

October 21, 2010

Mr. Roger P. Cochrane, General Manager  
Babcock and Wilcox Nuclear Operations Group, Inc.  
P.O. Box 785  
Lynchburg, VA 24505-0785

SUBJECT: INSPECTION REPORT NO. 70-0027/2010-205

Dear Mr. Cochrane:

The U.S. Nuclear Regulatory Commission (NRC) conducted a routine announced nuclear criticality safety (NCS) inspection at your Babcock and Wilcox Nuclear Operations Group, Inc. facility in Lynchburg, VA from September 27-30, 2010. The purpose of the inspection was to determine whether activities involving special nuclear materials were conducted safely and in accordance with regulatory requirements. Observations and findings were discussed with members of your management and staff throughout the inspection and at an exit meeting held on September 30, 2010.

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

In accordance with 10 CFR 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>.

R. Cochrane

-2-

If you have any questions concerning this report, please contact Dennis Morey, of my staff, at (301) 492-3112.

Sincerely,

***/RA/***

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

Docket No.: 70-27  
License No.: SNM-42

Enclosure: Inspection Report No. 70-0027/2010-205

cc: Barry Cole  
Licensing Officer  
Babcock and Wilcox Nuclear Operations Group, Inc.

R. Cochrane

-2-

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cc: Barry Cole  
Licensing Officer  
Babcock and Wilcox Nuclear Operations Group, Inc.

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

Docket No.: 70-27

License No.: SNM-42

Report No.: 70-27/2010-205

Licensee: Babcock and Wilcox Nuclear Operations Group, Inc.

Location: Lynchburg, VA

Inspection Dates: September 27- 30, 2010

Inspectors: Dennis Morey, Senior Criticality Safety Inspector  
Tamara Powell, Criticality Safety Inspector  
Alexis Sotomayor-Rivera, Criticality Safety Reviewer

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

Enclosure

## **EXECUTIVE SUMMARY**

### **Babcock and Wilcox Nuclear Operations Group, Inc. NRC Inspection Report 70-27/2010-205**

#### **Introduction**

Staff of the U.S. Nuclear Regulatory Commission (NRC) performed a routine and announced nuclear criticality safety (NCS) inspection of the Babcock and Wilcox (B&W) Nuclear Operations Group, Inc., Lynchburg, Virginia facility from September 27-30, 2010. The inspection included an on-site review of the licensee's NCS program, NCS-related inspections, audits and investigations, plant operations and open item review. The inspection focused on risk-significant fissile material processing activities including fuel fabrication and machining; the uranium recovery area; the Research, Test Reactor and Target (RTRT) area; the Specialty Fuels Facility (SFF); Vault 7; and various storage areas throughout the facility.

#### **Results**

- No safety concerns were identified regarding development, review, or approval of NCS analysis or calculations or resulting NCS controls.
- No safety concerns were noted regarding the licensee's identified NCS-related events and corrective actions were adequately tracked by the licensee.
- No safety concerns were identified regarding NCS audits.
- No safety concerns were identified regarding the licensee's Criticality Accident Alarm System (CAAS) coverage of fissile material operations.
- No safety concerns were identified during facility walkdowns.

## REPORT DETAILS

### 1.0 Summary of Plant Status

B&W Nuclear Operations Group, Inc., manufactures high-enriched uranium fuel, reactor core components and reactor cores at its facility near Lynchburg, VA. During the inspection, the licensee conducted routine fuel manufacturing operations and maintenance activities in the fuel fabrication areas. The uranium recovery area was shut down for semiannual inventory activities.

