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

ENCLOSURE 1

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATING TO FORT ST. VRAIN DESTRUCTIVE EXAMINATION REPORT FOR FUEL TEST ASSEMBLY-2 PUBLIC SERVICE COMPANY OF COLORADO FORT ST. VRAIN NUCLEAR POWER PLANT DOCKET NO. 50-267

1.0 INTRODUCTION

By letters dated July 18 and September 11, 1986 the Public Service Company (PSC) of Colorado, the licensee for the Fort St. Vrain nuclear power plant, submitted the results of the destructive examination of Fuel Test Element 2 (FTE-2) (Ref. 1 & 2). This submittal is in partial fulfillment of PSC's commitment in the Fort St. Vrain fuel surveillance program (Ref. 3). Additional information was submitted on May 2, 1988 which related the findings of the destructive examination to the fuel performance requirements to the end of its projected irradiation lifetime (Ref. 4).

The surveillance requirements in Fort St. Vrain were designed to satisfy the objectives of 10 CFR 50 Appendix A, GDC 10 and 26 and are set forth in the updated FSAR Vol. I (Ref. 5). Because of the lack of post irradiation examination for extensively irradiated fuel (in H-451 graphite in particular) there were two fundamental objectives in the surveillance program: (a) to provide means for the detection of the development of intolerable geometric distortions in the graphite fuel assembly; and (b) to monitor and quantify fuel performance in actual core conditions. The tests and examinations performed in the destructive examination of FTE-2 and their relevance to fuel performance are examined in the following evaluation.

2.0 EVALUATION

FTE-2 was one of eight fuel test assemblies inserted in Fort St. Vrain in 1979. FTE-2 is the first to be destructively examined. This examination was carried out by GA Technologies Inc. (Ref. 1 & 2). The residence time was 483 Effective Full Power Days (EFPD). The assembly experienced an estimated fluence of 1.9×10^{21} n/cm^2 (E > .18 Mev) and a volume average temperature of 700° F. The specific objectives of the examination were the following:

(a) validate the structural performance of the H-451 graphite;
(b) validate the axial and transverse graphite thermal expansivity and identify the differences between measured and predicted values;
(c) validate the graphite thermal diffusivity and identify any deviations from the predicted values;
(d) validate the axial and transverse tensile strength and Young's modulus;
(e) check for fuel rod structural integrity and signs of fuel rod-graphite interactions;
(f) measure the fuel stack push out force as a sign of fuel rod-graphite interaction;
(g) validate fuel performance by metallographic microstructure examination;
(h) perform fast and thermal neutron flux dosimetry to provide reference points for measured properties; and
(i) perform fuel burnup radiochemistry to provide reference points for measured properties.

The examination included (in addition to visual inspection) the disassembly of the element, metallographic examination of the fuel, observations and chemical examination of the fuel coating tc identify and measure degradation, examination of monitor crucibles, monitor analyses, and graphite analyses and evaluation for tensile properties, thermal expansivity and thermal diffusivity. Many of the monitor samples could not be extracted due to bonding and had to be cut out.

The results of the examinations showed that:

(a) The H-451 graphite block was in excellent condition. The measured tensile strength, Young's modulus, tensile fracture strain and thermal expansivity, were uniform through the assembly and within the prescribed values.

(b) The thermal expansivities appeared to average about 19% lower than the predicted values. However, supplemental measurements showed that the temperature was higher than originally estimated, thus, the discrepancy was attributed to the difference of the assumed temperature and the actual temperature experienced by the fuel element (Ref. 2).

(c) The thermal diffusivity measurements fall within 7% of the predicted values, which is satisfactory (Ref. 2).

(d) The fuel was in excellent condition with no matrix-particle interaction observed.

(e) There were no signs of fuel rod-graphite interaction.

(f) A large number of fissile and fertile particles were examined. A very small number of inner coating failures were identified. No outer coating failures were found.

(g) Fast and thermal neutron monitor measurements showed that the measured fast fluxes were lower than estimated and the thermal fluxes were higher than the estimates. However, the measured total fissions were very close to their estimate.

(h) The chemical behavior of the fuel particles was excellent with no observed signs of significant chemical degradation.

In summary both the fuel and the graphite performed as expected.

However, the question of interest is how to extrapolate the performance of FTE-2 at 483 EFPDs to its projected reactor residence of 1800 EFPDs. The licensee stated that existing experience indicates that graphite and fuel performance are linear with irradiation time. On this basis, the projected performance of FTE-2 to the end of its residence time in the reactor is estimated to be excellent.

3.0 SUMMARY AND CONCLUSIONS

We have reviewed two reports submitted by PSC documenting the measurements of destructive testing of FTE-2 after 483 EFPDs of irradiation in Fort St. Vrain. The destructive testing is mandated by the Fort St. Vrain surveillance program. Measurements of the pertinent graphite and fuel properties showed that they performed very well and within the anticipated limits and requirements of the Fort St. Vrain fuel surveillance program. Projection to the end of life indicate that the graphite and the fuel will perform safely and within the expected range. Therefore, we conclude that the fuel represented by FTE-2 is predicted to be safe for operation in Fort St. Vrain for 1800 EFPDs.

4.0 REFERENCES

1. Letter from H. L. Brey, Public Service Company of Colorado to H. N. Berkow, dated July 18, 1986, designated (P-86468) and attached report GA Technologies Inc. Doc. No. 908909 "Destructive Examination of Fort St. Vrain Fuel Test Element FTE-2," dated July 11, 1986.

2. Letter from H. L. Brey, Public Service Company of Colorado to H. N. Berkow, "FTE-2, Post Irradiation Examination Supplemental Report," (P-86545) dated September 11, 1986.

3. Letter from C. H. Hinson (NRC) to R. O. Williams, Jr., Public Service Company of Colorado, "Fort St. Vrain Nuclear Generating Station, Amendment No. 48 to Facility Operating License DPR-34," dated November 25, 1986.

(4) Letter from H. L. Brey, Public Service Company of Colorado to J. A. Calvo, "Additional Information on FTE-2 Post Irradiation Examination," dated May 2, 1988.

5. Fort St. Vrain, Updated FSAR Revision 2. Section 3.

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Principal Contributor: L. Lois