April 25, 2013

Mr. Joseph G. Henry
President
Nuclear Fuel Services, Inc.
P. O. Box 337, MS 123
Erwin, TN 37650

SUBJECT: NUCLEAR FUEL SERVICES, INC. – NUCLEAR REGULATORY COMMISSION INSPECTION REPORT NO. 70-143/2013-201

Dear Mr. Henry:

The U.S. Nuclear Regulatory Commission (NRC) conducted a routine, announced nuclear criticality safety (NCS) inspection at your facility in Erwin, Tennessee, from March 25-28, 2013. The purpose of the inspection was to determine whether operations involving special nuclear material were conducted safely and in accordance with regulatory requirements. An exit meeting was held on March 28, 2013.

The inspection, which is described in the enclosure, focused mainly on the more risk-significant activities and events, and the more important safety controls and management measures. The inspection consisted of a selective review of safety basis documents, examination of related equipment, procedures, and records, interviews with plant personnel, and facility walkdowns. The inspection observations and findings were discussed with members of your staff and management throughout the inspection. Activities involving nuclear criticality hazards were generally found to be conducted safely and in accordance with regulatory requirements. The inspection did identify a weakness with the timeliness of completing actions in your corrective action program. While your program identified issues needing correction, your performance in taking prompt and effective corrective action for identified non-compliances with your NCS Program warrants NRC inspection follow-up. Deficiencies that are not in compliance with your NCS Program and procedures should not be permitted to persist for several years until they are addressed.

In accordance with Title 10 of the *Code of Federal Regulations* 2.390 of NRC's "Rules of Practice," a copy of this letter and the enclosure will be made publicly available in the public electronic reading room of the NRC's Agency-Wide Document Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

If you have any questions concerning this report, please contact Christopher S. Tripp of my staff, at (301) 492-3214, or via e-mail to christopher.tripp@nrc.gov.

Sincerely,

/RA/

Michael X. Franovich, Chief
Program Oversight and Regional
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:
NRC Inspection Report 70-143/2013-201
w/Attachment: Supplementary Information

cc w/enclosure:
Doris D. Hensley
Mayor, Town of Erwin
211 N. Main Avenue
P.O. Box 59
Erwin, TN 37650

Gregg Lynch
Mayor, Unicoi County
P.O. Box 169
Erwin, TN 37650

Johnny M. Lynch
Mayor, Town of Unicoi
P.O. Box 39
Unicoi, TN 37692

George Aprahamian
Manager, Program Field Office – NFS
Knolls Atomic Power Laboratory
1205 Banner Hill Rd
Erwin, TN 37650

If you have any questions concerning this report, please contact Christopher S. Tripp of my staff, at (301) 492-3214, or via e-mail to christopher.tripp@nrc.gov.

Sincerely,

/RA/

Michael X. Franovich, Chief
Program Oversight and Regional
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:
NRC Inspection Report 70-143/2013-201
w/Attachment: Supplementary Information

cc w/enclosure:
Doris D. Hensley
Mayor, Town of Erwin
211 N. Main Avenue
P.O. Box 59
Erwin, TN 37650

Gregg Lynch
Mayor, Unicoi County
P.O. Box 169
Erwin, TN 37650

Johnny M. Lynch
Mayor, Town of Unicoi
P.O. Box 39
Unicoi, TN 37692

George Aprahamian
Manager, Program Field Office – NFS
Knolls Atomic Power Laboratory
1205 Banner Hill Rd
Erwin, TN 37650

DISTRIBUTION:

FCSS, r/f	ABlamey, RII	MCrespo, RII	KMcCallie, RII
KRamsey, FCSS	RJohnson, FCSS	MChitty, RII	MToth, RII

ML13100A098

OFFICE	FCSS/PORSB	FCSS/PORSB	FCSS	FCSS/PORSB
NAME	CTripp	TSippel	Program Assistant	MFranovich
DATE	04/11/13	04/10/13	04/17/13	04/25/13

OFFICIAL RECORD COPY

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

Docket No.:	70-143
License No.:	SNM-124
Report No.:	70-143/2013-201
Licensee:	Nuclear Fuel Services, Inc.
Location:	Erwin, TN
Inspection Dates:	March 25-28, 2013
Inspectors:	Timothy J. Sippel, Criticality Safety Inspector Christopher S. Tripp, Criticality Safety Inspector
Approved by:	Michael X. Franovich, Chief Program Oversight and Regional 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 70-143/2013-201

Introduction

The inspectors performed a routine, announced nuclear criticality safety (NCS) inspection of the Nuclear Fuel Services, Inc., (NFS) facility, in Erwin, Tennessee, from March 25-28, 2013. The inspectors reviewed the licensee's NCS program and evaluations, NCS audits, internal NCS event review and follow-up, criticality accident alarm system (CAAS), plant operations, and open items follow-up. Areas examined included high-enriched uranium fuel fabrication and the blended low-enriched uranium processing facility (BPF).

