GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, P.O. BOX 460, PLEASANTON, CALIFORNIA 94566

NUCLEAR ENERGY
ENGINEERING
DIVISION

September 23, 1980

Mr. Robert A. Clark, Chief
Operating Reactors Branch #3
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: Responses to Questions Regarding the General Electric Test Reactor (GETR) Fuel and Experimental Capsules - License TR-1, Docket 50-70

Dear Mr. Clark:

Attached are responses to the request for information regarding the analyses performed to verify that no fuel or equipment capsule failure occurs due to the design seismic events. This request was received on September 19, 1980 and also requested verification of the adequacy of the equipment associated with the experiment capsules.

Very truly yours,

R W Darmitzel

R. W. Darmitzel, Manager
Irradiation Processing Operation

OFFICIAL SEAL
VIRGINIA C. CASO
NOTARY PUBLIC - CALIFORNIA
ALAMEDA COUNTY
My comm. expires MAR 8, 1981

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attachments

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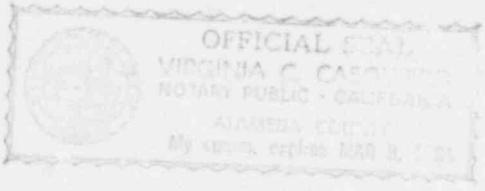
AFFIRMATION

The General Electric Company hereby submits the "Response to Additional Information Comment Regarding Fuel Elements and Fueled Capsules".

To the best of my knowledge and belief, the information contained herein is accurate.



R. W. Darmitzel, Manager
Irradiation Processing Operation

Submitted and sworn before me this 23rd day of September, 1980.

Virginia C Casqueiro, Notary Public in and for the County of Alameda, State of California.

GENERAL ELECTRIC TEST REACTOR

RESPONSE TO

ADDITIONAL INFORMATION COMMENT

REGARDING

FUEL ELEMENTS AND FUELED CAPSULES

SEPTEMBER 23, 1980

COMMENT

"Describe the analyses performed to verify that no fuel or equipment capsule failure occurs due to the design seismic events. Include a discussion of the input loads (and how they were developed), the analysis methods and results, the applicable materials and the stress allowances (and how they were determined), and a comparison of the maximum calculated stresses with the allowables. Also describe the resulting displacements and verify that they do not result in damage to the fuel or experiment capsules. In the case of the experiment capsules, verify the adequacy of the work table, the RAFT, and the associated bolts under seismic conditions."

RESPONSE

Fuel Elements

The General Electric Test Reactor fuel elements are flat-plate, uranium-aluminum assemblies that contain 19 fuel plates each 0.050 inches thick (nominal), 2.80 inches wide, and 37.25 inches long. The fuel plates are roll swaged into aluminum side pieces which hold and space the fuel plates. A cylindrical nose piece on the lower end of the fuel element seats and aligns the elements in the grid plate. An aluminum cross bar joins the two aluminum side pieces at the top of the element and serves as a lifting bail for handling. The control rod fuel follower is of similar construction but consists of 16 fuel plates. The fuel follower is latched to the poison section above and to the shock absorber section below it. The dimensions of the fuel elements, control rods, in-core experiment facilities and of other hardware (beryllium and aluminum filler pieces) are such as to tightly pack these components inside the two-foot reactor pressure vessel.

The fuel elements within the reactor core were evaluated for the criterion seismic event. These elements were evaluated using the analytical results from Reference 1. The reactor pressure vessel (RPV) was modeled and analysed for the criterion seismic event as described in Reference 1. Since the elements are tightly packed within the core, it was conservatively assumed that deformations of the fuel elements are the same as those of the shell and core as computed from the RPV model (Reference 1). The maximum relative displacement in the core area was 0.005 inches. These deformations were applied to the fuel elements, and the resulting stresses were determined by conventional beam theory to be very low. The maximum bending stress was computed to be 70 psi, and the allowable is at least 4,800 psi. It was therefore concluded that the fuel elements will not be damaged due to the design seismic events.