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

#### a. Inspection Scope

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

- [Quality Work Instruction] QWI 2.1.3, "ISA [integrated safety analysis] Methodology," dated April 16, 2010
- [Nuclear Criticality Safety Evaluation] NCSE-02, "Nuclear Criticality Safety Analyses [NCSA] and Quality Assurance Reviews," Rev. 38, dated October 30, 2009
- NCSE-02, "Nuclear Criticality Safety Analyses and Quality Assurance Reviews," Rev. 39, dated July 16, 2010
- NCS-2010-096, "NCS Safety Analysis Supporting the Removal of Pylons and Railings from around the Horizontal UT Tanks per CR-1033581," dated May 4, 2010
- NCS-2010-099, "NCS Safety Analysis Supporting the License Amendment for VFF [Virginia Forward Fit] Cluster Production," dated July 15, 2010
- NCS-2010-112, "NCS Safety Analysis Supporting the Modification of the A1B Solid Hafnium Poison Fixture," dated June 8, 2010
- NCS-2010-115, "Heated Expanded PVC 5-inch and 4-inch Columns in Recovery and LLD [Low Level Dissolution] Areas," dated August 31, 2010
- NSC-2010-117, "Establishment of the Calculation Margin (Bias) and Basis for the Safety Margin for the VFF Cluster," dated July 19, 2010.
- NCS-2010-135, "Calculations to Determine Mass Limits Specific Accumulation of Uranium Bearing Solution in the High Level Dissolver Pass-Through Glovebox," dated July 1, 2010
- NCS-2010-142, "NCSA for SER [Safety Evaluation Report] 10-029 Phase I Trough Pass-through Box Safety Analysis and System Modifications," dated September 15, 2010
- NCS-2010-182, "Nuclear Safety Extraction System," dated September 7, 2010

#### b. Observations and Findings

The inspectors reviewed NCS approvals, NCS evaluations, and supporting calculations for new, changed, and other selected operations. Within the selected aspects reviewed, the inspectors determined that the analyses were performed by qualified NCS

engineers, that independent reviews of the evaluations were completed by qualified NCS engineers, and that the analyses provided for sub-criticality of the systems and operations. The inspectors observed that the analyses contained appropriate limits on controlled parameters for each credible accident sequence leading to inadvertent criticality. NCSAs and supporting calculations demonstrated adequate identification and control of NCS hazards to assure operations within subcritical limits.

The NRC inspectors reviewed documentation of the new VFF cluster design, interviewed engineering and production/manufacturing staff, and performed walkdowns to examine procedures and operations described in the license amendment for the new design. The NRC inspectors reviewed NCS evaluations to establish calculational margin (bias) and safety margin for the new system, including supporting calculations for the new system design and other selected operations. Within the selected aspects reviewed, the inspectors determined that the analyses provided for sub-criticality of the new design and were performed by qualified NCS engineers. During walkdowns of the fuel fabrication and machining shops, the inspectors observed that in the manufacturing process, each component received multiple quality inspections as specified in the license amendment.

c. Conclusions

No safety concerns were identified regarding development, review, or approval of NCS analysis or calculations or resulting NCS controls.

### **3.0 Nuclear Criticality Safety Event Review and Follow-Up (IP 88015 & IP 88016)**

a. Inspection Scope

The inspectors reviewed the licensee's response to internally reported events. The inspectors reviewed the progress of investigations and interviewed licensee staff regarding immediate and long-term corrective actions. The inspectors reviewed selected aspects of the following documents:

- NCS-2010-100, "Safety Concern Analysis (SCA) for Piece Count Violation on a Bay 8 Cantilever," dated May 7, 2010
- NCS-2010-114, "30-Day Report to the General Manager for Excessive Moderating Material on a Component Cart," dated May 26, 2010
- NCS-2010-119, "30-Day Report to the General Manager for Piece Count Violation on Cantilever Rack," dated June 3, 2010
- NCS-2010-151, "SCA for Failure to Sample Acid Solution After Recovery Pickling Elements," dated July 26, 2010
- NCS-2010-155, "Safety Concern Analysis for a Piece Count Violation on a Transport Cart," dated July 28, 2010
- NCS-2010-156, "SCA for Smart Crane Procedural Violation," dated August 2, 2010
- NCS-2010-164, "SCA for ATR Vertical Plate Cart with Less than Required Spacing between Potential Fueled Zones," dated August 12, 2010
- NCS-2010-165, "30-Day Report to the General Manager for CA201001618 – Failure to Sample Acid Solution after Recovery Pickling Elements," dated August 18, 2010

