



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

November 8, 2001

Westinghouse Electric Company  
ATTN: Mr. R. Monley, Manager  
Columbia Plant  
Commercial Nuclear Fuel Division  
Drawer R  
Columbia, SC 29250

SUBJECT: NRC INSPECTION REPORT NO. 70-1151/2001-07

Dear Mr. Monley:

This refers to the inspection conducted on September 17-20 and October 10-12, 2001, at the Columbia Nuclear Fuel Plant. The purpose of the inspection was to determine whether erbia blending activities authorized by amendment #29 of the license could be conducted safely and in accordance with NRC requirements. At the conclusion of the inspection, the findings were discussed with those members of your staff identified in the enclosed report.

Areas examined during the inspection are identified in the report. Within these areas, the inspection consisted of selective examinations of safety analyses, procedures and representative records, interviews with personnel, and observation of safety equipment and testing activities in progress.

Based on the results of the inspection, no violations or deviations were identified. However, a discrepancy between the integrated safety analysis and the sampling method for determining uranium powder moisture content required resolution prior to the use of erbia process recycle material. Based on the inspection results, there was no objection to the operation of the erbia process provided that the erbia process recycle material was withheld from the erbia blender until the sampling discrepancy was corrected.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/NRC/ADAMS/index.html> (the Public Electronic Reading Room).

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

Sincerely,

*/RA/*

Edward J. McAlpine, Chief  
Fuel Facilities Branch  
Division of Nuclear Materials Safety

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

Enclosure: NRC Inspection Report

cc w/encl:  
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U. S. NUCLEAR REGULATORY COMMISSION

REGION II

Docket No.: 70-1151

License No.: SNM-1107

Report No.: 70-1151/2001-07

Licensee: Westinghouse Electric Company

Facility: Commercial Fuel Fabrication Facility  
Columbia, SC 29250

Inspection Conducted: September 17-20 and October 10-12, 2001

Inspectors: D. Ayres, Senior Fuel Facility Inspector, RII  
L. Berg, Nuclear Criticality Safety Inspector, HQ  
M. Phillips, Senior Fuel Facility Inspector, RIII

Accompanying  
Personnel: D. Collins, Director, Division of Nuclear Material Safety, RII

Approved by: E. McAlpine, Chief, Fuel Facilities Branch  
Division of Nuclear Materials Safety, RII

EXECUTIVE SUMMARY

The focus of this special announced inspection was the observation and evaluation of the licensee's newly installed and proposed operation of processing equipment to blend erbia powder with bulk quantities of uranium oxide powder for the production of fuel pellets containing a burnable nuclear absorber. The inspection also included evaluations of the licensee's management measures to ensure availability and reliability of safety controls associated with the erbia blending process and fire safety controls associated with nearby pellet sintering furnaces. The report includes inspection efforts of two regional inspectors and one headquarters inspector. The inspectors were accompanied by the Director, Division of Nuclear Material Safety, NRC Region II during one day of the inspection. The inspection identified the following aspects of the licensee programs as outlined below:

### **Criticality Safety**

- The licensee's design and construction of the erbia process adequately implemented the engineered safety controls as approved in the NRC licensing review.
- The proposed engineered controls provided adequate protection against the failure mechanisms analyzed in the NRC Safety Evaluation Report.
- The modifications to the facility did not significantly affect the ability of the Criticality Accident Alarm System to detect a criticality.

### **Plant Operations and Fire Safety**

- The licensee's operating procedures provided adequate guidance to workers for the safe operation of the erbia process.
- The licensee's process support procedures adequately covered the steps to take during off-normal conditions or loss of utilities. However, the procedures for sampling recycled material from the erbia process for moisture was not consistent with the licensee's safety analyses. The inspectors informed the licensee that prior to introducing uranium recycle material generated from the erbia process to the blender, this discrepancy must be corrected.
- Functional testing was well planned and adequate to verify the functionality of the safety controls prior to operation.
- The digital control system was adequate to maintain the functionality of safety systems and enhanced the operator's access to safety-significant process information.
- The level, frequency, and type of periodic maintenance identified to be performed on each control appropriately corresponded to the control's safety significance and was adequate to maintain the control's availability and reliability.
- Planned staffing of the erbia process used an appropriate mix of experienced and newer workers. Training of the workers covered all pertinent safety disciplines and testing adequately reflected the operator's knowledge of the area safety requirements.