Results

- No safety concerns were identified regarding implementation of the NCS program.

- An Inspection Follow-up Item (IFI) was identified regarding the licensee's NCS audits. Specifically, NCS audits and a review of the licensee's corrective action program identified that several corrective actions remained unresolved for an excessive period of time. The timeliness of corrective actions was identified as a programmatic weakness.

- No safety concerns were identified regarding the licensee's internal NCS event review and follow-up.

- No safety concerns were identified regarding the licensee's criticality alarm system, or the associated compensatory measures put in place during an unplanned alarm system outage.

- No safety concerns were identified during walkdowns of plant operations.

REPORT DETAILS

1.0 Summary of Plant Status

The plant was operating normally. The Commercial Development Line (CDL) has been shut down permanently. Portions of the blended low-enriched uranium (BLEU) facilities had been shut down or were in the process of being modified. For several hours during part of the inspection a plant-wide stop work order was in effect, due to work on the CAAS. For most of the inspection the alarm system covering the waste water treatment facility (WWTF) was malfunctioning, resulting in a stop work order for this process.

2.0 Nuclear Criticality Safety Program (IP 88015 & 88016)

a. Inspection Scope

The inspectors reviewed nuclear criticality safety analyses (NCSAs) and evaluations (NCSEs) to determine whether criticality safety was ensured through engineered and administrative controls with adequate safety margin and double contingency protection, and prepared and reviewed by qualified staff. The inspectors reviewed selected aspects of the following documents:

- 53T-12-0090, "Memo for TMT [Twelve Metric Ton] Uranium Carbide Commercial Grinder Testing," dated December 2012.
- 54T-12-0040, "Nuclear Criticality Safety Evaluation for 301 RFS Calciner Furnace," Rev. 4, dated December 2012.
- 54X-12-0005, "Addendum 10 to the Nuclear Criticality Safety Analysis for Handling Fissionable Material in Portable Containers (U)," Rev. 1, dated July 31, 2012.
- 54X-13-0002, "Control Flowdown and Field Verification for Addendum 10 to the Nuclear Criticality Safety Analysis for Handling Fissionable Material in Portable Containers," Rev. 1, dated February 4, 2013.
- 54X-12-0015, "Nuclear Criticality Safety Evaluation for Areas 100/200 of the Production Fuel Facility (U)," Rev. 5, dated October 22, 2012.
- 54X-98-0040, "Nuclear Criticality Safety Analysis Dry Chemical Fire Extinguisher Study," dated November 1998.
- NFS-A-7, "Procedure Listing for Control Lab Samples," Rev. 22, dated May 2010.
- NFS-SA-3-8, "Determination of Uranium in Process Solutions by Gamma Counting," Rev. 12, dated July 2007.
- NFS-SA-3-14, "Determination of Uranium in Solution Using High Resolution Germanium Detector Spectroscopy," Rev. 7, dated May 2010.
- NFS-SA-5-25, "Isotopic Analysis of Uranium by Mass Spectrometry," Rev. 3, dated March 2009.
- PIRCS # 38875, dated March 27, 2013.

b. Observations and Findings

The inspectors reviewed NCSAs and NCSEs that had been developed or revised since the previous NCS inspection in December 2012. Due to the small number of changes since the previous inspection, all new or revised analyses were reviewed.
The inspectors observed that the licensee typically adds an addendum to the portable container NCSA whenever a new container is introduced. The new container evaluated

in Addendum 10 to the NCSA is of similar volume but slightly different dimensions to other containers already in use; in Addendum 10, the licensee determined that it was bounded by its existing analysis. The inspector noted, however, that some dimensions listed in the control flowdown document were different (and less conservative than) the dimensions specified in the Addendum. The licensee determined that the analyst had changed dimensions in the course of developing the Addendum. These changes had been incorporated into the control flowdown document but they were not included in the Addendum, which had erroneously been finalized from an earlier draft. Because the analyst's intended dimensions were consistent with the as-built dimensions as included in the control flowdown document, the failure of the analysis to document the dimensions of the as-built configuration is a violation of minor safety significance. The licensee issued PIRCS # 38875 to update the documentation.