- NCS-2010-169, “SCA for Excess Moderation in the Filler Area,” dated August 24, 2010
- NCS-2010-171, “30-Day Report to the General Manager for CA201001668 - Procedural Violation Using the Smart Crane,” dated August 26, 2010
- NCS-2010-183, “30-Day Report to the General Manager for CA201001820 – Spacing Violation on Vertical Plate Cart in RTRT,” dated September 8, 2010
- NCS-2010-189, “SCA for Overconcentration in Product Column in 3-inch Extraction System,” dated September 15, 2010
- NCS-2010-190, “30-Day Report to the General Manager for CA201001962 – Excess Moderation in the Filler Area,” dated September 15, 2010
- NCS-2010-191, “SCA for Failed Quarterly Test of the Bay 7 Smart Crane,” dated September 16, 2010

b. Observations and Findings

The inspectors reviewed selected licensee internally-reported events. The inspectors determined that internal events were investigated in accordance with written procedures and appropriate corrective actions were assigned. The inspectors had no safety concerns regarding the licensee’s reporting, investigation, and correction of internal NCS related events.

c. Conclusions

No safety concerns were noted regarding the licensee’s identified NCS-related events and corrective actions were adequately tracked by the licensee.

#### **4.0 Nuclear Criticality Safety Inspections, Audits, and Investigations (IP 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:

- NCSE-03, “NCS Audits and Inspections,” Rev. 24, dated February 27, 2009
- NCS-2010-148, “NCS Violation and Observation Summary – 2nd Quarter 2010,” dated July 20, 2010
- NCS-2010-193, “NCS Analysis per SER 10-014, Phases 1 through 3 (Replacement of Primary and Raffinate Organic Raschig Ring Tanks),” dated September 21, 2010
- NCS-2010-197, “Nuclear Criticality Safety Release for Replacement of Primary and Raffinate Organic Raschig Ring Tanks (SER 10-014 Phase 1),” dated September 22, 2010

b. Observations and Findings

The inspectors accompanied an NCS engineer on a weekly inspection of the Chemical Recovery area. The inspectors determined that the licensee’s NCS inspections were conducted in accordance with written procedures. The inspectors noted that the inspections were performed by NCS engineers who reviewed open NCS issues from

previous audits; reviewed new violations that occurred during the audit quarter; reviewed the adequacy of control implementation; reviewed plant operations for compliance with license requirements, procedures, and postings; examined equipment and operations to determine that past evaluations remained adequate; and analyzed non-compliances for potential trends.

c. Conclusions

No safety concerns were identified regarding NCS audits.

**5.0 Criticality Accident Alarm System (IP 88017)**

a. Inspection Scope

The inspectors interviewed engineering staff regarding a planned upgrade of the CAAS.

b. Observations and Findings

The inspectors noted that the licensee is planning a complete replacement of the CAAS due to the unavailability of spare parts for the existing system. The current system relies on paired detectors to provide coverage and uses logic that requires a pair in an alarm condition to cause a signal. The inspectors noted that the planned new criticality alarm system will use sets of three circuits with 10-15 detectors on each circuit and a logic requiring alarm conditions on two different circuits, in a set of three, for a signal. The licensee expects that this arrangement will provide adequate coverage with fewer detectors. No safety concerns were identified regarding the planned criticality alarm system upgrade.

c. Conclusions

No safety concerns were identified regarding the licensee's CAAS coverage of fissile material operations.

**6.0 Plant Operations (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.

b. Observations and Findings

The inspectors performed walkdowns in fuel fabrication and machining; the uranium recovery area; the RTRT area; the SFF; Vault 7; and various storage areas throughout the facility. The inspectors interviewed production staff regarding details of the contactor centrifuge operation and performed a walkdown of that system. The inspectors verified that controls identified in NCS analyses were installed or implemented and were adequate to ensure safety. The inspectors also verified that safety was maintained for

observed facility operations. The cognizant, NCS engineers were knowledgeable and interacted regularly with operators on the process floors. The inspectors verified the adequacy of management measures for assuring the continued availability, reliability, and capability of safety-significant controls relied upon by the licensee for controlling criticality risks.

c. Conclusions

No safety concerns were identified during facility walkdowns.

**7.0 Open Item Review**

**URI 70-27/2009-03-01**

This item tracks licensee review of the NCS impact of transfers of thermally hot SNM-bearing solutions on Transparent Polyvinyl Chloride (TPVC) process columns. During a previous inspection, the inspectors questioned the effect of thermal expansion due to hot solutions on the criticality safety analysis of TPVC columns. During the current inspection, the inspectors noted that the licensee had completed NCS-2010-115, "Heated Expanded PVC [Polyvinyl Chloride] 5-inch and 4-inch Columns in Recovery and LLD Areas," which discussed the amount and effect of thermal expansion possible in TPVC process columns. The inspectors determined that the amount of likely thermal expansion due to hot solutions is on the order of 0.3 inches and will not affect the original analytical conclusion. The licensee changed the normal case for the analysis to be based on the slightly expanded size. The inspectors determined that the accident sequence was unchanged so that there was no unanalyzed condition. The inspectors also noted that the licensee had changed the associated limiting condition for operations in situations where heated solutions could be introduced into TPVC process columns. This item is closed.

