UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
SAM NUNN ATLANTA FEDERAL CENTER
61 FORSYTH STREET, SW, SUITE 23T85
ATLANTA, GEORGIA 30303-8931

April 24, 2009

EN 44890

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

SUBJECT: NRC INSPECTION REPORT NO. 70-143/2009-007

Dear Mr. Kudsin:

This report refers to the special inspection team (SIT) inspection conducted from March 23-27, 2009, at the Nuclear Fuel Services (NFS), Inc. facility in Erwin, TN. The purpose of the SIT was to inspect and assess the facts and circumstances surrounding the discovery of design issues regarding glove box drains identified as items relied on for safety (IROFS). A copy of the SIT Charter is included as Enclosure 1.

Areas examined during the inspection are identified in the report. Within these areas, the inspection consisted of a selective examination of calculations, procedures and representative records, interviews with personnel, and observation of activities in progress.

The SIT objectives were to: (1) review the facts surrounding the glove box event that occurred on March 4, 2009; (2) assess your response and investigation of the event; (3) evaluate NFS' root cause analysis for the late 2005 glove box event for any missed opportunities to identify the current event; and (4) identify any generic issues associated with this event.

The SIT determined that the NFS' actions regarding the discovery and subsequent corrective actions were consistent with the safe operation of the facility. The root cause associated with the late 2005 glove box violation was not related to the recently discovered design issues in numerous process glove boxes. Additionally, this issue will be considered for review within NRC's generic communication process.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, and its enclosures will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

Should you have any questions concerning this letter, please contact us.

Sincerely,

/RA/

Joseph W. Shea, Director
Division of Fuel Facility Inspection

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

Enclosures: 1. SIT Charter w/attachment
2. NRC Inspection Report

cc w/encls:
Timothy Lindstrom
Vice President, Operations
Nuclear Fuel Services, Inc.
Electronic Mail Distribution

B. Marie Moore
Director
Safety and Regulatory Management
Nuclear Fuel Services, Inc.
Electronic Mail Distribution

Lawrence E. Nanney
Director
TN Dept. of Environment & Conservation
Electronic Mail Distribution

William D. Lewis
Mayor
Town of Erwin
211 N. Main Avenue
P.O. Box 59
Erwin, TN 37650

cc w/encls: (Cont'd on page 3)

(cc w/encls: con t'd)
Gregg Lynch
Mayor
Unicoi County
P.O. Box 169
Erwin, TN 37650

Johnny Lynch
Mayor
Town of Unicoi
Unicoi, TN 37692

Distribution w/encls:
PUBLIC
S. Burris, RII
C. Payne, RII
M. Crespo, RII
G. Smith, RII
K. Ramsey, NMSS
M. Tschlitz, NMSS
N. Baker, NMSS
P. Habighorst, NMSS
nmed@inl.gov

X PUBLICLY AVAILABLE ☐ NON-PUBLICLY AVAILABLE ☐ SENSITIVE X NON-SENSITIVE

ADAMS: X Yes ACCESSION NUMBER:_____ X SUNSI REVIEW COMPLETE

OFFICE	RI:DFFI	RII:DFFI	RII:DFFI	RII:DFFI			
SIGNATURE	GS via email 4/22	OL 4/15/09	MC 4/14/09	CP 4/22/09			
NAME	GSmith	OLopez	MCrespo	CPayne			
DATE	4/ /2009	4/ /2009	4/ /2009	4/ /2009	4/ /2009	4/ /2009	4/ /2009
E-MAIL COPY?	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO

OFFICIAL RECORD COPY DOCUMENT NAME: G:\FFBII\REPORTS\DRAFT INSPECTION REPORT FOLDER\NFS\NFS IR 2009-007 (SIT) (2).DOC

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ATLANTA, GEORGIA 30303-8931

March 19, 2009

MEMORANDUM TO: Galen D. Smith, Team Leader
Nuclear Fuel Services Special Inspection

FROM: Victor M. McCree ***/RA/***
Deputy Regional Administrator for Operations

SUBJECT: SPECIAL INSPECTION CHARTER FOR NUCLEAR FUEL SERVICES (NFS), DOCKET NO. 70-143 (INSPECTION REPORT NO. 70-143/2009-07)

This memorandum confirms the establishment of a Special Inspection Team (SIT) at NFS to inspect and assess the facts and circumstances surrounding the discovery of design issues regarding glove box drains identified as items relied on for safety (IROFS). The issue was reported to the NRC Operations Center on March 4, 2009, (Event # 44890). You are the inspection leader and should report your status directly to me. Omar Lopez is assigned as a member of the team to assist in completing the objectives of the Charter.

