

October 6, 2005

Mr. Mark W. Fecteau, Plant Manager  
Westinghouse Electric Company  
Commercial Nuclear Fuel Division  
P.O. Drawer R  
Columbia, SC 29250

SUBJECT: INSPECTION REPORT NO. 70-1151/2005-202

Dear Mr. Fecteau:

The U.S. Nuclear Regulatory Commission (NRC) conducted a routine announced criticality safety inspection at your facility in Columbia, South Carolina, from September 12 through 16, 2005. The purpose of the inspection was to determine whether activities involving licensed materials were conducted safely and in accordance with NRC requirements. An exit meeting was held on September 16, 2005. Throughout this inspection, observations and findings were discussed with your managers and staff.

The inspection, which is described in the enclosure, focused on: (1) the most hazardous activities and plant conditions; (2) the most important controls relied on for safety and their analytical basis; and (3) the principal management measures for ensuring controls are capable, 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 nuclear criticality safety (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.

Based on the results of this inspection, the NRC has determined that one Severity Level IV violation of NRC requirements occurred. This violation is being treated as a Non-Cited Violation (NCV), consistent with Section VI.A of the Enforcement Policy. The NCV is described in the subject inspection report. If you contest the violation or significance of the NCV, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington DC 20555-0001, with copies to the Chief, Technical Support Group, Division of Fuel Cycle Safety and Safeguards, Office of Nuclear Material Safety and Safeguards, the Regional Administrator, Region II, and the Director, Office of Enforcement, United States Nuclear Regulatory Commission, Washington, DC 20555-0001.

In accordance with 10 CFR 2.390 of NRC's "Rules of Practice," a copy of this letter and the enclosure will be available in the public electronic reading room of the NRC's Agency-wide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>.

M. Fecteau

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If you have any questions concerning this report, please contact Dennis Morey, of my staff, at (301) 415-6107.

Sincerely,

**/RA/**

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

Docket No. 70-1151  
License No. SNM-1107

Enclosure: Inspection Report 70-1151/2005-202

cc w/enclosures: Mr. Sam McDonald  
Westinghouse Electric Company

cc w/o enclosure: T. Pearce O'Kelley  
Bureau of Radiological Health  
South Carolina Department of Health  
and Environmental Control

M. Fecteau

-2-

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

Docket No.: 70-1151

License No.: SNM-1107

Report No.: 70-1151/2005-202

Licensee: Westinghouse Electric Company

Location: Columbia, SC

Inspection Dates: September 12 - 16, 2005

Inspector: Dennis Morey, Senior Criticality Safety Inspector

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

Enclosure

**Westinghouse Electric Company  
NRC Inspection Report No. 70-1151/2005-202**

**EXECUTIVE SUMMARY**

**Introduction**

Staff of the U.S. Nuclear Regulatory Commission performed a routine and announced nuclear criticality safety (NCS) inspection of the Westinghouse Electric Company (WEC) Columbia, South Carolina facility from September 12 through 16, 2005. The inspection included an on-site review of the licensee's programs dealing with the NCS program, the NCS analytical basis, NCS event review, the criticality safety alarm system, and open items. The inspection focused on risk-significant fissile material processing activities including the chemical area, the uranium recycle and recovery system, the ammonium diuranate (ADU) conversion area and the integrated fuel burnable absorber (IFBA) area.

**Results**

- No safety concerns were identified during review of new and changed criticality safety analyses.
- A non-cited violation was identified regarding the stacking of rod transfer caskets containing IFBA rods.
- Appropriate compensatory measures were in place for a licensee-identified criticality alarm system audibility weakness.
- The licensee agreed to revise its criticality alarm audibility test procedure to improve its ability to detect inoperable horns.
- Plant operations involving fissile materials were being conducted safely and in accordance with written procedures.