The revision to the Area 100 and 200 NCSE was to revise the description of item relied on for safety (IROFS) FA-28 to include additional instances of the same control, which had no effect on the accident sequences or criticality calculations. The inspectors noted that IROFS FA-28 included a requirement that pipes penetrating through concrete walls be double-sleeved to prevent liquid accumulations in the hollow spaces within the walls. The inspector observed that many of these sleeves are filled with grout or caulk so as to ensure their continued efficacy as fire walls, but which could impede their ability to freely drain. The analyst justified this on the assumption that the metal sleeve would degrade more slowly than the grout in the event of a leak of the inner pipe. In response to the inspectors' questions, the licensee provided them with a copy of its reply to a Notice of Violation dated June 4, 2008, which addressed similar questions raised by the resident inspectors. As part of its corrective actions for the violation, the licensee had committed to using a removable grout so that the safety-related equipment (SRE) test of the sleeve's functionality could be performed. The inspectors determined that this was adequate because the material properties of the sleeve rendered it unlikely to degrade between occurrences of the SRE tests.[1]

The revision to the 301 RFS calciner furnace was made to allow the use of a new hand operated grinder in the calciner furnace glovebox, and clearly state that storage of a 2-liter bottle of 'dry' fire extinguishing agents is allowed. An inspector reviewed 53T-12-0090, which contains more details on the grinder and its intended use in the glovebox. The grinder will be used to grind material into a fine powder for better process characteristics. The memo discusses testing to determine the amount of powder accumulation in the grinder. The grinder's internal voids would allow small quantities of powder to remain in the grinder after it has been used. However, the maximum volume where material could accumulate is very small and the mass of the accumulation is much less than that considered for other equipment. The inspector confirmed that the use of the grinder is bounded by analyses performed for other equipment. The inspector also confirmed that the grinder was identified as configuration controlled equipment (CCE), and that its relevant parameters (e.g. internal volume) and safety functions were described. The inspector also reviewed 54X-98-0040, "Nuclear Criticality Safety Analysis Dry Chemical Fire Extinguisher Study," which contains the safety basis for the storage of some dry chemical fire extinguishing agents.
An inspector also reviewed the laboratory tests used to determine concentration for NCS control. The inspector reviewed procedures and discussed the laboratory analyses with

[1] Note in Section 6.0 below, the inspectors raise another concern regarding missing packing on a firewall penetration.

licensee personnel. The laboratory has multiple ways of preparing and analyzing samples to determine the concentration of uranium and ^{235}U. The procedure NFS-A-7 identifies the procedures/methods of analysis that should be used for routine criticality control sample types. Laboratory supervisors must identify the appropriate methods for analyzing non-routine sample types that aren't listed in the procedure. The laboratory has two types of detectors available to analyze samples: sodium-iodine and germanium-based detectors. In general, two separate samples will be taken; each sample will be analyzed once using different methods, equipment, technicians, etc. The procedure discusses acceptable methods to use when there are limitations on the degree of independence. For example, when only one type of detector is available it is acceptable to have different technicians analyze the two samples using different detectors. The procedure discusses a long list of acceptable combinations. The inspector also reviewed issues such as calibration frequency, calibration range, isotopic analysis, self-shielding, and the presence of large amounts of decay products. No safety concerns were identified.

c. Conclusions

No safety concerns were identified regarding the NCS program.

3.0 Nuclear Criticality Safety Inspections, Audits, and Investigations; and Event Review and Follow-up (IP 88015 & 88016)

a. Inspection Scope

The inspectors reviewed NCS audit reports, problem reports (Problem Identification, Resolution Control System [PIRCS] entries), and corrective actions to determine whether NCS staff were appropriately monitoring the conduct of fissionable material operations for safety and compliance, and whether problems were being appropriately identified and resolved. The inspectors reviewed selected aspects of the following documents:

- NFS-HS-A-16, "Safety Audits, Assessments, and Inspections," Rev. 14, dated January 16, 2013.
- NFS-HS-A-68, "ISA [Integrated Safety Analysis] Risk Assessment Procedure," Rev. 5, dated April 16, 2012.
- 21T-06-1956, "Nuclear Criticality Safety Audit Writer's Guide," Rev. 2, dated November 27, 2006.
- 21T-12-1254, "Nuclear Criticality Safety Evaluation/Analysis Writer's Guide," Rev. 9, dated January 16, 2013.
- NFS-CAP-009, "The NFS Corrective Action Program (CAP)," Rev. 1, dated September 10, 2012.
- Audit NCS-2012-34, dated December 13, 2012
- Audit NCS-2012-35, dated December 14, 2012
- Audit NCS-2012-36, dated December 14, 2012
- Audit NCS-2012-37, dated December 19, 2012
- Audit NCS-2012-38, dated December 20, 2012
- Audit NCS-2012-39, dated January 7, 2013
- Audit NCS-2012-40, dated January 7, 2013
- Audit NCS-2012-41, dated January 28, 2013

- Audit NCS-2013-01, dated January 15, 2013
- Audit NCS-2013-02, dated January 28, 2013
- Audit NCS-2013-03, dated February 13, 2013
- Audit NCS-2013-04, dated February 19, 2013
- PIRCS # 1798, dated January 21, 2004
- PIRCS # 1801, dated January 21, 2004
- PIRCS # 35499, dated July 19, 2012
- PIRCS # 37465, dated December 19, 2012
- PIRCS # 37457, dated December 19, 2012
- PIRCS # 37584, dated January 4, 2013
- PIRCS # 37681, dated January 10, 2013
- PIRCS # 37682, dated January 10, 2013
- PIRCS # 37846, dated January 23, 2013
- PIRCS # 37897, dated January 25, 2013
- PIRCS # 37925, dated January 28, 2013
- PIRCS # 38008, dated January 31, 2013
- PIRCS # 38277, dated February 13, 2013
- PIRCS # 38316, dated February 18, 2013
- PIRCS # 38440, dated February 25, 2013
- PIRCS # 38573, dated March 6, 2013
- PIRCS # 38586, dated March 7, 2013
- PIRCS # 38677, dated March 14, 2013
- 54T-09-0056, "Nuclear Criticality Safety Analysis for the BPF Process Ventilation System," Rev. 6, dated June 2010.
- 54T-10-0017, "Control Flowdown and Field Verification for BPF Process Ventilation System," Rev. 7, dated June 3, 2010.
- 54X-04-0006, "Nuclear Criticality Safety Evaluation for Area 500 and Area 400 Discard Columns of the Production Fuel Facility (U)," Rev. 0, dated May 13, 2004.

b. Observations and Findings

The inspectors reviewed audit reports issued since the previous NCS inspection. Audits are performed frequently and a different portion of the facility is selected for review in each audit. Among the items examined during the NCS audits are any open problem reports (PIRCS entries) and corrective actions. Although there were no findings or observations in most of the recent audits, the inspectors noted that there were several remarks about items in PIRCS that had not been resolved, in some instances for several years. In audit NCS-2012-36, the auditor observed that PIRCS # 1798 and 1801, both opened January 21, 2004, were still unresolved. Audit NCS-2013-03 observed that PIRCS # 8012, 8013, and 8014, all opened June 22, 2006, were still unresolved. A quick survey of the PIRCS system identified issues (criticality and otherwise) dating from 2001. The inspectors then reviewed these long-standing PIRCS items, as well as new items resulting from recently-performed audits, to determine their risk-significance and whether the timeliness of their resolution was commensurate with their significance.

PIRCS # 1798, opened January 21, 2004, had a currently assigned due date of January 1, 2020. This issue concerned the finding that certain portable containers authorized by procedure NFS-HS-CL-10 had not been analyzed or authorized for use in the applicable NCSA (portable container NCSA or its addenda). The licensee had justified this based on concluding that the risk was “very low” because the container was bounded by other, authorized containers. However, no record of this determination was provided during the inspection. Procedure NFS-HS-A-16 defines a “finding” as any condition that is not in accordance with regulatory requirements, license conditions, permits, procedures, or standard industry practices. An “observation” is a less serious condition that does not rise to the level of a finding. The licensee stated that designating the concern as a finding was appropriate because the failure to have a documented analysis covering the use of a container was not in compliance with NCS Program requirements. Because the inspectors determined that the dimensions did not differ significantly from those of other portable containers, the failure to have such a documented analysis for these containers is a violation of minor significance.

PIRCS #1801, opened January 21, 2004, also had an assigned due date of January 1, 2020. This issue concerned the observation that procedure NFS-HS-CL-10 allowed the transport of containers of sample bottles in outer containers without lids. The inspectors determined this was of minor significance because the sample bottles were required to be sealed.