The inspection and report will be performed in accordance with the guidance of Inspection Procedure (IP) 88003, and the applicable provisions of IP 93812 and IP 88020, and will be consistent with Management Directive 8.3 and Manual Chapter 2600. The report will be issued within 30 days of the completion of the inspection.

A copy of the Charter is enclosed for your use. The objectives of the inspection are to gather information and make appropriate findings and conclusions in the areas listed in the Charter. These results will be used as a basis for any necessary follow-up. As indicated in the Charter, the foremost objective is to determine the safety implications and adequacy of the licensee's corrective actions for the glove box design issues which resulted in the event.

CONTACT: Joseph Shea, RII/DFFI
404-562-4700

Enclosure 1

Special Inspection Team Charter
NFS Glove Box Design Issues

Event

During a review of calculations for flow rates of overflow drain(s) on glove boxes for the new Commercial Development (CD) line process, an engineer noted a discrepancy between his peer-reviewed calculations and the contractor's initial calculation. Following a re-examination of the calculations and actual glove box drain testing with water, it was noted that the overflow drains of glove boxes may not limit the height of liquid less than or equal to one inch (the IROFS designated limit) during an overflow situation. Nuclear Fuel Services (NFS) shut down all glove boxes with drains and tagged them as out-of-service until revised calculations and modified drains (reducing the lip height) are implemented and verified. Fourteen glove boxes in the fuels area and nine glove boxes in the BLEU Preparation Facility (BPF) were impacted by this event (23 total). The event was reported to NRC on March 4, 2009, (EN # 44890). NFS has stated that glove boxes will remain sub-critical even with liquid levels up to three and a half inches. Its new analyses are intended to confirm this information for both the pre-event and post-event glove box configurations. This event may be similar to another glove box event at BPF that occurred in October – November, 2005 with escalated enforcement issued in March, 2006. That event involved inadequate design of a water trap in the drain piping beneath the box rather than accumulation of liquid within the box above the IROFS limit.

Objectives

The objectives of the inspection are to: 1) review the facts surrounding the glove box event that occurred on March 4, 2009; 2) assess the licensee's response and investigation of the event; 3) evaluate the licensee's root cause analysis for the late 2005 glove box event for any missed opportunities to identify the current event; and 4) identify any generic issues associated with the event. To accomplish these objectives, the following tasks will be completed:

1. Evaluate the decision making process used by the licensee to expand the scope of potentially affected equipment once a glove box problem was identified during an engineering review in the CD line. Include a review and assessment of the thoroughness and effectiveness of the immediate corrective actions taken by the licensee in response to the event.

2. Review the engineering assumptions (both pre-event and post-event) used for the 23 affected glove boxes to determine if the solution level in the glove boxes could have exceeded the licensee's one inch liquid height limit for criticality accident scenarios, and that all appropriate factors and process conditions have been considered.

3. Review and evaluate a sample of new engineering calculations for the 23 affected glove boxes for technical completeness and accuracy. Assess the decision making process used for determining that specific glove boxes were safe to return to service.

4. Review and evaluate the licensee's root cause analysis for the late 2005 glove box event to determine if opportunities were missed that could have mitigated or prevented the current event. Specifically, identify and assess those areas of the analysis that, with broader consideration of underlying causes, may have presented the licensee with the opportunity to recognize this concern at that time.

