SAFETY EVALUATION REPORT
VENTILATED STORAGE CASK (VSC-24)
DOCKET NO. 72-1007
CERTIFICATE OF COMPLIANCE NO. 1007
AMENDMENT 2

1.0 INTRODUCTION

This Safety Evaluation Report (SER) documents the review and evaluation of an amendment request for the VSC-24, dated November 20, 1998, submitted by Sierra Nuclear Corporation (SNC). The VSC-24 Certificate of Compliance (CoC) No. 1007 is issued to Pacific Sierra Nuclear Associates, which is a partnership between SNC and BNFL Fuel Solutions Corporation. The staff prepared this SER as a supplement to the SERs for the initial release and Amendment 1 of CoC No. 1007.

The staff evaluation of the November 20, 1998, SAR amendment request is being provided for rulemaking as Amendment 2 to the VSC-24 CoC.

2.0 BACKGROUND

SNC submitted this proposed SAR amendment in response to a U.S. Nuclear Regulatory Commission (NRC) request that the SAR be revised to conform to the existing NRC SER for previously docketed revisions of the VSC-24 SAR, identified as Revisions 0A and 0AA. In addition, the proposed amendment includes the following SAR changes:

1. Establish consistency throughout the document and incorporate changes identified in NRC letter dated July 22, 1998, “Closure of Confirmatory Action Letter (CAL) 97-7-001;”

2. Incorporate selected design upgrades and design calculation revisions resulting from the completed Corrective Action Reports (CARs);

3. Expand the explanation of the closure weld process and ultrasonic testing (UT) guidelines;

4. Clarify ASME requirements for Non-Destructive Examination (NDE) of temporary attachments and impact testing of welds, base material, and heat affected zones;

5. Address NRC Bulletin 96-04 and CARs on hydrogen generation by Carbo-Zinc coating exposed to boric acid solution; and

6. Correct thermal calculation errors in the annulus flow rate of the ventilated concrete cask (VCC).

This SER is issued in response to SNC's request to amend Revision 0 of the VSC-24 CoC to incorporate the above information into the SAR. The staff evaluated this amendment request with respect to SAR changes evaluated in SNC's December 30, 1998, SAR amendment request (approved as CoC Amendment 1) and initial Revision 0 of the VSC-24 SAR.

3.0 EVALUATION

The staff evaluated the November 20, 1998, SAR amendment by reviewing the SAR and its supporting analyses. The scope of this SER is limited to those areas of the VSC-24 system which have been changed beyond SAR Amendment 1.

The staff reviewed revisions to the SAR addressing NRC CAL No. 97-7-001. This CAL discussed VSC-24 shortcomings associated with the double-seal welds of the shield and structural lids.

In addition, the staff reviewed revisions to the SAR addressing NRC Bulletin 96-04 on potential hydrogen generation during flooding of the multi-assembly sealed basket (MSB) with borated water.

3.1 Design Criteria

The proposed SAR amendments addressing changes to the SAR Revision 0 design criteria include:

1. Clarifying statements to specify ASME Boiler and Pressure Vessel (B&PV) Code Sections and Editions;

2. Methods for combining loads to meet the design criteria of ANSI 57.9 and ACI 349;

3. Expanding the fabrication and NDE of the confinement welds for the MSB; and

4. Structural design criteria relating to minimum limiting temperature for the movement of a loaded MSB.

NRC staff found that changes to the design criteria complied with 10 CFR Part 72 requirements and provided adequate assurance that the specified spent fuel can be stored safely.

3.2 Structural

The staff found that the proposed SAR amendment structural analysis of the MSB confinement vessel was identical to SAR Revision 0 with the exception of the incorporation of additional requirements for impact testing of the SA-516 Grade 70 steel. All MSBs manufactured after issuance of this amendment shall have an absorbed impact energy of 45 foot-pounds at 0°F. The staff found the proposed SAR amendment structural analyses satisfactory.

3.3 Thermal

The staff found that the proposed SAR amendment thermal evaluation used identical methodology, inputs, computer codes, and assumptions as SAR Revision 0. However, in response to an error identified by staff in 1996, SNC revised a thermal calculation on the VCC annulus air flow rate. The revised calculation on maximum long-term and short-term fuel cladding temperatures continued to demonstrate that values were within appropriate temperature limits. In addition, the calculated temperature values remained below their respective material temperature limits.

The staff found the thermal analysis to be satisfactory.

3.4 Shielding

Other than editorial changes, this SAR section was not changed as a result of this revision.

3.5 Criticality

Other than editorial changes, this SAR section was not changed as a result of this revision.

3.6 Confinement

The SAR amendment changed the MSB spent fuel confinement criteria for design, fabrication, and testing requirements of the double-seal welds to address items in NRC CAL No. 97-7-001. In response to the CAL, SNC included the following SAR amendments:

1. Revision of welding procedures to improve the structural and confinement integrity of the double-seal welds;

2. Revision of the material specification to require low carbon, low sulfur, calcium-treated, vacuum-degassed steel to prevent defects in shell material;

3. A requirement that the shield and structural lids be secured during the welding by a combination of large tack welds and a balanced root weld sequence to prevent improper fit-up;

4. Incorporation of a manual welding process for gaps larger than 1/16 inch;

5. A requirement for preheating of all shield and structural lids to 200^{o}F prior to welding and maintaining the temperature for a minimum of 1 hour after the completion of the final weld pass to prevent moisture contamination of the weld; and

6. A requirement for the use of only low hydrogen weld consumables (10 ml of hydrogen per 100 grams of deposited weld material) for the lid welds to prevent hydrogen induced cracking.

