CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES

1. a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE		PAGES
9788	19	71-9788	USA/9788/B(U)-96	1	OF	6

2. PREAMBLE

a. This certificate is issued to certify that the package (packaging and contents) described in Item 5 below meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 71, "Packaging and Transportation of Radioactive Material."

b. This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies, including the government of any country through or into which the package will be transported.

3. THIS CERTIFICATE IS ISSUED ON THE BASIS OF A SAFETY ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION

a. ISSUED TO *(Name and Address)*

U.S. Department of Energy
Division of Naval Reactors
Washington, DC 20585

b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION

Deactivated S5W Reactor Compartment Safety Analysis Report for packaging, dated July 1981, as supplemented.

4. CONDITIONS

This certificate is conditional upon fulfilling the requirements of 10 CFR Part 71, as applicable, and the conditions specified below.

5.

(a) Packaging

(1) Model Nos.: S5W Reactor Compartment, SN 688 Class Reactor Compartment, and NR-1 Reactor Compartment Disposal Package.

(2) Description

The package consists of a deactivated and defueled S5W, SSN 688 Class or NR-1 reactor compartment which has been separated from the remainder of the submarine hull and prepared for shipment by sealing all openings and attaching handling fixtures. For each package model, the reactor compartment itself is either between two containment bulkheads or one containment bulkhead and the hemispherical head end of the hull. The containment bulkheads are added to the package before shipping. The ship's hull and the containment bulkheads define the package containment boundaries. The containment bulkheads are either installed at the ends of the package or recessed. The strength of all package boundary closures is at least equivalent to the strength of the bulkheads. The deactivated reactor plant remains in place within the reactor compartment during shipment. The plant is defueled and drained except for small inaccessible pockets of liquid, primarily water. Potentially radioactively contaminated components and piping from other locations in the ship may be placed within the package and secured.

5. (a) Packaging (Continued)

(2) Description (Continued)

The S5W Reactor Compartment package is between 35 and 45 feet long and approximately cylindrical with a maximum diameter of approximately 33 feet. The containment bulkheads are made of HS steel. The bulkheads may be installed at the ends of the package or may be recessed. The forward containment bulkhead may include existing ship structures which have been sealed to form a watertight bulkhead. The hull is constructed of HY-80 steel. The maximum weight of the S5W package is 2,160,000 pounds for the 598 and 585 classes and is 2,262,400 pounds for all other classes.

The SSN 688 Class Reactor Compartment package is approximately 46 feet long and approximately cylindrical with a maximum diameter of approximately 33 feet. The containment bulkheads are made of HS steel. The bulkheads may be installed at the ends of the package or may be recessed. The hull is constructed of HY-80 steel. The maximum weight of the package is 3,360,000 pounds.

The NR-1 Reactor Compartment package is approximately 43 feet long and approximately cylindrical with a maximum diameter of approximately 12.5 feet. The NR-1 package has one containment bulkhead at the forward end of the package. The aft end of the package is the hemispherical head section of the hull. The new containment bulkhead is made of high strength steel and the hull is constructed of HY-80 steel. A 20-foot long box keel section remains attached to the bottom of the package. Additional plating of HS steel on the hull surrounds the pressure vessel region of the reactor compartment, and parts of the box keel. The maximum weight of the package is 406,500 pounds.

(3) Drawings

The package is constructed in accordance with the drawings, figures, and sketches included in the application, as supplemented (see References, below).

(b) Contents

Activated structural components associated with the S5W, SSN 688 Class, or NR-1 reactor vessel complex, plant piping, ion exchanger resin, purification filter media (SSN 688 Class only), residual liquid and other miscellaneous components and materials contaminated with radioactive corrosion products (crud).

6. Residual liquids contained within plant systems must be removed prior to transport to the maximum extent practical, in accordance with established procedures, methods, and controls, as described in submittal dated April 5, 1996, or in the Safety Analysis Report for the individual submarine class reactor compartment packages. Not more than 660 gallons

of residual liquids remain in the S5W Reactor Compartment package and not more than 1,200 gallons of residual liquids remain in the SSN 688 Class Reactor Compartment package, and not more than 90 gallons may remain in the NR-1 package.

7. For packages with recessed containment bulkheads, the aft containment bulkheads and stiffeners, horizontal divider plate, and any structure between the pressure hull and the outer non-pressure hull must be recessed at least 7 inches from the aft end of the S5W package. The forward containment bulkhead and stiffeners, existing tank stiffeners, deck structure, and horizontal girders must be recessed at least 15 inches from the forward end of the S5W package.

