

**SAFETY EVALUATION REPORT  
VENTILATED STORAGE CASK (VSC-24)  
DOCKET NO. 72-1007  
CERTIFICATE OF COMPLIANCE NO. 1007  
AMENDMENT NO. 1**

## **1.0 INTRODUCTION**

This Safety Evaluation Report (SER) documents the review and evaluation of the December 30, 1998, License Amendment Request (LAR) 98-01 for the Safety Analysis Report (SAR), as supplemented, on the Sierra Nuclear Corporation (SNC) Ventilated Storage Cask (VSC-24). The SAR amendment was submitted by SNC for the storage of burnable poison rod assemblies (BPRAs) with Babcock & Wilcox (B&W) 15x15 spent fuel assemblies in VSC-24s, following the format of Regulatory Guide 3.61. The VSC-24 Certificate of Compliance No. 1007, Amendment 0, was issued to Pacific Sierra Nuclear Associates, which is a partnership between SNC and BNFL Fuel Solutions Corporation.

The review of the SAR addressed the handling and dry storage of spent fuel in a single dry storage cask design, the VSC-24. The cask would be used at an independent spent fuel storage installation that would be licensed under 10 CFR Part 72 at a reactor site operating with a 10 CFR Part 50 license.

This SER is issued in response to a request by SNC to permit storage of BPRAs with B&W 15x15 spent fuel assemblies in VSC-24s. The LAR 98-01 is a supplemental document. It must be considered along with information provided in Revision 0 of the SAR.

## **2.0 EVALUATION**

### **2.1 Structural**

The addition of BPRAs to the B&W fuel increases the weight of the fuel assembly from 1,516 lbs to 1,576 lbs. The LAR contained SNC calculations to evaluate a drop height of 5 feet. Thus, the decelerations for the Multi-assembly Sealed Basket (MSB) are based on a 5-foot vertical drop of the Ventilated Concrete Cask (VCC) with the MSB. The bounding deceleration values of a fully loaded VCC with MSB have not changed from the values presented in Revision 0 of the SAR and are acceptable design values for an accident which could occur during transfer operations of the MSB inside the VCC.

The effect of the additional MSB weight on the drop accident has been evaluated by multiplying the stresses for the original MSB by the ratio of the weights of the amended MSB to the original MSB. An increase of 6 percent is noted for the stresses associated with the vertical drop only. There is no increase in the stresses for the horizontal drop because the specific load per unit length of the MSB shell and basket internals is lower for the LAR version. The higher stresses presented in the SAR for the original MSB are used conservatively in the LAR.

All supporting calculations documenting the structural integrity of the loaded VCC with the MSB during a drop accident are based on a 5-foot drop height. Therefore, the maximum lifting height of the VCC outside of the spent fuel pool building must be limited to 60 inches. Technical Specification 1.2.15 is revised to reduce the maximum VCC lift height from 80 inches to 60 inches.

With this Technical Specification the staff finds the VSC-24 structural effectiveness adequate to safely maintain spent fuel assemblies containing BPRAs.

## **2.2 Thermal**

The thermal load of the B&W fuel assemblies (with or without BPRAs) will remain at a maximum of 1 kW (0.95 BTU/sec).

## **2.3 Shielding**

Since BPRAs only contribute to the gamma source, the neutron source term for the B&W 15x15 fuel with BPRAs inserted is identical to the neutron source term previously used in support of Revision 0 of the SAR. The maximum increase in cask dose rates at the inlet vents of the VCC increased from 22 mrem/hr to 24.8 mrem/hr. The off-site dose rates remain well within the 10 CFR Part 20 and 72 limits.

## **2.4 Criticality**

Results of the LAR fuel criticality analyses show that the  $k_{\text{eff}}$  in the MSB, including statistical uncertainties, fuel parameter tolerances and biases, will remain below 0.95. Although pressurized water reactor fuel designs use a wide range of uranium dioxide densities, SNC's methodology conservatively assumed a bounding 95 percent density for all the fuel types. For some individual fuel designs, there is a range of parameters such as pellet outer diameter and active fuel length. SNC's methodology conservatively assumes the most limiting value (i.e., largest pellet diameter and longest fuel length) to maximize the calculated value of  $k_{\text{eff}}$ .

Based on SNC's criticality evaluation, as confirmed by the staff, the staff concludes that the pressurized water reactor basket will remain subcritical, with an adequate safety margin, under all credible normal, off-normal, and accident conditions.

## **2.5 Confinement**

This SAR section was not changed as a result of the LAR.

## **2.6 Operating Procedures**

This SAR section was not changed as a result of the LAR.

## **2.7 Acceptance Tests and Maintenance Program**

This SAR section was not changed as a result of the LAR.