In addition to the above, the SAR amendment request also elaborated on fabrication sequences; in particular, ASME Section III welding requirements for fabrication, examination, and repairs, and ASME Section V examination requirements for visual and radiographic techniques. These changes to the fabrication and testing of the double-seal welds are further augmented by ultrasonic testing of the structural lid weld.

NRC staff found that changes to the confinement section of the SAR met the intent of the CAL and provided reasonable assurance that the confinement boundary will be maintained as required by 10 CFR Part 72.

3.7 Operating Procedures

The proposed amendment request changed operational procedures for the double seal welds. SNC made these changes in response to NRC CAL No. 97-7-001. In particular, the operating procedures were revised to prevent moisture contamination of the double-seal welds as follows:

1. Verification that the water inside the MSB is adequately drained; and

2. Monitoring and venting of the air space beneath the shield lid during welding operations.

When monitoring for combustible gas accumulation, the proposed SAR amendment required that appropriate actions be taken if gas concentrations reach 10% of the lower explosive limit (LEL) of hydrogen or 0.4% hydrogen by volume (the LEL for hydrogen is 4.0% by volume). This amendment was incorporated in response to NRC Bulletin 96-04.

NRC staff found that the proposed SAR changes to the operating procedures adequately address the issues identified in CAL 97-7-001 and NRC Bulletin 96-04 regarding weld problems and hydrogen gas build-up beneath the shield lid.

3.8 Acceptance Tests and Maintenance Program

Other than editorial changes, this SAR section was not changed as a result of this revision.

3.9 Radiation Protection

Other than editorial changes, this SAR section was not changed as a result of this revision.

3.10 Accident Analysis

Several off-normal and accident scenarios were reanalyzed in the proposed amendment request due to the correction of an error in the calculation of the VCC annulus air flow rate. These revised accident thermal analyses resulted in small changes in the calculated temperatures for the VSC-24 components; however, all values remained within applicable material temperature limits. The staff found the revised thermal accident analyses adequate to meet 10 CFR Part 72.

3.11 Conditions for Cask Use and Technical Specifications

Three Technical Specifications (TSs) were completely revised to address NRC CAL No. 97-7-001 issues as follows:

1. TS 1.2.9, "Non-Destructive Examination of Shield and Structural Lid Seal Welds."
   - UT inspection of the structural lid in accordance with the criteria defined in the SNC document No. VSMB-98-001, latest revision, "Guideline Requirements for the Time-of-Flight Diffraction Ultrasonic Examination of the VSC-24 Structural Lid to Shell Weld."
   - Weld flaw indications will be characterized and evaluated for flaw proximity per the criteria of ASME Section XI, IWA-3300 (1989). The limiting condition in the SAR specifies the action to be taken if the UT flaw indications exceed the flaw screening criteria.

2. TS 1.2.10, "Time Limit for Draining the MSB."
   - Revised time limit for draining provides assurance that a fluid temperature of 212°F is not reached so the water in the MSB does not boil causing changes to the moderator density.

3. TS 1.2.13, "Minimum Temperature for Moving the Loaded MSB."
   - The MSB shall not be moved when the weld material temperature is less than 30°F. This is based on the weld material toughness for the allowable flaw sizes (depth and length), as discussed in TS 1.2.9.

The Conditions for Cask Use were revised to delete references to the SER (Conditions 1.1.1 and 1.1.2).

Condition 1.1.4 was revised to correct the definition of "MTC" (MSB Transfer Cask).

In addition, Condition 1.1.7, "Requirement for First Cask in Place," was also revised as follows:

1. Deleted reference to SER; and

2. Added statement that artificial thermal loads other than spent fuel may be used to obtain temperature data.

The following TSs were also revised:

1. TS 1.2.1, "Fuel Specification."
   - Deleted extraneous text and references to the SER and SAR; and
   - Spelled out mathematical symbols.

2. TS 1.2.2, "Maximum Permissible MSB Leak Rate."
   - Spelled out mathematical symbols; and
   - Added clarifying text for "inner seal."

3. TS 1.2.3, “Maximum Permissible Air Outlet Temperature.”
   – Revised reference to SAR rather than SER; and
   – Revised temperatures in accordance with revised thermal calculations.

4. TS 1.2.7, “MSB Vacuum Pressure During Drying.”
   – Spelled out mathematical symbols;
   – Deleted extraneous text; and
   – Added clarifying text.

5. TS 1.2.12, “Average Ambient Temperature.”
   – Deleted reference to SAR section.

6. TS 1.2.14, “Minimum Temperature for Lifting the MTC.”
   – Added clarifying text.

7. TS 1.2.15, “MSB Handling Height.”
   – Added clarifying text.

In addition, TS Table 2, “Summary of Surveillance Requirements,” was revised to reference Weld NDE rather than Weld Dye Penetrant.

3.12 Quality Assurance

The SAR section on Quality Assurance (QA) was revised to remove the QA commitments from the body of the SAR and to reference the SNC QA Manual as an attachment to the SAR. The QA Manual was reviewed by staff and found to meet the QA requirements of 10 CFR Part 72, Subpart G.

3.13 Decommissioning

Other than editorial changes, this SAR section was not changed as a result of this revision.

3.14 References

Other than editorial changes and additional references, this SAR section was not changed as a result of this revision.

3.15 SAR Appendices

Other than editorial changes, the SAR Appendices were not changed as a result of this revision.

4.0 EVALUATION FINDINGS

Based on the information provided in the November 20, 1998, SAR amendment request, supporting documentation, and the staff's own confirmatory analysis, the staff concludes that the amended VSC-24 SAR meets the acceptance criteria specified in 10 CFR Part 72.

Issued with Certificate of Compliance No. 1007, Amendment No. 2,
on November 6, 2000.