5. Assess this event for any potential generic implications at other sites or facilities.

Documentation

Document the inspection findings and conclusions in an inspection report within 30 days of the completion of the inspection

U.S. NUCLEAR REGULATORY COMMISSION

REGION II

SPECIAL INSPECTION TEAM

Docket No.:	70-143
License No.:	SNM-124
Report No.:	70-143/2009-007
Licensee:	Nuclear Fuel Services, Inc.
Facility:	Erwin Facility
Location:	Erwin, TN 37650
Dates:	March 23-27, 2009
Inspectors:	G. Smith, Team Leader O. López, Fuel Facilities Inspector
Approved by:	D. Charles Payne, Chief Fuel Facility Inspection Branch 1 Division of Fuel Facility Inspection

Enclosure 2

EXECUTIVE SUMMARY

Nuclear Fuel Services, Inc.
NRC Inspection Report 70-143/2009-007

The purpose of the special inspection team (SIT) was to review and assess the facts and circumstances surrounding the discovery of design issues regarding glove box drains identified as items relied on for safety (IROFS). The SIT objectives were to: (1) review the facts surrounding the glove box event that occurred on March 4, 2009; (2) assess your response and investigation of the event; (3) evaluate NFS' root cause analysis for the late 2005 glove box event for any missed opportunities to identify the current event; and (4) identify any generic issues associated with this event. The inspection results were as follows:

Event Evaluation

- The licensee exhibited a questioning attitude in identifying this issue. The issue was appropriately reported to the NRC and the glove boxes were modified to ensure compliance with the criticality safety program.

Evaluation of Engineering Calculations

- Engineering calculations were conservative and utilized sound assumptions in ensuring glove box compliance with the criticality safety program.

Evaluation of Root Cause Analysis Associated With the 2005 Glove Box Violation

- No evidence was noted that could link the recent glove box design issue to the 2005 glove box violation.

Generic Implications

- This issue should be considered for a generic communication to other NRC licensees.

Attachment:
Partial List of Persons Contacted
List of Inspection Procedures Used
List of Acronyms Used

REPORT DETAILS

1. Event Evaluation

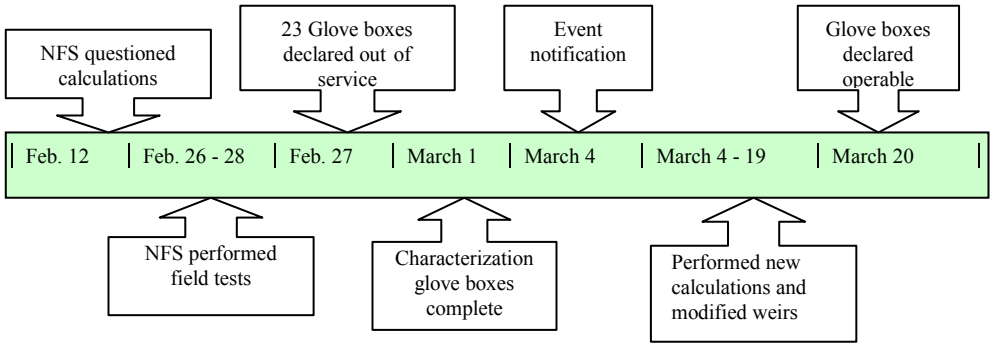
(1) Inspection Scope and Observations

In early February of 2009, an NFS project engineer was reviewing a set of contractor-developed glove box calculations associated with the new Commercial Development (CD) line located in Building 301. The purpose of these calculations was to show that for any upset condition within a particular glove box, the solution level of special nuclear material (SNM) would not exceed a depth of 1 inch due to the presence of installed glove box drain(s). The 1 inch depth was a licensee defined criticality safety limit established to preclude against the accumulation of a critical mass of SNM within the glove box. The NFS engineer noted some minor variations between the existing NFS calculations and the new calculations developed by the consultant. Discussions between NFS and the consulting engineer resulted in an agreement to pursue a different system model for the drain process. The existing model was based on fluid flowing through an orifice while the newly-proposed model was based on fluid flowing over a weir (each drain had a weir lip to contain minor spills in the glove box). This weir lip was nominally cut to be no more than ½ inch above the glove box floor. In order to validate the newly proposed model, the NFS engineer designed a test in which water was pumped into a glove box to measure the maximum height of the water at various flow rates. The results of the test validated that the weir model most closely predicted conditions that fit the glove box design. This new calculational method was later integrated into existing glove box analyses and calculations were reevaluated throughout the facility.

