NRC FORM 618
(8-85)
10 CFR 71

U.S. NUCLEAR REGULATORY COMMISSION

CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIALS PACKAGES

1.a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. PACKAGE IDENTIFICATION NUMBER	d. PAGE NUMBER	e. TOTAL NUMBER PAGES
9788	6	USA/9788/B(U)	1	3

2. PREAMBLE

a. This certificate is issued to certify that the 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.

c. DOCKET NUMBER 71-9788

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.: S3W Reactor Compartment, S4W Reactor Compartment, and S5W Reactor Compartment

(2) Description

The package consists of a deactivated and defueled S3W, S4W, or S5W 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 between two containment bulkheads which are added to the package before shipping. The ship's hull and the containment bulkheads define the package containment boundaries. There is an overhang of the hull structure beyond the bulkheads at both ends of the package. The strength of all package boundary closures is equivalent to the strength of the ship's 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.

The S3W Reactor Compartment package is between 46 and 48 feet long and approximately cylindrical with a maximum diameter of approximately 25 feet. The S3W package has a concrete-filled tank exterior to the hull at the top of the package. The containment bulkhead may include existing ship structure which has been sealed to form a watertight bulkhead. The hull is constructed of HT steel and the containment bulkheads are HT or HS steel. The maximum weight of the S3W package is 1,588,000 pounds.

The S4W Reactor Compartment package is approximately 45-1/2 feet long and approximately cylindrical with a maximum diameter of approximately 25 feet. In addition, the S4W package has a concrete-filled tank exterior to the hull at the top of the package. The containment bulkhead may include existing ship structure which has been sealed to form a watertight bulkhead. The hull is constructed of HT steel and the containment bulkheads are HT or HS steel. The maximum weight of the S4W package is 1,801,000 pounds.

5. (a) (2) Description (Cont'd)

The S5W Reactor Compartment package is between 35 and 45 feet long and approximately cylindrical with a maximum diameter of approximately 33 feet. The forward containment bulkhead may include existing ship structure which has been sealed to form a watertight bulkhead. The hull is constructed of HY-80 steel and the containment bulkheads are HT, HS or 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.

(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 S3W, S4W, or S5W reactor vessel complex, plant piping, ion exchanger resin (S5W package only), and other miscellaneous components contaminated with radioactive corrosion products (crud). As much as 230 gallons of residual liquid, primarily water, some of which contain low level radioactivity, may also be present in the package.

Ion exchanger resins with up to 3.1 curies of Co-60 may be shipped in the S5W package.

6. 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 7.0 inches from the aft end of the S5W package, or at least 15.0 inches from the aft end of the S3W or S4W package. The forward containment bulkhead and stiffeners, existing tank stiffeners, deck structure, and horizontal girder must be recessed at least 15.0 inches from the forward end of the S3W, S4W, or S5W package.

7. 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.

8. For S5W ships with a maximum of 3.1 curies of Co-60 on the ion exchanger resin at the time of shipment, the shipment shall not occur before 365 days after the final reactor shutdown. For S5W ships with fewer curies of Co-60 on the ion exchanger resin at the time of shipment, the minimum waiting period may vary between 185 and 365 days. For S3W and S4W ships, the shipment shall not occur before 6 years and 10 months after the final reactor shutdown.

9. Additional shielding may 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.

10. 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.

    (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.

11. Expiration date: December 31, 1997

REFERENCES

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

Supplements: Naval Reactors Memorandum Z#C90-14, 416 dated March 29, 1990 and supplement dated July 6, 1990; Naval Reactors Memorandum Z#C90-14456 dated August 30, 1990; Naval Reactors Memorandum Z#C92-14438 dated August 3, 1992; and Naval Reactors Memorandum Z#C93-00069 dated October 14, 1993.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Cass R. Chappell

Cass R. Chappell, Section Leader
Cask Certification Section
Storage and Transport Systems Branch
Division of Industrial and
Medical Nuclear Safety, NMSS

Date: _____

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

APPROVAL RECORD

S3W Reactor Compartment, S4W Reactor Compartment, and
S5W Reactor Compartment Packages
Certificate of Compliance No. 9788
Revision 6

By application dated October 14, 1993, the Department of Energy, Division of Naval Reactors, requested an amendment to Certificate of Compliance No. 9788. The applicant requested that deactivated and defueled S3W and S4W Reactor Compartments be added to the certificate.

