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NUCLEAR REGULATORY COMMISSION CERTIFICATE OF COMPLIANCE FOR THE NRBK-41 RADIOACTIVE MATERIAL SHIPPING CONTAINER; FORWARDING OF SUPPLEMENTAL INFORMATION TO SUPPORT RENEWAL

Reference: (a) NR letter S#06-01881 dated May 31, 2006

Background: In reference (a), Naval Reactors (NR) requested renewal of the current Nuclear Regulatory Commission (NRC) Certificate of Compliance (COC) USA/9221/B()F, which authorizes the shipment of various irradiated components in the NRBK-41 Radioactive Material Shipping Container. This renewal was requested with the restriction that cargo-specific material evaluations be performed prior to shipments of the NRBK-41 cask to show that the shipment meets the applicable radioactive material release requirements for the hypothetical fire accident conditions (10CFR71.51).

Discussion: In a discussion with NR (Leege) on August 24, 2006, the NRC (Cuadrado) requested additional information on the methodology for the cargo-specific evaluation. This information is provided in enclosure (1).

This process was used to evaluate two shipments which are representative of typical Naval Nuclear Propulsion Program shipments in this cask. Both evaluations demonstrated that the cargos met the applicable requirements of 10CFR71 for release of radioactive materials. In each case the evaluation showed that the total amount of radioactive material that could be released in a hypothetical accident condition was at least three orders of magnitude less than the limit specified in 10CFR71.51(a)(2).

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If you have any questions, please call me at (202) 781-6255 or David Leege at (202) 781-6045.

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Encl: (1) METHODOLOGY FOR CARGO-SPECIFIC MATERIAL EVALUATIONS FOR THE NRBK-41 RADIOACTIVE MATERIAL SHIPPING CONTAINER

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METHODOLOGY FOR CARGO-SPECIFIC MATERIAL EVALUATIONS FOR THE NRBK-41 RADIOACTIVE MATERIAL SHIPPING CONTAINER

The following process is used to evaluate the acceptability of future MIN-41 or HIP-41 shipments which may be unable to maintain a leak-tight seal following the hypothetical fire accident. Testing has shown that the PERMATEX sealant used on the MIN-41 and HIP-41 degrades at high temperatures.

At completion of assembly, the MIN-41 or HIP-41 container is helium leak tested and shown to meet the leak-tight criterion specified in ANSI N14.5 (1×10^{-7} ref-cc/sec or less). This standard has been identified by the Nuclear Regulatory Commission, in their Regulatory Guide 7.4, as an acceptable means of supporting compliance with the transportation requirements.

For all Normal Conditions of Transport (NCOT), as listed in 10CFR71.71, the inner container satisfies all documented conclusions of the NRBK-41 SARP and all of the regulatory requirements including the 10CFR71.51 (a)(1) requirement for loss or dispersal of radioactive content to a sensitivity of 10^{-6} A_2 per hour. This conclusion is based on the fact that the high temperatures that degrade the vacuum grease and PERMATEX sealant are not present during pre-shipment helium leak testing and NCOT.

For the hypothetical fire accident condition specified in 10CFR71.73(c)(4), the inner container is exposed to much higher temperatures than during NCOT. The degradation of the vacuum grease and PERMATEX sealant due to the hypothetical fire accident affects the quality of the containment boundary seal. The impact of the degraded seal would be to permit a limited amount of the radioactive contents in the MIN-41 or HIP-41 container to be released to the cask cavity and then out from the cask cavity to the external environment. This is assumed to occur despite having no structural failure of the inner container or the cask closure system. Under these conditions, the relevant issue is whether such a release can be demonstrated to satisfy the radioactive release requirements specified in 10CFR71(a)(2) of no external radiation dose exceeding 1 rem/hr at 1 meter from the package surface, no krypton-85 in excess of 10 A_2 in 1 week, and no radioactive material exceeding 1 A_2 in 1 week.

1. The inner container and cask closures are not structurally affected by any seal degradation and remain intact as concluded

in the SARP. Thus, based on existing SARP conclusions, the last item regarding post-accident radiation levels is satisfied if the radiation sources cannot physically move to a previously unevaluated position outside of the container.