The test also revealed that the subject glove box floor was not perfectly level and sometimes had some low points due to warping or other slight imperfections. Recognizing the outcome of the test could impact other glove boxes within the facility and to initiate a licensee review of the concern, the NFS engineer entered the issue into the Problem Identification Resolution and Correction System (PIRCS) as item #17543 on February 26, 2009. Specifically, the PIRCS entry identified that, under certain postulated upset conditions, the existence of localized depressions in the box could possibly lead to exceeding the 1 inch nuclear criticality safety (NCS) limit in the vicinity of the depression. On February 27, NFS identified all potentially affected glove boxes (23 total) within the facility and began a characterization of the topography of each glove box floor using direct water level measurements or a builder's transit. Concurrent with this characterization effort, the licensee began to modify all glove boxes to limit the weir height to less than ¼ inch. In some cases the weir height was reduced to less than 1/8 inch, as a precautionary measure.

On March 1, 2009, following completion of the glove box characterization, the licensee began a review of the drain calculations for the 23 affected glove boxes using the worst case depression depth as well as the new weir flow model to determine if any potential upset condition could possibly exceed the licensee's 1 inch criticality safety limit. On March 4, the licensee determined that, for some boxes, a postulated upset condition could exceed a level of 1 inch of SNM in a localized portion of the glove box. That day, the licensee promptly reported this condition to the Headquarters Operation Officer in accordance with 10 CFR 70, Appendix A, Section a(5). From March 4 to March 19, NFS engineers performed a detailed review and analysis of the 23 affected glove boxes.

Following the completion of each review, the glove boxes were returned to service on a case-by-case basis using a well-defined and safety-focused management review process. All glove boxes were returned to service by March 20. The following flow chart presents the sequence of events with respect to the decision making process taken by the licensee.



The inspectors evaluated the decision making process used by the licensee to identify the scope of potentially affected equipment once a glove box problem was confirmed. The evaluation included a review and assessment of the thoroughness and effectiveness of the immediate corrective actions taken by the licensee in response to the event.

The inspectors noted that the licensee demonstrated a questioning attitude and used a conservative approach in responding to the event. As an immediate corrective action, the licensee removed uranium-bearing materials from the affected glove boxes and declared them out of service to further evaluate the implications and extended condition of the event. The decision to declare the glove boxes out of service was based on a re-examination of set point calculations and field tests performed by licensee staff. The field tests revealed that during an overflow situation the drains installed on the glove boxes may not limit the height of liquid to less than or equal to one inch in certain localized areas of the glove boxes, as required by the credited items relied on for safety (IROFS). The licensee performed new set point calculations and modified drain weir heights to ensure appropriate discharge flow rates.

No significance concerns were identified with respect to the decision making process used by the licensee.

(2) Conclusions

The inspectors determined that the licensee used a timely conservative and safety-oriented decision making process to evaluate the potential implications of the event.

