PROPRIETARY INFORMATION TRADE SECRETS OR COMMERCIAL INFORMATION

Attachment 2

Decommissioning Funding Plan

(15 pages to follow)

Decommissioning Funding Plan

Nuclear Fuel Services, Inc.

RECORD OF REVISION

Reference	Description and Reason for Change		
Facility	Updated the date of the Decommissioning Cost Estimate.		
Description			
Estimate Procedure	Updated this section to include the breakdown of support function labor category factors and of total labor hour allocation to each project phase to incorporate NFS Response to RAI 1 (21G-16-0091, dated May 31, 2016, "Response to NRC Request for Additional Information (RAI) Concerning Updated Decommissioning Funding Plan"). There is no change in methodology from the previous estimate.		
Estimate Key Assumptions	Updated this section to include non-waste material inventory discussion to incorporate NFS Response to RAI 5 (21G-16-0158, dated August 30, 2016, "Revised Responses to NRC Request for Additional Information (RAI) Concerning Updated Decommissioning Funding Plan"). There is no change in methodology from the previous estimate. Updated this section to include a discussion of contract services costs to incorporate NFS Response to RAI 2 (21G-16-0091, dated May 31, 2016, "Response to NRC Request for Additional Information (RAI) Concerning Updated Decommissioning Funding Plan"). Updated this section to include a discussion of miscellaneous costs to incorporate NFS Response to RAI 4 (21G-16-0158, dated August 30, 2016, "Revised Responses to NRC Request for Additional Information (RAI) Concerning Updated Decommissioning Funding Plan"). There is no change in methodology from the previous estimate.		
Adjusting the Cost Estimate	Updated this section to include the consideration of the effects of the eight events on decommissioning costs.		
Adjusting the Funding Level for Financial Assurance	Updated the estimate dollar values and the form of financial assurance.		
Total Decommissioning Cost Estimate	Updated the total estimated cost of decommissioning.		
Throughout	Removed the decommissioning cost associated with the former BLEU Facility (NRC letter dated November 8, 2018, "Confirmation of Final Status Survey Report for Former BLEU Facility"). Made grammatical and minor modifications.		
Table 1	Updated Table 1 to current cost estimates and methods of financial assurance.		
Figure 1	Updated facility map to reflect the current plant site.		

Facility Description:

The Nuclear Fuel Services, Inc. (NFS) site is located in Erwin, Tennessee. The U.S. Nuclear Regulatory Commission (NRC) materials license number is SNM-124 (Docket Number 70-143). The specific quantities and types of licensed materials authorized for use at NFS can be found in SNM-124, Chapter 1, Section 1.2.3, "Type, Quantity, and Form of Licensed Material," and the Sensitive Information Addendum. A general discussion of how licensed materials are used at NFS can be found in SNM-124, Chapter 1, Section 1.1, "Facility and Process Information," and Section 1.2.4, "Authorized Uses."

The facility buildings and grounds are shown in Figure 1, the facility map titled "Decommissioning Responsibility." The facility components that require decontamination; the estimate of the volume of contaminated material, including that in the subsurface, containing residual radioactivity that will require remediation to meet the criteria for license termination; and quantities of materials or waste for disposal can be found in the estimate sheets in the Appendix, "Decommissioning Cost Estimate, November 30, 2018."

Oualification:

The decontamination and decommissioning (D&D) cost estimate is based on the experience of the NFS technical personnel preparing the estimate and historical data obtained from past and current D&D projects at NFS. The cost estimates were prepared by the NFS Engineering and Decommissioning Departments, which have developed numerous other decommissioning financial assurance cost estimates over the last 23 years. These estimates have been prepared for business ventures such as:

- Converting Rocky Flats Uranyl Nitrate (UN) to oxide
- Removing heels from UF₆ cylinders and converting to UN
- Converting U/Al alloy to UN
- Downblending UN
- Blending presscake
- Blending U/Al
- The BLEU Project (Uranyl Nitrate Building, BLEU Preparation Facility, Oxide Conversion and Effluent Processing Buildings)
- Commercial Development Line

NFS has also completed other D&D activities amounting to more than \$500 million dollars, under a Department of Energy (DOE) contract, including removal of process equipment from old process lines in Buildings 302/303, 301, 130, and 111. NFS has

completed equipment removal and building decommissioning of Buildings 234, 330, 400, 410, and 200 Complex, and exterior D&D projects including the former BLEU Facility, excavation of the Radiological Burial Ground, and remediation of three surface impoundments and surrounding North Site Area. NFS routinely generates and submits to its customer (DOE) cost estimates based on the actual and estimated cost of these projects.

