June 11, 2002

Ms. Nancy Blair Parr
Licensing Project Manager
Westinghouse Electric Company, LLC
Drawer R
Columbia, South Carolina 29250

SUBJECT: WESTINGHOUSE ELECTRIC COMPANY, LLC., AMENDMENT NO. 31 - REQUEST TO UPDATE SAFETY EVALUATION REPORT FOP AUTHORIZING NUCLEAR ABSORBER MIXING (TAC NO. L31584)

Dear Ms. Parr:

In accordance with your application dated December 7, 2001, (Westinghouse Electric Company (WEC) Document No. NRC-01-49) and pursuant to Part 70 to Title 10 of the Code of Federal Regulations, Materials License SNM-1107 is hereby amended to update the safety evaluation report (SER) issued on July 18, 2001. Accordingly, Safety Condition S-1 has been revised to include the date of December 7, 2001.

All other conditions of this license shall remain the same.

Enclosed are copies of the revised Materials License SNM-1107 and the Safety Evaluation Report which include the Categorical Exclusion. If you have any questions regarding this matter, please contact Don Stout of my staff at (301) 415-5269 or by e-mail at DES1@NRC.GOV.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter 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/reading-rm.html (the Public Electronic Reading Room).

Sincerely,

/RA/

Daniel M. Gillen, Chief
Fuel Cycle Facilities Branch
Division of Fuel Cycle Safety and Safeguards
Office of Nuclear Material Safety and Safeguards

Docket 70-1151
License SNM-1107

Enclosures: 1. Materials License SNM-1107
Safety Evaluation Report: Amendment No. 31, Request to Update SER for Authorizing Nuclear Absorber Mixing
Revision 1 - Safety Evaluation Report: Amendment No. 29, Request to Authorize Nuclear Absorber Mixing; Revision 19 SNM-1107

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Fuel Cycle Facilities Branch
Division of Fuel Cycle Safety and Safeguards
Office of Nuclear Material Safety and Safeguards

Docket 70-1151
License SNM-1107

Enclosures:
1. Materials License SNM-1107
2. Safety Evaluation Report: Amendment No. 31, Request to Update SER for Authorizing Nuclear Absorber Mixing
3. Revision 1 - Safety Evaluation Report: Amendment No. 29, Request to Authorize Nuclear Absorber Mixing; Revision 19 SNM-1107

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NRC FORM 374

U.S. NUCLEAR REGULATORY COMMISSION

MATERIALS LICENSE

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 36, 39, 40, and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee	
1. Westinghouse Electric Company LLC	3. License Number SNM-1107, Amendment 31
2. P.O. Box 355 Pittsburgh, Pennsylvania 15230-0355	4. Expiration Date November 30, 2005 5. Docket No. 70-1151 Reference No.

6. Byproduct Source, and/or Special Nuclear Material	7. Chemical and/or Physical Form	8. Maximum amount that Licensee May Possess at Any One Time Under This License
A. U-235	A. Any	A. 0.35 kg
B. U-235	B. Any, except metal, enriched to not more than 5.0 w/o	B. 75,000 kgs
C. U-233	C. Any	C. 5 grams
D. Pu-238, Pu-239	D. Sealed sources	D. 1.5 grams
E. Plutonium	E. Feedstock with transuranics and fission products	E. 5 grams

9. Authorized place of use: The licensee’s existing facilities at Columbia, South Carolina.

10. This license shall be deemed to contain two sections: Safety Conditions and Safeguards Conditions. These sections are part of the license and the licensee is subject to compliance with all listed conditions in each section.

MATERIALS LICENSE **SUPPLEMENTARY SHEET**	License Number SNM-1107
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11. Deleted by Amendment 20, dated November 1999.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Date: June 11, 2002

By: Daniel M. Gillen, Chief
Fuel Cycle Facilities Branch
Division of Fuel Cycle Safety
and Safeguards
Washington, DC 20555

MATERIALS LICENSE SUPPLEMENTARY SHEET	License Number SNM-1107
	Docket or Reference Number 70-1151
	Amendment 31

SAFETY CONDITIONS

S-1. Authorized use: For use in accordance with statements, representations, and conditions in the license application dated April 30, 1995, and supplements dated August 4 and 25, September 25, 1995; August 30, 1996; July 14, 1997; name change amendment December 22, 1997; June 30, July 23, 1998; name change amendment September 28, 1998; August 16, 1999; and January 28, July 24, September 8, November 21, 2000; and January 12, February19, March 12, March 20, and March 27, April 30, October 15, and December 7, 2001.

S-2. Criticality Safety Evaluations (CSEs) and Criticality Safety Analyses (CSAs) will define the interim criticality safety bases utilized throughout the CFFF. All CSEs/CSAs will be upgraded and/or completed in accordance with all applicable commitments in Chapter 6.0 of the License Application and all other regulatory requirements. Summaries of the CSEs/CSAs (in the format of License Annexes) will be submitted to NRC for review and approval. All completed CSEs/CSAs will be independently peer-reviewed in accordance with all applicable regulatory requirements and related procedures. Configuration control data packages for ongoing changes to facility structures, systems and components, and controls will be filed with their respective CSEs/CSAs to provide a substantially complete "living" framework for system Integrated Safety Assessments (ISAs) that will ultimately become the Final CFFF Design Safety Basis described in Chapter 4.0 of the License Application.

S-3. The licensee shall maintain and execute the response measures in the Site Emergency Plan, dated April 30, 1990, and revisions dated March 31, and September 30, 1992; March 25, August 15, and September 30, 1994; January 9, February 17, August 17, and October 23, 1995; or as further revised by the licensee consistent with 10 CFR 70.32(i).

S-4. Deleted by Amendment 12, April 1998.

S-5. By December 31, 2000, tables of Environmental/Radiological and Chemical/Fire controls will be added to the blank sections titled "Environmental Protection and Radiation Safety Controls" and "Chemical Safety and Fire Safety Controls" in the Enhanced Criticality Safety Evaluation License Annexes submitted in accordance with Safety Condition S-2.

S-6. For Amendment - 29, any "additional safety margin" information that the licensee provided to the NRC (see Table XII) to demonstrate an adequate safety basis, shall be identified and have sufficient management measures to ensure that the margin being relied upon is maintained.

S-7 In accordance with the information provided to the NRC during their site visit, the licensee shall maintain the following "additional safety margin" for Moderation control in the mixer by: (1) maintaining a low amount of moisture during the normal process; (2) having a low amount of poreformer added (i.e., only need up to 1 kg poreformer) to the mixer during the normal process; (3) allowing only 45% of the NCS k-effective poreformer limit available to the operator at any one time; and (4) allowing only one polypak of poreformer to be scanned/dumped into one mix of the blender.

S-8. Prior to the introduction of Special Nuclear Material into the nuclear absorber mixer / erbia blender,

A. the licensee shall demonstrate to the NRC that the NCS computer code functions correctly at low H/X ratios, specifically, that the k-effective limits described in the submittal for the mixer are accurate.

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B. (1) ChAMPS shall be fully tested (i.e., verification and validation) and (2) the Auto Dump Interlock shall be fully tested for erbia/uranium powder blending (i.e., similar to the functional verification and testing being performed for the current ADU Auto Dump Interlock).

C. the licensee shall verify; (1) the availability and reliability of necessary administrative and engineered fire protection controls identified as safety significant controls (SSC's) or items relied on for safety (IROFS), and, (2) fire protection design features and controls important for defense-in-depth for fire protection and the acceptable risks for operations.

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SAFEGUARDS CONDITIONS

SECTION 1.0 -- MATERIAL CONTROL AND ACCOUNTING

SG-1.1 The licensee shall follow pages i through xx and Chapters 1.0 through 9.0 of its “Fundamental Nuclear Material Control Plan for the Columbia Fuel Fabrication Facility,” which has been revised as indicated by Revision 33 (dated March 1, 2001). Any further revision to this Plan shall be made only in accordance with, and pursuant to, either 10 CFR 70.32(c) or 70.34.

SG-1.2 Operations involving special nuclear material which are not referenced in the Plan identified in Condition SG-1.1 shall not be initiated until an appropriate safeguards plan has been approved by the Nuclear Regulatory Commission.

SG-1.3 In lieu of the requirements contained in 10 CFR 74.13(a)(1) and (a)(2) to use the Forms DOE/NRC-742 and 742C, the licensee may use computer generated forms provided all information required by the latest printed instructions for completing the particular form is included.

SG-1.4 In lieu of the requirements contained in CFR 70.54 and 74.15 to use the DOE/NRC Form-741, the licensee may use computer generated forms provided all information required by the latest printed instructions for completing the particular form is included.

SG-1.5 Deleted Per Amendment 3, August 1996 Commitment now contained in licensee's Fundamental Nuclear Material Control Plan.

SG-1.6 Notwithstanding the requirements of the FNMC Plan identified in License Condition SG-1.1, the licensee may use (1) a single standard for measurement control (including daily control limit monitoring and bias corrections) for any linear-response tube or rod scales, in any initially demonstrated to be linear over its range of use within the discrimination of the scale by calculating a bias at four levels across the range of use and demonstrating that the four results are not statistically different, and (2) that the continued linearity of response of the scales is verified by monthly calibration against at least four traceable standards covering the range of use.

SG-1.7 Notwithstanding the requirements contained in Sections 5.2.2 and 5.2.3 of the licensee's Fundamental Nuclear Material Control Plan, the licensee is exempted from physical inventory requirements relative to the material identified in Condition S-4; provided the conditions and commitments contained in the licensee's November 30, 1993, letter (identification # NRC-93-036) are satisfied.

SG-1.8 Notwithstanding the requirement of Section 6.2.1(a).5 of the licensee's Fundamental Nuclear Material Control Plan to unpackage and perform an item count upon receipt of special nuclear material, the licensee is exempted from such requirement relative to the material identified in Condition S-4; provided the conditions and commitments contained in the licensee's November 30, 1993, letter (identification # NRC-93-036) are satisfied.

MATERIALS LICENSE
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License Number
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SG-1.9 Notwithstanding the requirement of Section II.A.7, block U, of NUREG/BR-0006, which is incorporated via 10 CFR 74.15, to complete receiver's measurements of scrap receipts (following recovery processing) within 60 days of receipt, the licensee shall not be subject to any time limit relative to recovering and measuring received UF_6 heels when the block U action code (of DOE/NRC Form 741) is used to book such receipts.

SG-1.10 With respect to Section 5.1.4 (b) of the Plan identified by Condition SG-1.1, *"allowed number"* within the phrase *"allowed number of defects"* is hereby specified as being:

(i) up to two defects when each item within a batch of items has an assigned value equal to or less than 50 grams U-235;

(ii) no more than one defect when each item within a batch of items has an assigned value of less than 500 grams U-235, but one or more items has an assigned value in excess of 50 grams U-235; and

(iii) zero defect when any item within a batch of items contains 500 or more grams U-235.

SG-1.11 Notwithstanding the first paragraph of Section 7.1 of the Plan identified by Condition SG-1.1, the licensee shall conduct shipper-receiver comparisons on all SNM materials received (regardless of whether booked on the basis of receiver's or shipper's values), except for those materials identified in Section 7.1 of NUREG-1065 (Rev. 2) as being exempted from shipper-receiver comparisons.

SECTION 2.0 -- PHYSICAL PROTECTION OF SNM OF LOW STRATEGIC SIGNIFICANCE

SG-2.1 The licensee shall follow the physical protection plan entitled, "Physical Security Plan," Revision 28 dated April 7, 2000 (letter dated April 7, 2000); and as it may be further revised in accordance with the provisions of 10 CFR 73.32(e).

SECTION 3.0 -- INTERNATIONAL SAFEGUARDS

SG-3.1 The licensee shall follow Codes 1 through 6 of Transitional Facility Attachment No. 5A dated August 31, 1988, to the US/IAEA Safeguards Agreement. Such Transitional Facility Attachment shall be interpreted in accordance with Conditions SG-3.1.1 through SG-3.1.7.

SG-3.1.1 With respect to Transitional Facility Attachment Code 2:

The reference design information is that dated by the licensee on October 14, 1985. "Information on the Facility" also includes other facility information submitted via Concise Notes in accordance with 10 CFR 75.11(c).