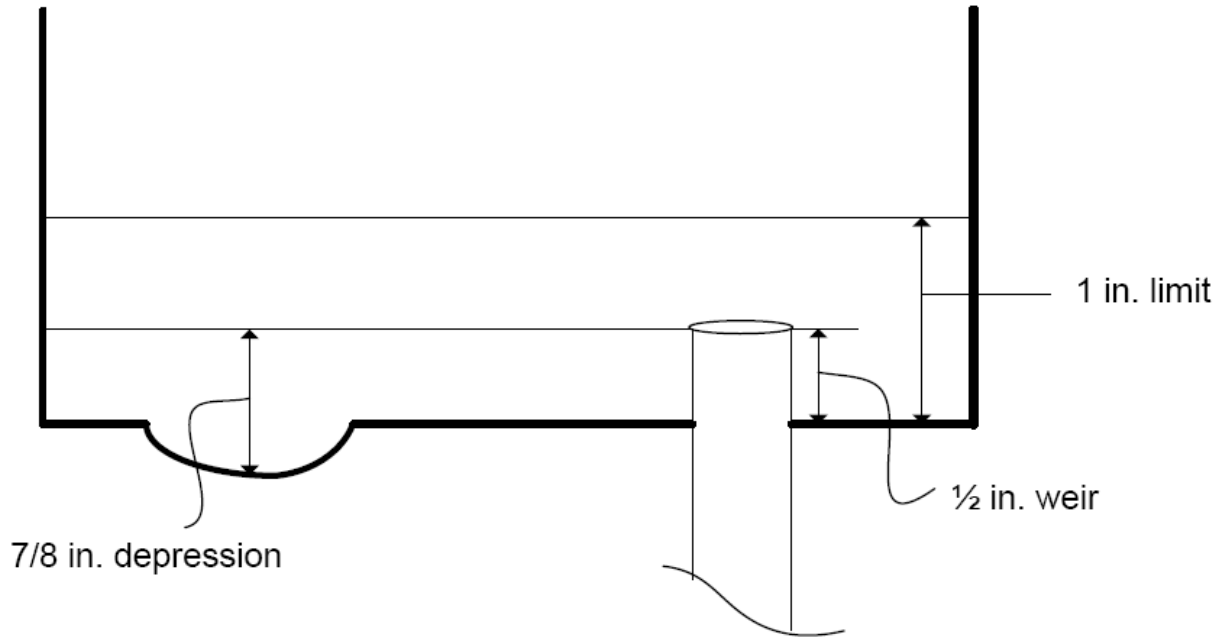
2. Evaluation of Engineering Calculations

(1) Inspection Scope and Observations

The inspectors evaluated the engineering assumptions (both pre-event and post-event) used in evaluating the nuclear criticality safety of the 23 affected glove boxes. This was

done to determine if the solution level in the glove boxes could have exceeded one inch in the worst case scenario and that all appropriate factors and process conditions had been considered.

The inspectors noted that original (pre-event) calculations were based on an orifice type calculation that assumed that the glove box floor was flat and did not account for the existence of a drain weir in the glove box. During the field tests, the licensee discovered that discharge flow rates were sensitive to drain weir heights and glove box floor flatness. The licensee noted that the affected glove boxes had depressions on the floor. Furthermore, the licensee identified some glove boxes with floor depressions up to 7/8 inch measured from the top of the weir (nominally, the weir height was about ½ inch above the glove box floor). This condition is illustrated in the following diagram (not drawn to scale).



The inspectors determined that the solution level in several glove boxes could have exceeded the 1 inch limit in localized areas of the glove boxes where the floor was sufficiently depressed. However, the inspectors concluded that even if the 1 inch limit was exceeded in some of these localized areas the potential safety consequences would have been minimal due to safety factors used in the calculations and nuclear criticality safety analysis (NCSA). The NCSA assumed that the solution level was uniform (not localized) throughout the box, the glove box was fully reflected on all sides (i.e. the room is flooded), and that the uranium enrichment was 100%. Based on these conservative assumptions, the NCSA determined that the condition where a criticality event becomes credible occurs when the solution level exceeds about 3.5 inches. These assumptions, in addition to the drains, provide sufficient margin for safe operation of the glove boxes. The criticality safety aspects associated with the potential for exceeding the 1 inch limit will be further evaluated for significance during a future inspection by a NCS inspector and documented in a separate NRC inspection report.

The inspectors noted that the post-event calculations were based on a circular weir type calculation. The post-event calculations also used a weir height based on the lowest point (greatest depression of the glove box floor) measured in the glove box. The inspectors noted that by using the lowest point of the glove box, the calculation results would be more conservative. In addition, the licensee physically modified the weir height to ensure an adequate drainage rate. The inspectors reviewed a sample of the post-event calculations for technical completeness and accuracy. The inspectors also assessed the decision making process used for determining that glove boxes were safe to return to service. The inspectors noted that the licensee evaluated each glove box individually. The licensee performed new set point calculations for each glove box and performed an inspection of each drain. The inspectors walked down several glove boxes to independently check the weir height modifications. No findings of significance were identified with respect to the decision making process used by the licensee.

(2) Conclusions

The inspectors determined that the licensee used sound engineering assumptions in the pre-event and post-event glove box set point calculations.

