyl nitrate solution.

Downblending of the purified UN solution~~The HEU solutions are processed in CDL or BPF and downblended~~ occurs with natural uranium in the BPF. The LE uranyl nitrate solution is transferred to the LEU Dilution and Loading Facility (Building~~Bldg.~~ 440) and ~~or~~ loaded directly into a shipping package at the BPF after verification that the solution meets the product specifications. Uranyl nitrate solution transferred to Building~~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.

Conversion to metal occurs in Building 301. HE uranyl nitrate is transferred from the BPF to Building 301 after purification, where it undergoes conversion to produce uranium metal or oxides ready for processing and shipment. Product that does not meet customer specifications is returned to the BPF or Building 301 uranium recovery area for further processing.

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 alloys in various forms ~~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, uranium metal 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, including the site NPDES permit.

Plant sanitary wastes are discharged through piping which goes to the Town ~~City~~ of Erwin publicly owned treatment works (POTW). The inputs for the sanitary sewer system from the NFS site include bathrooms and showers.

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 TownCity 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 BWXT 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).

5. Uranium Purification and Conversion
   ~~4.~~ Purification of enriched uranium in various forms and subsequent conversion into various forms to include uranium metal and oxides.

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

The period of License No. SNM-124 is twenty-five (25) years with an expiration date of August 31, 2037.

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 a Restricted Area 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.

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.
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.

Term	Definition
Equivalent Experience	For the purpose of meeting educational requirements described throughout the license, 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 security barrier and outer 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.

Term	Definition
Conditions Adverse to Safety	As used in Sections 2.2, 2.5.1, and 11.6, events that could have the potential to impact the safety of licensed activities, including equipment failures, malfunctions, or deficiencies; procedure problems, errors, or omissions; improper installations; non-conformances with regulatory requirements or commitments; quality-related issues; or a significant condition, such that if uncorrected, could have a serious effect on safety.

1.3 Site Description

1.3.1 Site Geography

The NFS site is located at 1205 Banner Hill Road, inside the ~~city limits~~Town of Erwin, in Unicoi County, Tennessee. The Protected Area of approximately 18 acres lies within approximately ~~70~~82 acres of land owned by NFS. The property is situated at approximately latitude 36°07'47"N and longitude 82°25'57"W.

The main facility is bounded on the north by Martin Creek; on the south by residential properties; on the east by Carolina Avenue~~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. The ~~city~~Town of Erwin, the seat of Unicoi County, has a population of approximately ~~6,100~~5,918 people, and the population of Unicoi County is approximately 17,700 people. Approximately 2,~~800~~754 people live within one (1) mile of the NFS site.

Erwin Health Care Center, a nursing home, is the only public facility within one (1) mile of the NFS site. Four other schools, Love Chapel Elementary School, Unicoi County Intermediate School, 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 is approximately 1.2 miles southwest of the NFS Site. Nursing homes 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 Erwin Resin Solutions, Inc., a low-level radioactive waste processing facility, are 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 near 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 for the 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 total annual rainfall in the Erwin area is ~~37.3~~47 inches, and the average total annual snowfall is ~~25~~9.3 inches. The average annual temperature is 55.4°F, with a monthly average minimum temperature in January of ~~25~~35.5°F and a monthly average maximum temperature in July of ~~87~~74°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. According to National Oceanic and Atmospheric Administration (NOAA) data since 1950 for Unicoi County, the maximum high wind recorded was 69 miles per hour.

There have been 2 tornadoes recorded in Unicoi County since 1950 which occurred in 1980 and 2011. 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.~~

The NFS site is not within the 100-year floodplain of the Nolichucky River. Development and related activities over the last 30 years have changed the topography in such a way to preclude the NFS site from being within the 100-year floodplain for the river. For example, the construction of US Routes 19/23, and the re-channeling/increase in depth of the river, which accompanied the highway construction combined with the re-routing of Martin Creek to enter the

Nolichucky River downstream of the NFS Site, have had the indirect effect of protecting the NFS site from a 100-year flood of the Nolichucky River. A significant flood of the Nolichucky River (92% of greatest recorded flow) which occurred in 1977 did not result in the flooding of any buildings on the NFS site.