The certificate currently authorizes the S5W Reactor Compartment package. The S3W and S4W Reactor Compartment packages are similar in configuration and construction to the S5W Reactor Compartment package. The only significant difference is that a concrete-filled tank is located at the top exterior of the S3W and S4W pressure hulls.

Structural

The applicant performed structural analyses for the S3W and S4W Reactor Compartment packages. The analyses show that no material will be released under normal conditions of transport. Based on the hypothetical accident condition analyses, the external concrete-filled tank is expected to break free from the hull under a 30-foot end drop. The concrete-filled tank could crush into the hull during the side drop on top of the reactor compartment. The reactor compartment could also be breached by the puncture test. However, even considering the structural damage, the application shows that the radiation dose rate and radioactivity release will remain within the regulatory limits.

The 30-foot end drop and corner drop analyses has shown that the aft and forward containment bulkheads of the S3W and S4W must be recessed at least 15 inches from the end of the package. Brittle fracture analysis has shown that the lowest service temperature (LST) for the S3W/S4W packages is -20 °F. To ensure brittle fracture is precluded, the packages will not be shipped unless its LST is less than the minimum temperature expected during the shipment.

Thermal

The applicant performed a thermal analysis for normal and hypothetical accident conditions of transport. The applicant used the TRUMP computer program to perform the analysis. For normal conditions, the analysis shows that the maximum temperature of the package structures is 185 °F, and the maximum temperature of an accessible surface 119 °F in the shade. For the

Radiation levels were calculated using the SPAN4 point kernel computer code with iron buildup factors. Three different accident configurations were evaluated. The accident configurations included puncture and other loss of shielding, and shifting of various activated components.

The calculated normal-condition dose rates are well below the regulatory limit in 10 CFR §71.47. The calculated dose rates for all three accident configurations also meet the regulatory limit.

Criticality

No criticality analysis is necessary because the reactor core will be defueled and only trace amounts of fissile material as crud will be left in the package.

Operating Procedures, Acceptance Tests, and Maintenance Program

The operating procedures, acceptance tests, and maintenance program for the S3W and S4W Reactor Compartment packages will be the same as for the S5W Reactor Compartment package.

Conclusion

The applicant has shown that the S3W and S4W Reactor Compartment packages meet the requirements of 10 CFR Part 71.

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accident conditions, the thermal analysis shows that the maximum temperatures experienced during and after the fire will be less than the melting temperature of any of the structural material. However, the fire will cause the polyethylene and lead shields to melt. The estimated lead loss is less than 1 inch. The shielding analysis shows that even with the loss of shielding, the external dose rate under accident conditions will be within the regulatory limit.

The applicant used the temperatures resulting from the thermal analysis to calculate the maximum internal pressure under normal and accident conditions. The calculated internal pressures are significantly less than the design pressures for the reactor compartment hull and the containment bulkheads.

Containment

The containment system of the package is the pressure hull and the forward and aft containment bulkheads. The containment system is completely welded closed. Containment penetrations are sealed with welded closure plates. The strength of all package boundary closures is equivalent to the strength of the ship's bulkheads.

Most radioactivity is present as activation products in the structural components of the reactor vessel and internals. These large components are maintained within the package under normal and hypothetical accident conditions. The radioactivity which is dispersible and which could be released from the package is primarily the activated corrosion product contamination (crud) which is present on the internal surfaces of the reactor system components.

For normal conditions of transport, it was shown that the reactor compartment would not be breached. Since all containment boundaries are welded closed, it was concluded that no release would occur. The applicant determined that the reactor compartment would be breached under hypothetical accident conditions. The applicant estimated the total radioactivity present in the crud and, using various release fractions, calculated the maximum quantity of radioactivity which could be released. The total quantity of radioactivity postulated to be released was well below a Type A quantity. The crud levels and release fractions estimated for the S3W and S4W reactor compartments were similar to the S5W reactor compartment disposal package, which was previously approved. NRC staff agrees that the package meets the containment requirements of 10 CFR §71.51.

Shielding

The applicant included radiation source terms from activated hardware and crud deposits. Radioactively contaminated components from other parts of the ship may be secured within the package. No ion exchange resins will be shipped in the S3W and S4W compartments. Both thermal and fast neutrons were considered in determining the activation source term.