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TMI-2 Cleanup Project Directorate
Attn: Dr. W. D. Travers
Director
US Nuclear Regulatory Commission
c/o Three Mile Island Nuclear Station
Middletown, PA 17057

Dear Dr. Travers:

Three Mile Island Nuclear Station, Unit 2 (TMI-2)
Operating License No. DPR-73
Docket No. 50-320
Extended Core Stratification Sample Acquisition Activity

The purpose of this letter is to describe the GPU Nuclear proposal to extend core stratification sample acquisition activities into the lower reactor vessel head debris bed and to obtain NRC approval of this activity. The proposed scope of this core sampling activity extends beyond that presented in GPU Nuclear letter 4410-85-L-0248 dated December 31, 1985. The proposed activity will be performed, as a continuation of the currently approved Core Stratification Sample Acquisition Program, at one or more locations corresponding to the lower head inspection ports in the flow distributor plate.

In general, this proposed sampling activity is bounded by the analysis presented in Reference 1. However, since this activity continues into the core debris bed in the lower head region, the potential impact on incore nozzle welds in proximity to the path of the core drill bit must be evaluated.

Section 4.1[illegible] (Reactor Vessel Integrity) of Revision 10 to the Defueling Safety Evaluation Report (SER) (Reference 2) presents a conservative assessment of the minimum in-core/vessel weld thickness (0.030 in.) and the minimum loads-to-failure for the conservative case. Those loads are:

Bending Moment - 1400 inch-pounds
Torque - 5800 inch-pounds
Axial Load - 5400 pounds

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The dimensional layout information used as a reference source is provided in Figure 1.

When sampling via the aligned flow distributor plate inspection ports, the closest instrument nozzle would be located approximately 8.5 inches (i.e., one fuel assembly width) from the drilling site, assuming the drill is centered in the inspection port. As shown on Figure 1, the upper 3 inches of the nozzle is positioned in the in-core instrument guide tube. In evaluating this proposed activity, the most conservative model is to assume an intact nozzle and guide tube but a 0.030 inch weld thickness, as described in Reference 1, since an intact nozzle provide for larger moment arm under bending moments.

Of the three potential loading modes, application of bending moment during drilling is the most feasible. With the nozzle and guide tube in place, the highest elevation at which a direct point of contact can occur between the nozzle and a load-transmitting object is 8 13/16 inch above the bottom of the vessel. The closest position of the drill bit relative to the instrument nozzle, if the drill bit pathway to the lower head region is maximally offset from the centerline of the opening in the lower core support (LCS) structures, is 6 3/4 inch. Four (4) potential scenarios for the application of a bending moment were considered in that context:

1. It is assumed that the drill becomes stalled in a plate-like monolithic piece of material enveloping the incore nozzle at an elevation of 8 13/16 inches above the vessel bottom such that the drill torque is applied as a radial bending load on the nozzle (Sketch 1). In this case, it has been calculated that 1075 inch-pounds of drill torque acting through a 6 3/4 inch moment arm will impart a force of approximately 160 pounds on the nozzle. This force, acting over the 8 13/16 inches nozzle length, will impart approximately 1400 inch-pounds of bending moment to the nozzle weld.

2. Application of a bending moment due to the downward force of the drill on the plate-like monolithic piece of core debris considered in Item 1 above is precluded because the monolithic material is assumed to be supported from below based on video examination of the lower head region. It also is assumed that large voids do not exist in the rubble bed below the flow distributor since the existence of large voids would be inconsistent with the assumption that the incore nozzle weld has melted to the 0.030 inch thickness, as described in Revision 10 of the Defueling SER (Reference 1).

3. It is assumed that the drill causes an elongated piece of material to spin and impact against the side of a nozzle (Sketch 2). In this case, it has been calculated that the resultant bending moment limit will not be exceeded provided the drill rotates at 100 rpm or less.