PIRCS # 8012, 8013, and 8014, were opened June 22, 2006, and had an assigned due date of January 1, 2020. All of these concerned issues identified in the BPF ventilation system NCSA. PIRCS # 8012 concerned the description of a block-and-bleed valve arrangement designated as IROFS BPV-5, and justification for the associated likelihood index in the integrated safety analysis. BPV-5 is one of three controls on accident sequence 4.1.6 concerning the inadvertent transfer from the scrubber blowdown tank to the WWTF. Between transfers, the two block valves are required to be closed and the bleed valve is required to be open. Inadvertent transfer to the WWTF requires two independent valving errors (one of the block valves is connected to the bleed valve such that one valve must be open when the other is closed and vice versa). The inspectors determined that while the description of this control could be improved, both its safety function as part of a system of controls used to meet the double contingency principle and its credited failure index were appropriate, and therefore there is no safety concern. The initiating event for this sequence is the failure of BPV-5, and is assigned a failure frequency index of -2. In addition to the initiating event, the occurrence of a criticality accident requires the failure of two additional IROFS that prevent the accumulation of significant quantities of Special Nuclear Material (SNM) in the blowdown tank.

PIRCS # 8013 concerned the lack of a detailed justification for the assigned initiating event frequency as required by procedure NFS-HS-A-68. The inspectors reviewed the NCSA discussion of this scenario and did not identify any particular concerns with the justification of the frequency index.

PIRCS # 8014 concerned the adequacy of the SRE test for several knockout columns associated with the BPF ventilation. As specified in the NCSA, the columns provide a visual indication of possible backflow, as part of a system of controls including overflow lines and siphon breaks. The attribute credited in the NCSA is that the columns must be transparent to allow for visual inspection. However, the SRE test specified checking the diameter and wall thickness of the columns only. The inspector reviewed the NCSA and control flowdown document and determined that although the issue remained open, the columns have since been removed from the SRE list. Rather than list the actual columns as SRE components, the control flowdown document currently lists only the overflows and siphon breaks as SRE components. The SRE test for overflow lines is now a visual test for obstruction, which implicitly requires transparency. Therefore, there is no longer any safety concern with the SRE testing.

In addition to the above PIRCS entries mentioned in the audit reports, the inspectors reviewed several new PIRCS opened during recent audits to determine whether they were being scheduled for resolution as appropriate to their significance. Audit NCS-2012-39 for uranium dissolution and storage columns identified two observations that resulted in PIRCS # 37465 and 37457; as discussed in the previous inspection report. The first observation was that a container was placed in an enclosure airlock without first completely filling out a runsheet to keep track of the mass. This resulted in PIRCS # 37465, which directed supervisors to coach operators on expectations for procedural compliance. The second observation involved discovery of a 2-liter bottle marked “No SNM” that contained solution. This resulted in PIRCS # 37457. The significance is low because the NCS controls for the glovebox allow the storage of 2 liter bottles containing solution. Audit NCS-2013-01 for waste drum storage and container storage racks identified two observations that resulted in PIRCS # 37681 and 37682. The first observation was that a higher mass limit than what is normally used for operations relying on non-destructive assay (NDA) measurements was used for a drum storage area. A single parameter mass limit of 350 g ^{235}U (which is already reduced from a minimum critical mass of ~700 g ^{235}U to account for double batching) is normally halved again to 175 g ^{235}U to account for an assumed 100% error in NDA methods. In this instance, the mass limit was somewhat higher but still less than 350 g ^{235}U. This resulted in PIRCS # 37681. The second observation was that the NCSE was inconsistent with the criticality models, in that it did not list credited rack dimensions and spacing as CCE attributes in a CCE table. This resulted in PIRCS # 37682. The licensee stated that the CCE table was inadvertently omitted from the NCSE, but the proper dimensions were all included in the control flowdown document and field-verified.

The inspectors reviewed the PIRCS associated with these audits and determined that the licensee appeared to take appropriate corrective action for the observation involving the use of runsheets to implement mass limits in an enclosure. The observation about to container marked “No SNM” was of very low safety significance. The two observations about whether there is adequate margin for NDA measurements and a failure to identify all CCE attributes are more significant, but were assigned a due date of December 31, 2016. While the identification of safety margin is often a matter of judgment, the failure to identify CCE attributes is not in compliance with NCS Program requirements. The failure to document CCE attributes in the NCSE is a violation of minor significance.