Currently, the northern portion of the NFS site is depicted as being within the 100-year floodplain of Martin Creek (which flows adjacent to the northern boundary) on 2008 National Flood Insurance Maps issued by the Federal Emergency Management Agency (FEMA). Martin Creek passes through a culvert at the CSX Railroad to the north of the NFS site. In the past, the size of this culvert was inadequate during high flow floods, causing a backwater or damming effect to the northern portion of the NFS site nearest the culvert. In 1990, the culvert was enlarged to accommodate expansion of the railroad. Additionally, grading has been performed on the north site since 1979 which is the year the survey was performed to develop the effective Base Flood Evaluation (BFE). Finally, newer more accurate field survey and LIDAR data was used to perform the 2021 ARCADIS floodplain analysis. This analysis shows the 100-year BFE immediately upstream of the railroad is 3.38 feet higher than the effective BFE at this location and is 3.03 feet lower than the effective BFE approximately 1,500 feet upstream of the railroad near Spar Mill Rd. The effective Flood Insurance Rate Map 47171C0068C depicts NFS within the 100-year floodplain of Martin Creek (FEMA 2008). The ARCADIS 2021 Floodplain study shows that the NFS Protected Area is completely outside of the 100-year floodplain and much of the northern portion of the NFS property is outside of the 100-year floodplain. A portion of the north site, 600 feet off Martin Creek along the railroad, and a small section along the Protected Area wall is within the 100-year floodplain based on 2021 ARCADIS floodplain analysis.

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. **BWX Technologies, Inc.** is a corporation that owns 100% of the stock of BWXT Investment Company.

2. **BWXT Investment Company** is a corporation that owns 100% of the stock of BWXT Government Group, Inc.

3. **BWXT Government Group, Inc.**, is a corporation that owns 100% of the stock of BWXT Nuclear Operations Group, Inc.

4. **BWXT Nuclear Operations Group, Inc.**, is a corporation that owns 100% of the stock of NOG-Erwin Holdings, Inc.

