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- # 1. AB Greninger
- # 2. WK Woods
- # 3. AA Johnson
- # 4. JT Lloyd
- # 5. DF Snoeberger - JB Lambert
- # 6. H Etherington, ANL
- # 7. G Anderson, ANL
- # 8. A Amarosi, ANL
- # 9. 700 File
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- # 12. Yellow Copy

December 27, 1949

TRIP REPORT

ARGONNE NATIONAL LAB., NAVAL REACTOR DIVISION

DECEMBER 12, 13, 1949

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Summary

This trip was spent in conferences with H. Etherington, A. Amarosi, Geo. Anderson, and L. W. Fromm; and in inspection of components now being built for the Navy Test Rig which is to be installed at H Pile.

Mr. Anderson believes that the entire assembly will arrive at Hanford between January 16 and 23, 1950. Much has yet to be designed and built, however. Also, certain incompatibilities with the H Pile were pointed out, and will be altered.

Discussion

The conferences were very valuable, and we are rapidly arriving at a design which will be suitable in all respects.

Design features will be considered in this report in the order in which they were presented in HW-15120 and GEH-15,732.

I. Heat Exchanger

The headers are schedule 160 pipe. A layer of ceramic insulator is between the primary and secondary fluids in the exchanger to reduce thermal shock.

II. System Pumps

The stator has both a high-point vent and a low-point drain. The drain can be drained into a pan when system is drained. The vent will be common with other vents and may go to the ventilation exhaust. One bearing failure took place in a similar pump at Oak Ridge after 3000 hours of operation.

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III. Surge Tank

A single surge tank with heaters surrounding the base is to be used. This is 6" schedule 80 pipe 5 ft. long. The bottom 20" is within the heater, and a sample line protrudes from the side 4" above the heater.

IV. Flow Meter

A strainer will be incorporated to catch particles of such size that they would foul the fuel plate assembly, which contains the smallest clearances in the system. Mr. Fromm said that the flow meter accuracy is claimed, by the manufacturers, to be $\pm 1\%$ at the ends of its range (10 gpm and 100 gpm).

V. Heater

Heaters will be turned off and pile scrambled when thermocouple immediately downstream of fuel element registers a temperature too near saturation. Mr. Anderson will suggest a method of establishing limits for all pressures.

VI. Valving System

The valving system will be essentially as suggested in HW-15120, except that arrangements will be made to flush the external system while the pressure tube is being cooled with process water. This changes the position of flush water entry. The feed-water pump is very small, and connects to the pure water supply, so process water will probably be used for flushing. The position of the pure-water supply tank was not discussed.

Rated flow in the system is 75 gpm, and Mr. Anderson suggests that this amount of process water be made available.

If the low point of the system cannot be conveniently connected to an atmospheric drain, helium pressure in the surge tank can be used to blow out the system.

The oil-type vacuum pump will evacuate to the hot vent, and will itself become partially contaminated. It will not have to be within a heavy shield, however.

VII. Fuel Channel Assembly

The sample line (part 22) is of questionable value, but will be retained because it is already welded into the pressure tube. The "pocket" at the end of the pressure tube is 6 5/8 inches long, giving it an L/d ratio of 2.4/1. It is believed that rapid sampling of this partially stagnant water will yield some useful data, although the dynamics of the water in this region are poorly known.

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Stock for the 3 1/2" O. D. aluminum thimble has not been found, so Hanford will determine whether any 3 1/2" I. D. stock is available.

Mr. Anderson is planning to install the pressure tube, thimble, and step plug all in the same operation. When we suggested that a plate would not be needed to protect the graphite, we were unaware of this. A plate is not feasible because it would tend to buckle during installation, and would have to be arranged so that the end could be grabbed at the time it is to be removed. Also installation and removal would require two extra operations in beams. We suggested that the thimble be installed first, and the pressure tube pushed into it. For all practical purposes, then, the thimble will serve the same function as the plate.

Small spacers are to be welded on the outside of the pressure tube to center it in the thimble. We suggested that they be deleted, because their purpose - to decrease heat loss to the pile - is of doubtful need. The central graphite will be at a temperature within 50°C of the pressure tube, and the shield, where the greatest temperature drop occurs, already contains a 1/8" gas gap. The projections will undoubtedly cause trouble during charge and discharge.

The end of the thimble and of the pressure tube will be rounded and polished to decrease the chances for galling.

VIII. Fuel Elements

Since Foote Metal has gone into mass production on Zr, the quality has dropped to the point where 75% is so impure that it corrodes rapidly and can not be used for this experiment.