3. Evaluation of Root Cause Analysis Associated With the 2005 Glove Box Violation

(1) Inspection Scope and Observations

In late 2005, NRC inspectors identified a Severity Level III violation associated with a glove box in the Blended Low Enriched Uranium (BLEU) Preparation Facility (BPF). Specifically, NRC inspection report No. 2005-010 documented a violation associated with the overflow system in a uranium-aluminum glove box. The violation noted that NFS failed to account for credible upset conditions when constructing the height of the overflow drains in the BPF. The specific upset condition dealt with the worst case that could occur in the glove box during the presence of a vacuum. This vacuum value needed to be factored into the design of the height of the P-style drain trap located outside of the glove box. Given an initiating event and a worst case vacuum, the inspectors determined that material could have backed up into the box and resulted in an unacceptable buildup of solution within the glove box.

The inspectors reviewed and evaluated the licensee's root cause analysis for the late 2005 glove box violation to determine if opportunities were missed that could have prevented the current event. Specifically, the inspectors identified and assessed those areas of the analysis that, with broader consideration of underlying causes, may have presented the licensee with the opportunity to recognize this concern at that time. Although the 2005 violation involved the operability of glove box drains, it did not relate to the physical topography of the glove box floor which was the major underlying factor of this most recent issue. Ultimately, the inspectors did not note any correlation between the 2005 glove box violation and the current non-conforming condition.

(2) Conclusions

No correlation between the 2005 glove box violation and the 2009 discovery of the glove box deficiency was noted.

4. Generic Implications

(1) Inspection Scope and Observations

The inspectors assessed the subject event for any potential generic implications at other sites or facilities. Due to the potential significance of glove box floor depressions in affecting NCS conditions while handling SNM, the inspectors noted that the issuance of a generic communication to inform the nuclear fuel cycle industry of the facts surrounding this event would be beneficial to all stakeholders.

(2) Conclusions

This issue should be considered for a potential a generic communication to inform the nuclear fuel cycle industry the facts surrounding this event.

5. Exit Meeting

The inspection scope and results were summarized on March 27, 2009, with Mr. D. Kudsin and other members of his staff as indicated in the attachment. Although proprietary documents and processes were occasionally reviewed during this inspection, the proprietary nature of these documents or processes have not been included in this report. No dissenting comments were received from the licensee.

ATTACHMENT

1. PARTIAL LIST OF PERSONS CONTACTED

Nuclear Fuel Services, Inc.

G. Athon, Jr., Director, Applied Technology and Principal Scientist
N. Brown, Nuclear Safety Engineer
D. Coulter, Health Physicist
R. Dailey, Engineering Director
M. Dotson, Maintenance Manager
R. Droke, Licensing and Compliance Director
D. Ferguson, Principle Advisor to the President
D. Kudsin, President, NFS
T. Lindstrom, Vice President, Operations
B. Long, Project Engineering Section Manager
M. Moore, Director, Safety and Regulatory
J. Nagy, Chief Nuclear Safety Officer
J. Quillen, Process Engineering Director
R. Shackelford, Nuclear Criticality Safety Manager
T. Sheehan, Director, High Enriched Uranium (HEU) Operations
M. Shope, Quality Assurance Manager
A. Vaughn, Director, Fuel Production
J. Wheeler, Licensing and ISA Manager
D. Wise, Director, Fuel and Operations

2. INSPECTION PROCEDURES (IP) USED

IP 88003	Reactive Inspection for Events at Fuel Cycle Facilities
IP 88020	Operational Safety
IP 93812	Special Inspection

3. LIST OF ACRONYMS USED

ADAMS	Agency Documents Access and Management System
BLEU	Blended Low Enriched Uranium
BPF	BLEU Preparation Facility
CD	commercial development
CFR	Code of Federal Regulations
DFFI	Division of Fuel Facility Inspection
IP	inspection procedure
IR	inspection report
IROFS	item relied on for safety
NCS	nuclear criticality safety
NFS	Nuclear Fuel Services, Inc.
NRC	U.S. Nuclear Regulatory Commission
PARS	publicly available records
SIT	Special Inspection Team
SNM	Special Nuclear Material