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RECOMMENDED HYDRAULIC MEASUREMENTS IN THE HFIR MOCKUP

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ABSTRACT

It is planned to build a full-scale mockup of the HFIR core for testing and evaluating the various design parameters involved. A brief analysis of the core hydrodynamics was undertaken in order to recommend which hydraulic measurements to make so as to demonstrate adequate cooling of all core components.

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INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

January 10, 1961

TO: D. T. Jones and W. H. Kelley

FROM: R. J. Kedl

SUBJECT: Recommended Hydraulic Measurements in the HFIR Mockup

It is planned to build a full-scale mockup of the HFIR core for testing and evaluating the various design parameters involved. A brief analysis of the core hydrodynamics was undertaken in order to recommend which hydraulic measurements to make so as to demonstrate adequate cooling of all core components. In accordance with this analysis, the following recommendations are made:

1. The overall core flow rate and pressure drop should be measured. In addition, the pressure drop across the fuel assembly and both inlet screens should be measured.

2. The flow rate distribution among each of the following parallel flow regions should be measured.

   a. Island Region - If inlets are used at multiple elevations in the Target Array Support Tube, then the inlet flow rate at each elevation should be measured. Pending a final design of the target array and associated hexagonal holders, it may be necessary to measure the flow distribution between the target region and the surrounding water annulus.

   b. Fuel Assembly

   c. Control Plate Region - Measure the flow rate through this region with the controls in all positions.

   d. Replaceable Reflector

   e. Permanent Reflector - It should not be necessary to drill all 600 - 1/8 in. coolant holes, however, a few should be drilled in order to measure a partial flow rate. The additional flow through this region should be made up in some way, probably with a few much larger flow channels drilled through.

   f. Pedestal

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g. Beam Tubes - The flow rate through each beam tube coolant annulus should be measured. Pending final design of the tangential beam tube, it may be necessary to establish adequate cooling in the region opposite the fluid exit port where stagnation may occur. This could probably best be done in a separate experiment.

3. Because of the vessel inlet configuration, provisions should be made to see if any large scale swirl develops. This could easily be done as a first order check, with sight ports in the upper port of the vessel and flags hanging in the flowing stream. These sight ports would also be useful for other things such as watching remote replacement of target rods, etc.

4. In regions where it is not too difficult, e.g., permanent reflector and region between permanent and temporary reflector, the pressure gradient due to fluid friction in the flow channels should be measured. This information would be useful in sizing the flow control orifices.

5. Heat transfer coefficients should be measured at the pressure vessel wall, at the reactor midplane and particularly in the protected cavity formed by the hole. This region is somewhat critical and it is desirable to have a reasonable estimate of the wall temperature. In this protected cavity, the effect of thermal convection may be low, therefore, it is desirable to know the contribution to cooling caused by the inlet jets.

6. Fluid induced vibrations should be measured on various components as listed in a letter by I. Spiewak and D. T. Jones to R. A. Charpie and C. E. Winters, and dated November 1, 1960.

All of the above recommendations assume perfect alignment of the mating ports that make up the various flow channels. If, for reasons of construction tolerances, thermal expansion, radiation induced warpage, etc., it is suspected that certain of these channels may be significantly non-uniform, then the case of flow through non-uniform channels should be investigated, probably in a separate experiment. This is especially essential in the case of cylindrical annuli where there is a possibility that the walls can touch or come very close. Another conceivable malfunction is if a normally closed crack between two mating ports opens up for reasons similar to those above. This could allow fluid to pass through the crack, thus starving the normal coolant channels.

TO: D. T. Jones and W. H. Kelley 4 DATE: January 10, 1961

No special measurements are recommended for the fuel region other than flow rate and pressure drop. This region has been investigated by W. R. Gambill et al., concerning burnout heat flux, heat transfer coefficients and friction factors and by D. T. Jones concerning overall pressure drop and physical integrity.

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