

January 7, 2009

Mr. Dwight B. Ferguson, President
and Chief Executive Officer
Nuclear Fuel Services, Inc.
P.O. Box 337, MS 123
Erwin, TN 37650

SUBJECT: INSPECTION REPORT NO. 70-143/2008-208

Dear Mr. Ferguson:

The U.S. Nuclear Regulatory Commission (NRC) conducted a routine announced criticality safety inspection at your facility in Erwin, Tennessee, from December 8-12, 2008. The purpose of the inspection was to determine whether activities involving licensed materials were conducted safely and in accordance with NRC requirements. Inspection observations were discussed with your management and staff throughout this inspection and at the exit meeting which was held on December 12, 2008.

The inspection, which is described in the enclosure, focused on the most hazardous activities and plant conditions; the most important controls relied on for safety and their analytical basis; and the principal management measures for ensuring controls are available and reliable to perform their functions relied on for safety. The inspection consisted of analytical basis review, selective review of related procedures and records, examinations of relevant nuclear criticality safety (NCS)-related equipment, interviews with NCS engineers and plant personnel, and facility walkdowns to observe plant conditions and activities related to safety basis assumptions and related NCS controls. Throughout this inspection, observations were discussed with your managers and staff.

In accordance with 10 CFR 2.390 of NRC's "Rules of Practice," a copy of this letter and the enclosure will be available in the public electronic reading room of the NRC's Agency-Wide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC web site at <http://www.nrc.gov/reading-rm/adams.html>.

D. Ferguson

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If you have any questions concerning this report, please contact Thomas Marenchin, of my staff, at (301) 492-3209.

Sincerely,

/RA/

Patricia A. Silva, Chief
Technical Support Branch
Division of Fuel Cycle Safety
and Safeguards
Office of Nuclear Material Safety
and Safeguards

Docket No.: 70-143
License No.: SNM-124

Enclosure: Inspection Report 70-143/2008-208

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- 2 -

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| OFFICE | FCSS/TSB | | FCSS/TSB | | FCSS/TSB | | FCSS/TSB |
| NAME | TMarenchin /C. Tripp for/ | | CTripp | | PJenifer | | PSilva |
| DATE | 12 /29/08 | | 12/31/08 | | 12/31/08 | | 01/ 07 /09 |

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**U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS**

Docket No.: 70-143

License No.: SNM-124

Report No.: 70-143/2008-208

Licensee: Nuclear Fuel Services, Inc.

Location: Erwin, TN

Inspection Dates: December 8-12, 2008

Inspectors: Thomas Marenchin, Criticality Safety Inspector
Christopher Tripp, Senior Nuclear Process Engineer

Approved by: Patricia A. Silva, Chief
Technical Support Branch
Division of Fuel Cycle Safety
and Safeguards
Office of Nuclear Material Safety
and Safeguards

Enclosure

EXECUTIVE SUMMARY
Nuclear Fuel Services, Inc.
NRC Inspection Report No. 70-143/2008-208

Introduction

Staff of the U.S. Nuclear Regulatory Commission (NRC) performed a routine and announced nuclear criticality safety (NCS) inspection of the Nuclear Fuel Services, Inc. (NFS), Erwin, Tennessee, facility from December 8-12, 2008. The inspection included an on-site review of the licensee NCS program, NCS program administrative procedures, NCS-related audits, NCS-related internal event review and follow-up, the facility criticality accident alarm system, plant operation, and open item review. The inspection focused on risk-significant fissile material processing activities including the blended low-enriched uranium processing facility (BPF), high-enriched uranium (HEU) fuel fabrication, and the CD Line.

Results

- A weakness was identified regarding justification of the basis for independence when crediting repeated failures of a single item relied on for safety (IROFS) as part of double contingency discussion in Nuclear Criticality Safety Evaluations (NCSEs).
- No safety concerns were noted regarding the NCS program.
- No safety concerns were noted regarding the licensee NCS inspections, audits, and investigations.
- No safety concerns were identified during a review of recent licensee investigation of internal events.
- No safety concerns were identified during plant walkdowns.

REPORT DETAILS

1.0 Plant Status

NFS conducts high-enriched uranium (HEU) fuel fabrication, downblending, uranium recovery, waste processing, remediation, and decommissioning operations at its Erwin, Tennessee site. During the inspection, NFS was performing routine fuel fabrication, downblending, maintenance, and construction activities and was completing installation of process equipment in the CD Line area.

