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Subject: CF 57-5-96 (Unclassified)
CF 57-6-25 (Unclassified)

Enclosed are seven copies each of the subject documents which we feel are of interest to the Westinghouse Pennsylvania Advanced Reactor Project. We will appreciate your making them available to them. These documents may also be used for the Civilian Application Program if considered applicable.

Very truly yours,

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N. T. Bray, Supervisor
Laboratory Records Department
Technical Information Division

/jr

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DATE: May 29, 1957

SUBJECT: FINAL PROCESS DESIGN FOR LEAK DETECTOR SYSTEM FOR SPECIAL FLANGES

TO: Distribution

FROM: E. A. Mason

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FINAL PROCESS DESIGN FOR LEAK DETECTOR SYSTEM FOR SPECIAL FLANGES

The attached figure is a schematic diagram of the leak detector system proposed for six special flanges in the high-pressure system of the HRT. The flanges are the dome and bottom flanges on the reactor vessel, the main flanges on the two heat exchangers, and the flanges on the two circulating pumps. The design incorporates the decisions made at the meeting held on April 25, and is a modification of System 3 proposed in CF 57-4-38.

The system consists of: (1) one gas pressurized reservoir containing heavy water; (2) a tubing manifold connecting the pressurizer to six separate lines each connected to one of the flanges; (3) tubing lines leading from the second hole on each of three flange pairs (dome and heat exchanger flanges) back into the instrument room, plus (4) required valves and fittings.

A mixture of hydrogen and helium (about 50 parts by volume of hydrogen to 2200 parts of helium) is to be used to maintain the total pressure in the system above reactor pressure. In the event a hole does develop from the flange ring area into the reactor fuel system, leakage will thus be from the leak detector system into the fuel solution. Hydrogen is used to suppress the presence of oxygen caused by the radiolytic decomposition of the heavy water. Use of deuterium is recommended when the isotopic exchange of heavy water into light water during the decomposition and recombination reactions is considered undesirable. A hydrogen pressure of about 50 psia is sufficient to maintain at least 10 ppm of hydrogen in all parts of the leak detector system; since a net consumption of hydrogen is considered unlikely, the oxygen content at the flanges under these conditions is therefore expected to be less than 0.1 ppm. The pressurizing gas is bubbled up through the liquid during charging to promote saturation of the liquid by the gas before the liquid enters the tubing lines.

Detection and measurement of leakage into the reactor system will be indicated by a sight glass on the reservoir, a capillary flowmeter (Ref. Dwg. D-27915) between the reservoir and the tubing header, and by a pressure gage and alarm on the header.

The return lines to the control room are equipped with valves to permit purging or sampling of the dome and heat exchanger flanges if desired when the reactor is shut down. During operation of the reactor the ends of these

sampling lines will be connected through autoclave connections to dead-ended tubes to prevent spillage of water into the control room if the valves should leak. Should a need for fluid circulation develop in the future, the return lines can be connected to the supply lines through small pumps. No provision for sampling or purging of the bottom flange or of the circulating pump flanges is to be provided.

A venting valve is provided on the reservoir for use when filling the reservoir with water (the filling will be done when the reservoir is at atmospheric pressure). A rupture disc and relief valve are also provided on the reservoir. A valve is provided between the pressure alarm and the reservoir so that the reservoir may be refilled without requiring relief of the pressure on the flanges. A pressure gage on the reservoir is provided so that the pressure in the reservoir may be followed during the filling and pressurizing operations.

For safety, it is recommended that the pressurizing gases be admitted from tanks containing the proper mixture of hydrogen and helium. To minimize the explosion hazard near the reactor the mixture should be prepared in an area away from the reactor.

The heavy water used in filling the system should have a very low electrolyte content to insure against introduction of chlorides with the water, and the heavy water should also be deoxygenated before charged to the pressurizer. Deoxygenation of the heavy water to be charged can be accomplished by boiling in a pyrex flask equipped with a water-cooled reflux condenser. To avoid contamination of the heavy water with light water from the air, the outlet of the condenser should be connected to a tube packed with a desiccant such as Drierite. To assist in the removal of oxygen and to prevent sucking oxygen back in from the atmosphere during cooling of the deaerated heavy water, it is recommended that hydrogen (or deuterium when it is used in the leak detector system) be bubbled through the boiling water at a slow rate for a few minutes at the end of boiling and during the cooling period. The flask used for boiling should therefore be equipped with a ground glass joint through which a tube can be inserted for introducing the hydrogen under the surface of the heavy water. Care should be exercised at all times in handling the heavy water to avoid any prolonged contact with the atmosphere.

The leak detector tubing used in these systems will be of the same type as used in the regular leak detector system connected to the other flanges in the reactor system. The pressurizer design will be similar to those in the regular leak detector system (Ref. Dwg. D-24268 and D-27855). Assuming that the leak detector system will be initially at a pressure 500 psi greater than

the pressure in the reactor system, leakage of 120 ml in the case of a reactor pressure of 2000 psia, and 140 ml in the case of a reactor pressure of 1700 psia, must be lost from the leak detector system before the pressures in the two systems are equalized.

All equipment external to the reactor cell is to be installed in the control room area.

Detailed design is underway (Ref. Dwg. D-27917).

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