

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

Docket No: 70-27

License No: SNM-42

Report No: 70-27/2005-202

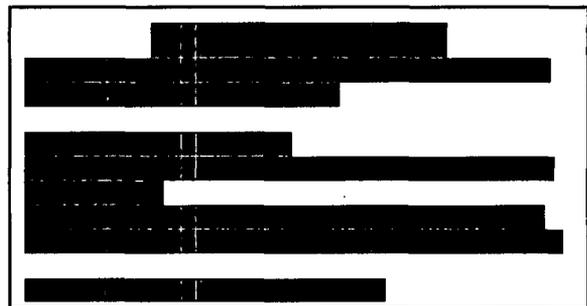
Licensee: BWX Technologies, Inc.

Location: Lynchburg, VA

Inspection Dates: March 7-11, 2005

Inspectors: Lawrence Berg, Criticality Safety Inspector, NRC Headquarters
Christopher Tripp, Senior Criticality Safety Reviewer, NRC Headquarters

Approved by: Melanie A. Galloway, Chief
Technical Support Group
Division of Fuel Cycle Safety
and Safeguards, NMSS



Attachment:
Supplementary Information

Enclosure

[REDACTED]

EXECUTIVE SUMMARY

BWX Technologies, Inc. NRC Inspection Report 70-0027/2005-202

Introduction

Staff of the U.S. Nuclear Regulatory Commission (NRC) performed a routine and announced nuclear criticality safety (NCS) inspection of the BWX Technologies, Lynchburg, Virginia, facility from March 7 through 11, 2005. The inspection included an on-site review of the license programs dealing with plant operations, criticality accident alarm systems, and the NCS function. The license programs were acceptably directed toward the protection of public health and safety, and in compliance with NRC requirements. The inspection focused on risk-significant [REDACTED] material processing activities including fuel fabrication and machining, [REDACTED], uranium recovery and [REDACTED].

Results

- The NCS function was adequate for maintaining acceptable levels of safety. Four technical issues associated with the licensee's validation process were identified.
 - The licensee's placement of criticality monitoring system detectors provides acceptable coverage of risk-significant operations.
 - NCS quarterly audits were adequate for maintaining acceptable levels of safety.
 - Plant operations involving [REDACTED] materials were conducted safely and in accordance with written procedures.
- [REDACTED]

REPORT DETAILS**1.0 NCS Function (88015)****a. Inspection Scope**

The inspectors reviewed NCS analyses to determine that criticality safety of risk-significant operations was assured through engineered and human performance (controls) with adequate safety margin/certainty, preparation and review by capable staff. The inspectors reviewed documentation associated with criticality code validation to confirm that the licensee appropriately validated its criticality codes and had adequate assurance of subcriticality. Documents reviewed included the NCS Benchmark Notebook, two validation reports for [REDACTED] and supporting documents. The inspectors reviewed selected aspects of the following documents:

- NCS 2004-281, "Nuclear Criticality Safety Analysis Supporting Posting Changes Associated [REDACTED] as a Result of OB-2004-24," dated December 2, 2004
- NCS 2004-250, "NCS Analysis for SER 03-035 Phase 1 for [REDACTED]," dated October 13, 2004
- NCS 2004-273, "Nuclear Criticality Safety Concern for an [REDACTED]," November 12, 2004
- NCS 2004-251, "Level 2 NCS Evaluation for "[REDACTED]," dated October 7, 2004
- NCS 2004-261, "SER 04-043 Phase 1 [REDACTED]," dated October 22, 2004
- NCS 2005-009, "Nuclear Criticality Safety Analysis Supporting All Phases of SER 04-060," dated February 8, 2005
- NCS 2004-284, "Nuclear Criticality Safety Analysis Supporting Phase 2 of SER 04-012," dated December 7, 2004
- NCS 2000-018, "Nuclear Criticality Safety Evaluation for [REDACTED]," February 17, 2000
- NCS 1990-167, "NCS of Less than [REDACTED] Containers on a [REDACTED] Edge-to-edge Spacing," August 8, 1990

[REDACTED]

there was no procedural requirement to use it to confirm calculations were within the validated ROA.