## REPORT DETAILS

### 1.0 NCS Program (88015)

#### a. Inspection Scope

The inspector 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 inspector reviewed selected aspects of the following documents:

- CSE-021-C, "Criticality Safety Evaluation (CSE) for BWR [boiling water reactor] Rod Storage and Handling," Revision 0, dated August 4, 2005
- CSE-99-A, "CSE for Transfer of Material from Type 3516 Shipping Container to Polypaks in the Crystals Area," Revision 0, dated September 7, 2005
- CRI-05-19, "Criticality Safety Analysis for the Transfer of Material from Type 3516 Shipping Container to Polypaks in the Crystals Area," Revision 0, dated September 7, 2005
- CSE-01-A, "CSE for IFBA [Integrated Fuel Burnable Absorber] Ventilation System F-7113," Revision 0, dated June 1, 2005
- RA-312, "NCS Calc Note Generation, Format and Content Requirements," Revision 0, dated March 10, 2005
- RA-310, "Nuclear Criticality Safety Independent Technical Review," Revision 9, dated March 10, 2005
- NCS-001, "Procedure for Evaluation of the CFFF [Columbia Fuel Fabrication Facility] NCS Technical Basis and Prioritization of Identified Updates," Revision 2, dated August 15, 2005

#### b. Observations and Findings

Within the selected aspects reviewed, the inspector determined that the analyses were performed by capable NCS engineers, that independent reviews of the evaluations were completed by other qualified NCS engineers, that subcriticality of the systems and operations was assured through appropriate limits on controlled parameters, and that double contingency was assured for each credible accident sequence leading to inadvertent criticality. The inspector determined that NCS controls for equipment and processes assured the safety of the operations.

#### c. Conclusions

No safety concerns were identified during review of new and changed criticality safety analyses.

## 2.0 NCS Event Review (88015)

### a. Inspection Scope

The inspector reviewed the licensee's response to a recent NCS reportable event. The inspector reviewed the progress of the investigation and interviewed licensee staff regarding immediate and long-term corrective actions. The inspector reviewed selected aspects of the following documents:

- CSE-12-A, "CSE [criticality safety evaluation] for Rod Transfer Caskets," Revision 0, dated August 21, 2005
- CRI-05-017, "Rod Casket Slab Calculations," Revision 0, dated August 21, 2005
- COP-871160, "Package IFBA Rods for Transport," Revision 16, dated February 10, 2005
- COP-871160, "Package IFBA Rods for Transport," Revision 17, dated August 22, 2005

### b. Observations and Findings

On August 19, 2005, the licensee reported that IFBA rod caskets had been found stacked in violation of criticality analysis and procedural requirements. After loading, IFBA fuel rods are transported to the quality control inspection area in a specially designed container designated as a rod casket due to its shape. Criticality safety analysis requires that the rod caskets remain in the same horizontal plane which precludes stacking. During a routine criticality safety audit by licensee NCS engineers, several IFBA rod caskets containing rods ready for quality control inspection were found stacked. Licensee investigation revealed that, although the work procedure prohibited stacking the caskets, the NCS posting on the caskets did not prohibit stacking.

Licensee immediate corrective actions included unstacking the caskets, halting casket loading operations, and retraining operators. Long-term corrective actions included modifying the caskets to prevent incorrect loading, modifying the caskets to prevent stacking, and revising the casket posting to prohibit stacking. The inspector determined that the licensee corrective actions would preclude recurrence of the problem. The inspector determined that stacking the caskets violated the caution statement following step 2.11 in licensee procedure COP-871160, "Package IFBA Rods for Transport." This non-repetitive, licensee-identified and corrected violation is being treated as a Non-Cited Violation, consistent with Section VI.A.8 of the NRC Enforcement Policy. Failure to maintain the IFBA transport caskets in a horizontal array is **Non-cited Violation (NCV) 70-1151/2005-202-01**.

### c. Conclusions

A non-cited violation was identified regarding the stacking of rod transfer caskets containing IFBA rods.

