



UNITED STATES  
NUCLEAR REGULATORY COMMISSION

WASHINGTON, D.C. 20555-0001

June 25, 2001

MEMORANDUM TO: E. William Brach, Director  
Spent Fuel Project Office, NMSS

THROUGH: M. Wayne Hodges, Deputy Director /RA/  
Technical Review Directorate  
Spent Fuel Project Office, NMSS

FROM: H. Kirke Lathrop, Safety Inspector/Technical Reviewer /RA/  
Technical Review Section A  
Technical Review Directorate  
Spent Fuel Project Office, NMSS

SUBJECT: ADEQUACY OF HOLTITE-A AND NS-4-FR AS NEUTRON SHIELDING  
MATERIALS FOR SPENT FUEL STORAGE AND TRANSPORTATION  
CASK DESIGNS

In March, 2000, the NRC SFPO staff developed a concern that an unreviewed safety question may exist with regard to the adequacy of Holtec International's (Holtec) neutron shielding material, Holtite-A, used in Holtec's spent fuel storage and transportation cask designs. The NRC performed an inspection of Holtec in May, 2000 (ref. NRC Inspection Report No. 71-0784/00-201), to examine this issue. During that inspection, the staff obtained documentation of testing conducted on samples of NAC International's (NAC) neutron shielding material, NS-4-FR, which indicated that defects, similar to those observed in test samples of NS-4-FR, could potentially affect its design function. The NRC conducted an inspection at NAC in June, 2000 (ref. NRC Inspection Report No. 71-0018/00-201), to examine material related to the development, testing, fabrication, and use of NS-4-FR in NAC's spent fuel storage and transportation cask designs.

The staff reviewed the documentation and information obtained from both Holtec and NAC on their respective neutron shield material, as well as the data and test results in Holtec's safety analysis report for the HI-STAR 100 spent fuel storage cask design. The staff concluded that the two materials were similar in many of their chemical, physical, and design properties, and had similar processes for formulating, mixing, casting and curing. However, the staff did not evaluate the equivalency of the two materials. Each material was reviewed independently on its own merits. Based on this review, the staff determined that both Holtite-A and NS-4-FR met their respective design requirements. Individually, each neutron shield material is acceptable for use in NRC-approved spent fuel storage and transfer cask designs. Also, the staff reviewed information to support thermal stability and radiation resistance requirements for Holtite-A and NS-4-FR throughout their design lifetimes.

To support its evaluation of Holtite-A and NS-4-FR, the NRC contracted with Advanced Technologies and Laboratories (ATL) International, Inc., to provide expertise in the field of resin polymers and their use in radiation shielding. The staff (with ATL assistance) performed a detailed review of, and conducted confirmatory analyses, as appropriate, on: (1) the Holtite-A data contained in the Holtec topical safety analysis reports for the HI-STAR 100 and HI-STORM 100 cask systems; (2) the findings and conclusions of the NRC inspections at Holtec and NAC; (3) the original Bisco test data and results, including the testing of two independent Japanese laboratories, on NS-4-FR; (4) supplemental material from both Holtec and NAC; and (5) the test data and results from Holtec's on-going confirmatory thermal and radiation testing of Holtite-A. ATL's final report, which discusses additional technical information on Holtite-A and NS-4-FR, is provided as an attachment to this memorandum. Based on the analyses, the staff has determined that there is reasonable assurance that both Holtite-A and NS-4-FR will meet their design performance requirements over their respective design lifetimes.

In a related matter, on May 26, 2000, Holtec submitted a 10 CFR Part 21 report to the NRC detailing the identification of apparent deficiencies in NS-4-FR samples procured from NAC that Holtec was using to qualify NS-4-FR for use in Holtec's spent fuel storage and transportation cask designs. While cutting out samples of NS-4-FR for thermal testing, Holtec discovered the presence of voids at the cut sections' surfaces. Subsequently, after about 200 days of thermal testing, the NS-4-FR samples showed significant signs of degradation, consisting of surface bubbling, cracking, and discoloration. As was determined during the two NRC inspections, neither Holtec or NAC had anticipated that the presence of voids would adversely affect the thermal testing of the NS-4-FR samples. Holtec was not able to determine a root cause for the NS-4-FR testing failures. Following the staff's review and evaluation (with the assistance of ATL) of the thermal data provided by both Holtec and NAC, the staff concluded that more data and/or testing would be required to unequivocally determine why the NAC NS-4-FR samples provided to Holtec exhibited significant signs of degradation during thermal testing. The staff noted that: (1) Holtec performed the thermal testing on NS-4-FR samples which were not manufactured in accordance with approved procedures and thus were not representative of the NS-4-FR used in NRC-approved cask designs; (2) the NS-4-FR samples were prepared in such a manner that contaminants may have been introduced into the base material; (3) the Holtec test temperature was significantly higher than that used in Bisco's testing and tests performed by two independent Japanese laboratories; and (4) the Holtec test temperature was not representative of the anticipated temperature of exposure in typical NRC-approved casks. Thus, the thermal tests performed by Holtec could be misleading in evaluating the behavior of NS-4-FR in actual NRC-approved casks. However, the staff has concluded that there is reasonable assurance that NAC NS-4-FR would perform as designed, in part because NAC has the Bisco formulation for NS-4-FR, which has been previously evaluated and tested by Bisco and several independent laboratories. The staff concludes that this issue represents a failure of atypical NS-4-FR material. Therefore, a safety concern does not exist and further evaluation of this issue is not warranted.

In conclusion, the staff has determined that there is reasonable assurance that both Holtite-A and NS-4-FR will independently maintain their respective neutron shielding capabilities throughout their design lifetimes. This determination is based on: (1) the technical evaluation and confirmatory analyses by the NRC staff (with assistance from ATL) of the data submitted in the applicable Holtec and NAC safety analysis reports, as supplemented by various later submittals; and (2) the findings and conclusions of the NRC inspections performed at Holtec

and NAC. Additionally, the staff has concluded that the deficient NS-4-FR samples described in Holtec's 10 CFR Part 21 report are not representative of the NS-4-FR used in NRC-approved storage and transportation cask designs and thus do not present a safety concern.

Docket Nos.: 71-9235, 71-9261, 72-1008, 72-1014,  
72-1015, 72-1025

Attachment: ATL Final Report, "Technical Assistance  
on the Evaluation of Resin Polymers Used  
in Storage and Transportation Cask Shield  
Designs," dated April 24, 2001.

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