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SG-3.1.2 With respect to Transitional Facility Attachment Code 2.2:

Substantive changes to the information provided in the Columbia Plant Design Information Questionnaire (DIQ) means those changes requiring amendment of the Transitional Facility Attachment. Such changes shall be provided by letter to the NRC Office of Nuclear Material Safety and Safeguards at least 70-days in advance of implementation.

Non-substantive changes to the information in the DIQ means those changes not requiring amendment of the Transitional Facility Attachment. Such changes shall be provided by Concise Note (From DOE/NRC-740M) within 30 days of receiving notification from the NRC that the facility has been identified under Article 39(b) of the US/IAEA Safeguards Agreement.

The types of modifications with respect to which information is required under 10 CFR 75.11, (to be submitted in advance), are those items stated in Code 2.2, specifically:

(a) "Any change in the purpose of type of facility" means:

Any deviation from the described activities involving special nuclear material and any change to the maximum enrichment and/or quantities of U-235 currently authorized by License No. SNM-1107, and/or as described in Paragraph 5 of the Design Information Questionnaire (DIQ) dated October 14, 1985, or as modified in accordance with 10 CFR 75.11(c). Included also is any deviation from the described special nuclear material (SNM) production activities described in paragraph 6 of the DIQ dated October 14, 1985, or as modified in accordance with 10 CFR 75.11(c).

(b) "Any changes in the layout of the facility which affects safeguards implementation of the provisions of the Protocol" means:

Any change in the existing facility and/or site layout or new addition affecting any activity involving SNM as described in Paragraphs 10 and 11 (per the referenced attachments of the DIQ dated October 14, 1985, or as modified in accordance with 10 CFR 75.11(c). Included also is any modification to, or deviation from, the data provided in Paragraphs 13 and 14 (per the referenced attachments) of the DIQ dated October 14, 1985, or as modified in accordance with 10 CFR 75.11(c).

(c) "Any change that makes the selected Key Measurement Points (KMPs) (as described in Code 3.1.2) inadequate for the Agency's accounting purpose" means:

Any change to the KMPs as described in Code 3.1.2 of the Westinghouse-Columbia Transitional Facility Attachment to the US/IAEA Safeguards Agreement, or as modified in accordance with 10 CFR 75.11(c), that results in any KMP alteration affecting the purpose of KMPs as stipulated by 10 CFR 75.4(m).

(d) "Any change in the physical inventory procedures that would adversely affect the inventory taking for the Agency's accounting purposes" means:

Any change to the description data contained in Paragraph 34 (per the referenced attachments) of the DIQ dated October 14, 1985, or as modified in accordance with 10 CFR 75.11(c), that would not permit the Agency to conclude an SNM material balance for the Westinghouse-Columbia facility.

(e) "Introduction of a significantly less accurate analytical method for accounting purposes" means:

Any recalculation of the "Relative Errors-Random and Systematic" as listed in Attachment 36.2 referenced in Paragraph 36 of the DIQ dated October 14, 1985, or as modified in accordance with 10 CFR 75.11(c), that results in the estimates of the random and systematic errors being affected by a factor of two or more.

(f) "Decrease in the frequency of calibrating measuring equipment if it significantly decreases the accuracy of the materials accounting system" means:

Any change that results in the estimates of the systematic error being affected by a factor of two or more.

(g) "Any change in the statistical procedures used to combine individual measurement error estimates to obtain limits of error for shipper/receiver (S/R) differences and material unaccounted for (MUF)" means:

Any deviation from (or modification of) the equations and/or calculations outlined in Attachments 37.1, 37.2, and 37.3 referenced in Paragraph 37 of the DIQ dated October 14, 1985, or as modified in accordance with 10 CFR 75.11(c).

SG-3.1.3 With respect to Transitional Facility Attachment Code 3.1.2:

KMP* -- This is a KMP in which all shipper receiver differences (SRDs) must be recorded and reported even if numerically zero. SRDs are computed and reported by the Nuclear Materials Management and Safeguards System upon receipt of the receiver's measurement results.

SG-3.1.4 With respect to Transitional Facility Attachment Code 4:

The licensee shall use the material composition codes documented in the DIQ dated October 14, 1985, and as modified by Concise Notes. Further, notwithstanding any other requirements for advance notification and/or reporting, the licensee may add or delete composition codes for nuclear material routinely processed and on inventory at CFFF immediately upon telephone notification to the Office of Nuclear Material Safety and Safeguards. Follow-up documentation, in the form of a Concise Note accompanied by appropriate changes to Table 1 of Attachment 34.8 to the DIQ shall be submitted within three regular workdays of the telephone notification.

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SG-3.1.5 With respect to Transitional Facility Attachment Code 4.1:

Measured discards should be reported as an SN (Shipment to non-safeguards facility) when shipped off-site to an authorized burial ground. (The IAEA system will not process measured discards as loss/disposal (LDs) when they are shipped off-site).

SG-3.1.6 With respect to Transitional Facility Attachment Code 5.1.1:

For inventory changes, time of recording, "upon" means: No later than the next regular workday (Monday through Friday).

For those occasions where natural or depleted uranium is inadvertently enriched above 0.711 percent through commingling with residual enriched uranium in process equipment, the resultant product shall be considered as being produced through a blending operation and the material category change shall be recorded upon obtaining measurement confirmation that a material category change has occurred.

SG-3.1.7 With respect to Transitional Facility Attachment Code 6.2.2:

For Concise Notes describing the anticipated operational programme, "anticipated operational programme" means: Anticipated physical inventory schedule.

DOCKET: 70-1151

LICENSEE: SNM-1107

SUBJECT: SAFETY EVALUATION REPORT: AMENDMENT NO. 31, REQUEST TO UPDATE SER FOR AUTHORIZING NUCLEAR ABSORBER MIXING (TAC NO. L31584)

BACKGROUND

By letter dated December 7, 2001, Westinghouse Electric Company (WEC) requests an update of NRC safety evaluation report (SER) which supported authorization of nuclear absorber mixing (i.e., erbia/uranium powder blending) operations in the Burnable Absorber Expansion System (BAES) facility in Columbia, South Carolina. The WEC's requests consist of deleting reference to an oxygen monitor for the erbia/uranium powder orbital blender and deleting a reference to fire dampers on the BAES facility dry process ventilation system in the SER. The reason for the request is the as-built conditions, after final installations of process and facility equipment, are different from those indicated in the SER.

DISCUSSION

On April 30, 2001, WEC requested amendment to the License SNM No. 1107 to authorize erbia/uranium powder blending in the BAES facility at the nuclear fuel manufacturing plant in Columbia, South Carolina. NRC granted approval of the request by Amendment No. 29 to the license, along with supporting SER, on July 18, 2001. Between September 17 and 20, 2001, NRC Region II performed an operational readiness review (ORR) inspection of the erbia/uranium blending process. Because of incomplete construction and incomplete management support programs, a second inspection was performed and completed on October 12, 2001. The results of the inspection are documented in Inspection Report No. 70-1151/2001-07 issued on November 8, 2001.

During the ORR inspection, NRC inspectors identified that two as-built conditions that were not consistent with descriptions for defense-in-depth fire protection in the SER. The first was the orbital blender for mixing erbia and uranium powder did not include provisions for an oxygen monitor. The second was the BAES facility main dry process ventilation system did not include fire dampers. WEC has determined that the as-built conditions do not impact the level of safety assumed in the SER and requests an update of the SER.

FIRE SAFETY REVIEW

The current SER authorizing the use of the erbia and uranium powder blending process described and assumed the presences of an oxygen monitor and fire damper for defense-in-depth fire protection. An oxygen monitor, if provided, would monitor oxygen level for adequate nitrogen-inert environment of the orbital blender. Also, fire dampers, if provided, would establish an additional barrier in the event that high-efficient particulate air (HEPA) filters are challenged by a major fire in the BAES facility.

The NRC staff reviewed the safety significance of inconsistency between assumed conditions in the SER and the WEC as-built conditions. The NRC staff determined that the as-built conditions did not impact the overall defense-in-depth fire protection. The bases for the NRC staff conclusions are discussed below.

Inerting of Orbital Blender

The potential fire hazards associated with the blending process is an oxidation reaction (or burnback) of UO_2 toU_3O_8 powder, under certain conditions when finely divided particles of UO_2 are present and they are exposed to heat generated from the blending process. The unwanted oxidation reaction can cause increase temperatures and pressure in the orbital blender. The increase temperature could thermally degrade the pneumatic inflatable rubber seal and cause the release of blend material into the blending process area, resulting in an airborne (i.e., inhalation) radiological hazard. The increase in temperature is not expected to cause a fire in the erbia blending process areas because of the noncombustible construction of equipment and a lack of combustibles sufficient to propagate a fire. The increase of pressure within the closed blender is relieved through a pressure relief valve.

To achieve a safety performance objective to minimize the potential of an oxidation reaction during blending operations, WEC provides an inert atmosphere in the blender using a nitrogen inerting system. WEC indicated, in the submittal of December 7, 2001, that a nitrogen purge of a sufficient rate and duration would be provided to displace oxygen and establish an inert atmosphere in the blender. Following the completion of the nitrogen purge, erbia and uranium powder would be introduced into the blender. Additional nitrogen would be introduced prior to mixing operations to ensure and maintain an inert atmosphere in the blender. This is a procedure approach in lieu of an engineered feature (i.e.., an oxygen monitor) to provide an adequate inert atmosphere prior to mixing of erbia and uranium powder. WEC has also installed a heat detector to monitor blending temperatures and provide an indication to operators of an oxidation reaction.

The NRC staff determined that WEC method of establishing an inert atmosphere is an acceptable method of achieving safety performance objective of minimizing the potential of an oxidation reaction during blending operations. There is not a distinct advantage in regards to reliability between the two methods in providing an inert atmosphere. The overall defense-in-depth protection is maintained and the level of safety assumed in the SER is not reduced. The NRC staff recommends the approval of WEC's request to delete reference to an oxygen monitor in Table XIII of the SER.

Fire Dampers

The references to ventilation system HEPA filters and fire dampers are found in the section of the SER that discuss facility's active engineered fire protection systems. The NRC staff had noted that the process and room ventilation system is a possible leak path for radiological contamination. To minimize this possibility, WEC installed HEPA filters for process and room ventilation to remove radiological contaminants prior to exhausting air from the facility. The HEPA filters are tested in accordance with independent testing laboratories for fire resistance performance. The presence of HEPA filters is a defense-in-depth protection safety components that minimize or protect against release of radiological contamination for the postulated fire scenarios.

The SER indicated that the deposition of large quantity of combustion products would plug the HEPA filters and prolong exposure to high temperatures. If exhaust fans continue to operate, the resulting conditions could challenge the integrity of the filter as a barrier. If fire dampers were provided, the NRC staff determined that they would provide an additional barrier for defense-in-depth that minimize this leak path against releases of radiological contaminants. The final design and construction did not include provision for fire dampers. WEC requests the deletion of SER references to fire dampers on the dry process and room ventilation systems on the basis that WEC would rely on the availability of facility's fire brigade to mitigate the spread of fire and minimize the spread of radiological contamination. The actions of responding fire brigade or operators would also include shutdowns of fans as needed from the control room within the BAES facility or at the roof ventilation unit. In addition, WEC has provided heat detectors upstream and downstream of the HEPA filters, along with pressure differentials monitors across each filter set, to alert operators at the early onset of abnormal conditions.

The NRC staff revisited the evaluation of fire dampers as an additional defense-in-depth feature for fire protection. Although the fire dampers would provide another protection barrier in the event of failure of HEPA filters, the staff determined it is not a requirement of established building code and standards or a typical industry practice for fuel cycle facilities handling uranium radioactive material. The BAES facility construction (i.e., existing) is not a fire rated enclosure for containing the spread of fire or smoke. Therefore, the protection of a possible leak path through the process and room ventilation exhausts does not provide additional risk reduction (i.e., minimize fire spread of radiological contaminants) in the event of a major fire. The WEC approach of providing a fire brigade response to suppress the fire and to shut down ventilation fans as needed, provide a reasonable additional defense-in-depth fire protection that radiological release would be minimized.

