

November 5, 2007

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. 70-143/2007-207

Dear Mr. Ferguson:

The U.S. Nuclear Regulatory Commission (NRC) conducted a routine announced criticality safety inspection at your facility in Erwin, Tennessee, from October 15 - 19, 2007. 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 October 19, 2007.

The inspection, which is described in the enclosure, focused on nuclear criticality safety (NCS) analysis, risk-significant NCS controls, items relied on for safety, and principal management measures for ensuring that NCS controls are capable, available, and reliable. The inspection consisted of NCS analytical basis review, selective examinations of relevant procedures and records, examinations of NCS-related equipment, interviews with NCS engineers and plant personnel, and facility walkdowns to observe in-plant conditions and activities related to NCS assumptions and 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 will be available electronically in the public electronic reading room of the NRC's Agency-Wide Document Access and Management System (ADAMS), 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 Dennis Morey, of my staff, at (301) 492-3112.

Sincerely,

***/RA/***

Deborah A. Jackson, 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 70-143/2007-207

D. Ferguson

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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.: 70-143/2007-207

Licensee: Nuclear Fuel Services, Inc.

Location: Erwin, TN

Inspection Dates: October 15 - 19, 2007

Inspectors: Dennis Morey, Senior Criticality Safety Inspector  
Tom Marenchin, Criticality Safety Inspector

Approved by: Deborah A. Jackson, Chief  
Technical Support Branch  
Division of Fuel Cycle Safety  
and Safeguards, NMSS

**Enclosure**

## **EXECUTIVE SUMMARY**

### **Nuclear Fuel Services, Inc. NRC Inspection Report No. 70-143/2007-207**

#### **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 October 15 - 19, 2007. The inspection included an on-site review of the licensee programs involving the NCS program, inspections, audits, and investigations, plant operations, NCS event review and follow-up and open item review. The inspection focused on risk-significant fissile material processing activities including the blended low-enriched uranium processing facility (BPF), the fuel manufacturing facility, the waste water treatment facility (WWTF), and the C and D production line.

#### **Results**

- An unresolved item was identified regarding licensee use of reflector conditions in computer models.
- No safety concerns were identified regarding the licensee problem identification, resolution, and correction system (PIRCS).
- Plant operations involving fissile materials were conducted safely and in accordance with written procedures.

## REPORT DETAILS

### 1.0 Plant Status

Nuclear Fuel Services, Inc. (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.

### 2.0 Nuclear Criticality Safety Program (IP 88015, 88016)

#### a. Inspection Scope

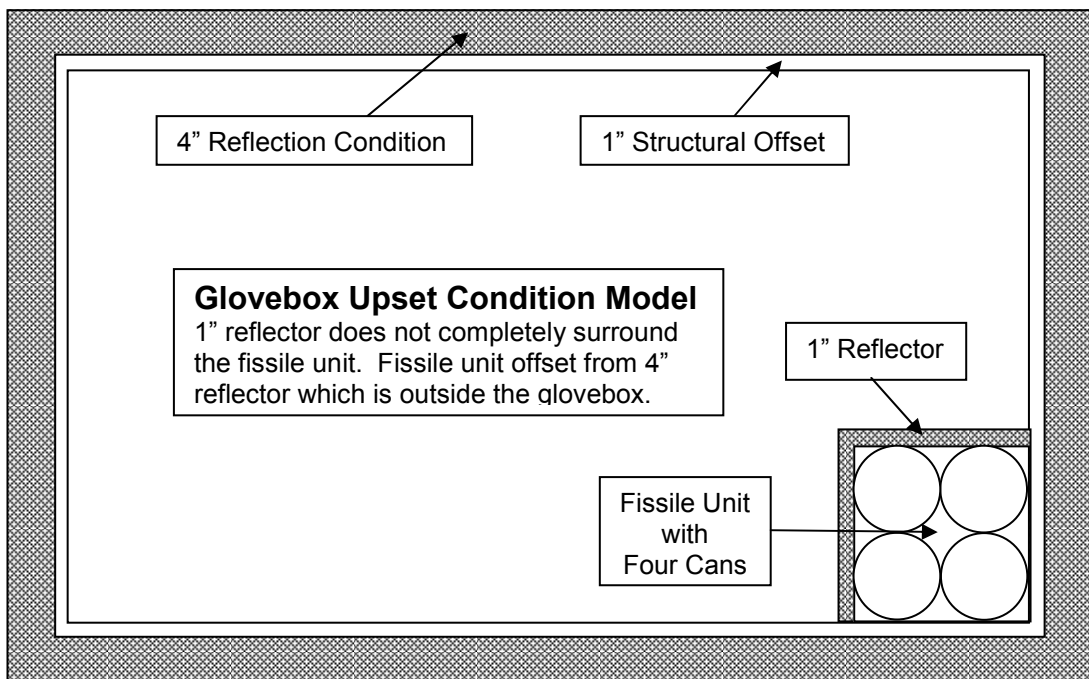
The inspectors reviewed Nuclear Criticality Safety Evaluations (NCSEs) to determine that criticality safety of risk-significant operations was assured through engineered and administrative controls, adequate safety margin, and review by qualified staff. The inspectors reviewed selected aspects of the following documents:

- 54T-07-0015, "NCSE for the Uranium Metal Sampling and the Uranium Metal Shear System," Revision 3, dated May 2, 2007
- 54X-07-0017, "NCSE for Area LA," Revision 2, dated September 5, 2007
- NFS-HS-CL-10-16, "NFS Building 304 - Area LA," Revision 6, dated September 6, 2007
- 54T-07-0018, "NCSE for the Dissolution of Uranium Metal and HEU Storage Columns," Revision 11, dated May 18, 2007
- 54T-07-0028, "Addendum 3 to NCSE of the waste water treatment facility (WWTF)," Revision 0, dated July 30, 2007

#### 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 were 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.

When the licensee relies on computer calculations to demonstrate double contingency, subcritical margin, or performance requirements for accident sequences leading to criticality, the calculations are required to use a 12-inch reflector unless conditions of less than full reflection are maintained. Less than full reflection conditions can be maintained, for example, by placing a barrier around the fissile unit or placing the fissile unit in an enclosure. The requirements for modeling reflection conditions for individual units are discussed in Section 4.2.1.2 of the license application. The minimum reflector condition allowed by the licensee is a 1-inch thick, tight-fitting, layer of water.



**Figure 1**  
**Glovebox Reflector Arrangement**

The license application specifically spells out when offset of the reflector is allowed. Offset of the reflector in computer calculations is limited to incidental reflection or, in Section 4.2.2.4, to interaction analyses. The inspectors noted that certain licensee calculations associated with gloveboxes contained computer models of fissile units with gaps between the reflector and the fissile unit (see Figure 1). Licensee NCS staff stated that, when a glovebox enclosure was relied on to maintain conditions of less than full reflection, the reflection condition can be modeled on the outside of the enclosure. The inspectors determined that the licensee NCS staff had intermingled requirements for less than full reflection with requirements for incidental reflection.

The inspectors determined that less than full reflection conditions were required to be modeled with a tight fitting layer around the fissile unit. In the glovebox cases, the enclosure is maintaining the conditions around the fissile unit but is not the outer boundary for the fissile unit and should not be used to offset the reflection condition. Therefore, the model shown in Figure 1 would require the one-inch reflector to completely surround the fissile unit if the model was used to demonstrate double contingency, subcritical margin, or performance requirements for an accident sequence leading to criticality.

Licensee NCS staff stated their belief during the inspection that tight fitting reflector conditions were not required for less than full reflection models. The inspectors reviewed a sampling of analyses and noted that, in every case with gaps in a glovebox model, the licensee had complementary models without gaps and that these tight fitting reflector models were situated in the corner of the glovebox so that two of the walls were more than 1-inch thick. Therefore, the inspectors did not identify an example of a

computer model with gaps in the reflector being used to establish compliance. The inspectors noted that the license requirements regarding reflection were complex and would require further review relative to the licensee models. The inspectors also noted that the combination of tight fitting and offset reflectors normally used in licensee models were relatively conservative and no immediate safety concern was identified. The licensee use of gapped reflector models of fissile systems is **Unresolved Item (URI) 70-143/2007-207-01**.

c. Conclusions

An unresolved item was identified regarding licensee use of reflector conditions in computer models.

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

a. Inspection Scope

The inspectors reviewed selected items in the licensee PIRCS system to determine whether issues were identified, corrective actions assigned, and the actions tracked to closure.

b. Observations and Findings

The inspectors observed that the licensee PIRCS system was used to identify and track appropriate items, assign corrective actions to responsible individuals, and track the items until the corrective actions were completed. The inspectors reviewed a sample of items being tracked in the PIRCS system. In one case, the inspectors noted that the PIRCS entry indicated that no station limit had been violated when the overall entry implied that a station limit had actually be violated. Licensee staff immediately corrected the entry and noted that corrective actions were not affected by the error so that there was no safety concern.

c. Conclusions

No safety concerns were identified regarding the licensee PIRCS system.

