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JUL 20 1979

Mr. Richard A. Nellis
Scottsdale Christian Home
3339 N. Civic Center Plaza
Scottsdale, Arizona 85251

Dear Mr. Nellis:

Thank you for your letters of May 16 and June 18 which were referred to the Nuclear Regulatory Commission by the Library of Congress. We have reviewed your inquiry regarding the characteristics of fuel assemblies in the Three Mile Island nuclear power plant and the nuclear characteristics of certain materials. We have provided our answers to your questions in the enclosure.

We are pleased to have been of service in this matter. Please let me know if additional information is needed.

Sincerely,
Original Signed by
F. Schroeder

Frank Schroeder, Deputy Director
Division of Systems Safety

Enclosure: As stated

cc: The Honorable Dennis DeConcini

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OFFICE ▶	DSS/CPB	DSS/RS/AD	DSS/DD			
SURNAME ▶	KKniel:pav	RPDenise	FSchroeder			
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Enclosure

Responses to Richard A. Nellis Letters to Library of Congress
Dated May 16, 1979 and June 18, 1979

The uranium dioxide fuel rods in TMI-2 are contained in fuel assemblies, which are groups of fuel rods arranged in square arrays with 208 rods per assembly. The metallic cladding of each fuel rod is Zircaloy-4, and each rod is approximately 153 inches in length with an outside diameter of 0.430 inches. The fuel column is 144 inches in length and is made up of sintered uranium dioxide pellets that are 0.700 inches long and 0.370 inches in diameter. Each fuel pellet weighs approximately 12.5 grams or 0.44 ounces. In TMI-2, the core contains 177 fuel assemblies, with a total uranium dioxide weight of 204,907 pounds.

Regarding the nuclear poison characteristics of boron and beryllium, natural boron has an average thermal neutron absorption cross-section of 755 barns while for beryllium, the absorption is only 0.01 barns. (The absorption cross-section, stated in barns, is a measure of the effectiveness of a material as a nuclear "poison"; the higher the cross-section, the more effective is the material in controlling nuclear reactors.) Boron-10 is the isotope responsible for the high cross-section in natural boron (~20% B-10) and by itself, has an absorption cross-section of 3815 barns. Boron can be enriched in the B-10 isotope in much the same way as uranium is enriched in U-235, thereby, increasing its cross-section for special application. Boron compounds, either as a solid form in rods or in solution in the primary coolant, are widely used for reactor control because of their very high neutron absorption cross-section. Beryllium has been used in some experimental reactors as a moderator or reflector. One of the reasons for using beryllium as a reflector is its very low absorption.

Regarding comments on nucleus stability, the absorption cross-section of an isotope in the low neutron energy range is largely determined by the reaction resonance parameters and energy level location in the excited state of the compound nucleus, i.e., the nucleus consisting of the absorbing isotope plus the neutron absorbed. The compound nucleus formed from B-10 plus the neutron is B-11 in which there is a reaction resonance for the change to Li-7 plus He-4. This resonance has a large reaction rate near thermal neutron energies, thus a large absorption cross-section. For Be-10, formed from Be-9 plus a neutron, this is not the case and thus, the cross-section for absorption is small.

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