### 3.0 Criticality Alarm System (88015)

#### a. Inspection Scope

The inspector reviewed the licensee's criticality accident alarm system including detector placement and audibility. The inspector reviewed the following document:

- MCP-202037, "GA-6M Criticality Alarm Calibration," Revision 12, dated August 1, 2002

#### b. Observations and Findings

The inspector determined that the licensee criticality accident alarm system consisted of an interconnected detector/annunciator system inside the main process buildings and three independent detector/annunciator systems covering exterior fissile material operations. The inspector noted that the licensee had identified that the criticality alarm system was inaudible in several exterior areas including outside office trailers. The licensee had proactively implemented a compensatory measure to address the audibility problem consisting of announcing criticality alarms on the public address system. The inspector noted that the public address system was audible in the affected areas. The inspector also noted that the licensee had engaged a contractor to survey the criticality alarm system and propose upgrades for coverage and audibility. Long-term improvement of the criticality alarm system including correction of current audibility weakness will be tracked as **Inspection Follow-up Item (IFI) 70-1151/2005-202-02.**

The inspector determined that the licensee procedure for testing the criticality alarm system consisted of sounding the alarm and noting if the guards at the main guard station could hear it or not. If the guards could hear the horns and no other employee reported inaudibility, the criticality alarm system was considered audible. The inspector noted that the test procedure could fail to detect a widespread audibility problem since many horns could become inoperable before the inaudibility became noticeable. The licensee agreed that the criticality alarm audibility test procedure should include a means to test the operability of individual horns on a regular basis and agreed to revise the test procedure. Revision of the criticality alarm system audibility test procedure will be tracked as **IFI 70-1151/2005-202-03.**

#### c. Conclusions

Appropriate compensatory measures were in place for a licensee-identified criticality alarm system audibility weakness. The licensee agreed to revise its criticality alarm audibility test procedure to improve its ability to detect inoperable horns.

#### 4.0 Plant Operations (88015)

##### a. Inspection Scope

The inspector 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 inspector performed walkdowns in the chemical area, the uranium recycle and recovery system, the ADU conversion area and the IFBA area. The inspector reviewed selected aspects of the following documents prior to performing walkdowns:

- SOI-I-275, "Handling of IFBA Rods with Protactinium," Revision 1, dated August 22, 2005
- COP-850600, "Transport Erbia Rods and Components," Revision 2, dated August 25, 2005
- RA-301, "Floor Storage of Special Nuclear Material," Revision 18, complete and pending administrative approval
- COP-874086, "Inspection of Ventilation Ducts," Revision 0, dated May 27, 2004

##### b. Observations and Findings

The inspector verified that controls identified in NCS analyses were installed or implemented and were adequate to assure safety. The cognizant NCS engineers were knowledgeable and able to explain the basis for changes in operations and controls. During walkdowns, the inspector noted that the licensee was proactively engaged in replacement of worn or damaged NCS postings. No safety issues were identified during walkdowns.

##### c. Conclusions

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

#### 5.0 Open Item Followup

**IFI 70-1151/2004-202-02** (Item number consistent with Section 1.0 of original report; item incorrectly numbered in original report attachment)

This item tracks licensee actions to clarify the spacing requirements for favorable geometry (in process) containers. The inspector noted during a previous inspection that favorable geometry (in process) containers (e.g., drip pans) that were widely employed throughout the chemical areas were spaced less than 12 inches from process piping and that this spacing was not adequately controlled by operating procedures. During the current inspection, the inspector noted that the licensee has drafted a new floor storage criticality safety analysis which will clarify the spacing requirements for favorable geometry (in process) containers. This item remains open.

**IFI 70-1151/2004-202-03** (Item number consistent with Section 1.0 of original report; item incorrectly numbered in original report attachment)

This item tracks licensee actions to clarify control requirements for greater than 5-gallon cardboard boxes in chemical areas. During a previous inspection, the inspectors noted a cardboard box in a chemical process area which could meet the licensee's definition of a non-favorable geometry container of any movable container in the chemical area of the plant having, in part, a volume greater than 5 gallons. During the current inspection, the inspector noted that the licensee had clarified control requirements for greater than 5-gallon cardboard boxes in chemical areas and completed retraining of operators. This item is closed.

**VIO 70-1151/2004-202-04**

This item concerned the failure to identify mop bucket limits and controls in a criticality safety analysis (CSA). During the previous inspection, the inspectors observed 6-gallon capacity wheeled mop buckets in use in areas with fissile material operations and determined that the licensee had a control limiting the contents of the buckets to 5-gallons but did not have a formal, approved NCS analysis for the mop buckets which supported the NCS limit. During the current inspection, the inspector noted that the licensee has drafted a new floor storage criticality safety analysis which will clarify mop bucket limits and controls. This item remains open.