2.0 Nuclear Criticality Safety Program (IP 88015, 88016)

a. Inspection Scope

The inspectors reviewed NCSEs to determine that criticality safety of risk-significant operations was assured through engineered and human controls with adequate safety margin and preparation and review by qualified staff. The inspectors reviewed selected aspects of the following documents:

- 54T-07-0031, "NCSE for the HSSA [High Security Storage Area] Storage Racks in Building 333 and in the Corridor Between Building 301 and 306W
- 54T-08-0036, "NCSE for BPF Liquid Waste Discard System," Revision 5, dated July 2008
- EAS-08-016, "ISA [Integrated Safety Analysis] Trends 2007," dated March 12, 2008
- NFS-HS-A-62, "Implementation of Nuclear Criticality Safety Evaluations," Revision 4, dated April 4, 2006
- NFS-HS-CL-27, "Nuclear Criticality Safety Buildings 520/530 OCB/EPB," Revision 9, dated December 4, 2008
- NCS-03-02-08, "Control Flowdown and Field Verification for Area 800," Revision 8, dated March 18, 2008
- 54T-08-0047, "Nuclear Criticality Safety Evaluation for the Blended Low Enriched Uranium Preparation Facility Solvent Extraction," Revision 9, dated October 24, 2008
- 54T-08-0035, "Nuclear Criticality Safety Evaluation for the High Security Storage Area in Building 311," Revision 7
- 54T-08-0038, "Nuclear Criticality Safety Evaluation for the WWTF Caustic Receipt Tank-26," Revision 0
- 54X-08-0014, "Nuclear Criticality Safety Evaluation for Areas 100/200 of the Production Fuel Facility," Revision 3, dated October 2, 2008

b. Observations and Findings

The inspectors determined that NCSEs were performed by qualified NCS engineers, that independent reviews of the evaluations were completed by qualified NCS engineers, that subcriticality of the systems and operations was assured through appropriate limits on controlled parameters, and that double contingency was assured for each credible accident sequence leading to inadvertent criticality. The inspectors determined that

NCS controls for equipment and processes assured the safety of the operations. With the exception of a weakness identified in Section 6.0 below, NCS analyses and supporting calculations demonstrated adequate identification and control of NCS hazards to assure operations within subcritical limits.

c. Conclusions

No safety concerns were noted regarding the NCS program.

3.0 Nuclear Criticality Safety Inspections, Audits, and Investigations (IP 88015)

a. Inspection Scope

The inspectors reviewed results of the most recent NCS audits to assure that appropriate issues were identified and resolved. The inspectors reviewed selected aspects of the following documents:

- NFS-HS-A-16, "Safety Audits and Inspections," Revision 10, dated July 31, 2007
- NFS-NCS-AUDITWG, "Nuclear Criticality Safety Audit Writer's Guide," Revision 2, dated November 27, 2006
- NCS-2008-29, "Nuclear Criticality Safety Audit of the NCSE for Dissolution," dated September 12, 2008
- NCS-2008-30, "Fourth Nuclear Criticality Safety Audit of the NCSE for Recovery Reagents," dated September 25, 2009
- NCS-2008-32, "Nuclear Criticality Safety Audit of the NCSE for the Bulk Chemical Supply System," dated October 9, 2008
- NCS-2008-33, "Nuclear Criticality Safety Audit of the NCSA for the Oxide Conversion Building Dryer/Calciner System," dated October 15, 2008

b. Observations and Findings

The inspectors observed that the licensee's NCS audits were conducted in accordance with written procedures. The inspectors noted that the audits were performed by NCS engineers who reviewed open NCS issues from previous audits; reviewed the adequacy of control implementation; reviewed plant operations for compliance with license requirements, procedures, and postings; and examined equipment and operations to determine that past evaluations remained adequate. Deficiencies identified within NCSEs and operating procedures were appropriately captured in the licensee corrective action program and resolved in a timely manner. The inspectors had no safety concerns regarding the identification, assignment and tracking of corrective actions.

c. Conclusions

No safety concerns were noted regarding the licensee's NCS inspections, audits, and investigations.

4.0 Nuclear Criticality Safety Event Review and Follow-up (IP 88015)

a. Inspection Scope

The inspectors reviewed the licensee's response to internally-reported events in its Problem Identification, Resolution, and Correction System (PIRCS). The inspectors reviewed the progress of investigations and interviewed licensee staff regarding immediate and long-term corrective actions. The inspectors reviewed selected aspects of the following documents:

- PIRCS Reports 15254, 15558, 15711, 15777, 15806, 15829, 15886, 15900, 15974, and 16454
- 54T-07-0002, "Nuclear Criticality Safety Evaluation Waste Water Treatment Facility"

b. Observations and Findings

The inspectors selected several licensee internally-reported events involving criticality safety that occurred since the previous inspection. The inspectors reviewed the PIRCS reports, any investigations that may have been performed, and the licensee's short- and long-term corrective actions. The inspectors reviewed the applicable NCSE dealing with the Waste Water Treatment Facility to verify that appropriate double contingency protection was provided for the scenario involved with PIRCS Event 15829. In this event, a single operator bypassed the required sample and performed an unauthorized solution transfer from a large storage tank by mistakenly opening the wrong valve. The inspectors questioned how this control system met double contingency, given that it was defeated by a single administrative error. Subsequent review showed that transfer from favorable to unfavorable geometry occurred upstream of the large storage tank, where fissile concentration was controlled by dual independent sampling and an in-line monitor. Therefore, double contingency for transfer into the large storage tank is established based on upstream controls and NCS control of fissile solution transfer out of the tank is considered acceptable.

The inspectors determined that the events were handled in accordance with written procedures and that appropriate corrective actions were taken. The inspectors did not identify any safety concerns regarding licensee reporting, investigation, and correction of internal NCS-related events.

c. Conclusions

No safety concerns were identified during a review of recent licensee investigation of internal events.

5.0 Plant Activities (IP 88015)

a. Inspection Scope

The inspectors performed plant walkdowns to review activities in progress and to determine whether risk-significant fissile material operations were being conducted safely and in accordance with regulatory requirements. The inspectors interviewed

operations staff and NCS engineers both before and during walkdowns. The inspectors reviewed selected aspects of the following document prior to performing the walkdowns:

- NCS-03-02-08, "Control Flowdown and Field Verification for Area 800," Revision 8, dated March 18, 2008

b. Observations and Findings

The inspectors performed walkdowns in BPF, HEU fuel processing areas, and the CD production line. The inspectors verified that controls identified in NCS analyses were installed or implemented and were adequate to ensure safety. The inspectors also verified that safety was maintained for observed facility operations. The cognizant NCS engineers were knowledgeable and interacted regularly with operators on the process floors. The inspectors verified the adequacy of management measures for assuring the continued availability and reliability of safety-significant controls relied upon by the licensee for controlling criticality risks.

c. Conclusions

No safety concerns were identified during plant walkdowns.

6.0 Open Item Review

URI 70-143/2008-206-01

This item tracks the licensee's use of a single IROFS to protect against an accident sequence while not being declared as a sole IROFS. During a previous inspection, the inspectors determined that an accident sequence involving the High Security Storage area relied on repeated failures of an administrative IROFS (mass and moderation limits in stored material).

HSSA Safety Basis

During this inspection, the inspectors reviewed the document 54T-08-0035, "Nuclear Criticality Safety Evaluation for the High Security Storage Area in Building 311" and the controls on mass and moderation. The inspectors determined that it would take multiple failures of these limits before criticality is possible. Calculations assume, first, that all the containers in the storage array exceed their mass or moderation limits, and second, that the containers in four adjacent storage locations in each aisle exceed their limits. The inspectors also examined data on the bulk and tap density of the various materials that may be stored in the array, and determined that there was significant margin between the mass values assumed in the upset case and the amount of material that could be fit into the containers. The inspectors determined that the safety basis was adequate and conservative.

Dual Independent Verification

The inspectors reviewed procedure 55T-08-0149, "Movement of BPF Nuclear Materials" (Standard Operating Procedure SOP 409), which describes requirements for moving an

item into an area with station limits. SOP 409 contains a requirement for two verifications of station limits on the "Controlled Access Area and Vault Container Storage Log" sheet by two different individuals. This administrative control requires independent verification of material composition, mass, and moderation limits before material can be moved into the area. Therefore, while IROFS 311-1 is listed as a single action in the ISA Summary, the inspectors determined that exceeding the limits would involve multiple failures by more than one individual.

Repeat Failure Independence

The inspectors noted that a large number of failures (more than 56) of mass or moderation limits would be required before criticality is possible. Given the large number of failures that would have to occur, the inspectors concluded that it is not credible that a single operator could be responsible for this condition. Therefore, in addition to requiring multiple failures by more than one operator before a single container that exceeded the limits could be introduced into the storage array, it would require additional failures by multiple individuals to achieve the minimum number of upset containers needed before criticality is possible. For this reason, IROFS 311-1 is not required to be a sole IROFS. This item (**URI 70-143/2008-206-01**) is closed.