2. The predominant source for krypton-85 is from material within small specimens; therefore, without specimen rupture, krypton-85 would not be released from the cargo and would not be available for release to the environment. Irradiated fuel test specimens will remain intact following hypothetical accident conditions based on the robustness of its design and manufacture. In addition, the test conditions for the fueled test specimens are greater than the temperatures that specimens are exposed to during the hypothetical accident conditions.

3. Provided the two previous criteria are met, it is possible to satisfy the remaining criterion, regarding release of radioactive material, by evaluating the potential release of the residual radioactive material (CRUD) on the exterior surfaces of the specimens that accumulated during irradiation. Bettis Atomic Power Laboratory developed a qualified Excel spreadsheet (SARPCONT) to generate an estimate of the amount of material that can be released during an accident based on the surface area and CRUD constituents available. SARPCONT has been used in the past to evaluate other Naval Nuclear Propulsion Program (NNPP) irradiated shipping containers. For a hypothetical accident condition, the relevant cargo information needed for generating the potential release value is as follows: the surface area of the cargo, the time after shutdown, the CRUD deposition, and the total fraction of cargo isotopes released during an accident.

a. The first two items, surface area and time after shutdown, are variable characteristics dependent on the specific cargo being evaluated.

b. The crud deposition is the value for the crud activity per unit surface area at the time of shutdown. A fixed value of 2000 micro-Curies per square decimeter is used, which is conservatively based on samples taken from Naval spent fuel and a worst-case multiplier applied to the test specimens.

c. The last item is the total fraction of cargo isotopes released during normal and accident conditions. Consistent with DOE-HDBK-3010-94, Airborne Release Fractions / Rates and Respirable Fractions for Nonreactor Nuclear Facilities, the fraction of total loose radioactive material within the container available for airborne release is set at 10% of the total loose radioactivity available. The amount of loose radioactive material is conservatively assumed to be 100% of the total surface activity of the CRUD for hypothetical accident conditions. This assumption is consistent with the guidance present in NUREG 1617. Provided the ratio of maximum releasable radioactive material to the A_2 quantity (the A_2 fraction), is less than one, the requirement of no release of radioactive material in excess of an A_2 quantity in 1 week is considered satisfied.

Table 1 provides a summary of the criteria that must be satisfied to allow shipments of loaded MIN-41 or HIP-41 inner container despite the inability to maintain a leak-tight seal following the hypothetical fire accident.

The process is consistent with the processes used to evaluate other NNPP irradiated shipping containers (e.g., M-130 and M-140).

This process was used to evaluate two shipments which are representative of typical NNPP shipments in this cask. Both evaluations demonstrated that the cargos met the applicable requirements of 10CFR71 for release of radioactive materials. In each case the evaluation showed that the total amount of radioactive material that could be released in a hypothetical accident condition was at least three orders of magnitude less than the limit specified in 10CFR71.51(a)(2).

Table 1: Criteria for Shipments of Loaded MIN-41 or HIP-41 containers

#	Requirement	Acceptability Criteria	Justification
1	No loss or dispersal of radioactive contents for NCOT, as demonstrated to a sensitivity of 10^{-6} A_2 per hour	The inner container must remain leak-tight per the criterion established in Reference (c) for all NCOT.	The high temperatures that degrade the vacuum grease and PERMATEX are not present during pre-shipment helium leak testing and NCOT.
2	No external radiation dose rate exceeding 1 rem/hr at 1 m from the external surface of the package after the HAC	The cargo specimens cannot move to a previously unevaluated position.	None of the NCOT or HAC characteristics will result in a structural failure of the container closure system as demonstrated by the SARP.
3	No release of krypton-85 exceeding 10 A_2 in 1 week after the HAC	The cladding of fissile specimens must be uncut and undamaged prior to shipment and must maintain its integrity during NCOT and HAC. This requirement does not apply to non-fissile cargo specimens.	The predominant source of krypton-85 is from material within the fissile specimens. The integrity of the cladding is maintained after the HAC.
4	No release of other radioactive material exceeding a total amount A_2 in 1 week after the HAC	The maximum releasable A_2 fraction for a hypothetical accident must be less than 1.	Based on an evaluation of the potential release of the residual radioactive material (CRUD) on the exterior surfaces of the specimens that accumulated during irradiation, the A_2 fraction can be estimated.