These historical decommissioning projects are a valuable reference for cost information and experience since these facilities were of similar construction to other NFS facilities slated for decommissioning and had similar internal equipment such as uranium contaminated gloveboxes, furnaces, and piping. These buildings included sheet metal clad buildings, cement masonry unit buildings, and reinforced concrete vaults, all of which are similar to facilities which are slated for future demolition. Many of the previously demolished buildings at NFS were built within the same time period as buildings slated for future demolition. Processes used to disassemble these facilities are expected to be similar to those projected in these estimates (especially projects like the former BLEU Facility decommissioning, Building 301 equipment removal, and Building 234 and 200 Complex facility demolition which were performed by contractors instead of NFS hourly personnel). The management and regulatory requirements for these projects are expected to be similar as well, as it was all done under the NFS license. The excavation of contaminated soils at the North Site and Radiological Burial Ground is also comparable to excavation of contaminated soils within the NFS plant due to similar soil types, contamination levels, and site conditions.

Estimate Process Summary:

The initial steps in the estimate are to determine expected waste volume associated with decontamination, disassembly, sectioning, and packaging of a contaminated facility and equipment for final disposal. The volumes of waste that would be shipped to a disposal facility are then used to estimate the number of operator hours required for the project based on actual factors collected from past projects. The waste volumes and operator hours are then used in factors to estimate work hours for support functions such as supervision, engineering, health physicists, radiation technicians, maintenance, and other groups along with material costs and special services. Rates and overhead charges (direct and indirect) are then applied to the estimated work hours based upon previous project quotations and inflated to present day dollars or current contract rates to generate a total cost estimate that reflects use of an independent contractor.

Estimate Scope:

The estimate scope assumes that NFS facilities which have been involved in licensed activities and are known or suspected to have radiological contamination will be dismantled, where possible decontaminated, packaged, and shipped for disposal to meet the criteria for unrestricted use in 10 CFR 20.1402. The remaining site will be left intact, and buildings and office trailers will be abandoned in place. No consideration is made in this estimate for decontamination or cleanup of any known or suspected chemical contamination (non-radiological) of any of the buildings or grounds. Such activities are regulated by the EPA/State of Tennessee. Within the Erwin Facility there are areas where the D&D liability is covered under contract with the Navy Nuclear Propulsion program, designated as DOE, and areas where the D&D liability is the responsibility of NFS from its commercial activities, designated as NFS. The costs for these two activities are estimated separately and then totaled into one complete number. Figure 1, "Decommissioning Responsibility," indicates which areas fall into each responsibility category.

The estimate is considered a Class 4 estimate as defined by the Association for the Advancement of Cost Engineering, Recommended Practice No. 18R-97, "Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries."

Estimate Procedure:

The procedure used in developing the waste volumes involves obtaining information such as floor plans, equipment lists, piping and instrumentation drawings (P&IDs), materials of construction, and if applicable, inspection of installed systems and structures. The engineer, through discussions with project members, reviews process utilities, site utilities, equipment sizes, and other data as necessary to estimate systems, piping runs, possible process contamination, and the potential for decontamination, if feasible. Disposal volume is estimated based on the size of the equipment, potential for sectioning, and potential for void filling with other smaller items. Estimates are made individually for each building in the project scope. Where available a detailed equipment listing is used for the estimate basis. Otherwise overall volume is estimated from P&IDs and/or inspections. D&D operator man hours are then estimated for each identified task or equipment system based on historical data by applying a difficulty factor to the tasks.