**IFI 70-1151/2005-201-01**

This item tracks licensee revision of the configuration management procedures. During a previous inspection, the inspectors noted that Step 6.1.2 of the licensee's configuration management procedure required the performance, but not documentation, of the NCS reviewers' evaluation and assessment of proposed or requested configuration changes. During the previous inspection, the licensee's configuration management procedures were in the process of being revised as part of the NCS improvement program to specify whether a new or revised criticality safety evaluation (CSE) was needed to approve a configuration change. During the current inspection, the inspector noted that revision of the configuration management procedures was ongoing with the planned improvement of the criticality safety program. This item remains open.

**IFI 70-1151/2005-201-02**

This item tracks licensee corrective actions for updating or removing single parameter limits based on the superceded limit of  $k_{\text{eff}} < 1.0$ . The licensee committed to develop specific corrective actions for updating single parameter limits. During the current inspection, the licensee indicated that this corrective action was a planned long-term project. This item remains open.

**VIO 70-1151/2005-201-03**

This item concerned the failure to correctly incorporate calculational bias into results calculated from explicit models. Part 1 of the license application, License Conditions, Chapter 6, Nuclear Criticality Safety, Section 6.2.3(a), states, in part, "A 95/95  $k_{\text{eff}}$ , including all applicable biases and calculated uncertainties, is determined by the following equation:  $95/95 k_{\text{eff}} = k_s + 2\sigma_s + (\text{bias} + \text{uncertainty})$ ." During a previous inspection, the inspectors noted that the use of  $1.6\sigma$  instead of  $2\sigma$  may result in a nonconservative bias. During the current inspection, the inspector noted that the licensee has completed corrective actions including revision of the criticality analysis procedure to assure compliance. This item is closed.

**IFI 70-1151/2005-201-04**

This item tracks revision of the safety basis screening procedure to address the discovery of a 95/95  $k_{\text{eff}}$  result greater than 0.98. The licensee had committed to revise the safety basis screening procedure to directly address the issue. During the current inspection, the inspector noted that the licensee has revised the procedure to assure compliance. This item is closed.

**IFI 70-1151/2005-201-07**

This item tracks revision of criticality safety training for general plant access to emphasize key concepts and controls. During a previous inspection, the inspectors noted that many employees with access to fissile material areas but with no process duties receive no additional criticality safety training other than general plant access. During the current inspection, the inspector reviewed a revised training package and concluded that key criticality safety concepts were effectively addressed. This item is closed.

**IFI 70-1151/2005-201-08**

This item tracks revision of procedure RA-301 to address the presence of residual material which remains in a container following rinsing, tapping or light brushing. During a previous inspection, the inspectors identified a partially full cream can containing about 1 liter of solution stored in an empty container storage area. The inspectors discussed the finding with the licensee's NCS manager who agreed to revise procedure RA-301 to address the presence of residual material which remains in the container following rinsing, tapping or light brushing. During the current inspection, the inspector noted that the licensee had revised the procedure to more effectively define "empty." This item is closed.

**VIO 70-1151/2005-201-10**

This item concerned the failure to establish double contingency protection for the nitrogen accumulator tanks. The inspectors noted that the licensee's corrective actions in response to the process upset included shutting down all five ADU conversion lines and replacement of the nitrogen accumulator tanks. The inspector also noted that the licensee's corrective actions included implementation of the NCS program upgrades discussed in Section 2.0, performance of failure modes and effects analysis in the

conversion areas, and identification and creation of a checklist of administrative controls. During the current inspection, the inspector determined that the licensee had established double contingency protection for ADU conversion Line 3 by replacing the nitrogen accumulator tanks with safe geometry vessels and completing other corrective actions. This item is closed.

**VIO 70-1151/2005-004-01**

This item concerned the failure to establish double contingency for the IFBA-7113 ventilation system. During a previous inspection, the inspectors determined that criticality in the FL-7113 high-efficiency particulate-air (HEPA) filter housing was credible, and the technical safety basis did not assure that at least two unlikely, independent and concurrent changes in process conditions would be needed before a criticality accident was possible. During the current inspection, the inspector reviewed licensee corrective actions and concluded that the corrective actions were complete with the exception of NCS program improvements and that double contingency for the FL-7113 HEPA filter housing was assured. This item is closed.