4. It is assumed that the drill is operating in loose, chunk-like pieces of debris and the rotation of the drill causes a chunk of debris to impart a radial load through other loose debris to the nozzle

(Sketch 3). Impact loading assumed to be imparted by this model is bounded by Item 3 above. Application of a steady load, imparted through the loose chunks, is considered incredible because the rotational motion of the drill will cause rotation of each piece in directions opposite to adjoining pieces, thus causing the pieces to tend to slip out of the plane of the force.

Based on the above models, it has been concluded that the potential for exceeding the limits for a bending load imparted to the incore nozzles during core boring can be precluded by limiting the delivered torque to the bit. During drilling below the flow distributor, delivered torque will be limited to less than 1075 inch-pounds at speeds of 100 rpm or less.

Using the small-diameter (2.25 in.) coring tools, the core stratification sample (CSS) system torque controls can be operated within these limits and still acquire a sample; drilling time will be slightly extended. The key phrase is "delivered torque." During lower head sample acquisition, the torque will be controlled to 1075 inch-pounds of torque plus that torque value necessary to overcome frictional losses due to machine operation and penetration above the flow distributor. This frictional loss will be determined procedurally prior to beginning the lower head sampling activities.

The magnitude of the applied bending moments would not be affected by drill string deflection since significant deflection (i.e., lateral warping) of the drill string within the limited space defined by the LCS structure and/or the material now occupying that area is not considered to be credible; the short reach (7 ft) and the lateral constraints essentially preclude deflection. The CSS system incorporates a deflection detector capability which automatically suspends drilling if pre-set limits are exceeded.

Application of excessive torque directly to the instrument nozzle by the drill bit is not considered credible because the allowable nozzle torque (i.e., 5800 inch-pounds) is greater than the drill bit delivered torque limit (i.e., 1075 inch-pounds) imposed for lower head activities. Further, the two centerlines are offset by at least 6 3/4 inches.

The CSS system is electronically limited to a maximum downward force of approximately 9000 lbs. If the maximum force at the drill bit is transmitted to a nozzle/weld through a cone-shaped monolithic structure 6 inches high and 6 3/4 inch in radius (i.e., enveloping the drill bit and nozzle/weld), it has been calculated that the maximum axial load imparted to the nozzle weld would be less than 350 pounds. Since the nozzle is assumed to be intact, downward forces are expected to be less, depending on the frictional losses along the axis of the nozzle. Since the CSS system varies the downward load in an effort to maintain constant torque, the lower-than-normal torque limits imposed by the bending moment limits discussed above will result in reduced "weight on bit" loads. These loads are estimated to be less than 4000 lbs. based on experience with the large-diameter coring tools. Thus, further reduction of the axial loadings on the incore nozzle results. These loads are maintained electronically by programming the CSS or by operator actions.

Consequently, a sample of core material may be obtained from below the flow distributor without imparting excessive axial loads to the incore nozzles. (Sketches 4 and 5.)

Combinations of loading modes also were considered and it is a best engineering judgment that loading combinations will not significantly contribute to incore nozzle loadings due to the geometry involved. The four (4) possible loading combinations considered were:

1. Torque and Axial - The 6 3/4 inch minimum offset between the nozzle and drill bit prevents the direct application of simultaneous torque and axial loadings.

2. Torque and Bending - The 6 3/4 inch minimum offset prevents the direct application of torque loadings. The mechanisms required to effect simultaneous torque and bending loads on the incore nozzle are incompatible.

3. Bending and Axial - The only identified mechanisms for effecting a combined bending and axial loading is through a monolithic structure surrounding an incore nozzle. In this event, axial loadings are reduced due to the offset, as described previously. Bending loads would be integrated over the length of the monolith/nozzle interface; thus, loading would tend to be reduced. Additionally, the bending moments would be lessened by frictional forces between the monolith and supporting debris. This combination of loadings is not expected to significantly increase the loads imparted.

4. Axial, Bending, and Torque - Based on the above discussions, it has been concluded that the occurrence of significant combinations of all three loading modes is not credible.