Five difficulty factors are used in the estimate (0 to 4) in order to provide reasonable guidelines to standardize the estimate process. The man hours/ft3 of waste volume is shown in the table below:

Operator Hours per ft³ Factor	Operator Hours	
Difficulty Factor 0	0.1	
Difficulty Factor 1	0.25	
Difficulty Factor 2	0.75	
Difficulty Factor 3	1.5	
Difficulty Factor 4	3	

The assignment of the difficulty factor for each line item requires the judgment of the estimating engineer. Criteria such as: clean vs. contaminated disposal; disassembly or sectioning required vs. whole unit disposal; expected use of hand tools vs. power tools and use of mechanical equipment such as excavators, back-hoes, or loaders; are used to assign the difficulty factors. The difficulty factors are determined based on site specific conditions such as accessibility, radiation control measures, effort involved in sectioning, personal protective equipment (PPE) required, etc. A study of past experience with D&D projects on the plant site was used to define the operator hours for each factor. The difficulty factors are directly applied to the operator hours. Because the other labor categories, as well as supplies and equipment, are calculated based on a percentage of operator hours, the difficulty factors are applied indirectly to these categories.

General guidelines for the difficulty factors assignment are as follows:

Operator Hours per ft ³ Factor	Usage		
Difficulty Factor 0	Used for clean equipment with no disassembly. Used for clean or contaminated waste removed with automated equipment such as soil removal with an excavator.		
Difficulty Factor 1	Used for clean equipment with disassembly. Used for contaminated items with no disassembly.		
Difficulty Factor 2	Used for contaminated waste with minimal disassembly and low use of PPE.		

Operator Hours per ft ³ Factor	Usage
Difficulty Factor 3	Used for contaminated waste with disassembly and/or sectioning. Also used where equipment density is high restricting number of workers present. Used where PPE usage is high.
Difficulty Factor 4	Primarily used for contaminated waste where PPE usage is high (such as Pu contaminated areas where full body pressurized suits would be required).

The total work hours are then allocated to each of the five phases of the D&D project (Planning, Decontamination and Dismantling, Restoration of Contaminated Areas, Final Radiation Survey, and Site Stabilization and Long-Term Surveillance) based on historical factors. Support functions consisting of project managers, engineering, health physicists, operation specialists, environmental specialists, supervision, maintenance, NDA specialist, and radiation technicians are determined by historical factors based on a review of previous estimates from past D&D projects conducted at NFS over the last 23 years and by averaging the labor factors included. These hours are based on a percentage of operator hours. Support function labor categories are calculated using the following factors:

- 0.188 Project Manager hours
- 0.16 Process Engineer hours
- 0.04 Health Physics hours
- 0.02 NDA Specialist hours
- 0.08 Operational Specialist hours
- 0.08 Environmental Specialist hours
- 0.174 Supervision hours
- 0.142 Maintenance hours
- 0.354 Radiation Technician hours

The total labor hours are then calculated from these factored estimates. The total labor hours (operator hours + support function hours) are then allocated to each project phase as follows:

10% Planning
80% Decontamination and Dismantling
5% Restoration of Contaminated Areas
2.5% Final Radiation Survey
2.5% Site Stabilization and Long Term Surveillance

Labor hour prices, which are based on NFS' current services agreement for contract labor, including indirect overhead and management fees, are applied to these hours to calculate the total labor estimate for each project phase.

NUREG-1757, Vol. 3, Rev. 1, Appendix A.3.12, suggests building the decommissioning cost estimate beginning with crew size and estimating the amount of work accomplished per workday. This would then lead to a value for cost per day and cost per year estimates. While this approach is valid for projects with a known workforce size, it is not an appropriate estimating approach for projects that are schedule driven rather than spend-rate driven. The daily and yearly labor costs are more a function of how large the assigned labor force would be than how many labor hours are involved in executing the assigned tasks, since many of the decommissioning tasks for this site can and should be done in parallel.

For the NFS decommissioning cost estimate specifically, the problem of determining the crew size is compounded by the fact that over 90% of the funding for the plant-wide decommissioning will be federal funds which will be subject to annual uncertainties of budget allocations. This makes the rate of spending for a potential site decommissioning project (and also the expected total project timeline) uncertain. Since the project duration is not known, NFS chose to complete the estimate by calculating the total expected labor hours for each labor category and project phase rather than on a daily basis.