The licensee stated that it assigned items of low perceived safety-significance to “long-term” status, and assigned an arbitrary due date to them as a way to track suggested improvements in its PIRCS system. However, the inspectors determined that some items were not merely suggested improvements, but rather deficiencies needing correction in order to restore compliance with the NCS Program as described in the License Application and implemented in administrative procedures. In addition, the inspectors determined that some of these observations identified during audits were more appropriately characterized as findings (such as PIRCS # 37682), and that the time allowed to complete corrective actions was excessive. The inspectors therefore found the licensee’s corrective action adequate in identifying issues, but inadequate in taking prompt and effective corrective action to restore compliance with the licensee’s NCS Program.

In response to the inspectors' questions, the licensee updated PIRCS # 1798 and 37682 to change the due date to December 31, 2013 (and issuing CA 797 and 19187). The completion of the corrective actions associated with these items and scheduling of future corrective actions will be tracked as **Inspector Follow-up Item (IFI) 70-143/2013-201-01**.

c. Conclusions

A programmatic weakness was identified regarding the follow-up of audit findings and observations, and the timely completion of corrective actions associated with program non-compliances. The corrective action program warrants NRC inspection follow-up because it did not always take prompt and effective corrective action to restore compliance or resolve identified weaknesses.

4.0 Criticality Alarm Systems (IP 88017)

a. Inspection Scope

The inspectors had planned to review the criticality alarm system design and response testing, but instead observed the licensee's response to an unplanned outage of the system. The inspectors also reviewed the licensee's emergency plan for responding to and mitigating the consequences of a criticality accident. The inspectors reviewed selected aspects of the following documents:

- 21T-12-1050, "Nuclear Criticality Safety Building 330 WWTF," Rev. 21, dated October 2012.
- NFS-HS-A-21, "Operation and Testing of the Criticality, Fire, and CO_2 Alarm Systems," Rev. 30, dated October 2011.
- NFS-HS-E-02, "Emergency Criticality Evaluation," Rev. 39, dated October 2012.
- NFS-HS-E-07, "On-Site Radiological Emergency Assessment," Rev. 28, dated October 2012.
- PIRCS # 38840, dated March 25, 2013
- PIRCS # 38854, dated March 26, 2013
- PIRCS # 38860, dated March 26, 2013
- "Functional Design Specification Criticality Monitoring Supervisory System," Rev. 4, dated May 23, 2012.

b. Observations and Findings

During the inspection, one of the gamma detectors in the Building 330 North criticality detector pair failed. This building is associated with the WWTF, and the 330 North detector pair covers this building and the outside wastewater treatment tanks.

The licensee sent electricians and radiation protection personnel to fix the system, which the inspectors observed. Prior to the inspectors' arrival the licensee replaced a section of wiring between the detector and a 'junction box.' At first the licensee believed that this resolved the problem, but the unit continued to malfunction. At this point the inspectors arrived and observed the licensee staff replace the malfunctioning detector with a new detector that had worked when 'bench tested' in the lab. The local RMS3 unit was then checked to see if the detector was now working. However, the local RMS3 unit wasn't reporting a signal from the detector; all readings for that detector were zero. The CAAS alarm board continued to report a failure warning for that detector. The technicians attempted to source check the detector from both the local RMS3 unit and the main board. When the detector didn't respond the RMS3 unit was replaced with one that had worked with the detector when bench tested. However, the detector still didn't respond when source checked, or when exposed to a cesium source by radiation protection personnel. The CAAS was eventually repaired a couple days later after all the wiring between the detector and the RMS3 unit was replaced. An inspector also reviewed the functional design specification for the CAAS to review the system and detector specific states and logic.

The licensee's procedures require that the licensee stop work with SNM in the area affected; which in this case is the WWTF. The licensee made a conservative decision to stop work with SNM in all areas when working on the CAAS, because the horns throughout the facility are disabled when working on the CAAS. While the horns are disabled, personnel are assigned to watch the CAAS alarm board and use the public address system to signal evacuation if a criticality accident occurs. However, the licensee considered it safer to stop all SNM handling while the CAAS was being worked on, in order to reduce the risk of a criticality accident. The announcements the licensee made during this time were in accord with the requirements in NFS-HS-A-21, "Operation and Testing of the Criticality, Fire, and CO_2 Alarm Systems."