   For SSN 688 Class packages with recessed containment bulkheads, both the aft and forward containment bulkheads, stiffeners and horizontal girders must be recessed at least 15 inches from the end of the package.

8. The Lowest Service Temperature (LST) must be determined for each package. The package shall not be shipped unless its LST is less than or equal to the normal daily minimum temperature expected during the shipment of the package as determined on the basis of weather forecasts.

9. Ion exchanger resin with up to 3.1 curies (1.1×10^{11} becquerels) of Co-60 may be shipped in the S5W package. Shipment of the S5W packages shall not occur before 180 days after final reactor shutdown.

10. For SSN 688 Class packages, the Co-60 activity of the ion exchanger resin (A_{IX}) and activity of the purification filter media (A_{PF}) must meet the following conditions (Reference Table 5-3 of the application):

    (a) when only the purification filter is solidified,
    $A_{PF} * 27.2 + A_{IX} * 283.8 \leq 995$ mr/hr (Curies)
    $A_{PF} * 7.35 \times 10^{-10} + A_{IX} * 7.67 \times 10^{-9} \leq 995$ mr/hr (becquerels)

    (b) when only the ion exchanger is solidified,
    $A_{IX} * 53.9 + A_{PF} * 299.6 \leq 995$ mr/hr (Curies)
    $A_{IX} * 1.46 \times 10^{-9} + A_{PF} * 8.10 \times 10^{-9} \leq 995$ mr/hr (becquerels)

    (c) when both the purification filter and ion exchanger are solidified,
    $A_{IX} * 53.9 + A_{PF} * 27.2 \leq 995$ mr/hr (Curies)
    $A_{PF} * 1.46 \times 10^{-9} + A_{IX} * 7.35 \times 10^{-10} \leq 995$ mr/hr (becquerels)

    (d) when neither the ion exchanger or purification filter are solidified,
    $A_{PF} \leq 3.3$ curies of Co-60 (1.22×10^{11} becquerels),
    $A_{IX} \leq 3.5$ curies of Co-60 (1.30×10^{11} becquerels), and
    $A_{IX} + A_{PF} \leq 4.5$ curies of Co-60 (1.67×10^{11} becquerels)
    If the activity exceeds any of the above values, supplemental shielding must be added. See Condition 12 and 13 for the supplemental shielding requirements.

These activity limits are based on limiting the total radiation levels to 995 mr/hr under hypothetical accident conditions. If contaminated filters are shipped with the package, the sum of the radiation levels from each filter at 1 meter, shielded by the hull, must be subtracted from this 995 mr/hr, and the A_{PF} and A_{IX} activity limits must be reduced accordingly for SSN 688 Class packages.

11. Shipment of the SSN 688 Class packages shall not occur before 365 days after final reactor shutdown.

12. Prior to shipment, radiation surveys of the exterior of the unshielded package must be taken. Additional shielding must be provided on the exterior of the package by steel plates securely welded to the package surface so as to remain in place under the hypothetical accident conditions in 10 CFR Part 71 if either of the following conditions exists:

    (a) Radiation levels on the exterior of the package obtained via surveys exceed 200 mr/hr on-contact or 10 mr/hr at 2 meters.

    (b) When the purification filter and ion exchanger are not solidified, and $A_{PF} > 3.3$ curies of Co-60, $A_{IX} > 3.5$ curies of Co-60, or $A_{IX} + A_{PF} > 4.5$ curies of Co-60. (SSN 688 Class only)

    Radiation surveys must be re-performed after adding supplemental shielding. Final radiation levels must not exceed 200 mr/hr on-contact and 10 mr/hr at 2 meters.

13. When condition 12(a) exists, 0.5-inch thick steel plates must extend from one inch above the bottom of the shielded tunnel on the starboard side to 87° beyond the keel on the port side and extend 110 inches forward and aft of the centerline of the Pressure Vessel. Additional 1.25” steel plate must extend 22° beyond the keel on the port and starboard side and 77 inches forward and aft of the centerline of the Pressure Vessel.