Given the lack of descriptiveness regarding the range of tabulated parameters over which different materials were considered validated, the inspectors were concerned that this could lead to the performance of non-conservative calculations that were not covered by the existing validation. The inspectors selected cases involving [REDACTED] to evaluate the licensee's existing process for demonstrating coverage within the ROA. The inspectors reviewed the [REDACTED] validation report and three calculations (NCS-1995-032, NCS-1995-086, and NCS-1996-098) involving [REDACTED] containing [REDACTED]. The inspectors determined that the [REDACTED] validation report contained 27 validation cases containing varying amounts of [REDACTED]. The inspectors verified that the range of parameters evaluated in the criticality calculations fell within the ROA of the [REDACTED] validation report. No safety concerns were identified with the licensee's existing process for demonstrating coverage within the ROA. During the inspection, the licensee indicated that a validation database was in development. Development of the validation database for demonstrating compliance with the validated ROA will be tracked as **IFI 70-27/2005-202-02**.

The inspectors noted an unusually large spread in the calculated k_{eff} values, ranging from [REDACTED]. The observed spread in k_{eff} values was approximately the same magnitude as the margin of subcriticality. Examination of the calculated k_{eff} values for HEU systems [REDACTED]

[REDACTED] The inspectors examined the descriptions of both the highest and lowest k_{eff} cases and observed that many of the cases with a large negative bias involved material forms and compositions that were significantly different from both analyzed and actual process conditions. In addition, the inspectors noted that the configurations for several of the cases with the highest and lowest k_{eff} values were poorly described with experimental uncertainties not readily available. Because the observed spread in k_{eff} values was from a finite set of validation cases, the inspectors were concerned that the spread could be larger for either an expanded or different set of validation cases and possibly challenge the approved subcritical margin. Examining the poorly described cases and determining their uncertainties will be tracked as **IFI 70-27/2005-202-03**.

In response to the inspectors' questions regarding the large spread in k_{eff} values, the licensee stated that the following actions were already in progress at the time of the inspection to characterize bias trends: (1) establishing the pedigree of validation cases, including use of poorly described configurations and the uncertainties associated with them; (2) removing validation cases that the licensee determined to not be of benchmark quality or contain apparent errors; and (3) examining subsets of the data to determine the reasons for the large positive and negative biases. The inspectors noted that the licensee had taken a conservative approach to removing erroneous validation cases and is not discarding apparent outliers based only on statistics. Examining

[REDACTED]

individual subsets of the data localized bias trends (especially those resulting in low calculated k_{eff} values) will be tracked as **IFI 70-27/2005-202-04**.

The inspectors then reviewed the [REDACTED] validation report, dated August 4, 2003, which validates use of the code with the [REDACTED]-group cross section libraries. The inspectors noted that this validation report was very similar to the [REDACTED] report with the exception of some minor issues (e.g., trending of k_{eff} as a function of ECALCF was not done). Following discussions with the licensee, the inspectors determined that no new calculations were being performed using [REDACTED]. Therefore, no followup was requested of the minor issues identified with the validation report.

c. Conclusions

The NCS function was adequate for maintaining acceptable levels of safety. Four technical issues associated with the licensee's validation process were identified and will be tracked as IFIs.

2.0 Criticality Alarm System (88015)

a. Scope of Inspection

The inspectors reviewed criticality monitoring system (CMS) detector placement analyses to determine the adequacy of models, assumptions, variance reduction, and calculation results used to support the licensee's efforts to reduce the number of installed detectors. The inspectors visually inspected detector placement configurations to verify that dual detector coverage of risk-significant operations was being maintained. The inspectors reviewed selected aspects of the following document:

- NCS 2004-285, "NCS Analysis [REDACTED]: SER 04-051," dated December 14, 2004

b. Observations and Findings

The inspectors observed that the licensee had reevaluated placement of criticality monitoring system (CMS) detectors at the [REDACTED] using Monte Carlo N-Particle (MCNP) calculations. The calculations were required to evaluate the impact on coverage associated with the relocation of detectors. The inspectors determined that the steady-state source used in the MCNP calculations [REDACTED] was adequately bounding for the materials expected and produced the same integrated dose as the original depletion analyses (i.e., 20 Rads at 2 meters in one minute), and that the MCNP calculational methodology did not use biasing to force convergence. The inspectors noted that the calculations demonstrated acceptable detector coverage.

c. Conclusions

The licensee's placement of criticality monitoring system detectors provides acceptable coverage of risk-significant operations.

