DROP TESTING AT THE OAK RIDGE NATIONAL LABORATORY

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Two different types of packages, the TRUPACT-I shipping system and a TMI-2 defueling canister, were recently subjected to a series of drop tests at the Oak Ridge National Laboratory (ORNL). The testing programs for the two packages are described herein.

TRUPACT-I SHIPPING SYSTEM

The TRUPACT-I shipping system is a Type B package designed to transport transuranic waste to the Waste Isolation Pilot Plant, which is located at Carlsbad, New Mexico. This package weighs approximately 16,000 kg (35,000 lb) empty and 22,700 kg (50,000 lb) when full. The sequence of the TRUPACT-I drop tests and their specifications were developed by Sandia National Laboratory (SNL). Both normal operating and accident test sequences were carried out; the tests can be summarized as follows:

Height of drop (m)	Type of drop	Point of impact
0.33	Impact	Flat bottom
9	Impact	Longitudinal edge
9	Impact	Corner
1	Punch	Flat bottom
1	Punch	Flat end
1	Punch	Corner
1	Punch	Door seal area

The package was instrumented with 7 accelerometers and 40 strain gages; however, not all of these were utilized in every drop test. A microprocessor-controlled activation system was developed to maintain complete control over all phases of the tests. Rigging and releasing the packages took considerable effort and are described in detail in the full paper.

Results

The TRUPACT-I shipping system showed significant external damage at the end of this series of tests. No internal damage was apparent; in fact, no leakage was ever detected across the double seal of the inner door. The package was returned to SNL for additional analysis and fire testing.

TMI-2 DEFUELING CANISTER

A second set of tests was carried out to confirm the design analyses on a defueling canister from the Three Mile Island, Unit 2 (TMI-2) Nuclear Power Station. Three types of canisters have been designed for defueling the

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TMI-2 core. One of these, the knockout canister, contains internal poison rods designed to maintain a critically safe mass when loaded with pieces of spent fuel from the core of the reactor. This canister was physically tested to confirm that the nuclear poisons remain in place even if the cask that transports the canister is subjected to the hypothetical accident conditions.

A full-scale prototype of the knockout canister was fabricated and sent to ORNL before being assembled. This canister, which is 3.1 m long, has an OD of 35.56 cm and a wall thickness of 0.64 cm. Internally there are one large and four small steel tubes that contain B_4C pellets to control the neutron multiplication factor. For the tests the gross weight of the canister was adjusted to approximately 1300 kg (2580 lb) by loading the canister with a mixture of water and lead shot to simulate pieces of spent fuel. The tests, all of which were made from a height of 9 m (30 ft), can be summarized as follows:

Drop number	Attitude of drop	Contents frozen
1	Vertical, canister head up	Yes
2	Horizontal	Yes
3	Vertical, canister head down	No
4	Horizontal	Yes

The Drop Tests

The sequence of drops was specified by EG&G, Babcock and Wilcox, and other TMI personnel assigned to license the shipping system. An important aspect of the drop series is that in three of the drops, it was necessary to create significant force on specific internal poison rods during the impact. This was accomplished by allowing the water-lead mixture to freeze around the rod of interest before the drop was made.

ORNL designed an energy-absorbing system to be attached to a cask simulation vessel, into which the canister would be placed and which would restrict the decelerations experienced by the canister to 60 to 80 g axially and 90 to 110 g laterally. The impact limiters were constructed of polyurethane foam.

Results

Following the four drop tests, all internal poison rods appeared to be straight and all welds undamaged. The two internal support webs that bent had displacements of 1.40 and 0.75 cm, respectively, but this condition did not affect the position of the poison rods.

In summary, no damage was produced that would affect the assumptions made concerning rod locations which had been established during a study of the subcriticality of the fuel-canister-cask system.