- The licensee's management was premature in arranging for the original readiness review inspection as evidenced by the unfinished condition of the process construction and management support structure.

## REPORT DETAILS

### **1. Background**

On April 30, 2001, Westinghouse Electric Company submitted a request for a license amendment to expand the use of nuclear absorber materials to accommodate the needs of certain customers. This request involved the addition of a product line to mix erbium oxide (erbia) powder with uranium oxide powder as part of the Burnable Absorber Expansion System (BAES). This mixture would be pressed into pellets, placed into fuel rods, and inserted into fuel assemblies as needed. Since the existing license did not specifically allow the blending of neutron absorber powder with uranium powder, a license amendment was needed for this new operation. Other operations associated with the BAES were not included as part of the license amendment request since they were already authorized by the facility's operating license. On July 18, 2001, based on a review of the licensee's safety analyses, the NRC approved the license amendment for the mixing of nuclear absorbers with uranium oxide powder. As part of the approval, the NRC issued a Safety Evaluation Report (SER) and the required safety conditions associated with the amendment. This inspection was performed to verify that the safety analyses and systems associated with the erbia powder blending operation were in accordance with the approval of the license amendment, as stated in the SER and safety conditions, prior to the introduction of special nuclear material to the new process.

### **2. Criticality Safety (O2) (IP 88015)**

#### **(a) Inspection Scope**

The inspectors reviewed the nuclear criticality safety analysis portion of the integrated safety analysis (ISA) for "The Erbia Orbital Screw Blender," dated September 10, 2001. The inspectors conducted a walk down of the process area to verify 1) the criticality controls were installed as required in the analysis, 2) the proposed controls provided adequate protection against failure mechanisms analyzed by the NRC staff in the SER, and 3) equipment modifications and installations had not affected the criticality alarm coverage.

#### **(b) Observations and Findings**

##### **Nuclear Criticality Safety Analysis/Integrated Safety Analysis**

The normal operating conditions for the orbital screw blender included powder transfers from unfavorable geometry bulk containers into the blender. Because sufficient fissionable material would be available, loss of moderation control (i.e., introduction of more than 20 liters of water or more than 32 kg of pore former) was the dominant criticality safety risk associated with the operation.

The inspectors observed that the licensee identified the integrity of the bulk containers, the integrity of the blender, powder dumping interlocks, and criticality safety postings as specific items relied on for moderation control. Following an observation of the process area, the inspectors concluded that bulk container/blender integrity was an effective barrier to accidental introduction of moderator. To ensure the continued reliability and availability of container/blender integrity as a criticality safety barrier, the inspectors noted that the

licensee implemented specific container/blender integrity verification requirements in the area operating procedures. These requirements included steps to immediately stop operations in the event that damaged, cracked, or broken vessel walls were identified.

According to the ISA and fault tree, the dumping interlock was used to prevent introduction of more than a programmed quantity of pore former by utilizing a computerized inventory tracking system called the Chemical Area Manufacturing Process System (ChAMPS). The inspectors attended a table top demonstration of the ChAMPS system in which the computer simulated interlock system response (i.e., would not permit material transfer) in conjunction with attempts to introduce unauthorized batches (e.g., batches which exceed the programmed limit) into the blender. Based on that demonstration, the inspectors concluded that ChAMPS, provided substantial margin of criticality safety for blending activities involving pore former.

During observations of the blender room, the inspectors noted the presence of a manway cover on top of the blender which was not described in either the ISA or the licensee's fault tree. The inspectors determined that the uncontrolled presence of such a cover posed significant challenges to criticality safety given the availability of mop water in the area (the mop water pouring station is located in an adjacent room). However, the inspectors determined that administrative controls (postings) were established by the licensee to restrict the volume of moderating liquids permitted in the blending room to a safe volume (i.e., less than 5 gallons). Following queries from the inspectors to the licensee staff, the inspectors noted that the licensee installed a chain and lock on the manway cover with the key controlled by the process supervisor. Although the chain and lock (including supervisory oversight of the key) are not identified as items relied on for safety, the inspectors observed that additional administrative controls which were identified as items relied on for safety prevented the blender or bulk container from being open when unattended. The inspectors concluded that controls were in place to ensure the presence of the manway cover did not present an undue risk to workers or the public.