Fire Safety Conclusions

Overall, the licensee has identified a list of administrative and engineered controls to minimize the risk of fires and protect against potential exposure from fire and explosion hazards for the nuclear absorber mixing/erbia blending operations. The WEC request to delete references to an oxygen monitor and the references to fire dampers for update of the current SER to reflect as-built conditions does not significantly decrease the defense-in-depth fire protection for the erbia/uranium powder blending process. The NRC staff concludes that if the key safety controls and defense-in-depth administrative and engineered controls as discussed in the current SER, along with the requested changes, and the current license commitments are adequately implemented, there would be reasonable assurance for protection of the health and safety of the public and the environment. Therefore, approval of the amendment application and update to the current SER is recommended.

ENVIRONMENTAL REVIEW

Authorization of the erbia and uranium powder blending (i.e., nuclear absorber mixing) constitutes a change in process operations and equipment and meets the following requirements:

4. there is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite,

5. there is no significant increase in individual or cumulative occupational radiation exposure,

6. there is no significant construction impact, and

   there is no significant increase in the potential for or consequences from radiological accidents.

The WEC requested changes to the SER and the operation of the nuclear absorber mixing will not cause a change in the types or significant increase in the amounts of any effluents that may be released offsite. The materials used in the system have similar radiological characteristics as currently authorized at the site. The small amounts of liquid effluent generated by the system will be treated by unit operations, and managed to assure all applicable discharge limits is met. Gaseous effluents discharged by the system (normal conditions) will be controlled by HEPA filtered ventilation systems capable of removing greater than 99 percent of entrained particulates. Solid combustible waste will be processed through the incinerator for volume reduction.

Since the nuclear absorber mixing process has similar radiological characteristics as the fuel process system currently authorized at the site, the authorization of this process will not result in any significant increase in individual or cumulative occupation radiation exposure.

There will be no significant construction impact because the system has been installed in an existing facility. The construction activities in the existing facility were limited to slight modifications and equipment installation.

Also, there will be no significant increase in the potential for or consequences from radiological accidents. The licensee performed a Process Hazards Analysis which identified the accidents that could occur due to nuclear absorber mixing operation. NRC staff has determined that the mitigative and preventive measures associated with the mixing process will reduce the frequency and consequences from the postulated accidents to acceptable levels.

Accordingly, NRC staff has determined that the criteria from 10 CFR 51.22(c)(11) for a categorical exclusion has been met. Therefore, neither an environmental assessment nor an environmental impact statement is warranted for this action.

CONCLUSION

Based on the preceding discussion and adherence to the license commitments, the NRC staff concludes that the requested changes to the current SER will have no adverse effect on worker and public health and safety or the environment. Therefore, approval of the amendment application is recommended.

PRINCIPAL CONTRIBUTORS
Peter Lee
Donald Stout

DOCKET: 70-1151

LICENSEE: SNM-1107

SUBJECT: REVISION 1 - SAFETY EVALUATION REPORT: AMENDMENT NO.29, REQUEST TO AUTHORIZE NUCLEAR ABSORBER MIXING; REVISION 19.0 SNM-1107

BACKGROUND

By letter dated April 30, 2001, the licensee requested an amendment to authorize nuclear absorber mixing in fuel fabrication (i.e., erbia/uranium powder blending) in connection with the facility Burnable Absorber Expansion System (BAES). The amendment request provided information and referenced submitted material dated January 12 and March 27, 2001. In addition, NRC staff visited the site from May 7-11, 2001, to assist in the Nuclear Criticality Safety (NCS) review (i.e., toured areas, reviewed site documents, spoke with site personnel). There was an entrance meeting with licensee personnel and the NCS review was discussed during an exit meeting with the licensee. Also, on May 23-25, 2001, NRC staff visited the site to review supporting technical and process information that was not included in the Westinghouse Electric Company's (WEC's) written submittal. This visit was necessary in understanding WEC's safety basis for fire protection with the BAES facility.

Safety documents submitted by Westinghouse in the form of Integrated Safety Assessment License Annexes dated January 12, April 30, 2001, and an Integrated Safety Plan dated March 27, 2001, did not provide sufficient information to allow NRC staff to independently determine that safety and health for the workers and the public and protection of the environment had been adequately evaluated. Consequently, license safety reviewers for nuclear criticality safety and fire safety visited the Columbia, SC facility to review safety documentation that was maintained onsite and develop their own findings of safety.

For clarification, note that two supplements were provided on April 30, 2001. In the WEC Document No. NRC-01-17, dated April 30, 2001, WEC requested withdrawal of their license amendment request and supplements dated October 1, 2000 and January 12, 2001 (NRC TAC No. L31409). Also, on April 30, 2001, in Document No. NRC-01-18, WEC submitted a revised license amendment request for the mixing of nuclear absorber. During subsequent on-site reviews conducted by the NRC, portions of the January 12, March 27, and April 30, 2001, submittals were used to demonstrate the safety basis and were included in Materials License SNM-1107, Safety Condition S-1.

To avoid any potential misunderstanding, the criticality reviewer did not address the following items during the review of this amendment request because they were not germane. These items were:

> The definition that "meeting the double contingency principle" was equivalent to meeting the "highly unlikely" requirement of 10 CFR 70.61(b);

The Integrated Safety Analysis Plan dated March 27, 2001; and

Any part of the Burnable Absorber Expansion System, other than nuclear absorber mixing (i.e., erbia/uranium powder blending).

DISCUSSION

The nuclear criticality safety reviewer conducted his review specifically for the nuclear absorber mixing process at WEC. The NRC reviewer developed a general methodology to evaluate whether accident sequences would meet the "highly unlikely" requirement. Then based on the general methodology, the staff developed a specific methodology for evaluating whether the accident sequences met the "highly unlikely" requirement for erbia/uranium powder blending. The methodology is detailed in the nuclear criticality safety discussion below. To emphasize the uniqueness of this review process, the specific methodology used does not apply to any other process at this site and is not applicable for any process at any other site. This specific methodology was developed exclusively for the erbia/uranium powder blending/nuclear absorber mixing at this site. As a result of the nuclear criticality safety and fire safety review, the following license conditions are recommended:

S-6. For Amendment - 29, any "additional safety margin" information that the licensee provided to the NRC (see Table XII) to demonstrate an adequate safety basis, shall be identified and have sufficient management measures to ensure that the margin being relied upon is maintained.

S-7 In accordance with the information provided to the NRC during their site visit, the licensee shall maintain the following "additional safety margin" for Moderation control in the mixer by: (1) maintaining a low amount of moisture during the normal process; (2) having a low amount of poreformer added (i.e., only need up to 1 kg poreformer) to the mixer during the normal process; (3) allowing only 45% of the NCS k-effective poreformer limit available to the operator at any one time; and (4) allowing only one polypak of poreformer to be scanned/dumped into one mix of the blender.

S-8. Prior to the introduction of Special Nuclear Material into the nuclear absorber mixer or erbia blender,

A. the licensee shall demonstrate to the NRC that the NCS computer code functions correctly at low H/X ratios, specifically, that the k-effective limits described in the submittal for the mixer are accurate.

(1) ChAMPS shall be fully tested (i.e., verification and validation) and (2) the Auto Dump Interlock shall be fully tested for erbia/uranium powder blending (i.e., similar to the functional verification and testing being performed for the current ADU Auto Dump Interlock).

C. the licensee shall verify; (1) the availability and reliability of necessary administrative and engineered fire protection controls identified as safety significant controls (SSC's) or items relied on for safety (IROFS), and, (2) fire protection design features and controls important for defense-in-depth for fire protection and the acceptable risks for operations.

During the site visit for nuclear criticality safety, information about the BAES process was obtained that was not part of the license amendment submittal. This information may be beneficial to NRC staff members during a review. The staff determined that: (1) the frequency of roof inspections appears to be every six months and the licensee had made contractor recommended repairs; (2) the functional test results for the Auto Dump Hood Interlock demonstrated that the interlock was working properly during the last test; (3) the erbia containers will be the same containers as those used previously at the site for the dry conversion process, which, after initial test use and repair, did not require further repairs; (4) if erbia container repairs are necessary, a temporary enclosure will be used; (5) a little more than three erbia containers (i.e., 500 kg each) can be filled from one uranium oxide powder bulk container (i.e., 1800 kg each); (6) there will only be six erbia containers at various points in the BAES at any one time; (7) the licensee has not yet decided what the staging process for the erbia and poreformer will be; and (8) there will not be a solvent extraction process in the BAES, instead the limited BAES solvent extraction work would proceed in batches using the current solvent extraction equipment, after it is cleaned out.

Licensee Process Description for Nuclear Absorber Mixing/Erbia-Uranium Powder Blending

The erbia process operator will move an erbia bulk container containing virgin (i.e., non-erbia uranium oxide powder) from the Ammonium Diuranate (ADU) process onto the erbia bulk container unloading station, which will be located on the second floor of the Erbia Powder Blending Room (EPBR). The EPBR will be a moderation-controlled (MODCON) area. The operator will scan the bar code on the bulk container in order for the Chemical Area Manufacturing Process System (ChAMPS) to verify that the bulk container to be transferred into the blender is correct. If ChAMPS verifies that the transfer should be made, then (1) ChAMPS will communicate with the equipment Programmable Logic Computer (PLC) control system to allow the erbia powder blending system to operate and (2) the operator will transfer the powder from the bulk container into an orbital screw blender via a vibratory feeder. Load cells (i.e., measuring weight) at the unloading station will be used to control the amount of material being transferred into the blender.

Based on the weight of the uranium oxide powder that was transferred into the blender, the erbia blend engineer will create a blend recipe using ChAMPS. The blend recipe will define the desired amounts of erbia, U_3O_8, and poreformer to be added to the blender. Those ingredients will be located in polypaks on the second floor of the EPBR. As a MODCON area safeguard, all materials in polypaks will have been twice verified for moisture by ChAMPS. The polypaks will also have to have been released by Quality Control to allow the blender to operate.

The operator will gather the identified blend recipe ingredients. For each ingredient, the following steps will be followed: (1) the operator will scan the barcode on the polypak and place the polypak in the dump hood; (2) if ChAMPS verifies that the polypak meets the requirements for blending and moisture content, then the dumper will upend the polypak and dump its contents into a small hopper; and (3) the material in the small hopper will be transferred into the blender via a vibratory feeder. ChAMPS will be used to communicate and be interlocked with the dump hood PLC control system to prevent the dumping of polypaks containing high or unknown moisture powder.

After all materials are transferred into the blender, the operator will turn on the automatic orbital screw blending system. The orbital screw blender will be a cone-shaped vessel with a rotating screw that orbits around the inside perimeter of the blender. Material will be pulled from the bottom of the blender to the top of the mix and folded into the center of the mix. The blender will have a mixing capacity of 1,200 liters. The typical blend will be ~1,000 kg. A nitrogen purge will be used to prevent material from packing in the dead zone at the bottom of the blender and to provide an inert atmosphere to prevent oxidation of the UO_2 due to the heat generated by the mixing cycle. At the end of the mixing cycle, the blender will automatically stop. The operator will obtain a powder sample from an automatic sampling station on the blender. The sample will be taken to the laboratory for analysis of homogeneity, impurities, isotopic enrichment, oxide/uranium ratio, and percent erbium. The results will be obtained and, if approved by the erbia blending engineer, the operator will empty the blend into an erbia bulk container at the bottom of the blender.

To perform the blended powder transfer, the operator will position an empty erbia bulk container under the discharge station of the blender on the first floor of the EPBR. The container will be automatically raised to mate with an inflatable seal that is fixed to the discharge valve of the blender. Load cells (i.e., measuring weight) will be used at the erbia bulk container station to control the amount of material being transferred. When the operator turns on the automatic unloading system, (1) the nitrogen purge will turn off, (2) the blender discharge valve will open, and (3) the screw will turn on to allow the contents of the blender to be transferred into the container. After the blender has been emptied, the valves will automatically close. The operator will (1) remove the container from the station, (2) weigh the container on an offline scale, and (3) scan the barcode on the container in order to allow ChAMPS to assign an item number with the associated weight and erbia powder blend properties to the container.