3.0 Inspections, Audits and Investigations (88015)

a. Inspection Scope

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

- NCS 2004-245, "3rd Quarter 2004 NCS Findings and Observation Summary," dated October 4, 2004
- NCS 2004-286, "4th Quarter 2004 NCS Findings and Observation Summary," dated January 7, 2005

b. Observations and Findings

The inspectors observed that the licensee NCS audits were conducted in accordance with written procedures. The inspectors noted that the audits were performed by NCS engineers who: (1) reviewed open NCS issues from previous audits; (2) reviewed the adequacy of control implementation; (3) reviewed plant operations for compliance with license requirements, procedures, and postings; and (4) examined equipment and operations to determine that past evaluations remained adequate. No safety concerns were noted.

c. Conclusions

NCS quarterly audits were adequate for maintaining acceptable levels of safety.

4.0 Plant Operations (88015)

a. Inspection Scope

The inspectors performed plant walkdowns to review activities in progress and to determine whether risk-significant [REDACTED] material operations were being conducted safely and in accordance with regulatory requirements. The inspectors verified the adequacy of management measures for assuring the continued availability, reliability and capability of safety-significant controls relied upon by the licensee for controlling criticality risks to acceptable levels. The inspectors performed walkdowns of fuel fabrication and machining, [REDACTED], uranium recovery, and [REDACTED] process areas.

The inspectors reviewed selected aspects of the following documents prior to performing the walkdowns:

- NCS 2004-251, "Level 2 NCS Evaluation for [REDACTED] [REDACTED]," dated October 7, 2004
- NCS 2005-009, "Nuclear Criticality Safety Analysis Supporting All Phases of SER 04-060," dated February 8, 2005
- NCS 2004-284, "Nuclear Criticality Safety Analysis Supporting Phase 2 of SER 04-012," dated December 7, 2004
- NCS 2004-273, "Nuclear Criticality Safety Concern for an [REDACTED] [REDACTED]," November 12, 2004
- NCS 2004-261, "SER 04-043 Phase 1 [REDACTED] [REDACTED]," dated October 22, 2004

b. Observations and Findings

The inspectors verified that controls identified in NCS analyses were installed or implemented and were adequate to assure safety. The cognizant NCS engineers were knowledgeable and had good interfaces with operators on the process floors. No safety issues were identified during the walkdowns.

c. Conclusions

Plant operations involving [REDACTED] materials were conducted safely and in accordance with written procedures.

5.0 Open Item Review

Inspector Follow-up Item 70-27/2004-207-01

This item concerned the licensee's revision of [REDACTED] [REDACTED] postings to clarify the storage requirements. During inspection 70-27/2004-207, the inspectors identified examples where more than [REDACTED] appeared to be stored per storage location. The inspectors observed that the licensee had eliminated the requirement to limit storage [REDACTED] to no more than [REDACTED] per storage location. The inspectors noted that the requirement for spacing between [REDACTED] confirmed that criticality safety was assured by existing controls on mass [REDACTED]. During tours of the process areas, the inspectors verified that the [REDACTED] postings had been revised to remove the [REDACTED] location requirement. The inspectors determined that the licensee's revision of [REDACTED] postings was adequate for maintaining safety. This item is closed.

[REDACTED]



6.0 Exit Meetings

The inspectors presented the inspection scope and results to members of the licensee's management and staff during an exit meeting on March 11, 2005. The licensee acknowledged and understood the findings as presented.



[REDACTED]

SUPPLEMENTARY INFORMATION

1.0 List of Items Opened, Closed, and Discussed

Opened

- IFI 70-27/2005-202-01 Correction of subcritical margin for [REDACTED] and references to the [REDACTED]
[REDACTED]-group cross section libraries in [REDACTED] validation report
- IFI 70-27/2005-202-02 Development of the validation database for demonstrating
compliance with the validated ROA
- IFI 70-27/2005-202-03 Reviewing poorly described validation cases; determining and
analyzing experimental uncertainties
- IFI 70-27/2005-202-04 Examining individual subsets of data to determine localized bias
trends (including reason for low k_{eff} values)

Closed

- IFI 70-27/2004-207-01 Tracks licensee actions to clarify the posting requirements [REDACTED]
[REDACTED]

Discussed

None

2.0 Inspection Procedures Used

- IP 88015 Headquarters Nuclear Criticality Safety Program

3.0 Partial List of Persons Contacted

BWXT

- * T. Brown Manager, Operations
- * L. Duncan Manager, Nuclear Criticality Safety
- * C. Reed Manager, Uranium Recovery Process Systems
- * S. Schilthelm Manager, Safety and Licensing
- * D. Ward Manager, Environment, Safety, Health and Safeguards
- M. Mitchell NCS Engineer
- L. Wetzel NCS Engineer
- B. Kidd NCS Engineer

* All attended the exit meeting on March 11, 2005.

ATTACHMENT

[REDACTED]