The potential for drilling into the walls of the lower head of the Reactor Vessel is precluded by several mechanisms. First, the CSS system incorporates "positive stop" provisions so that the depth of drilling is controlled and deflection is limited to prevent contact with the Reactor Vessel walls. Secondly, should contact with the vessel wall occur, the cladding material or postulated layer of silver on the lower head (i.e., from control rods) will coat the bit face and the cutting capability of the CSS virtually will be neutralized. By monitoring the available operating parameters, contact with the reactor vessel wall can be precluded and, in any case, will be obvious. Thus, the drilling operation can be terminated before significant damage could occur to the Reactor Vessel.

Based on the above discussions, failure of an incore nozzle weld due to lower head core boring is highly unlikely. However, should failure of an incore nozzle weld occur, the resulting leak rate from the reactor vessel is less than the failure of an instrument tube outside the reactor vessel. This latter, worst case failure has been previously evaluated in Technical Specification Change Request No. 46 and NRC Amendment of Order dated

September 12, 1985. These evaluations demonstrate that sufficient makeup capability exists to keep the core covered with an adequate supply of borated water to maintain core cooling and subcriticality.

Since the consequences of failure of an incore nozzle weld have been evaluated previously, this proposal does not create the possibility of an accident of a different type nor increase the consequences of an previously evaluated accident or malfunction.

By assuring that loads imparted to incore nozzle welds remain below those minimum loads calculated to be necessary to cause an incore nozzle weld failure, the proposed accident neither increases the probability of a previously evaluated accident nor reduces the margin of safety as defined in the basis for any Technical Specification. Thus, the proposed activity does not constitute an unreviewed safety question and can be performed without undue risk to the health and safety of the public.

Per the requirements of 10 CFR 170, an application fee of $150.00 is enclosed.