**4.0 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 documents prior to performing the walkdowns:



- NFS-HS-CL-10, "NCS Fuel Manufacturing Facility," Revision 24, dated October 18, 2007
- NFS-HS-CL-15, "NCS Building 330 WWTF," Revision 16, dated January 26, 2007
- NFS-HS-CL-15-01, "NCS Building 330 WWTF," Revision 16, dated January 26, 2007

b. Observations and Findings

The inspectors performed walkdowns in BPF, the fuel manufacturing facility, WWTF, and the C and D 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 licensee NCS engineers were knowledgeable and interacted frequently with operators on the process floors.

NCS procedure NFS-HS-CL-10 Section 4.13, "Reflection Control," requires that columns or equipment requiring reflection controls will be posted as such with Station Limit Cards. The inspectors noted that all gloveboxes in the facility apparently either required or was reflector controls. Licensee NCS staff indicated that the procedural control really meant that administrative controls needed to be posted. The licensee corrected the procedure during the inspection to say that columns or equipment requiring administrative reflection controls will be posted as such with Station Limit Cards.

c. Conclusions

Plant operations involving fissile materials were conducted safely and in accordance with written procedures.

**5.0 Open Item Follow-up**

**IFI 70-143/2005-208-02**

This item tracks licensee actions to amend Safety Condition S-9 of the license to eliminate references to the American Nuclear Standards Institute/American Nuclear Society series standards and clarify the meaning of "published experimental data." During this inspection the licensee indicated that work on this open item has not begun yet. This item remains open.

**IFI 70-143/2007-202-02**

This item tracks commitment to clarify license commitments regarding calculation of effective neutron multiplication factor ( $k_{eff}$ ) and the use of positive bias. During this inspection the licensee indicated that work on this open item has not begun yet. This item remains open.

**6.0 Exit Meeting**

The inspectors presented the inspection results to members of the licensee's management and staff during an exit meeting on October 19, 2007. The licensee acknowledged and understood the findings as presented.

## SUPPLEMENTARY INFORMATION

### 1.0 List of Items Opened, Closed, and Discussed

#### Items Opened

URI 70-143/2007-207-01      Tracks licensee use of gapped reflector models of fissile systems.

#### Items Closed

#### Items Discussed

IFI 70-143/2005-208-02      Tracks licensee actions to amend Safety Condition S-9 of the license to eliminate references to American Nuclear Standards Institute/American Nuclear Society series standards and clarify the meaning of "published experimental data"

IFI 70-143/2007-202-02      Tracks commitment to clarify license commitments regarding calculation of effective neutron multiplication factor ( $k_{eff}$ ) and the use of positive bias

### 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.

\*N. Brown                      Engineer, NCS  
\*R. Crowe                      Manager, Corrective Actions Program  
\*R. Droke                      Director, Licensing / Safety  
\*D. Ferguson                      Chief Executive Officer  
\*T. Lindstrom                      Executive Vice President, HEU Operations  
R. Mauer                      Engineer, NCS  
\*B. Moore                      Vice President, Safety and Regulatory  
\*J. Nagy                      Senior Licensing and Regulatory Compliance Officer  
R. Shackelford                      Manager, NCS  
\*P. Goddard                      SNM Inventory Supervisor  
\*T. Lindstrom                      General Manager  
\*C. Brown                      Material Manager  
\*C. Athon                      Vice President Applied Technology  
\*G. Hazelwood                      Engineering Director  
\*S. Sanders                      Training Manager  
\*D. Gardner                      Licensing Specialist  
\*D. Hopson                      BPF Safety Manager  
\*M. Eakin                      NCS Engineer  
\*S. Skiles                      NCS Engineer

*R. Bond	Project Director HEU Operations
*D. Chang	MC&A Test Coordinator
*S. Strouth	Statistical Supervisor
*R. Holley	Environmental Manager

**NRC**

*S. Burris	Senior Resident Inspector, NRC Region II
*G. Smith	Resident Inspector, NRC Region II
*D. Morey	Senior Criticality Safety Inspector, NRC Headquarters
*T. Marenchin	Criticality Safety Inspector, NRC Headquarters
*G. Tuttle	MC&A Inspector, NRC Headquarters
*M. Williams	MC&A Inspector, NRC Headquarters
*M. Romano	MC&A Inspector, NRC Region II

\*Attended the exit meeting on October 19, 2007.

**4.0 List of Acronyms and Abbreviations**

BPF	blended low-enriched uranium processing facility
C and D line	new commercial process
HEU	high-enriched uranium
IFI	inspector follow-up item
IP	inspection procedure
$k_{eff}$	effective neutron multiplication factor
NCS	nuclear criticality safety
NCSE	nuclear criticality safety evaluation
NFS	Nuclear Fuel Services, Inc. (licensee)
PIRCS	problem identification, resolution, and correction system
URI	unresolved item
WWTF	waste water treatment facility