Weakness in Basis for Independence

The inspectors reviewed several accident sequences in other NCSEs as part of their review of new and revised analyses, and determined that crediting repeated IROFS failures is widespread in the facility. In many cases, the NCSE does not contain sufficient justification of why the multiple failures may be considered independent. In the HSSA, the inspectors were able to make this determination, but this would have to be determined on a case-by-case basis. Independence is required by the double contingency principle and by the licensee's ISA methodology, because it sums up likelihood indices as though they were independent. The inspectors reviewed Attachment III to the procedure NFS-HS-A-68, "ISA Risk Assessment Procedure," Revision 4 (dated October 26, 2007), and found the criteria for considering multiple failures as independent to be acceptable. The inspectors determined that the basis for independence is not always documented in the NCSE. The licensee therefore committed to justify the basis for independence in its double contingency discussion in future revisions to NCSEs, and opened a problem report (PIRCS Report 16531, dated December 11, 2008) to track its corrective actions. Licensee corrective actions to justify the basis for independence when crediting repeated failures of a single IROFS as part of the double contingency discussion in NCSEs will be tracked as **Inspection Follow-up Item (IFI) 70-143/2008-208-01**.

IFI 70-143/2008-207-01

This item tracks the licensee's corrective actions to clarify the applicability of the requirements in NFS-HS-CL-27 to the Oxide Conversion Building (OCB) and/or the Effluent Processing Building (EPB). During a previous inspection, the inspectors observed that in procedure, NFS-HS-CL-27, NCS controls were identified as standard practices consisting of limits and controls for both the OCB and the EPB. The procedure did not clearly identify, for each of the standard practices, if they applied to either the

OCB or the EPB or to both buildings. The licensee staff indicated that controls in the procedure were not intended to be used in both buildings. The licensee committed to revise the procedure to clarify which standard practices are applied to each building. During this inspection, the inspectors reviewed the revised NFS-HS-CL-27 procedure which now describes separate controls for each building. The inspectors determined that the revised procedure clearly identifies which building each of the limits and controls are associated with as the licensee committed to in the previous inspection. This item is now closed.

7.0 Exit Meeting

The inspectors presented the inspection results to members of the licensee's management and staff during an exit meeting on December 12, 2008. The licensee acknowledged and understood the findings as presented.

SUPPLEMENTARY INFORMATION

1.0 List of Items Opened, Closed, and Discussed

Items Opened

IFI 70-143/2008-208-01 Tracks the licensee's corrective actions to justify the basis for independence when crediting repeated failures of a single IROFS as part of double contingency discussion in NCSEs.

Items Closed

URI 70-143/2008-206-01 Single IROFS protecting an accident sequence not declared as a sole IROFS.

IFI 70-143/2008-207-01 Tracks the licensee's corrective actions to clarify the applicability of the requirements in NFS-HS-CL-27 to the OCB and/or the EPB.

Items Discussed

None.

2.0 Inspection Procedures Used

IP 88015 Nuclear Criticality Safety Program
IP 88016 Nuclear Criticality Safety Evaluations and Analyses

3.0 Key Points of Contact

Nuclear Fuel Services, Inc.

| | |
|----------------|--|
| C. Athon | Vice President, Applied Technology |
| N. Brown | Engineer, NCS |
| R. Droke | Director, Licensing / Safety |
| M. Eakin | Engineer, NCS |
| T. Lindstrom | General Manager |
| J. Miller | Safety |
| J. Nagy | Vice President, Chief Nuclear Safety Officer |
| J. Perkins | Quality Assurance |
| S. Sanders | Training Manager |
| S. Skiles | NCS Engineer |
| R. Shackelford | Manager, NCS |
| A. Vaughan | Director, Fuel Production |

NRC

| | |
|--------------|---|
| S. Burris | Senior Resident Inspector, NRC Region II |
| T. Marenchin | Criticality Safety Inspector, NRC Headquarters |
| C. Tripp | Senior Nuclear Process Engineer, NRC Headquarters |

All attended the exit meeting on December 12, 2008.

4.0 List of Acronyms and Abbreviations

| | |
|-------|---|
| BLEU | blended low-enriched uranium |
| BPF | BLEU Preparation Facility |
| EPB | Effluent Processing Building |
| HEU | high-enriched uranium |
| HSSA | High Security Storage Area |
| IFI | Inspection Follow-up Item |
| IP | inspection procedure |
| IROFS | item relied on for safety |
| ISA | Integrated Safety Analysis |
| NCS | nuclear criticality safety |
| NCSE | nuclear criticality safety evaluation |
| NFS | Nuclear Fuel Services, Inc. (licensee) |
| OCB | Oxide Conversion Building |
| PIRCS | Problem Identification, Resolution, and Correction System |
| SER | safety evaluation report |
| SOP | standard operating procedure |
| URI | Unresolved Item |