An extremely conservative allowable stress value for the fuel element was determined based on a single side of the aluminum-uranium-aluminum sandwich of a fuel plate as if it were not fabricated into the fuel plate, nor the fuel plate roll swaged into the side plates. This material is aluminum alloy 1100 and meets the requirements of ASTM B209. The minimum specified yield stress in the fabricated condition is 8,000 psi with about 8% minimum elongation. Based on data in "Radiation Effects Design Handbook, section 7, Structural Alloys", NTIS-N71-36885, for fluence well above (10 times) that

which the GETR elements receive to license limit burnup, the minimum yield stress increases to about 17,000 psi with minimum elongation at around 8%. ASME Section III specifies allowable stress for this material in the non-irradiated condition as about 2,000 psi. Utilizing the factor of 2.4 times normal stress for the maximum earthquake allowable stress, the allowable stress value is 4,800 psi.

Fuel Experiment Capsules

The fuel experiment capsules which are irradiated in the pool adjacent to the GETR reactor pressure vessel are bolted inside a tubular structure (facility tube) which in turn is mounted to the Radial Adjustable Facility Tube (RAFT) or Vertical Adjustable Facility Tube (VAFT). The RAFT/VAFT provides capability for adjusting the distance of the experiment capsule from the reactor pressure vessel. Descriptions of it and the related Vertical Adjustable Facility Tube are found on pages 10-25, 10-26 and 10-27 of the GETR Safety Analysis Report (NEDO 12622) forwarded to the NRC in July, 1977. The RAFT is mounted to the experiment table/pedestal (work table).

The test facility consists of the RAFT, facility tube, and fuel capsule. A simplified and conservative bounding analysis was performed to assess the integrity of the capsule body during and after the criterion seismic event. The maximum bending stress was computed assuming that the capsule body was horizontally restrained as a cantilevered beam above the facility tube. The seismic forces were obtained multiplying the peak spectral acceleration (for 3% damping) at the core times a factor of 1.5 times the contributing mass. The maximum seismic stress was computed as 27,000 psi. Displacement was not computed.

The stress due to internal pressure was computed to be 7,000 psi. The total maximum stress is therefore 34,000 psi. The allowable stress for stainless steel for the maximum earthquake condition is 37,400 psi. Reference 1 (Section 3-2 and Table 3-3) discusses the various load combinations and allowable stresses. It was therefore concluded that there will be no fuel capsule failure due to the design seismic event. Other capsules are irradiated in the pool at GETR. Their dimensions and the geometry of their test facilities are expected to produce substantially lower earthquake loading. Evaluation of these capsules and facilities has not been done, but will be and the results forwarded to the NRC for review prior to their use.

The above analysis is conservative since it does not include the hydrodynamic effects or the additional restraint provided by the flexible hose at the top of the capsule body. The hydrodynamic effects will decrease the frequency and increase the damping. The above worst case analyses will not be affected by deflections of the RAFT or facility tube. Therefore, it was not necessary to perform analyses of the latter two components.

The experiment table supporting the test facility was also evaluated to determine its capability to resist the criterion seismic event. The analysis and results of the evaluation were discussed in Reference 2 (Section 5.3.1) and 3 (response to request 9, page 21). It was concluded that the experiment table will be able to resist the seismic forces.

References:

1. Engineering Decision Analysis Company, Inc., "Seismic Analysis of Primary Cooling System and Reactor Pressure Vessel (RPV), General Electric Test Reactor", prepared for the General Electric Company, San Jose, California, EDAC 117-1217.05, 30 June 1978.

2. Engineering Decision Analysis Company, Inc. (EDAC), "Seismic Analysis of Reactor Building, General Electric Test Reactor -- Phase 2", prepared for the General Electric Company, San Jose, California, EDAC 117-217.03, 1 June 1978.

3. Letter from R. W. Darmitzel (G.E.) to V. Stello (NRC) dated July 26, 1978, to transmit "Responses to NRC Requests for Additional Information on The Phase 2 Report", 25 July 1978.