The specific safety function reviews are discussed below for: (1) nuclear criticality safety; (2) fire safety; (3) chemical process safety; (4) environmental safety; and, (5) radiation safety.

NUCLEAR CRITICALITY SAFETY REVIEW

This section presents a summary of the information provided by the licensee in the amendment submittals and during the NRC site visit. The NRC staff's evaluation of the information is presented in the following section, under FINDINGS.

Licensee Provided: NCS Controlled Parameters for Erbia/Uranium Powder Blending

The only NCS control for the conical mixer and erbia bulk container was Moderation control. For the other NCS parameters, normal and bounding assumptions were provided. The normal conditions and NCS k-effective limits for Moderator Control are shown in Table I.

If any of the four NCS limits were violated, an accidental criticality would be possible. The licensee identified additional safety margin for Moderation control being: (1) the low amount of moisture in the normal process; (2) low amount of poreformer that is expected to be added (i.e., only need up to 1 kg poreformer) in the normal process; (3) only 45% of the poreformer limit will be allowed to be available for the operator at any one time; and (4) only one polypak of poreformer will be allowed to be scanned/dumped into one mix of the blender.

Table I. Moderator Control Normal Conditions and NCS k-effective Limits

Moderator Control	Normal Condition	NCS k-effective Limit
Moisture	0.3 wt.%, <3 liters	4.9 wt.% (in the blender), 20.48 liters (critical sphere)
Poreformer	<1.0 wt.%, <10 kg	7.4 wt.% (in the blender), 17.5 kg (in the blender)

Licensee Provided: Link Between PHA and Submittal for Erbia/Uranium Powder Blending

The licensee performed a Process Hazard Analysis (PHA), specifically using the "what-if" and "checklist" methodologies, to determine the hazards. The PHA NCS team members included two Senior NCS Engineers and one NCS Engineer. The result of the PHA was that the only safety discipline with consequences exceeding the "high" consequences of 10 CFR 70.61(b) was NCS. In addition, the only NCS hazard was a "potential criticality if sufficient moderator is introduced into an erbia bulk container or the conical screw mixer." Therefore, the "high consequence" event of an accidental criticality in either the erbia bulk container or conical screw mixer needed to be made "highly unlikely."

The licensee determined that (1) having double contingency protection (i.e., meeting the double contingency principle) satisfied the condition that the risk of nuclear criticality accidents was limited by assuring subcriticality under normal and credible abnormal conditions, as required by 10 CFR 70.61(d); (2) requiring the double contingency principle to be met satisfied the NCS baseline design criteria of 10 CFR 70.64(a); and (3) having the current criticality accident alarm system (CAAS) in place satisfied the CAAS requirements of 10 CFR 70.24.

The licensee determined that double contingency protection was demonstrated by the fault-tree for the "Erbia Bulk Container and Conical Mixer." This fault-tree identified two independent process upsets that, when combined, may potentially lead to an accidental criticality. The occurrence of a process upset was considered to be a contingency, while controls, either individually or collectively, used to prevent, mitigate, or detect the process upset were considered to be a barrier. Based on the fault-tree, the licensee-identified two contingencies are shown in Table II.

Table II. Description of Contingencies "A" and "B"

Contingency	Description
"A"	Sufficient quantity of moderator is present to cause an accidental criticality
"B"	Sufficient quantity of moderator is introduced into the non-favorable geometry conical mixer or erbia bulk container

Both of these contingencies used only Moderation control to prevent its occurrence. Therefore, Moderation control was the only NCS parameter being controlled. Based on the fault-tree, the licensee identified barriers and controls for each contingency.

In Contingency “A” for the fault-tree, the licensee identified six barriers with four having one control, one having two controls, and one having eight controls. The licensee-identified barriers and controls for Contingency “A” are shown in Table III.

Table III. Barriers and Controls for Contingency “A”

Barrier	Control
1A: unauthorized quantity of moderator exceeding the NCS limit into the EPBR	#107
2A: double roof leaks	#101 & 102
3A: fire occurs and fire-fighters fail to follow proper procedures (i.e., no water)	#114
4A: polypak with high/unknown moisture selected for blend	#120
5A: fail to follow add poreformer procedures	#121
6A: dual independent, sampling process fails to identify high moisture polypaks	#105, 106, & #108-113

In Contingency “B” for the fault-tree, the licensee identified six barriers with three having one control and three having two controls. The licensee-identified barriers and controls for Contingency “B” are shown in Table IV.

Table IV. Barriers and Controls for Contingency “B”

Barrier	Control
1B: fail to keep container or mixer closed when unattended	#119
2B: container or mixer becomes cracked or is breached during handling & operator fails to detect it and remove it from operations	#116
3B: two operators fail to perform a visual inspection of a bulk container for moderator	#117 & #118
4B: container or mixer is breached and not detected by the operator	#103 & #901
5B: scan/dump interlock fails when moisture in polypak exceeds 0.3 wt.% but is less than 10.0 wt.% (required for visual inspection)	#104
6B: fail to visually inspect the polypak for excessive moisture (>10 wt.% moisture required for visual inspection)	#104 & #115

The table of Safety-Significant controls identified that all the NCS controls would be placed under Quality Assurance (QA) Level C, which are treated the same as QA Level B. As described in documents on-site, QA Level B and C criteria include the following: (a) QA organization; (b) QA program; (c) equipment/system design control; (e) instructions, procedures, and drawings; (f) document control; (h) identification and control of materials, parts, and components; (j) internal inspections; (k) test control; (m) handling, storage, and shipping controls; (n) inspection, test, and operating status; (o) control of nonconforming materials, parts, or components; (p) corrective action; and (r) audits. However, QA Level B and C criteria do not include the following: (d) procurement document control; (g) control of purchased materials, equipment, and services; (i) control of special processes; (l) control of measuring and test equipment; and (q) QA records.

The table of Safety-Significant controls indicated that, in addition to the level of assurance for QA Level C, (1) the 3 passive-engineered controls (i.e., #101-Integrity of Outer Roof, #102-Integrity of Inner Roof, #103-Integrity of Container and Mixer) would have periodic inspections; (2) the 1 active-engineered control (i.e., #104-Auto Dump Hood Interlock) would have a periodic functional test; (3) the two augmented-administrative controls (i.e., #105 and #106 - Proper Independent Moisture Results Recorded) would have no additional attributes; and (4) the 16 administrative controls (i.e., #107 through #121, 901) would have no additional attributes. A summary of the NRC evaluation of all these controls is in Table IX.

Licensee Provided: Three Types of Accident Sequences for Erbia/Uranium Powder Blending

The licensee's standard fault-tree consists of three branches, each representing the loss of control of one parameter (i.e., Mass, Moderation, Geometry). The standard interpretation of the results was that, if at least two of the three branches occur (i.e., two contingencies occurred), then an accidental criticality was possible. However, when only one of the three parameters was used for control, the licensee's fault-tree consists of two branches, each representing the loss of control of the same parameter. For this case, an additional interpretation of the results was that even if both contingencies occur, an accidental criticality would not be possible; however, each contingency was not 'not credible.' In this evaluation, the only parameter being controlled was Moderation. Therefore, the fault-tree consisted of two branches with each branch being the loss of Moderation Control.

Out of the 36 combinations of "A" and "B" Contingencies (i.e., accident sequences) that the licensee identified, 13 were considered 'not applicable,' 3 were considered 'not credible,' and 20 were considered 'credible.' For the 'not credible' and 'credible' accident sequences, in order for an accidental criticality to happen, both contingencies must occur, with "A" occurring first. The licensee provided definitions for the three types of accident sequences are shown in Table V.

Table V. Definitions of Three Types of Accident Sequences

Term	Definition
not applicable	even if both contingencies occurred, an accidental criticality was not possible
not credible	not physically possible, precluded by process theory, not believable, or extremely highly unlikely
credible	not 'not applicable' and not 'not credible'

Licensee Provided: "Highly Unlikely" for Erbia/Uranium Powder Blending

The licensee provided two definitions of "highly unlikely," but used only one. The definition that was used was that "highly unlikely" was based on the "strength of controls and the amount of margin to the criticality safety limit." The definition that was not used was that "highly unlikely" meant that "the double contingency principle was met."

The licensee based the 'strength of controls' on the (1) robustness of the barrier against a contingency from occurring, (2) reliability and availability of the controls, and (3) maintenance and surveillance of the controls. The licensee based the 'amount of margin to the criticality safety limit' on the k-effective limits for Moderation control.

Licensee Evaluation: Accident Sequences for Erbia/Uranium Powder Blending

For the 23 not ‘not applicable’ accident sequences, the licensee identified the unmitigated consequence, likelihood, and conclusion. Descriptions of the 23 accident sequences are shown in Table VI.

Table VI. Descriptions of the Not - ‘Not Applicable’ Accident Sequences

Type and Number of Accident Sequences	Unmitigated Consequence	Likelihood	Conclusion
Not Credible - 3	not credible	not credible	not credible
Credible - 20	high	highly unlikely	highly unlikely

Each of the 23 accident sequences were identified as BC-x (yA, zB), with ‘x’ being the accident sequence number, ‘y’ being one of the six barriers in Contingency “A,” and ‘z’ being one of the six barriers in Contingency “B.” When numbering the 23 accident sequences, the licensee did not take into account the ‘not applicable’ accident sequences. Also, based on the fault-tree, accident sequences BC-22 and BC-23 were actually each 16 separate accident sequences, BC-22 (a-p) and BC-23 (a-p). Thus, there were a total of 53 accident sequences with the licensee identifying 3 as being ‘not credible’ (i.e., BC-5 (1A, 5B), BC-11 (2A, 5B), and BC-17 (3A, 5B)) and the other 50 as being ‘credible.’

In conclusion, the licensee determined that (1) the margin of safety was evaluated to be strong based on the unlikely occurrence of moderator of sufficient quantity to cause an accidental criticality in the erbia bulk container or conical mixer and (2) controls present to prevent an accidental criticality in the uranium oxide bulk container strengthen the margin of safety for the erbia/uranium powder blending by ensuring that moderator was not introduced from the virgin uranium oxide powder.

NRC Nuclear Criticality Safety Reviewer Findings

This section presents the NRC staff evaluation of the licensee information provided in the amendment submittals and during the NRC site visit. Notwithstanding NRC's disagreement with the licensee's assertion that having double contingency protection meets 10 CFR 70.61(b) criteria for "highly unlikely" and NRC's disagreement with the licensee's documented approach to meet 10 CFR 70.61(b); the staff determined, through their own methodology, that the licensee will have in place a Nuclear Criticality Safety program in accordance with 10 CFR 70.61(b).

NRC Evaluation: NCS Controlled Parameters for Erbia/Uranium Powder Blending

The staff evaluated the normal conditions, boundary conditions for parameters not being controlled, and k-effective limits for parameters being controlled for the NCS parameters. The staff determined that the information concerning Mass, Geometry, Spacing, Density, Neutron Absorbers, Enrichment, and Reflection were reasonable because these parameters were not being controlled and the values were conservative based on the physical attributes of the equipment or system. Because Moderation was the only parameter being controlled, the use of Moderation control was reviewed in more detail.

There is heavy reliance on the additional margin for k-effective limits for Moderation control because if any of the four limits were violated, an accidental criticality would be possible. The staff evaluated the additional margin and determined that they were necessary to provide for safety, but not identified by the licensee. Therefore, the following License Conditions are recommended:

S-6. For Amendment - 29, any "additional safety margin" information that the licensee provided to the NRC (see Table XII) to demonstrate an adequate safety basis, shall be identified and have sufficient management measures to ensure that the margin being relied upon is maintained.

S-7 In accordance with the information provided to the NRC during their site visit, the licensee shall maintain the following "additional safety margin" for Moderation control in the mixer by: (1) maintaining a low amount of moisture during the normal process; (2) having a low amount of poreformer added (i.e., only need up to 1 kg poreformer) to the mixer during the normal process; (3) allowing only 45% of the NCS k-effective poreformer limit available to the operator at any one time; and (4) allowing only one polypak of poreformer to be scanned/dumped into one mix of the blender.