### **Criticality Accident Alarm System Coverage (CAAS)**

The inspectors determined that CAAS coverage was not affected by the modifications supporting the burnable absorber expansion system. The inspectors reviewed the licensee's coverage documentation which was based on free-air line of sight calculations. Given the small footprint of the actual process areas and the materials of construction used, the inspectors concluded that the modifications to the facility did not significantly affect the ability of the CAAS to detect a design basis minimum accident of concern.

### **(c) Conclusions**

The licensee had installed engineered criticality safety controls as specified in the ISA. The proposed engineered controls provided adequate protection against the failure mechanisms analyzed in the SER. The modifications to the facility did not significantly affect the ability of the CAAS to detect a criticality. Thus, there was reasonable assurance that the licensee would be able to safely operate the erbia orbital screw blender as proposed.



**3. Plant Operations (O3) (IP 88020)**  
**Fire Safety (O4) (IP 88055)**

(a) Inspection Scope

This portion of the inspection focused on the way the licensee designed and planned to operate the erbia/uranium blending process to ensure the safety controls were available and reliable.

(b) Observations and Findings

The inspectors reviewed the licensee process and instrumentation drawings (P&IDs) to verify that the safety controls approved as described in the SER were included in the design of the erbia blending process. The inspectors reviewed P&IDs of the blending equipment, ventilation systems, and flammable gas piping systems. The drawings contained adequate detail of engineered controls installed in these systems. The inspectors found that engineered controls for criticality safety and radiological safety were adequate to meet the requirements of the license amendment approval and the descriptions in the SER. However, the inspectors found that two engineered controls mentioned in the SER for fire protection were not part of the system designs. The SER had discussed the installation of an oxygen monitor within the erbia orbital screw blender and the installation of fire dampers in the process ventilation system. An oxygen monitor in the blender would be used to prevent rapid oxidation of the uranium powder that could create significant heat generation and lead to “burnback” of the powder. Fire dampers in the ventilation system would be used to prevent the spread of fires to/from other process areas through the ventilation systems. The inspectors brought these issues to the attention of the NRC licensing function. Discussions between the licensee and the NRC licensing reviewers led to the decision that the licensee already had adequate protection against significant oxidation of the powder through nitrogen purging of the equipment prior to and during operation of the blender, and temperature sensors in the blender. The licensee was also deemed to provide adequate protection against the spread of fire to/from other areas through the use of fire dampers in the ventilation for processes adjacent to the erbia process. The inspectors observed the installed safety controls in the process area to verify the configuration of the process was as depicted in the licensee’s drawings. By the end of the inspection, installation of all safety controls depicted in the licensee’s P&IDs had been adequately completed. Thus, the inspectors found that the licensee’s design and construction of the erbia process adequately implemented the engineered safety controls as identified in the license amendment and SER.

The inspectors reviewed the licensee’s procedures for operating the erbia/uranium powder blending process. The inspectors found that the procedures described steps for the system operators to take during normal operations, but found several occasions where the operating procedures did not inform operators of what to do if the system did not respond as expected. The inspectors also found some instances where specific details that were needed to ensure the safe operation of the process had been omitted from the procedures. The licensee adequately corrected these procedural deficiencies prior to the end of the inspection.

The inspectors reviewed the licensee's general support procedures for the erbia process operations. This included procedures for safety significant laboratory analyses, operation of utility systems, and performing functional verifications of safety controls. The inspectors also reviewed procedures for the operation of nearby equipment that used flammable gases. The inspectors found that the procedures for utilities adequately covered the steps to take during off-normal conditions or loss of utilities. The inspectors found that the procedures for performing functional verifications of safety provided adequate instructions for testing the functionality of safety controls, and that all engineered safety controls identified in the licensee's safety analyses were covered by the procedures. The inspectors observed portions of the functional tests being performed and found them to be well planned and adequate to verify the functionality of the safety controls.