The total waste volume is used to estimate the total disposal cost. Disposal rates are applied based on the disposal costs stated in NFS' contracts, with disposal at licensed disposal sites for contaminated rates and disposal at the local landfill for all clean rates. These rates include the cost of the container, preparing the container for transportation, transportation to each disposal site and return, and the fee charged by each disposal site.

Materials needed for decontamination, sectioning, PPE, and contamination control are factored into the total costs based on historical factors and the waste volume. The general materials and equipment costs are estimated based on a factor of the total operator hours. Specifics include tools/equipment for sectioning (saws, blades, torches), PPE (Tyvex suits, shoe covers, respirators), decontamination (cheesecloth, cleaning materials, high pressure cleaning equipment), and contamination control (portable ventilation units, tents). Special services, such as equipment rentals, crane service, and laboratory analyses are estimated based on historical factors from previous engineering and D&D projects.

As conducted in previous D&D Projects at NFS, it is assumed that once all equipment, piping, and accessories are removed from a building, any remaining contamination will be fixated if necessary. The building will be demolished by contract. The demolition cost is estimated based on the square footage footprint of the building using factors from historical projects. The calculated cubic footage of rubble is added to the disposal volume estimate.

Final survey, backfill, and long term surveillance contract costs are based on the process area total square footage. The non-process areas are assumed left intact. No credit for any salvage value that might be realized from the sale of potential assets (e.g., recovered materials or decontaminated equipment) during or after decommissioning is included in the estimate.

The total estimated costs are then summarized and a 25% contingency is applied per the NUREG-1757, Volume 3, guidance to obtain a total estimated cost.

Estimate Key Assumptions:

Key assumptions for the estimate methods and rates are detailed in this section.

Surface and Subsurface Soil Excavation and Disposal

As part of the volume of material containing residual radioactivity that will require remediation, the estimate assumes that after a building is removed an average of four feet of soil will also have to be removed from the building footprint and surrounding area for disposal. Estimated soil volumes are based on general knowledge of previous plant operations and knowledge gained through decommissioning, sampling, and construction activities. Generally, the areas where soil excavation depths are estimated to average four feet deep include the building footprints and adjacent areas which extend along the northern and western boundaries of the protected area. Additionally, average excavation depths of four feet are also estimated for certain building footprints and surrounding areas in the central section of the protected area. This section of the plant includes Buildings 111, 130, 105 Complex, and certain 300 Complex Buildings where processing or processing support activities have been conducted. The total area where four feet of excavation is expected is about 448,100 ft². In addition, a 20 percent swell factor was used to estimate the difference between the volume of soil excavated (compacted) and the volume of soil loaded into containers for disposal (loose). The swell factor can be found as a footnote on page 61 of 108 of the estimate. Therefore, the total volume to be excavated equals 448,100 ft² times an average depth of 4 feet times a swell factor of 20 percent, or 2,150,880 cubic feet. This area is shown on Figure 1 and is within the red-bordered outline area.

Within the NFS Protected Area, the liability of removing contaminated soils under and adjacent to buildings belongs to the DOE due to historical uses of the facilities and grounds, even though some of those buildings are now used by NFS for commercial projects. Therefore in these particular buildings, no liability was included in the estimate for soil removal.

Any references in the building specific tables to "Soils – Contaminated" or "Soils – Clean" are shown as zero volume, and those volumes are included in the totals on the "Soils" table on page 61 of 108 of the estimate. Costs for contaminated disposal and clean disposal are based on current rates from NFS contracts.

The former BLEU Facility (the Joint Venture) was decommissioned in 2017, and the NRC granted concurrence for unrestricted release in accordance with 10 CFR 20, Subpart E, on November 8, 2018. Therefore, no liability for the former BLEU Facility was included in the decommissioning cost estimate.

Subsurface Groundwater Contamination

Elevated concentrations of uranium are present in groundwater in the shallow alluvial aquifer in some locations on the NFS site. The shallow alluvial aquifer at the site contains a number of other contaminants unassociated with the NFS Site or its operations and is in hydraulic communication with nearby surface water features, making it susceptible to producing poor water quality (NFS 2000).