The inspector discussed the use of the CAAS during evacuation and emergency response with licensee personnel. The licensee has made provisions for accessing the CAAS during evacuation by providing a 'read-only' CAAS alarm board at the assembly area. The licensee relies on the use of hand held detectors in its emergency response procedures to verify if an actual criticality occurred or not. However, the CAAS has the ability to indicate the dose rates at the various detectors, which detector(s) alarmed, and why they alarmed. So if the CAAS is operational following a criticality accident it can be used to assist the emergency response function.

The licensee has committed to ANSI-ANS-8.3; which includes the statement "All components of the system should be located or protected to minimize damage in case of fire, explosion, corrosive atmosphere, or other extreme conditions." To accomplish this, the licensee located the detectors high above the ground and indoors or inside a protective enclosure. The CAAS components are anchored to robust structural members. The CAAS is also connected to the site backup power supply and has dedicated batteries to power the system if the site backup power can't supply power.

c. Conclusions

No safety concerns were identified during review of the criticality accident alarm system, and associated emergency plans. No safety considers were identified with the licensee's handling of the repairs to the malfunctioning detector.

5.0 Plant Activities (IP 88015)

a. Inspection Scope

The inspectors walked down fissionable material processes in operation to determine whether the operations were being conducted safety and in accordance with regulatory requirements. The inspectors also reviewed aspects of the following documents:

- 54T-13-0001, "Nuclear Criticality Safety Evaluation for the Dissolution of Uranium and High Enriched Uranium Storage Columns," Rev. 18, dated March 2013.
- PIRCS # 38856, dated March 26, 2013.
- SOP [Standard Operating Procedure] 409, Section 8, "U-Oxide Dissolution," Rev. 47, dated March 12, 2013.

b. Observations and Findings

An inspector walked through BPF and the fuels area while SNM handling was prohibited site-wide during the CAAS repairs. The inspector observed that licensee personnel had stopped handling SNM in accordance with NFS-HS-A-21 and the licensee's announcements.

The inspectors also conducted walkdowns of systems in the BPF, and in the 800 Area. One of the systems walked down was the uranium oxide dissolution system in BPF. This system was recently modified to better prevent backflow and buildup. The inspectors examined the new configuration and discussed possible initiating events and criticality accident sequences with licensee NCS engineers. The system and controls observed in the walkdown was compared to the description and function in 54T-13-0001. The inspectors didn't identify any safety significant issues with this system.

However, during a walkdown the inspectors noticed an unpacked piping penetration of a firewall. The licensee requires that penetrations of firewall be packed to prevent the spread of a fire. Closer examination revealed that one side of the penetration was packed and the other wasn't. The licensee NCS engineers referred this issue to the licensee's fire protection function. The fire protection function examined the wall and identified a further instance where a penetration had no packing at all. This was documented in PIRCS # 38856, along with the immediate corrective actions taken, such as establishing a fire watch. The inspectors referred this fire protection issue to the resident inspectors.

c. Conclusions

An issue with the packing of penetrations in firewall was identified and referred to the resident inspectors. No other safety concerns were identified during plant walkdowns.

6.0 Open Item Review

IFI 70-143/2012-204-01

This finding concerned the adequacy of the licensee's NDA methods to identify and characterize wet uranium accumulations in process ventilation. During the previous inspection, the inspectors determined that the NDA methods then in use had not been approved for use with moderated deposits. As a result of the investigation of the event involving the discovery of uranium solution in the bag-out bag on FILTER-4A02 in the CDL, the licensee opened PIRCS # 15358 to examine possible corrective actions to improve the NDA methods. During the current inspection, the inspectors examined the results of the licensee's investigation and the associated corrective actions.

The inspectors reviewed the licensee's Apparent Cause Analysis (ACA), which resulted in three recommendations: (1) Add guidance to the engineering design guide to specify that high-efficiency particulate air (HEPA) filters installed on enclosures with saturated off-gas be installed on vertical runs of process off-gas lines, and prefilters should also be installed; (2) consider adding the periodic removal and inspection of the HEPA filters as part of the SRE test; and (3) maintain the investigation report as part of the plant "operating experience." The ACA identified a flawed design as the root cause, in that the HEPA had been installed on a horizontal section of pipe, so that condensation could not drain back into the enclosure, and that it had been assumed that the installed wet off-gas line would be sufficient to carry off any entrained liquids. The ACA further found that there was no periodic inspection of the filter and that NDA methods needed improvement. The licensee completed the first action (CA 19354) in adding to Section 281.01 of the Stainless Steel HEPA Filter Housing Specification that wherever saturated vapors could be produced, the HEPA filter should be mounted vertically or have a separate drain leg to prevent liquids from accumulating. The licensee completed the second action (CA 19355) in modifying the SRE test to require a visual inspection for accumulation, and in removing the differential pressure test. Licensee staff stated that the differential pressure test would still be performed, but would no longer be credited for criticality purposes as part of the SRE test. The licensee further stated that it had decided not to require removal of the HEPA filter because frequently removal could result in leaks in the sealing surface. The licensee completed the third action (CA 19386) by developing and operating experience report (OE-RPT-2013-008).