Since moderation control in the unfavorable geometry blender was the sole method for ensuring criticality safety of the blender, the inspectors reviewed the procedures for sampling and analyzing materials added to the blender. This included procedures for sampling recycled uranium oxide powder from the erbia process that did not previously meet specification. The inspectors found that the procedures for sampling this recycled material was not consistent with the licensee's safety analyses. The inspectors found that the ISA used to approve the license amendment required that all powder added to the blender be confirmed to be less than a prescribed moisture limit by two independent laboratory analyses. However, the sampling procedures involved performing composite sampling of multiple containers of recycle material for the first analysis, and randomly sampling a small number of these containers for the second moisture overcheck analyses. The inspectors pointed out that these sampling methods were not adequate to confirm that all powder added to the blender was less than the moisture limit. The inspectors discussed the situation with the NRC license reviewer and subsequently informed the licensee that prior to introducing uranium recycle material generated from the erbia process to the blender, this discrepancy must be corrected. This would involve either changing the sampling procedure to match the safety analysis or revising the safety analysis and obtaining approval of the revision from the NRC licensing function. The licensee stated that the erbia blending process would have to be operated a considerable time before it generated enough recycle material to add back to the process. Thus, the correction of this discrepancy did not affect the initial start-up of the blending process. The correction of this discrepancy between the licensee's erbia recycle material sampling methods and the corresponding safety analyses will be tracked as Inspector Follow-up Item (IFI) 01-07-01.

The inspectors reviewed the licensee's use of digital control systems for implementing process and safety controls throughout the erbia process. The inspectors observed that the digital controls for the erbia process were a significant improvement over the control systems used in other areas of the facility. The inspectors observed that a graphical display of operating parameters was available to operators at nearly every process station. Process alarms were easily identifiable and many safety alarms annunciated both at the station and in the facility's central control room. The inspectors also observed that separate watchdog timers monitored the system for fault conditions to identify potential problems in the digital control system. The inspectors also reviewed the digital control system qualification report that described the methods used to functionally verify the functionality of the control system. The inspectors observed some of the qualification tests being performed on the digital control system and found them to be properly coordinated and well planned. The inspectors found the licensee's digital control system, and methods for its

functional verification, to be adequate to maintain the functionality of safety systems and enhanced operator access to safety-significant process information.

The inspectors reviewed the licensee's program for maintaining the availability and reliability of safety controls. This program included a system of procedures for periodic maintenance, calibrations, inspections, and functional testing instructions. The inspectors noticed that all controls identified in the safety analyses were included in the program. The inspectors also noted that the level, frequency, and type of maintenance to be performed on each control appropriately corresponded to the control's safety significance.

The inspectors reviewed the staffing and training of the workers designated to operate the erbia process. The inspectors observed that the blending process would be available for operation two shifts per day. The inspectors observed that the blending process would not be operated during the third shift each day, but that workers would be in the area to address any unusual occurrence that may affect the blending operation. The inspectors observed that each shift used a combination of highly experienced operators along with newer workers to maximize the knowledge base of the work force while providing a good environment for on-the-job training. The inspectors reviewed the formal training and testing of the designated workers and found that the training covered all pertinent safety disciplines and the testing adequately reflected the operator's knowledge of the area safety requirements.

Although the inspectors ultimately found the licensee's programs adequate for start-up of the erbia process, the licensee was not adequately prepared when they originally made arrangements for this readiness review inspection. During the first portion of the inspection (September 17-20, 2001), much of the preparations for start-up of the erbia process was unfinished. For example, most of the procedures were found to be incomplete and still in the licensee's review and approval process. Some of the process equipment, including engineered safety controls, were still being installed. Functional verifications of the operability of safety controls had not begun. Operating staff had not yet been chosen, and thus training had not been started. All of these items had been adequately completed by the conclusion of the inspection October 10-12, 2001. However, licensee management was premature in arranging for the original readiness review inspection.

(c) Conclusions

The licensee's design and construction of the erbia process adequately implemented the engineered safety controls as approved in the NRC licensing review. The licensee's operating procedures provided adequate guidance to workers for the safe operation of the erbia process.