In acknowledgement of this fact, the NRC has agreed that groundwater from the shallow alluvial aquifer is unsuitable as drinking water, that it is unlikely that such use might be sought in the future, and that drinking water pathway may be excluded from consideration in derivation of DCGLs for residual radioactivity in soils at the site (NRC 2001). Therefore, according to this risk informed approach, the groundwater component of subsurface contamination is being excluded from financial assurance considerations as it would meet the unrestricted use criteria in 10 CFR 20.1402 (73 FR 3815; January 22, 2008).

NFS 2000. Nuclear Fuel Services, Inc. Additional Information Supporting NFS'
Decommissioning Plan, Letter from B.M. Moore to Director, Office of
Nuclear Materials Safety and Safeguards (NMSS), U.S. Nuclear
Regulatory Commission, NFS Letter No. 21G-00-0166, October 19, 2000.

NRC 2001. U.S. Nuclear Regulatory Commission, *Materials License SNM-124, Amendment No.27,* together with transmittal letter from Melvin N. Leach,
NMSS, to B.M. Moore, NFS, Washington, DC, June 19, 2001.

Non-Waste Material Disposal Estimate

NFS does not own or take title to any of the Special Nuclear Material (SNM) which NFS processes under contract. Non-waste material in the inventory includes the following high-enriched and low-enriched uranium (HEU and LEU) materials: feed material, partially processed or work-in-process materials, finished product materials, rejected materials, and scrap materials.

HEU Materials

Per the current Naval Reactors contract, title to all uranium, including material which is unused, partially processed, rejected, scrap, and residues, remains with the Government. Per the current Downblending contract, title to the delivered HEU also remains with the Government. Transport of HEU is a National Security Concern, and as such, HEU materials can only be transported by the DOE Office of Secure Transport (OST). Accordingly, NFS is exempted from the requirement for a transportation security plan because the HEU coming to and going from NFS is only transported via the DOE OST.

The basis of the decommissioning estimate is that, as the owner of any non-waste material, the DOE would be responsible for packaging, loading, and transporting their material off-site prior to the commencement of any decommissioning activities, and as such, the cost is not included in the estimate.

LEU Materials

Per the current Downblending contract, title to the Derived LEU remains with the Government. NFS is responsible for transport of the Derived LEU product from Erwin, TN, to Columbia, SC. A conservative assumption would be that, at the start of decommissioning, the two (2) tanks in Building 440 used to load the LR230 shipping packages are full, and one (1) tank in Building 333 used to finalize the blend is full.

The total cost to load, survey, and ship ten (10) LR230 transport trailers to Columbia, SC, is approximately \$54,000. The detail cost estimate is enclosed in the decommissioning cost estimate on page 92. less than 0.25% of the total decommissioning cost for the NFS Liability category. Based on the accuracy of the estimate, less than 0.25% is considered negligible, and as such, the cost is not included as a specific activity or line item in the estimate.

Return of the natural uranium to the supplier would cost much less than shipping the above LEU material and, as such, is considered to be a negligible cost and is not specifically included in the estimate. In addition, the State of Tennessee is responsible

for regulating source materials such as natural uranium under Radioactive Material License S-86001.

Labor Rates

The labor rates used in the estimate are intended to represent the cost of an independent contractor doing the work without any overhead or costs from NFS. Labor hour prices are based on NFS' current services agreement for contract labor or previous project quotations inflated to present day dollars, including indirect overhead and management fees.

Costs of Materials and Other Contracted Services

Material prices are based on previous project quotations inflated using the Producer Price Index for finished goods.

Contract Services for services such as Building Demo Labor, Backfill, Lab Cost for Survey Samples, and Final Survey Sample, Analysis, and Reporting are based on actual contract costs for performing similar work for a defined square foot area of the NFS plant site.

Miscellaneous Costs

As stated on page A-24 of NUREG-1757, Volume 3, "... overhead typically includes "period" costs, such as insurance, utilities, rent, supplies, property taxes..." Items such as license fees, insurance, taxes, and security are covered by labor overhead rates in the NFS estimate.

The Total Direct Labor Cost included in the estimate is as follows:

Liability Category	Total Direct Labor Cost	Estimate Reference
DOE	\$126,501,232	Page 9 <u>8</u> 7
NFS	\$13,145,317	Page 1043
Total	\$139,646,549	

While the cost for security and regulatory fees for NFS is significant due to the nature and quantities of the special nuclear material held on site when operating, the estimate basis assumes that NFS is no longer in operation and all of the special nuclear material requiring such security has been removed. Planning has established that DOE will retrieve strategic special nuclear material requiring extensive security measures if operations cease. See HEU Materials section, page 11. This will result in much lower security and regulatory fees.