The fuel element assembly is designed to be three feet long, and to have a clearance all around of .010" (.020" total). I objected to this as being too apt to bind during charge or discharge (it being stainless steel on stainless steel). Square welded sections are apt to twist considerably. The retrieving arrangement can exert only a few thousand pounds pull, and itself is designed so that such a pull might spring it out against the sides of the square channel. The water around the assembly will be slow-moving because of the small clearance. Therefore, any particles in the system would tend to collect in this space. It is our experience that these particles increase the chance of galling many fold. Particles of perhaps .005" will be removed by the filter, but smaller ones would deposit in stagnant water. The support mentioned in VIII-C was not discussed, (GEH-15,732).

IX. Shielding

To obtain close shielding around the pressure tube, the thimble will end at the inner end of the step plug. The step plug will then fit closely around the pressure tube. This will require that the thimble be gas-sealed to the step plug. If the thimble is fastened to the step-plug

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during insertion in the pile, the thimble is very apt to be damaged because of the cumbersomeness of operation.

J. West feels that graphite can replace Masonite in the step plug without a significant increase in fast neutrons outside the pile.

Mr. Anderson will install a thermocouple to determine the temperature of the hottest Masonite surrounding the step plug. I suggested that the shielding at the end of the pressure tube be such as to give a 5-minute tolerance in the event of loss of water from the system.

The sides of the pressure tube will be shielded with lead adequately to permit discharge of the irradiated fuel section. Nothing will project beyond the limits of this shield. The flange is so large that it will be shielded only for the water activity, with a removable shield to be put in place during discharge of fuel.

I stated that shield support brackets could be welded to the pile skin. Mr. Anderson will receive prints of H Pile and determine the proper location for the brackets. The 1" lead shield surrounding the plumbing will be replaced by an equivalent steel plate, which will weigh no more, be easier to install, and will serve to baffle high-pressure water leaks.

X. Charge and Discharge

The discharge cask will be on an adjustable stand. It will fasten to the end of the pressure tube so it can not move during the discharge operation.

Discharge of the pressure tube will be facilitated if it can be pulled directly from the pile and out the window. Mr. Anderson will make calculations to determine the expected radiation during such a process.

A cutter has been devised, for the pressure tube, operating on a principle similar to a pipe threader. The methods of disposing of the square channel, the two downstream thermocouples and the sample line were not discussed.

If the thimble were discharged at the same time as the pressure tube, the cutter cask would have to be arranged to somehow clamp the pressure tube after the thimble is cut through. Mock-ups of this operation will be performed at Hanford.

XI. Position

"A" hole has been made available for this experiment for six months. This is to include removal of special installations and restoration of the hole to normal.

A stainless steel pan will lay under the entire assembly where drips might occur, including the steel shield.

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XII. Operation

System temperature may be controlled from a downstream thermocouple. One downstream thermocouple will be used to scram the pile in the event of excess temperature. Mr. Anderson will suggest a system for determining automatically the safe temperature for all pressures. It was agreed that 15°C would be established as the nearest that downstream temperature could approach saturation without scrambling the pile. The pumps cause cavitation when the pressure is within 100 psi of saturation pressure. Mr. Anderson suggested that the differential temperature between the surge tank and the downstream thermocouple may be used to establish the scram point. He will provide normally-open contacts which will be wired to the lock-out and scram circuits. The potentiometer or other circuit which analyses the information which may be used to scram the pile will be locked by the Instrument man.

XIII. Activity

The activity of the fuel elements at the time of discharge will be calculated by Argonne. Mr. Anderson will supply us with an estimate of the volume of water in the system.

XIV. Electric Supply

Hanford will order transformers immediately. Although the heaters are a number of calrod units connected in series-parallel, Mr. Anderson states that it would be very difficult to change the circuit for 440.

XV. Schedules

Argonne is paying premium wages in order to rush construction of this experimental equipment. The rig will be shipped as a few large assemblies for connection to our services upon arrival. All equipment will arrive at Hanford in one shipment between January 16 and 23. Mr. Anderson felt there was no advantage in sending the step-plug and thimble before hand.

Mr. Lloyd agreed to furnish an immediate estimate of whether or not it was advisable for Argonne to continue construction at premium rates.

It is obvious, however, that several things are designed and built without due consideration for the problems they will encounter at the Hanford Pile. It seems to the writer advisable to make changes and alterations at Argonne before the equipment is shipped, since General Electric has not agreed to make any shop time available except that required to connect the rig. Some Hanford shop time will also be required to handle work not now foreseen, but all construction and assembly at present contemplated must be done at Argonne before the rig is shipped.

J. B. Lambert
Pile Technology Division

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