The licensee's process support procedures adequately covered the steps to take during off-normal conditions or loss of utilities. However, the procedures for sampling recycled material from the erbia process for moisture was not consistent with the licensee's safety analyses. The inspectors informed the licensee that prior to introducing uranium recycle material generated from the erbia process to the blender, this discrepancy must be corrected.

Functional testing was well planned and adequate to verify the functionality of the safety controls prior to operation.

The digital control system was adequate to maintain the functionality of safety systems and enhanced the operator's access to safety-significant process information.

The level, frequency, and type of periodic maintenance identified to be performed on each control appropriately corresponded to the control's safety significance and was adequate to maintain the control's availability and reliability.

Planned staffing of the erbia process used an appropriate mix of experienced and newer workers. Training of the workers covered all pertinent safety disciplines and testing adequately reflected the operator's knowledge of the area safety requirements.

The licensee's management was premature in arranging for the original readiness review inspection as evidenced by the unfinished condition of the process construction and management support structure.

#### **4. Exit Meetings**

Since this inspection was performed in two phases, exit meetings were held at the end of each phase. The exit meeting at the end of the first phase was held on September 20, 2001. The inspectors and NRC management expressed disappointment over the unfinished condition of the process construction and management support structure. Since the installation and testing of controls, operating procedures, and staffing and training were not yet completed, numerous items were identified by the inspectors as being needed for completing the readiness review. The discrepancy between the SER and the process design concerning two fire safety controls (oxygen monitors and fire dampers) were also discussed. This discrepancy was subsequently resolved through discussions with the NRC fire safety license reviewer.

The exit meeting at the end of the second phase of the inspection was held on October 12, 2001. The discrepancy between the licensee's safety analysis and the method for sampling the erbia process recycle material for moisture was discussed. The licensee was informed that this discrepancy must be corrected prior to introducing erbia process recycle material to the blender. This would involve either changing the sampling procedure to match the safety analysis or revising the safety analysis and obtaining approval of the revision from the NRC licensing function. Based on the inspection results, the licensee was informed that there was no objection to the operation of the erbia process provided that the erbia process recycle material was withheld from the erbia blender until the sampling discrepancy was corrected.

Although proprietary documents and processes were occasionally reviewed during this inspection, the proprietary nature of these documents or processes has been deleted from this report. No dissenting comments were received from the licensee.

ATTACHMENT

**PARTIAL LIST OF PERSONS CONTACTED**

Licensee Personnel

- # S. Ayers, Information Services
- \*# M. Corum, Nuclear Criticality Safety
- \*# L. Frye, Project Engineer
- \*# J. Heath, Integrated Safety Manager
- \*# S. Hightower, Chemical Process Engineer
- \* J. Hooper, Fire Safety Engineer
- \*# R. Lacy, Project Engineering Manager
- \*# S. McDonald, Environment, Health and Safety Manager
- \* R. Monley, Plant Manager
- \*# S. Ogunji, BAES Operations Manager
- # C. Perkins, Maintenance Manager

NRC Personnel

- \* D. Collins, Manager, Division of Nuclear Materials Safety, Region II
- H. Felsher, Nuclear Criticality Safety Licensing Reviewer
- P. Lee, Fire Safety Licensing Reviewer
- D. Stout, Licensing Project Manager

- \* Attended exit meeting on 9/20/01
- # Attended exit meeting on 10/12/01

**INSPECTION PROCEDURES USED**

- |          |  |
|----------|--|
| IP 88015 | Headquarters Nuclear Criticality Safety Program        |
| IP 88020 | Regional Nuclear Criticality Safety Inspection Program |
| IP 88055 | Fire Protection  |

**LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED**

Opened

- |          |     |   |
|----------|-----|---|
| 01-07-01 | IFI | Discrepancy between the licensee's erbia recycle material sampling methods and the corresponding safety analyses. |
|----------|-----|---|

Closed

None

Discussed

None

**ACRONYMS**

BAES	Burnable Absorber Expansion System
CAAS	Criticality Accident Alarm System
ChAMPS	Chemical Area Manufacturing Process System
IFI	Inspector Follow-up Item
ISA	Integrated Safety Analysis
NRC	Nuclear Regulatory Commission
P&IDs	Piping and Instrumentation Drawings
SER	Safety Evaluation Report