**6.0 Exit Meeting**

The inspector communicated the inspection scope and results to members of Westinghouse management and staff throughout the inspection and during the exit meeting on September 16, 2005. Licensee representatives acknowledged and understood the findings as presented.

## SUPPLEMENTAL INFORMATION

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

#### Items Opened

- NCV 70-1151/2005-202-01** Concerned the failure to maintain the IFBA transport caskets in a horizontal array. (Section 2.0)
- IFI 70-1151/2005-202-02** Tracks long-term improvement of the criticality alarm system including correction of current audibility problems. (Section 3.0)
- IFI 70-1151/2005-202-03** Tracks revision of the criticality alarm system audibility test procedure. (Section 3.0)

#### Items Closed

- IFI 70-1151/2004-202-03** Tracks corrective actions for greater than 5-gallon cardboard boxes in non-favorable geometry exclusion areas.
- VIO 70-1151/2005-201-03** Failure to correctly incorporate calculational bias into results calculated from explicit models.
- IFI 70-1151/2005-201-04** Tracks revision of the safety basis screening procedure to address the discovery of a 95/95  $k_{\text{eff}}$  result greater than 0.98.
- IFI 70-1151/2005-201-07** Tracks revision of criticality safety training for general plant access to emphasize key concepts and controls.
- IFI 70-1151/2005-201-08** Tracks revision procedure RA-301 to address the presence of residual material which remains in the container following rinsing, tapping or light brushing.
- VIO 70-1151/2005-201-10** Failure to maintain double contingency protection for Conversion Line 3.
- VIO 70-1151/2005-004-01** Failure to establish double contingency protection for a ventilation system
- NCV 70-1151/2005-202-01** Failure to maintain the IFBA transport caskets in a horizontal array.

**Items Discussed**

|                                |  |
|--------------------------------|--|
| <b>IFI 70-1151/2004-202-02</b> | Tracks clarification of spacing requirements for process containers used for collection of process solutions.                          |
| <b>VIO 70-1151/2004-202-04</b> | Failure to identify specific limits and controls in place for fissile material operations in a CSA.                                    |
| <b>IFI 70-1151/2005-201-01</b> | Tracks the licensee revision of the configuration management procedures.   |
| <b>IFI 70-1151/2005-201-02</b> | Tracks licensee corrective actions for updating or removing single parameter limits based on the superseded limit of $k_{eff} < 1.0$ . |
| <b>VIO 70-1151/2005-004-01</b> | Failure to establish double contingency protection for a ventilation system  |

**2.0 Inspection Procedures Used**

IP 88015                      Criticality Safety

**3.0 Partial List of Persons Contacted**

**Westinghouse Electric Company**

|              |                          |
|--------------|--------------------------|
| N. Parr      | Licensing                |
| M. Fecteau   | Plant Manager            |
| R. Winiarski | NCS Manager              |
| S. McDonald  | EH&S Manager             |
| M. Rosser    | NCS Program Manager      |
| J. Nicki     | EH&S                     |
| J. Heath     | EH&S Engineering Manager |

**NRC**

|           |                                      |
|-----------|--------------------------------------|
| D. Morey  | Criticality Safety Inspector, NRC HQ |
| R. Gibson | Fuel Cycle Inspector, NRC Region II  |

#### **4.0 List of Acronyms and Abbreviations**

|       |  |
|-------|--|
| ADAMS | Agency-wide Documents Access and Management System |
| ADU   | ammonium diuranate                                 |
| BWR   | boiling water reactor                              |
| CFFF  | Columbia Fuel Fabrication Facility                 |
| CSA   | criticality safety analysis                        |
| CSE   | criticality safety evaluation                      |
| EH&S  | Environmental Health and Safety                    |
| HEPA  | high-efficiency particulate-air                    |
| IFBA  | integrated fuel burnable absorber                  |
| IP    | inspection procedure                               |
| NCS   | nuclear criticality safety                         |
| NRC   | U.S. Nuclear Regulatory Commission                 |
| SNM   | special nuclear material                           |
| WEC   | Westinghouse Electric Company                      |