In addition, the staff identified a concern with the k-effective limits on Moderation control. There is a generic NCS concern regarding whether NCS computer codes calculate a proper k-effective value at a low moderator-to-fissile-material (H/X) ratio because of the lack of benchmark experiments. There are many ways of validating a code. In this case, two of these ways are to use the Sensitivity/Uncertainty analysis developed by the Oak Ridge National Laboratory (see "Sensitivity and Uncertainty Analyses Applied to Criticality Safety Validation," NUREG/CR-6655, Vols. 1 and 2, November 1999) or to plot the fission cross-section energy spectrum and show that the results are in the thermal energy range, rather than in the intermediate energy range. Therefore, the following License Condition is recommended:

S-8. Prior to the introduction of Special Nuclear Material into the nuclear absorber mixer or erbia blender,

A. the licensee shall demonstrate to the NRC that the NCS computer code functions correctly at low H/X ratios, specifically, that the k-effective limits described in the submittal for the mixer are accurate.

There is heavy reliance on the fact that this is a MODCON area. The staff evaluated the use of a MODCON area at the site by reviewing the NCS requirements (1) for the control of moderating materials (i.e., both Limited MODCON Areas and Full MODCON areas); and (2) in the License Application for a MODCON area (i.e., following the Moderation control standard, dual independent sampling, controls to remove unauthorized moderation and to prevent it from entering a system). The staff determined that the requirements for a MODCON area, including responsibilities for manufacturing, analysis services, NCS, and maintenance, are appropriate NCS practices. Also, many of the identified administrative controls come from the requirements for a MODCON area and assist in the NCS basis.

NRC Evaluation: Link Between PHA and Submittal for Erbia/Uranium Powder Blending

The staff evaluated the licensee's PHA. The staff determined that the licensee (1) had performed a PHA using generally acceptable methods, which included having NCS personnel as PHA team members; (2) had identified an NCS hazard (i.e., sufficient moderator is introduced into an erbia bulk container or the conical screw mixer), which would exceed the "high" consequences of 10 CFR 70.61(b) and therefore, would have to be made to be "highly unlikely;" (3) agreed to have double contingency protection (i.e., to meet the NCS baseline design criteria of 10 CFR 70.64(a)); (4) used double contingency protection to ensure subcriticality under normal and credible abnormal conditions (i.e., as required by 10 CFR 70.61(d)); and (5) had performed an evaluation that demonstrated that the current CAAS coverage in the area of the EPBR would meet the requirements of 10 CFR 70.24 because Part 70 licensed material had previously been stored in that area, the requirements had been met at that time, and the coverage was still in place. These are appropriate NCS practices. The staff determined that the fault-tree methodology (i.e., contingency, barrier, control) used to develop the "Erbia Bulk Container and Conical Mixer" fault-tree was a generally acceptable method for meeting double contingency protection.

During the site visit, information about the documentation of the safety basis was obtained that was not part of the submittal. This information may be reviewed as part of an NRC visit. The staff determined that the licensee: (1) used the PHA results to perform NCS calculations; (2) used the NCS calculations and the PHA results to write the amendment request submittal; (3) had not written a criticality safety evaluation (CSE) for the erbia/uranium powder blending; (4) will write the BAES CSE, after all design changes for the BAES is completed; (5) will base the erbia/uranium powder blending part of the CSE on the amendment submittal and information gained from the site visit; and (6) will not allow Special Nuclear Material (SNM) into the BAES until all the safety basis documentation on the site has been technically and managerially approved for use.

The staff determined that this is not the normal process that staff would expect a licensee to use for an amendment request. Staff would expect that the following process would be used for evaluating NCS: (1) the PHA would be completed; (2) based on the PHA, the NCS calculations would be completed; (3) based on the PHA and the NCS calculations, the CSE would be completed; (4) based on the safety basis documentation of all the disciplines, the entire safety basis document would be completed; and (5) based on the safety basis document, the amendment request submittal, including summary information, would be completed.

NRC Evaluation: Three Types of Accident Sequences for Erbia/Uranium Powder Blending

The staff evaluated the licensee's use of 'not applicable,' 'not credible,' and 'credible' accident sequences and determined that they were reasonable. The 'not applicable' accident sequences are not discussed further because, if they occurred, an accidental criticality would not be possible. The 'not credible' and 'credible' accident sequences are discussed further.

NRC Evaluation: "Highly Unlikely" for Erbia/Uranium Powder Blending

The staff evaluated the licensee's first definition of "highly unlikely" for the accident sequences. This is that "highly unlikely" was based on (1) the strength of controls and (2) the amount of margin to the criticality safety limit. The staff determined that this use of "highly unlikely" was reasonable in theory. However, the licensee did not provide the criteria and attributes of those two elements and how they were applied to the identified accident sequences in enough detail. Therefore, in order to determine if 10 CFR 70.61(b) had been met, the staff developed criteria and attributes based on the types of controls identified by the licensee and applied them to the accident sequences. The staff did not evaluate the licensee's second definition that "meeting the double contingency principle" met the "highly unlikely" requirement because the licensee did not use that definition in determining whether an accident sequence met 10 CFR 70.61(b).

NRC Development of Specific Methodology for Erbia/Uranium Powder Blending

The staff developed a general methodology to evaluate whether accident sequences would meet the "highly unlikely" requirement. Based on the general methodology, the staff developed a specific methodology for evaluating whether the accident sequences met the "highly unlikely" requirement for the erbia/uranium powder blending at the licensee's site. This specific methodology is not applicable for any other process at this site. This specific methodology is not applicable for any process at any other site. Do not use this specific methodology in any other situation other than the erbia/uranium powder blending at this site.

This specific methodology was developed for evaluating the accident sequences for "highly unlikely" in a quantitative 'scoring' manner for the erbia/uranium powder blending. In this methodology, Level 0.0 is 'will happen,' Level 10.0 is 'highly unlikely to happen,' and above Level 10.0 is 'above highly unlikely to happen.' The licensee identified four control types (i.e., passive-engineered, active-engineered, augmented-administrative, and administrative) in the accident sequence analyses.

The preferred design approach was passive-engineered controls over active-engineered controls, preferred over administrative controls. Therefore, control types will be graded and will start out at different levels with passive-engineered controls starting out at Level 6.0, active-engineered controls starting out at Level 4.0, and administrative controls starting out at Level 2.0. Having no controls means starting out at Level 0.0. These starting levels assume that appropriate nominal (i.e., normal) measures exist to ensure that they will be available and reliable to perform their intended function through the application of management measures. Based on the appropriateness of the measures, the levels of the control types can decrease (i.e., lower than nominal or worse) or increase (i.e., higher than nominal or better). Based on what environment the controls are expected to function in, the level values can be decreased below worse or above better. As shown in Table VII, the control types and attributes were developed, with human error events broken down further based on information from a Savannah River Site study on general human errors (see "Savannah River Site Human Error Data Base Development for Nonreactor Nuclear Facilities", WSRC-TR-93-581, February 1994).

Table VII. Control Types and Attributes for Specific Methodology

Control Type	Attributes
passive-engineered	loss of structural integrity of objects
active-engineered	failure of Scan, Check database for acceptability, If allow acceptable then allow action, Otherwise do not allow action (SCIO)
administrative	human error events
human error, basic	failure to follow procedure
human error, basic	checker verification error
human error, basic	supervisor verification error
human error, basic	wrong recording of data
human error, complex/maintenance & testing	miscalibration
human error, complex/facility operations	lab analysis error
human error, complex/accident response	failure of visual inspection

As shown in Table VIII, the worse, normal, and better starting levels and descriptions for the specific controls in the licensee's accident sequences were matched to the Savannah River Site general human errors information and their level values were conservatively chosen.

Table VIII. Control Types and Attributes, Criteria, and Levels for Specific Methodology

Control Type and Attribute	Criteria	Level
PE1. loss of structural integrity	normal, [default value and circumstances]	6.0
AE1. failure of SCIO	normal, [default value and circumstances]	4.0
AD1. failure to follow procedure	normal, non-routine, typical circumstances	3.0
AD1. failure to follow procedure	better, routine, repetitive circumstances	5.0
AD2. checker verification error	better, checking requires active participation	3.0
AD3. supervisor verification error	better, check-off sheet, low dependence	1.4
AD4. wrong recording of data	better, excellent recording system	3.4
AD5. miscalibration	normal, single-person, operator check	3.0
AD6. lab analysis error	normal, low dependence check	5.4
AD7. failure of visual inspection	better, procedure followed, event easy to observe	3.0

The staff determined that, based on the specific application of the controls identified in Table IX, additional information and adjustments to level values had to be made for some of them.

PE1 was listed as a passive-engineered control type for control #103 (Integrity of Container and Mixer). Although the control is at the normal attribute, there are two items that need to be maintained. Therefore, the Level Number for control #103 will be adjusted down to Level 5.0.

AE1 was listed as an active-engineered control type for control #104 (Auto Dump Interlock). Although the control is at the normal attribute, the Auto Dump Interlock had never failed to stop “unknown moisture” during operations or during functional tests and is a robust control. Therefore, the Level Number for control #104 will be adjusted higher to Level 5.0. However, ChAMPS has not yet been programmed for erbia or poreformer dumping and the Auto Dump Interlock has not yet been functionally tested for the erbia/uranium powder blending dumping. The licensee intends to follow their validation and verification plan for changes to software and hardware. Therefore, the following License Condition is recommended:

S-8. Prior to the introduction of Special Nuclear Material into the nuclear absorber mixer or erbia blender,

> ChAMPS shall be fully tested (i.e., verification and validation) and (2) the Auto Dump Interlock shall be fully tested for erbia/uranium powder blending (i.e., similar to the functional verification and testing being performed for the current ADU Auto Dump Interlock).

AD4 was listed as an augmented-administrative control type for controls #105 and #106 (Proper Moisture Samples #1 and #1 Recorded). AD4 should be an augmented-administrative control type because the technician does not perform the calculations and enter the information into ChAMPS. Instead, the technician enters the raw data into another software program, which performs the computation and enters the information into ChAMPS. In addition, technicians do not know which samples they are testing and so it would be difficult for them to enter the same incorrect raw data for both samples. Also, more than one technician performs sample testing, so it is not likely that a technician would perform sampling on both samples. Therefore, based on the environment in which the controls are expected to function in, the Level numbers for controls #105 and #106 will be adjusted higher to Level 5.0.

NRC Application of Specific Methodology for Erbia/Uranium Powder Blending

In order to determine whether the “highly unlikely” requirement in 10 CFR 70.61(b) had been met for the licensee’s 3 ‘not credible’ and 20 ‘credible’ accident sequences, the staff evaluated them by the criteria and attributes described above. If the attribute was determined to be either ‘worse’ or ‘better,’ then additional information was provided. The licensee identified controls and their NRC identified control types/criteria and levels are shown in Table IX.

Table IX. Controls, Control Types/Criteria, and Levels for Erbia/Uranium Powder Blending

#	Control	Control Type/Criteria	Level
101	Integrity of outer roof	PE1, normal	6.0
102	Integrity of inner roof	PE1, normal	6.0
103	Integrity of container and mixer	PE1, normal (see description above)	5.0
104	Auto dump hood interlock	AE1, normal (see description above)	5.0
105	Proper moisture #1 recorded	AD4, better (see description above)	5.0
106	Proper moisture #2 recorded	AD4, better (see description above)	5.0
107	No unauthorized moderator in the EPBR	AD1, better (MODCON area)	5.0
108	Proper moisture sample #1 taken	AD1, normal	3.0
109	Proper chem lab std during shift	AD5, normal	3.0
110	Proper chem lab std between #1 & #2	AD5, normal	3.0
111	Proper sample analysis #1 done	AD6, normal	5.4
112	Proper sample analysis #2 done	AD6, normal	5.4
113	Proper moisture sample #2 taken	AD1, normal	3.0
114	Proper firefighting	AD1, better (MODCON area)	5.0
115	Visual inspection of polypak prior to dump	AD7, better (easy to observe)	3.0
116	Detect crack in container or mixer during operations	AD7, better (event would have had to already occur)	3.0
117	Interior container visual inspection (ICVI)	AD7, better (easy to observe)	3.0
118	Check of ICVI by the second operator	AD2, better (active participation)	3.0
118	Check of ICVI by the supervisor	AD3, better (low dependence)	1.4
119	Lid closed when unattended	AD1, better (lids not regularly open)	5.0
120	Do not select high moisture pack	AD1, better (routine)	5.0
121	Correctly add poreformer	AD1, normal	3.0
901	Exterior container visual inspection	AD7, better (easy to observe)	3.0

NRC Evaluation: “Not Credible” Accident Sequences in Erbia/Uranium Powder Blending

As stated above, each of the 23 accident sequences were identified as BC-x (yA, zB), with ‘x’ being the accident sequence number, ‘y’ being one of the six barriers in Contingency “A,” and ‘z’ being one of the six barriers in Contingency “B.” When numbering the 23 accident sequences, the licensee did not take into account the ‘not applicable’ accident sequences.