A conservative assumption would be that contractor overhead rates are 50%. If the 50% rate is applied to the Total Direct Labor Cost, \$69.8M is available for overhead. Although the estimate does not explicitly include costs for items like license fees, insurance, taxes, or security, the overhead dollars are more than sufficient to cover these items while decommissioning is taking place.

Adjusting the Cost Estimate:

The cost estimate for this Decommissioning Funding Plan (DFP) is also used as the basis for the NFS corporate accounting liability estimates in compliance with FAS-143. This requires that the estimate be reviewed and updated on at least an annual basis. This has caused the cost estimate to become an evergreen document. In order to support the FAS-143 use, additional detail schedules have been added for some of the buildings in order to separate the decommissioning costs for a given building into "layers" representing the year of addition.

Every three years, the overall DFP is updated and resubmitted to the NRC per 10 CFR 70.25(e)(2). Adjustments are made to account for inflation, changes in the prices of goods and services, changes in the facility conditions or operations, and for changes in expected decommissioning procedures. Changes in waste inventory, changes in disposal costs, and facility modifications (additions or removal of equipment/facilities) are also considered. Remediation of spills and leaks is conducted promptly after detection in order to minimize spread of contaminants through the subsurface to the environment.

For preparation of this decommissioning cost estimate, NFS took the following eight factors (per 10 CFR 70.25(e)(2)) into consideration:

- Spills of radioactive material producing additional residual radioactivity in onsite subsurface material
 - No spills of radioactive material producing additional residual radioactivity in onsite subsurface material have been documented.
- Waste inventory increasing above the amount previously estimated
 - Waste inventory is less than 1% different than the 2015 waste inventory cost estimate.
- Waste disposal costs increasing above the amount previously estimated
 - Waste disposal costs have decreased by less than 1% since the 2015 decommissioning cost estimate.
- Facility modifications
 - o The former BLEU Facility (the Joint Venture) has been decommissioned.
 - o The Groundwater Treatment Facility has been decommissioned.

- Changes in authorized possession limits
 - o There have been no changes in authorized possession limits.
- Actual remediation costs that exceed the previous cost estimate
 - o There are no remediation costs that exceed the previous cost estimate.
- Onsite disposal
 - o There has been no onsite disposal.
- Use of a settling pond
 - There is no use of a settling pond.

Adjusting the Funding Level for Financial Assurance:

Financial assurance information regarding assumption of liability for decommissioning costs is contained in SNM-124, Chapter 10, Section 10.3, and Appendix 10A. Due to NFS contracts with the DOE, the U.S. Government would be expected to pay approximately 369 Million Dollars of this latest estimated decommissioning cost. The remaining 25 Million Dollars would be paid by NFS in the form of a surety bond and standby trust agreement. Other financial assurance instruments may be utilized if determined by the NRC to meet the requirements specified in Title 10, Code of Federal Regulations, Part 70.25. Table 1, "Summary of NFS D&D Liability and Financial Assurance," contains a summary of the methods of financial assurance in use and the corresponding instruments currently in place.

Total Decommissioning Cost Estimate:

The total estimated cost for decommissioning is approximately 394 million dollars.

TABLE 1
SUMMARY OF NFS D&D LIABILITY AND FINANCIAL ASSURANCE
As of November 30, 2018

D&D Cost Estimate Category Name	General Type of Contract(s)	Method(s) of Financial Assurance	Share of Estimate Value	Financial Assurance Documents
DOE	Government	1 Statement of Intent	~ \$369M	Letter from DOE/Naval Reactors dated 11/09/2016 (\$372.6M)
NFS	Commercial	1 Surety Bond + 1 Standby Trust Agreement	~ \$25M	Surety Bond: Argonaut Insurance Company, Bond No. SUR0032603, dated 05/23/2017 Standby Trust Agreement: Regions Bank, N.A. Trust Agreement dated 03/01/2016; Amendment No. 2, dated 05/23/2017
TOTAL			~ \$394M	