In a separate investigation (Investigation 15614), the licensee re-evaluated its *in situ* NDA methods and determined that, while the use of sodium iodide detectors was sufficient for routine NDA scanning—to determine if a gross deposit existed—it was not adequate for determining the mass of such a deposit due to the poor energy resolution. The investigation recommended purchasing a portable high-purity germanium (HPGe) detector to provide a more accurate estimation of the mass (CA 19628). Licensee staff stated that the ability to resolve multiple gamma peaks allowed it to apply software corrections for the presence of wet materials, self-absorption, and non-uniformities. In addition, the licensee will develop several additional standards applicable to wet uranium deposits to calibrate the detectors. The licensee stated that it was still evaluating the type of HPGe to purchase and had not yet written the SRE test for filter inspection. The inspectors stated that it was not yet clear when the new HPGe system would be used and when the old NaI system would be used. The inspectors determined that the design changes for the HEPA filter housings exposed to saturated off-gas seemed reasonable and effective to prevent recurrence. The inspectors noted that the use of FILTER-4A02 had been discontinued as part of the shutdown of the CDL. In addition, the inquiries into revising the NDA methods for use with wet materials seemed appropriate. However, since the licensee has not settled on the type of HPGe system, and has not finalized its revised procedures for performing NDA or the SRE test for performing visual inspections, this item will remain open.

7.0 Exit Meeting

The inspector presented results of the inspection to the licensee during an exit meeting on March 28, 2013. The licensee stated that it understood the findings as presented.

SUPPLEMENTARY INFORMATION

1.0 List of Items Opened, Closed, and Discussed

Items Opened

IFI 70-143/2013-201-01	Completion of corrective actions identified as "long-term" in the Problem Identification, Resolution, and Corrective System that involve programmatic non-compliances.

Items Closed

None

Items Discussed

IFI 70-143/2012-204-01	Tracks completion of investigations and corrective actions associated with, and examination of NDA methods suitable for, wet uranium accumulations in process ventilation.

2.0 Inspection Procedures Used

IP 88015	Nuclear Criticality Safety Program
IP 88016	Nuclear Criticality Safety Evaluations and Analyses
IP 88017	Criticality Alarm Systems

3.0 Key Points of Contact

NFS

N. Brown	NCS Manager
R. Droke	Senior Regulatory Advisor
M. Elliott	Director, Safety & Security
M. Lee	Licensing Specialist
M. McKinnon	Ops Section Manager
R. Shackelford	Manager, Nuclear Safety & Licensing

NRC

M. Chitty	Senior Resident Inspector, RII
T. Sippel	Nuclear Process Engineer, NRC Headquarters
C. Tripp	Nuclear Process Engineer, NRC Headquarters

All attended the exit meeting on March 28, 2013.

4.0 List of Acronyms and Abbreviations

ACA	Apparent Cause Analysis
ADU	ammonium diuranate
BPF	BLEU preparation facility
CA	corrective action
CAAS	Criticality Accident Alarm System
CAP	corrective action program
CCE	configuration controlled equipment
CDL	commercial development line
EPB	Effluent Processing Building
HEPA	high-efficiency particulate air
HPGe	high-purity germanium
IFI	inspector follow-up item
IP	inspection procedure
IROFS	item relied on for safety
NCS	nuclear criticality safety
NCSA	nuclear criticality safety analyses
NCSE	nuclear criticality safety evaluation
NDA	non-destructive assay
NFS	Nuclear Fuel Services, Inc. (licensee)
NUN	natural uranium nitrate
OCB	Oxide Conversion Building
PIRCS	Problem Identification, Resolution, and Corrective System
QA	Quality Assurance
SOP	Standard Operating Procedure
SRE	safety related equipment
SNM	Special Nuclear Material
TMT	twelve metric ton
UNB	Uranyl Nitrate Building
WWTF	wastewater treatment facility