The three licensee identified 'not credible' accident sequences were BC-5, BC-11, and BC-17. Even though they were determined to be 'not credible,' the licensee identified controls. The staff determined that this did not make sense. If accident sequences need controls placed on them, then they are 'credible' accident sequences and the controls need to be identified and available and reliable to perform their intended function. The staff reviewed the three accident sequences and determined that they did not meet the licensee's definition of 'not credible' and therefore, had to be evaluated for "highly unlikely." As shown in Table X, the staff used the licensee identified controls and their NRC identified control types/criteria and levels to determine whether "highly unlikely" had been met.

Table X. NRC Evaluation of Licensee Identified 'Not Credible' Accident Sequences

Accident Sequence	Controls	Levels	Total
BC-5 (1A, 5B)	104 and 107	5.0 and 5.0	10.0
BC-11 (2A, 5B)	101, 102, and 104	6.0, 6.0, and 5.0	17.0
BC-17 (3A, 5B)	104 and 114	5.0 and 5.0	10.0

Therefore, because all three accident sequences have a Level of at least 10.0, the staff determined that they meet "highly unlikely."

NRC Evaluation: "Credible" Accident Sequences in Erbia/Uranium Powder Blending

The 20 licensee identified 'credible' accident sequences were BC-1 through BC-4, BC-6 through BC-10, BC-12 through BC-16, and BC-18 through BC-23. The staff determined that all the BC-23(a-p) accident sequences were the same as BC-22(a-p) with the addition of another control (i.e., #115). Thus, the staff determined that BC-23(a-p) were covered under BC-22(a-p). Thus, there was a total of 50 'credible' accident sequences. As shown in Table XI, the staff used the licensee identified controls and their NRC identified control types/criteria and levels to determine whether "highly unlikely" had been met. If "highly unlikely" was not met, then additional margin would be needed to reach Level 10.0.

Table XI. NRC Evaluation of Licensee Identified 'Credible' Accident Sequences

Accident Sequence	Controls	Levels	Total
BC-1 (1A, 1B)	107 and 119	5.0 and 5.0	10.0
BC-2 (1A, 2B)	107 and 116	5.0 and 3.0	8.0
BC-3 (1A, 3B)	107, 117, and 118	5.0, 3.0, and 3.0	11.0
BC-4 (1A, 4B)	103, 107, and 901	5.0, 5.0, and 3.0	13.0
BC-6 (1A,6B)	104, 107, and 115	5.0, 5.0, and 3.0	13.0
BC-7 (2A, 1B)	101, 102, and 119	6.0, 6.0, and 5.0	17.0
BC-8 (2A, 2B)	101, 102, and 116	6.0, 6.0, and 3.0	15.0
BC-9 (2A, 3B)	101, 102, 117, and 118	6.0, 6.0, 3.0, and 3.0	18.0

BC-10 (2A, 4B)	101, 102, 103, and 901	6.0, 6.0, 5.0, and 3.0	20.0
BC-12 (2A, 6B)	101, 102, 104, and 115	6.0, 6.0, 5.0, and 3.0	20.0
BC-13 (3A, 1B)	114 and 119	5.0 and 5.0	10.0
BC-14 (3A, 2B)	114 and 116	5.0 and 3.0	8.0
BC-15 (3A, 3B)	114, 117, and 118	5.0, 3.0, and 3.0	11.0
BC-16 (3A, 4B)	103, 114, and 901	5.0, 5.0, and 3.0	13.0
BC-18 (3A, 6B)	104, 114, and 115	5.0, 5.0, and 3.0	13.0
BC-19 (4A, 5B)	104 and 120	5.0 and 5.0	10.0
BC-20 (4A, 6B)	104, 115, and 120	5.0, 3.0, and 5.0	13.0
BC-21 (5A, 5B)	104 and 121	5.0 and 3.0	8.0
BC-22a (6A, 5B)	104, 105, and 106	5.0, 5.0, and 5.0	15.0
BC-22b “ ”	104, 105, and 110	5.0, 5.0, and 3.0	13.0
BC-22c “ ”	104, 105, and 112	5.0, 5.0, and 5.4	15.4
BC-22d “ ”	104, 105, and 113	5.0, 5.0, and 3.0	13.0
BC-22e “ ”	104, 106, and 108	5.0, 5.0, and 3.0	13.0
BC-22f “ ”	104, 108, and 110	5.0, 3.0, and 3.0	11.0
BC-22g “ ”	104, 108, and 112	5.0, 3.0, and 5.4	13.4
BC-22h “ ”	104, 108, and 113	5.0, 3.0, and 3.0	11.0
BC-22i “ ”	104, 106, and 109	5.0, 5.0, and 3.0	13.0
BC-22j “ ”	104, 109, and 110	5.0, 3.0, and 3.0	11.0
BC-22k “ ”	104, 109, and 112	5.0, 3.0, and 5.4	13.4
BC-22l “ ”	104, 109, and 113	5.0, 3.0, and 3.0	11.0
BC-22m “ ”	104, 106, and 111	5.0, 5.0, and 5.4	15.4
BC-22n “ ”	104, 110, and 111	5.0, 3.0, and 5.4	13.4
BC-22o “ ”	104, 111, and 112	5.0, 5.4, and 5.4	15.8
BC-22p “ ”	104, 111, and 113	5.0, 5.4, and 3.0	13.4

The staff determined that the submittal indicated that AD2 was an administrative control type for control #118 (Check of the Interior Visual Inspection of the Container) and was to be done by another operator. However, on-site discussion indicated that this might be done by a supervisor, which would change this control type from AD2 to AD3. If so, then this would (1) change the Level from 3.0 to 1.4; (2) change the results in BC-3, BC-9, and BC-15; and (3) mean that additional margin would be needed for BC-3 and BC-15 to reach a Level of 10.0.

Therefore, as shown in Table XII, using the licensee identified additional margin for those accident sequences that did not reach Level 10.0, the staff performed the “highly unlikely” evaluation again.

Table XII. NRC Evaluation of Identified Accident Sequences Needing Additional Margin

Accident Sequence	Total from Above	Additional Margin	Total w/ Additional Margin Included
BC-2 (1A, 2B)	8.0	integrity of container and mixer (2.0)	10.0
BC-3 (1A, 3B) (with AD3 rather than AD2)	9.4	>5 times the normal moderator needs to be bought in (1.0)	10.4
BC-14 (3A, 2B)	8.0	integrity of container and mixer (2.0)	10.0
BC-15 (3A, 3B) (with AD3 rather than AD2)	9.4	few combustibles in the EPBR (1.0)	10.4
BC-21 (5A, 5B)	8.0	45% of the poreformer limit will be allowed to be available at any time and only one polypak of poreformer will be allowed into one mix of the blender (2.0)	10.0

Therefore, because all 50 accident sequences have a Level of at least 10.0, the staff determined that they meet “highly unlikely.”

NRC Review of Licensee’s Conclusion

These two paragraphs are offered to WEC as specific examples where NRC staff believe that WEC’s safety evaluation does not provide a sufficient information to justify conclusions and merits future reviews by the licensee.

The staff reviewed the licensee’s conclusion that (1) the margin of safety was evaluated to be strong based on the unlikely occurrence of moderator of sufficient quantity to cause an accidental criticality in the erbia bulk container or conical mixer and (2) controls present to prevent an accidental criticality in the uranium oxide powder bulk container strengthen the margin of safety for the erbia/uranium powder blending by ensuring that moderator was not introduced from the virgin uranium oxide powder.

The staff determined that the licensee had not provided sufficient information regarding ‘strong margin of safety’ and ‘unlikely occurrence” to reach the first conclusion. The staff determined that the licensee was incorrect in assessing the impact of the controls present to prevent an accidental criticality in the uranium oxide powder bulk container because there is a step missing (i.e., erbia container in an elevator with hydraulic lines) between the uranium oxide powder bulk container and erbia/uranium powder blending that was not part of the review for this amendment request. The NRC expects that the licensee would take this into consideration as part of the safety basis for BAES.

Information Provided During NRC Site Visit

During the site visit, information about the safety basis was obtained that was not part of the submittal. This information may be useful to NRC staff during future visits. The staff determined that the licensee: (1) used the PHA results to perform NCS calculations; (2) used the NCS calculations and the PHA results to write the amendment request submittal; (3) had not written a CSE for the erbia/uranium powder blending; (4) will write the BAES CSE, after all design changes for the BAES is completed; (5) will base the erbia/uranium powder blending part of the CSE on their amendment submittal and information obtained during NRC site visit; and (6) will not allow SNM into the BAES until all the safety basis documentation on the site has been technically and managerially approved for use.

NRC Review of the NCS License Conditions

In review, the staff recommends the following three license conditions for nuclear criticality safety:

S-6. For Amendment - 29, any “additional safety margin” information that the licensee provided to the NRC (see Table XII) to demonstrate an adequate safety basis, shall be identified and have sufficient management measures to ensure that the margin being relied upon is maintained.

S-7 In accordance with the information provided to the NRC during their site visit, the licensee shall maintain the following “additional safety margin” for Moderation control in the mixer by: (1) maintaining a low amount of moisture during the normal process; (2) having a low amount of poreformer added (i.e., only need up to 1 kg poreformer) to the mixer during the normal process; (3) allowing only 45% of the NCS k-effective poreformer limit available to the operator at any one time; and (4) allowing only one polypak of poreformer to be scanned/dumped into one mix of the blender.

S-8. Prior to the introduction of Special Nuclear Material into the mixer

A. the licensee shall demonstrate to the NRC that the NCS computer code functions correctly at low H/X ratios, specifically, that the k-effective limits described in the submittal for the mixer are accurate.

B. ChAMPS shall be fully tested (i.e., verification and validation) and (2) the Auto Dump Interlock shall be fully tested for erbia/uranium powder blending (i.e., similar to the functional verification and testing being performed for the current ADU Auto Dump Interlock).

Nuclear Criticality Safety Conclusion

For this amendment only (i.e., nuclear absorber mixing or erbia/uranium powder blending in the Burnable Absorber Expansion System), the staff has reasonable assurance that the licensee will have in place a Nuclear Criticality Safety program in accordance with the Nuclear Criticality Safety requirements in 10 CFR 70.61(b), 10 CFR 70.61(d), 10 CFR 70.64(a)(9), and 10 CFR 70.24.

Based on this review, the staff concludes that the licensee's Nuclear Criticality Safety program provides reasonable assurance that performing the nuclear absorber mixing (i.e., erbia/uranium powder blending in the Burnable Absorber Expansion System) will not pose an undue risk to public health and safety or the environment.

FIRE SAFETY REVIEW

The NRC staff reviewed the Westinghouse Electric Company (WEC), submittal dated April 30, 2001, requesting an amendment to the license to allow the use of the erbia blending process for the Burnable Absorber Expansion System (BAES) at the nuclear fuel manufacturing plant in Columbia, South Carolina. During a site visit, May 23-25, 2001, the licensee provided the staff with information related to the BAES design and construction, the process hazards analysis (PHA), and other supporting technical and process information that was not included in the submittal, but was important to understanding the licensee's safety basis for fire protection and overall safety of operations. This safety evaluation documents the staff's review of key process fire hazards and required controls, key facility fire protection systems, and licensee commitments to implement programmatic requirements to provide reasonable assurance that the risks and/or consequences of fires are minimized for the proposed nuclear absorber mixing/erbia blending operations.

