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

January 23, 1998

MEMORANDUM TO: Mark S. Delligatti, Senior Project Manager
Spent Fuel Licensing Section
SFPO/NMSS

FROM: Stephen C. O'Connor, Safety Inspection Engineer
Transportation and Storage Inspection Section
SFPO/NMSS

THROUGH: Patricia L. Eng, Chief
Transportation and Storage Inspection Section
SFPO/NMSS

SUBJECT: HOLTEC HI-STAR 100 DROP TEST TRIP REPORT

On December 10-11,1997, David Tang and I observed drop testing of a quarter-scale model of Holtec International Corporation's HI-STAR 100. On December 30, 1997, Ken Battige, Steve McDuffie, and Susan Shankman observed additional drop testing of the quarter-scale HI-STAR 100 model. Holtec performed the drop tests to demonstrate that the impact limiters would function in a transportation accident as described in the Holtec Safety Analysis Report (SAR) application, Report No. HI-951251, Revision 5. The Holtec test program, Report No. HI-951278, Revision 3, identified four orientations to drop test the test specimen: end drop, side drop, slapdown, and center of gravity (CG) over corner of impact limiter. The test program also required the test specimen to be dropped from 30-feet, in accordance with 10 CFR 71.73(c)(1), in each orientation.

Holtec contracted the Oak Ridge National Laboratory (ORNL) to perform the impact limiter drop testing and to prepare a report of the test results for Holtec. Six accelerometers were used for obtaining deceleration values at various locations on the test specimen. ORNL also used high speed photography to document the tests and to perform evaluations of the test results.

December 10-11 Tests

Previous to this test, ORNL performed drop testing on the HI-STAR 100 impact limiters for Holtec at ORNL on August 6-7, 1997. However, the impact limiters and related hardware did not perform as Holtec had predicted in the SAR application. The testing that David and I observed was to demonstrate that the revised impact limiter design would perform as Holtec had predicted. We observed the end drop and CG over corner tests. The attached photographs show the test equipment and test specimens used in the ORNL tests.

I examined in-process test data sheets and reviewed activities related to the accident condition testing against the requirements of 10 CFR 71.73(c)(1). With the exception of the observation noted below, I found the test plan adequately implemented and test data well documented for the accident condition tests performed.

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The observation that I made was that the ORNL technician was using an inappropriate torque wrench to tighten the bolts used to attach the top and bottom impact limiters to the transportation overpack. Specifically, a 100 foot-pound (ft-lb) torque wrench was used to torque the impact limiter bolts to 15 ft-lb. Industry practice for use of a torque wrench is to not use the wrench in the upper or lower 20 percentage of its range. In other words, a 100 ft-lb torque wrench should be used to torque bolts from 20 to 80 ft-lb. I informed the ORNL Quality Assurance Specialist aware of my concern on December 10, 1997; however, I noticed that the technician was still using the same torque wrench to tighten the bolts on December 11.

Prior to each test, all six accelerometers were calibrated using a device that transmitted a 1-g (one times the force of gravity) load to the accelerometer. The data acquisition system was also calibrated. During the two tests we observed, two of the six accelerometers produced outputs significantly different than the other four. After the CG-over-corner test, ORNL evaluated the performance of the suspected defective accelerometers. Each of the suspect accelerometers was secured to a suspended large steel plate along with two new accelerometers. An ORNL test technician then hit the steel plate with a sledge hammer on the opposite side from the accelerometers and the output signals of the accelerometers were compared. ORNL determined that the two suspect accelerometers were defective.

December 30 Test

During the side drop test performed on December 11, the bolts attaching the bottom impact limiter to the cask failed. Holtec subsequently modified the impact limiter design by increasing the number and diameter of the bolts used to secure the impact limiter to the transport overpack. In addition, Holtec changed the bolt material to Grade B8S stainless steel. This is the same material used for the bolts to secure the top impact limiter to the transport overpack. The bottom impact limiter was secured to the transport overpack using 16 bolts of 7/16 inch (in) diameter, instead of the previous 8 bolts of 1/4 in diameter used in the December 11 test. The bolts were tightened to a torque of 28 ($\pm$1) inch-pounds (approximately hand-tight) using a 0-30 in-lb torque wrench. A Holtec representative told the NRC observers that the actual torque value was irrelevant because no analysis was based on the torque of the bolts.

In order to demonstrate the revised impact limiter design, Holtec decided to perform the drop test in the slapdown orientation. The cask was released 15 degrees ($\pm$1 degree) from horizontal, with the top impact limiter striking the ground first. This orientation subjected the bottom impact limiter to greater deceleration than the top. Holtec stated to the NRC observers that the test appeared to be successful in that the bolts remained intact and deceleration levels appeared within design criteria.

Conclusion

Holtec told the NRC observers that additional test details and high-speed video of the drop tests will be available in the near future. Holtec plans to complete the drop testing by performing the side drop orientation as soon as more quarter-scale impact limiters are fabricated.

Please note that the attachment contains potentially proprietary information and should not be distributed for public dissemination.

Individuals Contacted

A partial list of individuals contacted during the tests is as follows:

Wayne Avant	Southern Nuclear Operating Co.
Max DeLong	Northern States Power Co.
K. Girishankar	Sargent and Lundy (representing Commonwealth Edison Co.)
Vic Gupta	Holtec
Chris Howard	Southern Nuclear Operating Co.
Sandra Lambert	ORNL
Mike Phipps	Holtec
Larry Shappert	ORNL
Alan Soler	Holtec
Mark Soler	Holtec
Gary Tjersland	Holtec
Maurice Tuse	American Electric Power Co.
Blake Vanhoy	ORNL
Paul Zurawski	Commonwealth Edison

Attachment:
As stated

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