## 2.8 Radiation Protection Evaluation

The MSB Transfer Cask (MTC) radial and axial shielding was decreased to reduce the weight of the MTC when transferring an MSB loaded with the fuel assemblies containing BPRAs. This reduction in MTC shielding results in higher potential occupational contact dose rates (from 300mrem/hr to 1932 mrem/hr) at the bottom center of the MTC doors. However, workers are not expected to be in this region of the MTC. The MTC weight reduction is required to maintain the loaded MTC weight within the allowable crane capacity.

The estimated annual occupational exposure for routine activities such as visual surveillance of cask air inlets/outlets and radiation protection surveys on a cask filled to design capacity would be 0.007 person-rem/year/cask. Based on these expected occupational activities, the staff has reasonable assurance that individual exposures will be below the annual occupational limit of 5 rem specified in 10 CFR 20.1201.

The staff determined that the BPRAs will result in an increase of approximately 7.5 percent in the calculated offsite direct and skyshine dose rate to the public as calculated and presented in Revision 0 of the SAR. The annual public dose at 1500 feet from an array of 68 VSC-24 casks loaded with 5-year cooled spent nuclear fuel would increase from 3.9 mrem/year to 4.2 mrem/year, which remains well below the 25 mrem/year limit in 10 CFR 72.104.

## 2.9 Accident Analysis Evaluation

The limiting conditions for operation for transfer operations without impact limiters is that the center of gravity of the loaded VCC with the MSB is not able to fall through more than 60 inches in either the horizontal or vertical orientation.

SNC performed additional calculations to analyze the drop condition to account for the increase in weight and length of the MSB as described in the LAR. An increase of 6 percent is noted for the stresses associated with the vertical drop only. There is no increase in the stresses for the horizontal drop because the specific load per unit length of the MSB shell and basket internals is lower for the LAR version. The staff finds that stresses due to the drop condition and the associated load combination comply with the ASME Code allowable stresses for Service Level D accident conditions.

SNC performed a revised analysis of a postulated accident in which fresh B&W 15x15 fuel is loaded into the MSB with borated water present. The criticality safety of this scenario is analyzed for a range of enrichments from 1.1 to 4.2 weight percent <sup>235</sup>U using B&W 15x15 fuel both with and without BPRAs.

A soluble boron concentration was determined that resulted in a total calculated  $k_{\text{eff}}$  of less than 0.95 for B&W 15x15 fuel assemblies, both with and without BPRAs. The resulting minimum boron concentration, as a function of initial enrichment, is presented as a curve in revised Technical Specification 1.2.6.

SNC performed analyses to evaluate the increase in MSB pressure as a result of a postulated accident condition in which 100 percent of the fuel and BPRA rods rupture. The staff found that MSB stress values remained within the ASME Code Service Level D allowable stresses.

## **2.10 Conditions for Cask Use and Technical Specifications**

The Conditions for Cask Use and Technical Specifications (TSs) changed as a result of this amendment are as follows:

1. Condition 1.1.2, "Operating Procedures," deleted specific name of valve manufacturer;
2. Condition 1.1.7, "Requirements for First Cask in Place," clarified requirement that first MSB shall be loaded with 24 spent fuel assemblies constituting a heat source of up to 24kW;
3. TS 1.2.1, "Fuel Specification," changed to include storage of BPRAs and to clarify conditions for fuel loading;
4. TS 1.2.6, "Boron Concentration in the MSB Cavity Water," changed to add a concentration curve for spent fuel pool boron concentrations when loading B&W, Mark B, 15X15 fuel with BPRAs with initial enrichments over 3.3 weight percent uranium-235;
5. TS 1.2.8, "MSB Helium Backfill Pressure," changed to correct a typographical error; and
6. TS 1.2.15, "MSB Handling Height," changed to reduce the maximum lift height from 80 inches to 60 inches to correspond with the analyzed values provided in SNC calculations and correct typographical errors.

## **2.11 Quality Assurance**

This SAR section was not changed as a result of the LAR.

## **2.12 Decommissioning**

This SAR section was not changed as a result of the LAR.

## **3.0 EVALUATION FINDINGS**

Based on the information provided in LAR 98-01 (by reference to Revision 0 of the SAR) and supporting documentation and the staff's own confirmatory analyses, the staff concludes that the VSC-24 system meets the acceptance criteria specified in 10 CFR Part 72.

The staff performed a detailed safety evaluation of the proposed Certificate of Compliance amendment request and found that the addition of the BPRAs to the B&W 15x15 fuel does not reduce the VSC-24 safety margin. In addition, the staff determined that the storage of BPRAs in the VSC-24 does not pose any increased risk to public health and safety.