Erbia Blending Process Fire Hazards and Risks

Westinghouse will use the burnable absorber mixer/erbia blending process in the erbia pelleting portion of the newly constructed BAES. The process involves the storage and transport of UO_2, U_3O_8, erbia, and poreformer and the blending in an orbital screw blender.

Dominant Process Fire Hazards and Risks

The licensee's PHA determined that under certain conditions (i.e., when finely divided particles of UO_2 are exposed to heat generated from the blending cycle), an oxidation reaction (or burnback) of UO_2 to U_3O_8 powder could result, increasing temperature and pressure in the orbital blender. This postulated sequence of events could result in the thermal degradation of the pneumatic inflatable rubber seal that release blend material into the blending process area. The expected consequence was an airborne (i.e., inhalation) radiological hazard. The licensee plans to locate the pneumatic inflatable seal for the orbital blender inside the erbia bulk container enclosure which is a room constructed of concrete block walls that will prevent the spread of most airborne contamination. No other physical damage that challenges the integrity of the orbital blender is expected because it is made of stainless steel and has a pressure relief valve that vents to process exhaust ventilation system. The increase in temperature is not expected to cause a fire in the erbia blending process areas because of the noncombustible construction of equipment and a lack of combustibles sufficient to propagate or result in a major fire.

In accordance with the PHA results, the licensee plans to use a nitrogen purge in the orbital blender to provide an inert atmosphere that will limit the concentration of oxygen. This will minimize or prevent a burnback during blending operations. In the PHA, the licensee postulated that a loss of the nitrogen inert atmosphere would lead to an increased risk of a burnback. The licensee's PHA identified a number of other engineered and administrative controls for preventing or minimizing the occurrences of the postulated accident scenario and its consequences. However, the licensee did not state which of the controls were key to the safety basis for fire protection. The staff determined that treating all controls in the PHA as equally important to fire protection would be an unnecessary burden and dilute the importance of those controls that provided the greatest risk reduction. The staff therefore reviewed the list of controls in the PHA and determined that controls listed below in Table XIII, were key engineered controls that perform a safety function that minimizes potential occurrences of burnback during blending operations.

Table XIII. Key Engineered Controls Identified in PHA to Prevent Burnback

Engineered Control	**Safety Performance**
Nitrogen-inert system	Provide inerting atmosphere that minimizes or prevents burnback in the orbital blender during operations.
Noncombustible construction of orbital blender	Limit potential total loss of material containment due to abnormal process temperatures and a fire involving the orbital blender.
Pressure relief valve	Relieve potential increased internal pressures within the orbital blender to prevent physical damage that could lead to loss of containment.
Erbia bulk container enclosure	Contain a radiological release in the event of an oxidation reaction that causes the loss of containment at the equipment pneumatic seal or unexpected damage to the blender.

The staff determined that these engineered controls would provide reasonable assurance that a postulated accident would result in minimal fire hazards. The staff did not identify additional controls that were not already considered in the PHA. The staff concluded that the licensee's plan to enclose the erbia bulk container provides sufficient assurance that if such an accident occurred, the potential radiological release would be contained within a small area of the BAES. Other controls described in the PHA, such as operator training and written operating procedures, general plant safety programs requirements (e.g., preventive maintenance activities, housekeeping, safety walkthroughs and audits), and plant emergency response, in combination with the described engineered controls, provide the required defense-in-depth protection for the proposed blending operations. The staff determined that the licensee has adequately identified the dominant process upset conditions that could lead to a fire hazard (i.e., a burnback) and has established reasonable controls to minimize such occurrences and their possible consequences.

Other Process Fire Hazards or Risks

The licensee's PHA considered a fire in the erbia blending process area. The consequences described was an increased radiological hazard due to possibility that a fire could damage process equipment or hoods, releasing uranium and increasing airborne contamination within the process areas. In the PHA, the licensee described a number of controls to minimize or prevent fires and mitigate possible consequences. The staff noted that the PHA and other licensee's safety documents examined did not identify the key controls and safety performances that reduce the risk of a fire and mitigate possible consequences.

Again, the staff reviewed the licensee's identified controls and determined that the following administrative and engineered controls and related safety performances listed below in Table XIV, are required to prevent or minimize the potential of a major fire in the erbia blending process and mitigate the possible consequences.

Table XIV. NRC Staff - Identified Safety Controls

Administrative and Engineered Control	**Safety Performance**
Control of fixed combustibles	Control fixed combustibles (process equipment, support systems, facility structural elements) to minimize the potential contribution as fuel to a fire or the spread of a fire.
Control of transient combustibles	Limit transient combustibles, by amount and location, to levels that minimize fire severity and fire spread and ensure the success of trained operators to extinguish a fire using fire suppressant contained in two portable fire extinguishers.
Manual fire suppression by operators	Extinguishment of an incipient (small) fire by operators trained in firefighting using portable fire extinguishers.
Fire alarm system	Automatic detection of a fire and manual means of initiating a plant fire alarm for a plant emergency response.
Plant emergency brigade (and/or offsite fire departments) manual fire suppression	Containment and suppression of a fire that has developed beyond its incipient stage or beyond the suppression capabilities of trained operators.

Control of Combustibles

The licensee plans to use noncombustible construction material in the design and construction of process equipment and minimal combustibles or exposed combustibles (e.g., plastics, wires and cables, etc.) so as to minimize overall fixed combustible loading in the process areas. The licensee also used noncombustible construction materials in the design and construction of the facility (see discussion of facility fire protection). The staff determined that built-in fire protection in the design of equipment was a sound prevention control that minimizes potential fire hazards associated with the proposed erbia blending operations.

In addition, the licensee plans to control transient combustibles by not allowing accumulation or storage (e.g., empty polypaks and lids, wooden pallets, spare supplies) in the blending process area and to limit the quantity and type transient combustible materials to those needed for day-to-day normal operations (e.g., plastic gloves, cleaning rags/paper, small quantities of cleaning fluids). Under some plant or operating conditions, such as plant shutdown for maintenance or other activities (i.e., cutting and welding), the licensee expects to have a temporary increase in transient combustibles with appropriate additional controls (e.g., fire watch, terminating operations, protecting against possible fire exposures). Since the licensee's submittal and other safety documentation did not provide specific performance limitations on the amount or location of combustibles that would be considered acceptable for the control of transient combustibles, the staff has determined the following safety performances listed below in Table XV, to be acceptable.

Table XV. Acceptable Safety Practices

Control of Transient Combustibles	Safety Performance
Minimizing likelihood of fire propagation	A fire involving transient combustibles will not propagate beyond the physical “foot print” area of the combustible material where the fire originated.
Minimize fire severity	A fire involving transient combustibles will not result in a flame height greater than 3 feet above the base of the fire at its peak burning (e.g., similar to a small waste basket fire or approximately 300-500 KW peak heat release rates) and will not last longer than 15 minutes after flame is observed.
Maximize success of operator response	A fire involving transient combustibles is sufficiently small to be suppressed by full discharge of fire suppressants contained in two portable fire extinguishers.
Minimize fire consequences	A fire involving all transient combustibles in the process area is not of sufficient peak energy or total energy to cause a flashover or raise the upper room level temperatures near the ceiling of the room above 112 degrees Fahrenheit.

An important factor that was considered by the staff in determining acceptable safety performances for the control of combustibles was the licensee’s reliance on control or exclusion of moderators for nuclear criticality safety. Quantities of combustibles must be kept low, with an adequate margin of safety. This ensures that if a fire occurs, it is small, has minor consequences (e.g., as described above) and will not require the use of water-based fire suppressants. Another factor is that a fire in the process area must not present a challenge to the integrity of high-efficiency particulate air (HEPAs) filters that are used to prevent possible releases of radiological contamination from the facility. The control of combustibles is routinely implemented and the safety performances indicated are routinely achieved by this licensee and other licensees. The staff determined that the control of transient combustibles is a key to the licensee’s success in minimizing the risk of a fire.

The staff also determined that the availability of process operators to respond quickly and extinguish a fire is a mitigating system or protection against the consequences of major fires. A basic requirement is that operators be present in the erbia blending process area at all times during operations to quickly detect and suppress a fire. Another requirement for assuring the success of operations is adequate training of process operators to suppress fires. The remaining controls identified in the licensee’s PHA (e.g., fire alarm system, plant emergency brigade or offsite fire department response, training and written procedures, and plant safety programs) contribute to defense-in-depth fire protection. Overall, the licensee has identified and planned for a reasonable set of controls that minimize or prevent the occurrence of a major fire in the erbia blending process area.

Potential Exposure Fire or Explosion Hazards and Risks

The proposed erbia blending process does not involve the use or handling of flammable gases or liquids, so there is little or no risk of a fire involving flammable gas or liquids or an explosion. However, the planned erbia pelleting operations, adjacent to the erbia blending process areas, use hydrogen and natural gas in the operations of furnaces. Therefore, a fire or explosion in the adjacent process could present a fire or explosion exposure hazard to the erbia process operations. The licensee's PHA identified the potential hydrogen fire or explosion as the dominant risk and lists controls to prevent or minimize such occurrences. The staff considered controls listed below Table XVI, to be key engineered and administrative controls.

Table XVI. Key PHA Listed Controls

Key Engineered and Administrative Controls To Minimize Potential Exposure Fire/Explosion Hazards From Pelleting Operations
Hydrogen supply piping complies with plant process piping for hydrogen services and is installed appropriately to minimize possible physical damage.
Excess flow check valves on hydrogen supply line to the erbia pelleting facility.
Manual and automatic shutoff valves and all automatic interlocks to isolate hydrogen feed piping to each furnace and hydrogen supply to the facility.
Furnace controls and interlocks on furnace doors to lock on abnormal conditions of flame curtain, and nitrogen supply system and interlock to allow opening of one furnace door at any given time.
Automatic furnace shut down on abnormal conditions of nitrogen supply.
Exhaust ventilation for the pelleting area provides high flow rates (i.e., approximately seven air exchanges per hour) that prevent the accumulation of hydrogen concentration above the lower flammable or explosive limit (e.g., the typical industry safety practice is 25% of lower flammable limits of 4% hydrogen concentration by volume)
Excess furnace temperatures controllers and interlocks to shut off electrical power for furnace.
Operator training and written startup, shutdown, and operating procedure for furnaces.

The staff determined that the availability and reliability of the above administrative and engineered controls minimized the risk associated with the use of hydrogen by achieving the following safety performances: (i) prevent possible accumulation of concentration of hydrogen in the flammable or explosive ranges (between the upper and lower flammable or explosive limits) (ii) provide automatic isolation of hydrogen supply to the process furnace or the process facility on abnormal conditions, and (iii) reduce possible human errors in furnace operations.

The licensee plans to provide similar prevention and mitigation features (i.e., piping requirements, excess flow check valves, odorized gas to detect leaks, and exhaust ventilation for dilution in the event of a leak) to minimize the potential fire and explosion hazards from the use of the natural gas that provides a flame curtain at each furnace door. In accordance with the license, the PHA, and plant procedures, the licensee commits to meeting applicable requirements of NFPA 86C, "Standard for Industrial Furnace Using a Special Processing Atmosphere," and NFPA 54, "National Fuel Gas Code," for safe furnace operations.

The staff determined that the licensee's commitment to provide and maintain engineered controls and administrative controls for process safety and automatic process shutdowns or isolations of flammable gases provides a reasonable set of controls that would minimize the occurrence of a fire or explosion in the erbia pelleting process areas. As a result, reasonable assurance would be provided against the potential of exposure fire or explosion hazards to the proposed erbia blending operations.

Facility Fire Protection

Facility Passive Engineered Fire Protection Systems

The licensee renovated the southeast portion of the main plant to construct the BAES facility that houses the erbia pelleting process and rod assembly process. The erbia powder blending portion and the remaining BAES facility are constructed to meet applicable fire protection requirements in the Standard Building Code (SBC), as required by the County of Richland, and the National Fire Protection Association (NFPA) 101, "Life Safety Code."