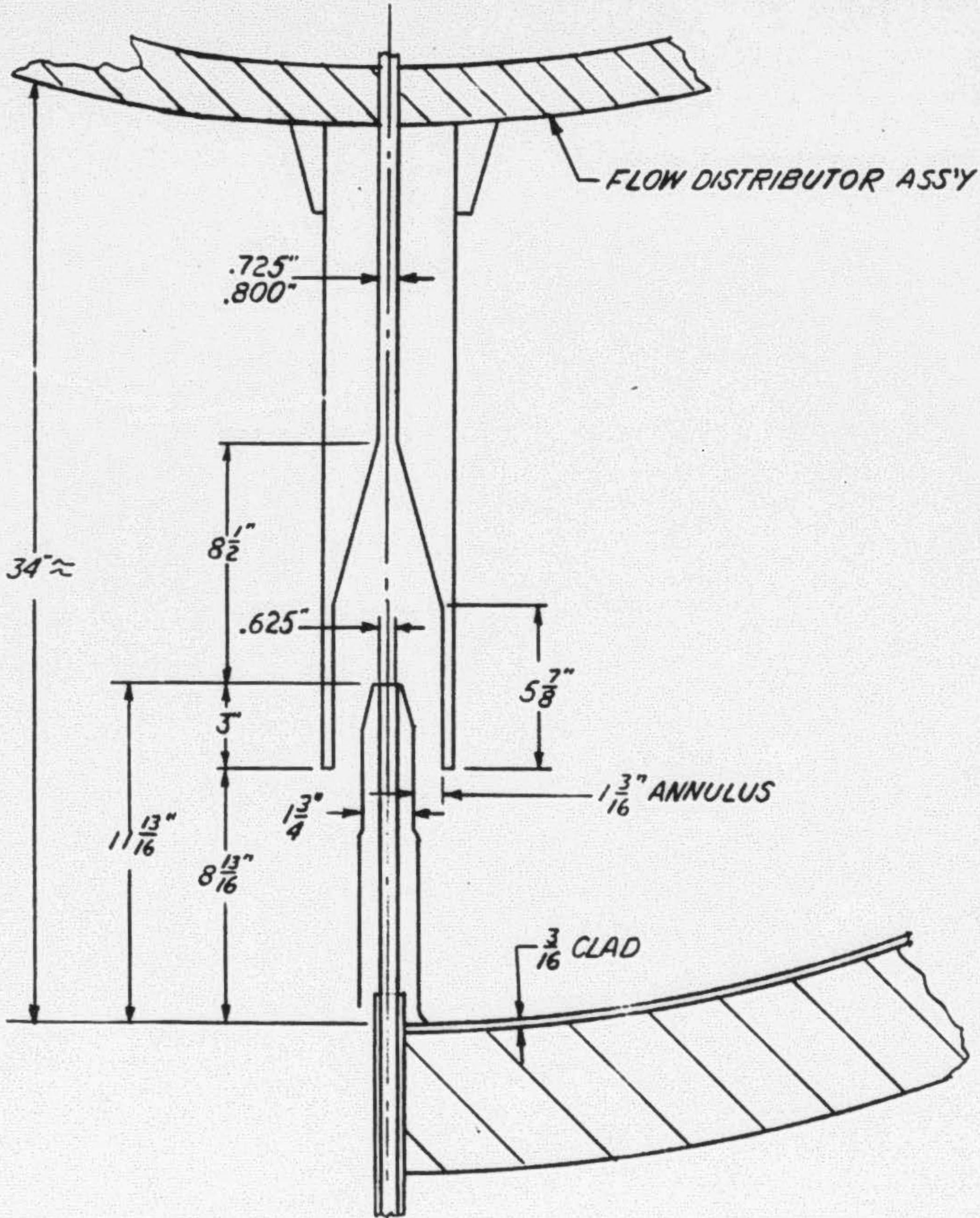
Sincerely,

FR Standerfer

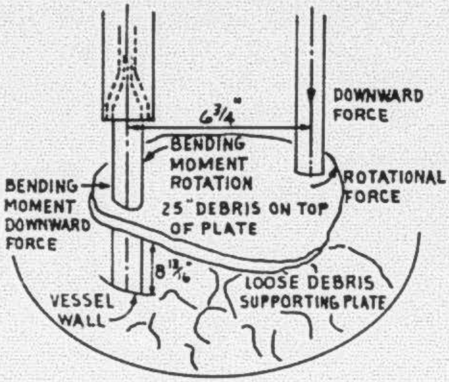
F. R. Standerfer
Vice President/Director, TMI-2

FRS/RBS/eml

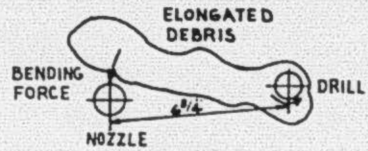
Enclosure: GPU Nuclear Corp. Check No. 00024281



LOWER GRID FLOW DISTRIBUTOR &
GUIDE TUBE ASSEMBLY



SKETCH 1



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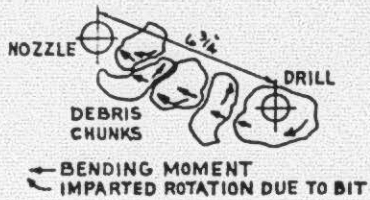

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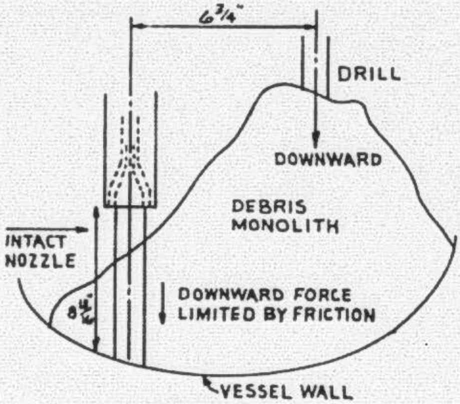

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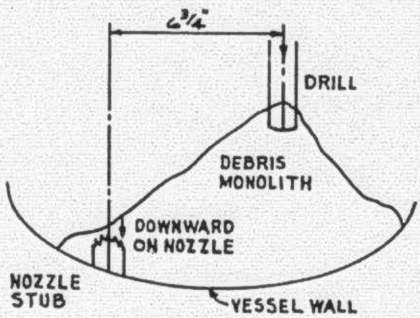

SKETCH 5