UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

November 18, 1976

Honorable Marcus A. Rowden
Chairman
U. S. Nuclear Regulatory Commission
Washington, DC 20555

SUBJECT: REPORT ON PROPOSED QUALIFICATION CRITERIA TO CERTIFY PACKAGES FOR AIR TRANSPORT OF PLUTONIUM

Dear Mr. Rowden:

At its 199th meeting, November 11-13, 1976, the Advisory Committee on Reactor Safeguards (ACRS) completed its review of the qualification criteria proposed by the Nuclear Regulatory Commission (NRC) Staff for the certification of packages for air transport of plutonium. This matter was considered by a Working Group of the ACRS at meetings in Washington, D. C., on October 23, 1975, and February 12, 1976, and in Chicago, Illinois, on August 28, 1975, April 20, 1976, and November 5, 1976. During this review the Working Group and the ACRS had the benefit of discussions with representatives of the NRC Staff, the Energy Research and Development Administration, and their consultants and contractors. The Committee also had the benefit of the documents listed.

These criteria were developed in response to the requirements of Public Law 94-79 which requires, in part, that the NRC not license shipments by air of plutonium in any form until it "has certified to the Joint Committee on Atomic Energy of the Congress that a safe container has been developed and tested which will not rupture under crash and blast-testing equivalent to the crash and explosion of a high-flying aircraft."

The proposed criteria require that a package for the shipment of plutonium by air meet certain rigorous qualification criteria in addition to those now required by 10 CFR 71. These additional criteria define a set of conditions representing those to which a shipping package would be subjected during and following various kinds of aircraft crashes; they require tests and, in some cases, analytical assessments, to demonstrate that the package can undergo these conditions without rupture and without developing leakage that could lead to more than a negligible release of plutonium to the environment.

The criteria require a sequential series of tests involving impact, crushing, puncture, exposure to fire, and subsequent immersion in water, after which leak tightness must be demonstrated. In addition, individual nonsequential tests are required to simulate the conditions of impact following free-fall of the package from a high-flying aircraft and of submersion in a deep body of water.

The approach, followed by the NRC Staff in defining the crash environment and the required tests, has been to select deterministic upper bound values corresponding to a maximum credible accident. The one exception to this is the requirement of the impact test, which involves impact at a velocity of 422 ft/sec at a right angle onto a flat, essentially unyielding surface. The NRC Staff believes that this test is an upper bound for all crashes likely to occur during aircraft landing or take-off or in the vicinity of an airport. Although it cannot be established with certainty that impacts at higher velocities cannot occur, the requirements of impact at a right angle and onto an essentially unyielding surface represent extreme conditions that are very unlikely to occur and thus provide a degree of conservatism that is expected to compensate for possible higher impact velocities. Further conservatism is provided by the requirement of a sequence of five tests, each representing the worst condition to be expected.

The NRC Staff has considered other possible threats to a shipping package, including the possibility of its being struck by high-velocity fragments from a failed jet engine. The NRC Staff has eliminated this threat from consideration on probabilistic grounds. The Committee believes that the combination of low probability and the inherent resistance of a package designed to these criteria to excessive damage from a jet-engine fragment, leads to an acceptably safe situation.

The Committee notes the imposition of operational controls, to assure stowage of plutonium shipping packages in the aft-most cargo carrying area of the aircraft, as a means of reducing the hazard from longitudinal crushing by other cargo. The Committee agrees that this is a suitable solution to this particular problem but believes that requirements for tie-down of the packages to resist movement under normal conditions and under accident conditions less severe than those considered in the proposed criteria are desirable.

The acceptance standards for survivability require not only that the containment vessel not be ruptured following the various sequential and individual tests but also that it must still provide a sufficient degree of containment to restrict leakage to a very small amount, in accordance with the International Atomic Energy Agency Regulations for the Safe Transport of Radioactive Materials.

The Committee notes that the Sandia Laboratories, acting as contractor to the NRC, have designed, fabricated, and tested a package that meets all of the proposed criteria. It should be noted, however, that although the proposed test and acceptance criteria are of such a nature that they are applicable to packages containing plutonium in any form, the Sandia Laboratories' package has been tested and its acceptability has been demonstrated only for the shipment of plutonium oxide. If plutonium is to be shipped in other forms, further demonstration of the acceptability of this design will have to be made.

The Committee believes that the qualification criteria proposed by the NRC Staff are properly responsive to the requirements of Public Law 94-79, and that there is reasonable assurance that a package meeting these criteria, properly assembled and suitably stowed in the aft-most portion of an aircraft, will be capable of maintaining its integrity in the event of a crash without leakage of plutonium to the environment in amounts that would represent an undue hazard to the health and safety of the public.

Sincerely yours,

Dade W. Moeller

Dade W. Moeller
Chairman

References:

1. Nuclear Regulatory Commission Staff Working Paper on Proposed Qualification Criteria for Plutonium Package Certification, dated September 27, 1976
2. Letter, A. Snyder, Sandia Laboratories, to K. Chapman, Nuclear Regulatory Commission, concerning Plutonium Package Certification Program, dated September 10, 1976
3. Lockheed-Georgia Company Report on Determination of Crash Impact Conditions Pertaining to Multi-Engine Transport Aircraft, dated November 1970