    When condition 12(b) exists, 1-inch thick steel plates must either:

    (a) Extend from one inch above the bottom of the shielded tunnel on the starboard side to 64° beyond the keel on the port side and extend from frame 73 to frame 76. In this case, A_{PF} cannot exceed 7.8 curies of Co-60 (2.89×10^{11} becquerels), A_{IX} cannot exceed 8.2 curies of Co-60 (3.03×10^{11} becquerels), and the total of A_{PF} and A_{IX} cannot exceed 8.5 curies of Co-60 for D1G-2 cores or 9.0 curies of Co-60 for D2W cores (3.14×10^{11} and 3.33×10^{11} becquerels, respectively); or

    (b) Extend from one inch above the bottom of the shielded tunnel on the starboard side to 37° beyond the keel on the port side and extend from frame 73 to frame 76. In this case, A_{PF} cannot exceed 7.8 curies of Co-60 (2.89×10^{11} becquerels), A_{IX} cannot exceed 3.5 curies of Co-60 (1.30×10^{11} becquerels), and the total of A_{PF} and A_{IX} cannot exceed 8.5 curies of Co-60 for D1G-2 cores or 9.0 curies of Co-60 for D2W cores (3.14×10^{11} and 3.33×10^{11} becquerels, respectively).

When both conditions 12(a) and 12(b) exist, 1-inch thick steel plates must extend from one inch above the bottom of the shielded tunnel on the starboard side to 87° beyond the keel on the port side and extend 110 inches forward and aft of the centerline of the Pressure Vessel. Additional 0.75 inch steel plates must extend 22° beyond the keel on the port and starboard side and extend 77 inches forward and aft of the centerline of the Pressure Vessel. In this case, A_{PF} cannot exceed 7.8 curies of Co-60 (2.89×10^{11} becquerels), A_{IX} cannot exceed 8.2 curies of Co-60 (3.03×10^{11} becquerels), and the total of A_{PF} and A_{IX} cannot exceed 8.5 curies of Co-60 for D1G-2 cores or 9.0 curies of Co-60 for D2W cores (3.14×10^{11} and 3.33×10^{11} becquerels, respectively).

The activity limits for the ion exchanger and purification filter are based on limiting the total radiation levels to 995 mr/hr under hypothetical accident conditions. If contaminated filters are shipped with the package, the sum of the radiation levels from each filter at 1 meter, shielded by the hull, must be subtracted from this 995 mr/hr, and the A_{PF} and A_{IX} activity limits must be reduced accordingly for SSN 688 Class packages.

14. Ensure the radiation surveys are completed as described in Enclosures 3, 4, and 5 of the supplement dated December 2, 2011.

15. In addition to the requirements of Subpart G of 10 CFR Part 71:

    (a) Each package must be prepared for shipment and operated in accordance with the procedures described in Chapter 7.0, "Operating Procedures," of the application, as supplemented.

    (b) Each package must be tested and maintained in accordance with the procedures described in Chapter 8.0, "Acceptance Tests and Maintenance Program," of the application, as supplemented.

16. The hydrogen concentration within the package must be less than 5 percent by volume during the shipment period, as demonstrated by test or analysis.

17. Expiration date: September 30, 2023.

REFERENCES

Deactivated S5W Reactor Compartment Safety Analysis Report for Packaging, WAPD-REO(C)-250, dated July 1981.

Supplements: Naval Reactors Memoranda Nos. Z#C90-14416 dated March 29, 1990, and supplement dated July 6, 1990; Z#C90-14456 dated August 30, 1990; Z#C92-14438 dated August 3, 1992; Z#C93-00069 dated October 14, 1993; Z#C95-00113 dated March 16, 1995; Z#96-14430 dated April 5, 1996; Z#96-14434 dated April 10, 1996; Z#C95-00191 dated December 14, 1995; Z#96-14457 dated June 20, 1996; Z#C96-14520 dated November 22, 1996; Z#C96-14549 dated December 19, 1996; Z#C97-14698 dated October 31, 1997; Z#C98-00021 dated February 27, 1998; Z#C02-03057 dated March 15, 2002; Z#C07-02023 dated September 19, 2007; Z#08-03540 dated September 11, 2008; Z#C07-04862 dated January 3, 2008; Z#C09-02922 dated July 1, 2009; and NR (Angerhofer) email dated July 30, 2008; S#C11-01953 dated April 29, 2011; S#C11-02849 dated June 30, 2011; S#C11-04480 dated October 27, 2011; S#C11-05155 dated December 2, 2011; Z#13-02768 dated June 21, 2013; Z#18-01456 dated April 17, 2018; and Z#C18-02148 dated June 4, 2018.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

/RA/

John McKirgan, Chief
Spent Fuel Licensing Branch
Division of Spent Fuel Management
Office of Nuclear Material Safety
and Safeguards

Date: 2/16/19