February 15, 1985

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Docket No. 50-320

Mr. F. R. Standerfer
Vice President/Director
Three Mile Island Unit 2
GPU Nuclear Corporation
P.O. Box 480
Middletown, PA 17057

Dear Mr. Standerfer:

Subject: Characterization of Fuel Material in the Lower Region of the Reactor Vessel

Reference: Letter, 4410-84-L-0002, F. Standerfer to B. Snyder, dated January 3, 1985

In the referenced letter, you submitted a Safety Evaluation Report (SER) addressing the proposed plan to characterize fuel deposits in the lower region of the Reactor Pressure Vessel (RPV). Your staff provided additional information on the proposed activity and responded to questions posed by NRC staff members in a meeting held on January 30, 1985. Based on our review, as documented in the enclosed safety evaluation, we conclude that the proposed activity poses a minimal threat to the integrity of the incore instrumentation piping and can therefore be conducted safely. The conduct of the planned fuel characterization effort will be subject to NRC approval of the written procedures.

Sincerely,

/s/ R. A. Weller for

Bernard J. Snyder, Program Director
Three Mile Island Program Office
Office of Nuclear Reactor Regulation

Enclosure:
As stated

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NRC STAFF SAFETY EVALUATION OF THE
FUEL CHARACTERIZATION IN THE LOWER RPV

Introduction

In a letter dated January 3, 1985, GPU submitted a safety evaluation of their proposed method for estimating the quantity of fuel debris deposited in the lower reactor vessel head as a result of the March 28, 1979 accident at Three Mile Island, Unit 2. Miniature ion chambers are to be inserted into the center calibration tubes of incore detector assemblies at selected locations to provide vertical gamma profiles in the region between the lower core support structure and the bottom of the Reactor Pressure Vessel. These profiles will be used to determine the depth of the debris bed, from which the volume and mass of fuel debris can be estimated. The data obtained from this activity will aid in the development of defueling plans and fuel accountability efforts.

Probe Insertion

At six locations, a miniature ion chamber will be inserted into the lower RPV region through the center calibration tubes of selected incore detector assemblies. Each incore detector assembly consists of an outer inconel sheath (0.25 inch I.D.) and nine monitoring tubes surrounding the center inconel calibration tube (0.093 inch I.D.). Each of these assemblies is housed in an incore instrument guide tube that forms part of the reactor coolant pressure boundary. The guide tube pipe run consists of a 3/4" schedule 160 inconel nozzle that penetrates the RPV lower head, a 3/4" x 1/2" schedule 80 reducer, and a 1/2" schedule 80, 304L stainless steel pipe extending for approximately 120' from the bottom of the RPV to the seal table at elevation 347'6". The incore detector assemblies (O.D. 0.292

inch) are not secured to the instrument guide pipes (I.D. 0.546 inch).

Prior to ion chamber insertion, thirteen of the 52 incore locations will be probed with dummy wires. Six of the thirteen locations will be probed to determine if the ion chambers can be successfully inserted into the region of interest via the center calibration tubes. The remaining seven locations will be probed to determine the point inside the RPV at which the incore instruments were damaged. This data will be correlated with previous accident data. The procedure calls for repeated use of a single dummy wire, which will be wiped down after each withdrawal. If a dummy wire or probe is stuck at any time, i.e., cannot be easily removed manually, it will be left in place and that instrument guide pipe will be sealed. The ion chamber probes will be inserted into the lower RPV and gamma readings will be taken at vertical increments to determine the bed depth of accumulated fuel debris.

Safety Considerations

The primary safety concern raised by the proposed activity involves the potential for unisolable primary coolant leakage from a failed incore instrument guide tube. To assess the integrity of the incore guide tubes, technical assistance was provided by the NRC's Chemical Engineering Branch (CMEB) and Structural and Geotechnical Engineering Branch (SGEB). Their respective safety evaluations are documented in References 1 and 2.

Following the accident, the incore guide piping was submerged in reactor building sump water and, thus, was exposed to environmental conditions with the potential for chemically-induced degradation. However, it is highly unlikely that the incore instrument guide tubes have experienced significant degradation. The guide piping and welds are made of low carbon stainless steel (304L) and the RPV penetration nozzles are made of Inconel, materials which are relatively resistant to SCC. A review of important post-accident parameters, including pH, chloride concentration, and water temperature, indicates that little potential existed for chloride-induced stress corrosion cracking (SCC) of the guide tubes. The primary system is currently depressurized and there is no evidence of any RCS leakage, a further indication that the incore instrument guide piping has retained its integrity.

The structural review of the incore instrument guide piping indicates that the anticipated stresses imparted to the piping from the probing operations are much smaller than the stresses incurred from previous activities. GPU calculated that the highest axial stress on a guide pipe due to probe insertion and withdrawal would be 31 psi. This calculation was independently verified by the staff (Reference 2). This stress is significantly below previously induced stresses which did not result in guide tube failure, including RCS pressurization to 50 psi (with a corresponding stress on the guide tubes of 123 psi), pipe stress due to hydrostatic pressure (42 psi), and maximum bending stresses due to the weight of the piping and its contents (630 psi). Also, the guide tube piping was designed to ANSI/ASME standards for an allowable stress of 15,700 psi. GPU demonstrated that the maximum force that can realistically be exerted on the probe wire by manual means is approximately two to three pounds; in the calculations, GPU conservatively assumed a value of ten pounds which translates to a stress of 31 psi imparted to the instrument guide tube.

In the unlikely event of a guide tube failure, procedures are in place to maintain RCS water level and to minimize the impact of such a leak.

Concerning occupational exposure, several decontaminations in the area of the seal table have been performed, resulting in substantial dose rate reduction. Lead bags may be used to shield contaminated electrical cable in the vicinity. Full scale mock-up testing of the operation has been completed; that experience will help ensure that occupational exposures will be kept ALARA. A total exposure of 4.5 man-rem for the job is estimated by GPU. We find this estimate to be reasonable and acceptably low.

Conclusions

The proposed insertion and withdrawal of miniature ion chambers and probe wires through the center calibration tube of the incore detector assemblies poses no significant threat to the integrity of the incore instrumentation piping which forms part of the primary system boundary. It is extremely unlikely that the incore instrumentation piping has undergone chemically-induced degradation, based on our review of the post-accident environment and an analysis of the piping and weld materials. The anticipated stresses on the piping are substantially below stresses induced by other cleanup activities during which no guide pipe failures or leakage were observed. The estimated occupational exposure for this activity is acceptably low. This activity will not pose a significant risk to the health and safety of the public and is within the scope of the activities evaluated in the Final Programmatic Environmental Impact Statement (NUREG-0683). Therefore, we conclude that the proposed fuel characterization in the lower RPV head by insertion of miniature ion chamber detectors through the incore instrument piping is acceptable.

REFERENCES

1. Memorandum from W. Johnston to B. Snyder, dated February 14, 1985.

2. Memorandum from G. Lear to B. Snyder, dated February 8, 1985.