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November 19, 1993
ML-93-054

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Docket No. 71-6294
RIII File 70-0036

Mr. Ross C. Chappell, Section Leader
Cask Certification Section
Storage and Transportation Systems Branch
Division of Industrial Safety and Medical Nuclear Safety
Office of Nuclear Materials Safety and Safeguards
U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Subject: **Wetted Uranium Oxide in UNC-2901 Pellet/Powder Shipping Container, Certificate of Compliance No. 6294**

Dear Mr. Chappell:

This letter requests an amendment to Certificate of Compliance No. 6294 to ship special nuclear material of a different content than currently approved.

Combustion Engineering requests approval of the use of our Model UNC-2901 shipping containers for uranium oxide with up to 4 kilograms contained water per shipping container. Enclosure I describes the intended contents, and, with reference to our existing application, provides a safety evaluation.

H-84

ABB Combustion Engineering Nuclear Power

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If there are any questions or comments concerning this matter, please do not hesitate to call me or Mr. Mark A. Michelsen of my staff at (203) 285-5261.

Very truly yours,

COMBUSTION ENGINEERING, INC.

John F. Conant

John F. Conant
Manager
Nuclear Materials Licensing

Enclosures: As Stated

cc: G. France (NRC - Region III)
S. Soong (NRC)
N. Osgood (NRC)

Enclosure I to
ML-93-054

COMBUSTION ENGINEERING, INC.

UNC-2901 POWDER/PELLET SHIPPING CONTAINER

CERTIFICATE OF COMPLIANCE NO. 6294

November 1993

COMBUSTION ENGINEERING, INC.
UNC-2901 POWDER/PELLET SHIPPING CONTAINER
CERTIFICATE OF COMPLIANCE NO. 6294

Combustion Engineering requests approval for use of the Model UNC-2901 powder/pellet shipping container with contents consistent with the existing Certificate of Compliance No. 6294, except with the addition of up to 4 kilograms water per shipping container.

Description of Contents

The material to be shipped consists primarially of U_3O_8 powder in polyethylene bags which had been pressed and compacted into blocks. The enrichment is less than 4.5 wt% in the U-235 isotope. Each pressed block was placed in polyethylene bag and then placed in a perforated aluminum can. There are 28 such blocks per aluminum can. Water was then injected into the blocks. There is as much as approximately 1,800 grams of water per can. The cans weigh, on the average, 17.4 kg grams each, of which almost 2 kg is water.

Criticality Safety

Based on the results of the accident mode analysis in the current Certificate of Compliance application for the UNC-2901 shipping packages, up to 100 individual shipping containers (Fissile Class II) may be transported. Based on the analyses from the existing Certificate of Compliance application, the maximum loading for 5 weight percent U-235 is 35 kg per shipping container.

Since the accident analysis in the Certificate of Compliance application bounds the conditions of shipment intended, only the newly defined normal transportation mode analysis needed to be repeated.

The analysis for the normal transportation mode assumes a fully reflected 8x8x8 array size (512 containers). The inner container and surrounding annulus are assumed to suffer no ingress of additional water. Also, the interstitial region between shipping containers within the reflected array is assumed dry. The criticality limit criterion employed for the analysis is as follows: The sum of the effective multiplication factor computed by the KENO IV code plus twice the KENO IV standard deviation plus any other applicable adjustment shall be less than or equal to 0.95.

Herein, "powder can package" refers to that of the standard powder can described in the C-E application for the Certificate of Compliance, and into which the intended material would be placed. The standard powder package consists of two powder cans in a lifting cradle. The loading limit is established on a total powder basis.

Should less than two cans be placed in a UNC-2901, the space normally occupied by the second can shall be filled by a wood block approximating the external dimensions of a powder can.

The model used for the criticality evaluation of the normal transportation mode for the intended shipment of low enriched uranium oxide was identical to that used in the current Certificate of Compliance application for the UNC-2901 shipping container, with the exception of the amount of water impurity in the powder can containers. Previously, the UO_2 powder was assumed completely dry (H/U = 0), whereas for this analysis an H/U = 4.30 was assumed. Outlined in the following paragraphs is a brief description of the shipping container and how it was modeled.

The powder can package consists of a lifting cradle which holds two powder cans and the free-volume-displacing wood blocks. A 5.5 inch high by 10 5/8 inch square wood block is placed at the bottom of the inner container beneath the lifting cradle. A 1.5 inch thick by 9 3/4 inch diameter block of wood is placed upon the top-most can in the cradle to fill the space between the top of the can and the closure cover to the inner container of the UNC-2901. When unloading the UNC-2901, removal of the latter wood block uncovers the lifting eyes of the cradle. The wood blocks are dimensioned such that when the inner container cover is in place there is insufficient space for a powder can cover to be unseated far enough for powder to exit the can and enter the free volume of the inner container exterior to the powder cans.

Figure 6-1 of the Certificate of Compliance application shows the KENO IV model for the shipping container with the powder can package. It should be noted that the structures employed to position the inner container within the steel shell are omitted in the model; only the wood structures above and below the inner container are modeled. The four vertical arms of the lifting cradle are not shown explicitly in Figure 6-1, but are included explicitly in the calculational model by use of the generalized geometry option of the KENO IV code. The overall height of the shipping container outer shell used in the models was 35.5 inches, which is less than the actual overall height of 36.625 inches. The reduction in height (and consequently smaller volume) as compared to the actual outer shell dimension is conservative for the purpose of assessing criticality safety. The internal and external diameters of the outer shell were modelled as 22.5 and 22.6 inches, respectively.

Each powder can is represented explicitly (as were other items detailed in Figure 6-1 of the Certificate of Compliance application) and centered within the cross sectional area of the inner container. The powder cans are represented as 0.050 inch thick stainless steel cans, with an internal volume per can of 13.1 liters. The total mass of the UO_2 was 35 kg (17.5 kg per can) which was mixed homogeneously with 4 kg of equivalent full density H_2O (2 kg per can), resulting in an H/U ratio for the mixture of 4.30.

The KENO IV model discussed above coupled with the 16 group Hansen and Roach cross section library resulted in an effective multiplication factor of 0.53503 ± 0.00261. This value when compared to the previous normal transportation case (for completely dry powder) showed a net increase in Keff of approximately 0.12 delta K-effective units.

Other Accident Conditions Considered

In the event of heating in a fire, the additional water in the powder cans could expand as vapor, in addition to the air expansion. As discussed in the C-E application (Appendix 2.1-A, Section 3.2.3), the inner container experience temperatures of 180 - 200°F during the fire test. Based upon a conservative calculation, this would result in a pressure of 15 psig within the inner container if it did not leak to relieve pressure. Such a small internal pressure would not cause the container walls to fail. It is therefore concluded that the additional water in the container is acceptable for a postulated fire.