**IFI 70-27/2010-201-01**

This item tracks revision of validation and supporting calculations to adequately justify use of PVC piping as a neutron absorber. During a previous inspection, the inspectors noted that the criticality analysis for PVC piping took credit for the thickness and density of the piping as a neutron absorber in some models. The inspectors questioned whether PVC was properly validated for use in these calculations. The licensee had planned to revise the PVC piping analysis to evaluate for sensitivity of these models to the presence of chlorine and enhance the validation by adding more experiments containing chlorine. During this inspection, the licensee stated that the revision to the PVC piping analysis had not yet been completed. This item remains open.

**VIO 70-27/2010-203-01**

This violation tracks the failure to conduct operations according to administrative limits (e.g. storing moderating material on a cart designated for fuel). During the previous inspection, the inspectors performed a walkdown of the fuel fabrication areas, and observed an unattended cart being used to store wooden crate material in an area used to process fuel. Upon further discussion with NCS personnel, the inspectors determined that there was an area procedure in place restricting carts designated for fuel from being

used to store non-fuel components constructed primarily of moderating material. During this inspection, the inspectors determined that the licensee adequately identified both the root cause of the violation and the corrective actions to prevent recurrence, which have been entered into the licensee's corrective action program. The corrective actions included performing an NCS evaluation to evaluate the effects of reflection from carts containing non-fuel components constructed primarily of moderating material when placed adjacent to fuel bearing items and revising the procedure to clarify the proper use of designated fuel carts. This item is closed.

## **8.0 Exit Meeting**

The inspectors presented the inspection scope and results to members of the licensee's management and staff during an exit meeting on September 30, 2010. The licensee acknowledged and understood the findings as presented.



## SUPPLEMENTARY INFORMATION

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

#### Items Opened

None

#### Items Discussed

**IFI 70-27/2010-201-01** Tracks revision of validation and supporting calculations to adequately justify use of PVC piping as a neutron absorber.

#### Items Closed

**URI 70-27/2009-03-01** Tracks licensee review of the NCS impact of transfers of thermally hot SNM-bearing solutions on TPVC process columns.

**VIO 70-27/2010-203-01** Failure to conduct operations according to administrative limits (e.g. storing moderating material on a cart designated for fuel)

### 2.0 Inspection Procedures Used

IP 88015 Nuclear Criticality Safety Program  
IP 88016 Nuclear Criticality Safety Evaluations and Analyses  
IP 88017 Criticality Accident Alarms

### 3.0 Partial List of Persons Contacted

#### B&W NOG

D. Faidley Manager, Nuclear Criticality Safety  
L. Wetzel Senior Engineer, Nuclear Criticality Safety  
B. Cole Manager, Licensing and Safety Analysis  
D. Ward Manager, EHS&S  
D. Spangler Nuclear Safety & Licensing

#### NRC

D. Morey Senior Criticality Safety Inspector, NRC Headquarters  
T. Powell Criticality Safety Inspector, NRC Headquarters  
A. Sotomayor-Rivera Criticality Safety Inspector, NRC Headquarters  
S. Subosits Senior Resident Inspector, NRC Region II

#### 4.0 List of Acronyms

B&W	Babcock and Wilcox
IFI	inspector follow-up item
IP	inspection procedure
ISA	integrated safety analysis
LLD	Low Level Dissolution
NCS	nuclear criticality safety
NCSA	nuclear criticality safety analysis
NCSE	nuclear criticality safety evaluation
NOV	Notice of Violation
PVC	Polyvinyl Chloride
RTRT	Research, Test Reactor and Target
SCA	safety concern analysis
SER	Safety Evaluation Report
SFF	Specialty Fuels Facility
SNM	Special Nuclear Material
TPVC	Transparent Polyvinyl Chloride
VFF	Virginia Forward Fit