Noncombustible Facility Construction

The erbia powder blending process areas and the remaining process areas of the BAES were designed to meet Type IV, unprotected construction (i.e., noncombustible structural elements) in accordance with Table 600 of the SBC. Because of the design requirement to use noncombustible materials to construct walls, floors, roofs, structural support systems of the facility, the licensee achieved its fire protection objective of limiting the amount of fixed combustibles that could contribute to the severity or the spread of a fire in the erbia process areas. As a result, a fire involving a process upset (e.g., a burnback in the orbital blender) or a fire involving transient combustibles would not spread by means of the facility construction material. The licensee's plan to provide and maintain the noncombustible construction of the facility structural elements is a fundamental requirement of the safety basis for providing an adequate level of fire protection within the facility.

Fire Resistance - Rated Assemblies

In accordance with the SBC and NFPA 101, the vertical shafts and high-hazard areas (i.e., the elevator shaft and elevator equipment room) are constructed to provide 1-hour fire rated assemblies with 3/4-hour doors, and fire stopping protection of openings and penetrations. The fire-rated barrier for the separation of hydraulic liquid fire hazards is a key passive engineered system that the licensee relies on to protect against a fire that could spread into the erbia blending process areas. This emphasizes the licensee's safety basis assumption that a fire in the process areas would be limited and controlled to an acceptable level (i.e., small fires).

Although a majority of the facility structural elements are unprotected (noncombustibles with no fire resistance ratings), both the SBC and the Life Safety Code require fire resistance rated assemblies for egress components (e.g., exit access corridors, exits, and exit passageways) for emergency egress in the event of a fire. The licensee commits, in Chapter 8 of the license, to meet applicable requirements of NFPA 101. To meet the greater fire protection requirements in NFPA 101, the licensee plans to provide 1-hour fire resistance rated assemblies, with 3/4-hour fire doors for protection of openings, and fire stopping of penetrations. The licensee's design and construction of building egress components and other life safety features (e.g., emergency lighting) in accordance with NFPA 101 ensure safe egress of process operators from a fire and provides means of establishing safe separation distances from potential radiological hazards in emergencies. It also provides easy and unobstructed access for the emergency brigade responding to a fire. Therefore, on the basis of the licensee's commitment to meet and maintain the requirements of NFPA 101, the staff determined that the licensee has provided reasonable assurance of unobstructed access for response by the plant emergency brigade to mitigate a fire in the erbia blending process or adjacent erbia pellet process areas by manual fire suppression methods.

Facility Active Engineered Fire Protection Systems

Fire Alarm System

The licensee plans to provide a fire alarm system in the BAES for automatic detection of a fire, automatic and manual initiation of a plant fire alarm, and audible and visual indication of a fire. The key safety function of the fire alarm system is to provide automatic detection and means of manually initiating a plant fire alarm for emergency response. The process and room ventilation duct system (i.e., intake and exhaust) also have automatic fire detection coverage. As a result, the fire alarm system and components (including the secondary power supply) are important to meeting the safety performances of initiating a response of the plant emergency brigade to manually contain and suppress a fire before conditions challenge process operations safety controls that increase the risk of a different type of accident. The staff determined that the fire alarm system is an engineered system and if maintained available and reliable, contributes to defense-in-depth fire protection of the erbia blending operations.

Engineered Automatic Fire Suppression System

Consistent with fire protection provided in other high fire hazards areas at the plant and the need to minimize potential use of water-based fire suppressants to contain and suppress a fire involving hydraulic liquid in the elevator equipment room, the licensee commits to installing an engineered automatic fire suppression system. The minimal performance of such as system is that it will minimize the size of a fire and its severity. The staff expects the engineered fire suppression system provided will be effective for combustible liquid fires and will not result in a nuclear criticality safety concern (i.e., introduction of unacceptable moderators). The availability of the automatic fire suppression system will increase the likelihood that a fire inside the elevator equipment will be contained (or suppressed) and, combined with the required 1-hr fire rated enclosure and the availability of a plant fire brigade or offsite emergency assistance, will provide a defense-in-depth protection against fire exposure hazards to the erbia blending process areas.

Ventilation System HEPA filters and Fire Dampers

As previously discussed under protection against possible fire and explosion hazards, the process and room ventilation provides a key safety function. The staff also noted that the ventilation system is also a possible leak path for combustion products containing radiological contamination. To minimize this possibility, the licensee plans to install HEPA filters for process and room ventilation to remove radiological contaminants prior to exhausting air from the facility. The presence of HEPA filters is a defense-in-depth protection safety components that protect against release of radiological contamination for the postulated fire scenarios. However, if a major fire occurred, the staff expects the deposition of large quantity of combustion products would plug the filters quickly and the high temperatures and prolonged exposure could challenge the integrity of the filter as a barrier against releasing radiological contamination beyond the facility boundaries. WEC plans to rely on the availability of facility's fire brigade to mitigate the spread of fire and the spread of radiological contamination. The actions of responding fire brigade and personnel would also include the shutdown of ventilation fans as needed from the control room within the BAES facility or at the roof ventilation unit. In addition, WEC has provided heat detectors upstream and downstream of HEPA filters enclosure to activate the plant fire alarm system that initiate the fire brigade response. The WEC approach of providing a fire brigade response and to shutdown ventilation fans as needed is an additional defense-in-depth fire protection that provides a reasonable assurance that radiological releases would be minimized.

Plant Fire Protection Program

The licensee has committed, in Chapter 8 of the current license, to provide and implement a fire protection program that will minimize the occurrence, the potential severity, and the consequences of a fire. The fire protection program assures the required level of safety through the following commitments and resulting safety performance:

Provide administrative controls on accumulation of combustibles and the use and storage of flammable and combustible material to minimize potential fire severity and fire involvement of the building structural elements and nuclear process equipment and provide administrative controls of ignition sources to minimize occurrences of fire.

Provide and maintain engineered safety features for detection and notification in the event of a fire and automatic fire suppression and/or fire barriers to limit the severity and spread of a fire.

Provide and maintain an onsite emergency response capability and equipment (including an adequate water supply system) and offsite fire department assistance to respond promptly and effectively to extinguish fires and mitigate their possible consequences.

The implementation of these fire protection measures ensures the defense-in-depth protection and safety performances necessary to minimize the likelihood of major fires in the proposed erbia blending operations. These fire protection and management measures are the safety envelope that minimizes the potential of a fire that could impact or involved licensed material or cause a loss of safety controls that could lead to an accident of a different type.

Fire Safety Conclusions

The staff concluded that the submittal dated April 30, 2001, did not provide sufficient information in accordance with requirements of Sections 70.65b(1), 70.65b(2), and 70.65b(3) to independently evaluate the potential fire hazards, resulting consequences or the controls necessary to reduce or mitigate such hazards. The staff determined that information required to demonstrate compliance with section 70.65(4) was not presented for fire protection. Section 70.65(4) requires the licensee to demonstrate compliance with the performance requirements of Section 70.61, e.g., an explosion resulting from inadequate controls on the use of hydrogen in the erbia pelleting process area could cause the loss of safety controls and/or create consequences that lead to an increased risk to nuclear safety or a release of radiological material for the proposed nuclear absorber mixing/erbia blending operations. Accordingly, a number of controls from the licensee's PHA would be identified as safety significant controls (SSCs) or items relied on for safety (IROFS) that acceptable risks within the performance requirements of Section 70.61. Such information was not provided in accordance with requirements of Section 70.65b(4) and 70.65b(6).

Based on information reviewed during a site visit, the staff concluded that the licensee's PHA provided a comprehensive list controls for protection of specific fire hazards associated with the processes. However, the licensee's PHA process did not implement analysis requirements in accordance with Section 5.4 of the licensee's procedure, "Guidelines for Preparing Baseline Integrated Safety Assessment," dated November 11, 1997. This analysis step of the PHA process is imperative to developing an adequate baseline integrated safety analysis. Section 5.4 describes performance of a "Fire Safety Analysis" that would provide a comprehensive assessment of potential and required protection against fires and explosions (e.g., defining maximum fire loading, analyzing potential consequences, defining minimum fire protection performance requirements, documenting facility design basis and code and standard requirements, describing defense-in-depth protection, documenting comprehensive detailed technical bases for adequate fire protection). The staff anticipates that the fire safety analyses will be integrated into ISA documents and the ISA Summary that are required by 10 CFR Part 70. Until completion of a fire hazards analysis, the staff has described in this safety evaluation the minimal safety performances that are expected for adequate fire protection. Accordingly, the following safety condition is recommended:

S-8. Prior to the introduction of Special Nuclear Material into the nuclear absorber mixer or erbia blender,

> the licensee shall verify; (1) the availability and reliability of necessary administrative and engineered fire protection controls identified as safety significant controls (SSC's) or items relied on for safety (IROFS), and,
> (2) fire protection design features and controls important for defense-in-depth for fire protection and the acceptable risks for operations.

Overall, the licensee has identified a list of administrative and engineered controls to minimize the risk of fires and protect against potential exposure from fire and explosion hazards for the proposed nuclear absorber mixing/erbia blending operations. The staff concluded that if the key safety controls and defense-in-depth administrative and engineered controls (discussed above), and the current license commitment is adequately implemented, there would be reasonable assurance that the health and safety of the public and protection of the environment would be provided. Therefore, approval of the amendment application is recommended.

CHEMICAL PROCESS SAFETY

Based on the information provided by the licensee, no new hazardous chemicals are being introduced into the nuclear absorber mixing/erbia blending process. The greatest hazard is from soluble uranium or chemical oxidation of uranium dioxide powder which is addressed respectively by radiation safety and fire safety functions.

The staff concludes that the requested changes will have no adverse effect on public health and safety or the environment. Therefore, approval of the amendment application is recommended

ENVIRONMENTAL REVIEW

Authorization of the nuclear absorber mixing constitutes a change in process operations and equipment and meets the following requirements:

1. there is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite,

2. there is no significant increase in individual or cumulative occupational radiation exposure,

3. there is no significant construction impact, and

   there is no significant increase in the potential for or consequences from radiological accidents.

Operation of the nuclear absorber mixing will not cause a change in the types or significant increase in the amounts of any effluents that may be released offsite. The materials used in the system have similar radiological characteristics as currently authorized at the site. The small amounts of liquid effluent generated by the system will be treated by unit operations, and managed to assure all applicable discharge limits are met. Gaseous effluents discharged by the system will be controlled by HEPA filtered ventilation systems capable of removing greater than 99 percent of entrained particulates. Any solid combustible waste will be processed through the incinerator for volume reduction.

Since the nuclear absorber mixing process has similar radiological characteristics as the current fuel process system currently authorized at the site, the authorization of this process will not result in any significant increase in individual or cumulative occupation radiation exposure.

There will be no significant construction impact since the system is being installed in an existing facility. Construction activities in the existing facility are limited to slight modifications and equipment installation.

There will be no significant increase in the potential for or consequences from radiological accidents. The licensee performed a Process Hazards Analysis which identified the accidents that could occur due to nuclear absorber mixing operation. NRC staff has determined that the mitigative and preventive measures associated with the mixing process will reduce the frequency and consequences from the postulated accidents to acceptable levels.

Accordingly, NRC staff has determined that the criteria from 10 CFR 51.22(c)(11) for a categorical exclusion has been met. Therefore, neither an environmental assessment nor an environmental impact statement is warranted for this action.

RADIATION SAFETY

The licensee as part of its renewal application submitted on October 30, 1990, described its procedures for meeting the requirements of 10 CFR Part 20 and described its radiation safety program. By letter dated November 3, 1995, the NRC found the licensee radiation safety program acceptable. Since the Burnable Absorber Expansion System has similar Radiological characteristics as the current fuel process system currently authorized at the site, the authorization of this process will not result in any significant increase in the types or amounts of any effluents that may be released offsite or any significant increase in individual or cumulative occupation radiation exposure. Accordingly, the staff concludes that the current radiation protection procedures currently in place are acceptable.

CONCLUSION

Based on the preceding discussion and adherence to the license safety conditions described above, the staff concludes that the proposed changes will have no adverse effect on worker and public health and safety or the environment. Therefore, approval of the amendment application is recommended.

Region II staff and Safety and Safeguards Support Branch inspection staff have no objection to this proposed action.

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