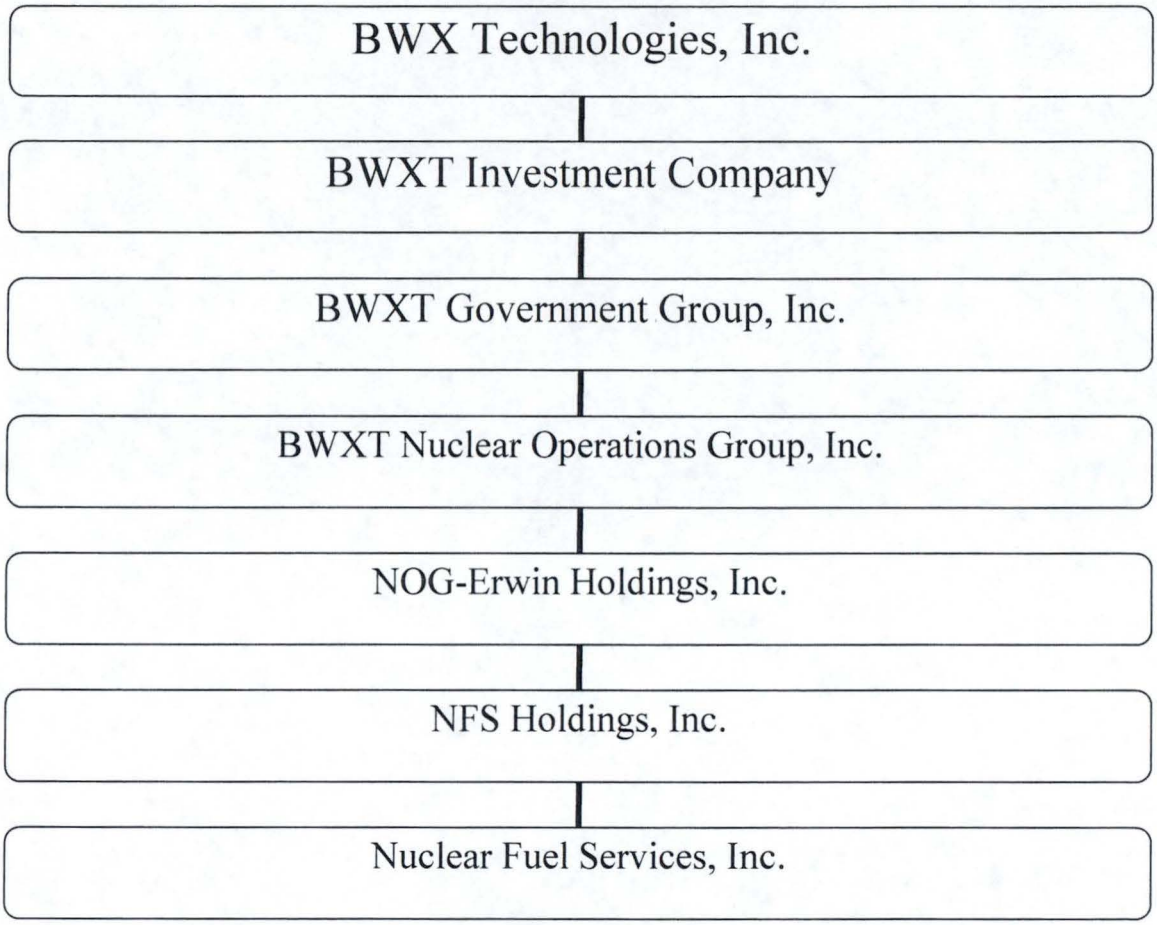
5. **NOG-Erwin Holdings, Inc.**, is a corporation which owns 100% of the stock of NFS Holdings, Inc.

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

7. **Nuclear Fuel Services, Inc. (NFS)**, is a manufacturer and processor of specialty nuclear fuels which is also engaged in decontamination, decommissioning, and remediation services. These services are performed at NFS' Erwin, Tennessee, location.

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-aAmmonium 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) and alloys	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	$UO_4 2H_2O$
Uranium trioxide	UO_3
Ttriu~~U~~ranium octoxide	U_3O_8
Uranium sulfate	$U(SO_4)_2 4H_2O$
Uranium sulfate	$U(SO_4)_2 8H_2O$
Uranium sulfate	$U(SO_4)_2 9H_2O$
Uranium disulfide	US_2
Uranium monosulfide	US
Uranium sesquisulfide	U_2S_3
Uranyl acetate	$UO_2(C_2H_3O_2)_2 2H_2O$
Uranyl benzoate	$UO_2(C_7H_5O_2)_2$
Uranyl bromide	UO_2Br_2
Uranyl carbonate	UO_2CO_3
Uranyl perchlorate	$UO_2(ClO_4)_2 6H_2O$
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	$UO_2(NO_3)_2 6H_2O$
Uranyl nitrate	$UO_2(NO_3)_2$
Uranyl nitrate hydrate	$UO_2(NO_3)_2 XH_2O$, where X is less than 6
Uranyl oxalate	$UO_2(C_2O_4)_2 3H_2O$
Uranyl mono-H phosphate	$UO_2HPO_4 4H_2O$
Uranyl potassium carbonate	$UO_2CO_3 2K_2CO_3$
Uranyl sodium carbonate	$UO_2CO_3 2Na_2CO_3$
Uranyl sulfate	$UO_2SO_4 3H_2O$
Uranyl sulfate	$2(UO_2SO_4) 7H_2O$
Uranyl sulfide	UO_2S
Uranyl sulfite	$UO_2SO_3 4H_2O$