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SUBJECT: HRT Cooling Water System Evaluation
Results of HRT Engineering Tests VI A-2,3,4,5;
B-1 a,b and B-3

TO: R. Van Winkle

FROM: R. E. Brooksbank

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HRT COOLING WATER SYSTEM EVALUATION
Results of HRT Engineering Tests VI A-2,3,4,5;
B-1 a,b and B-3

Summary

The cooling water system has been tested and found to perform satisfactorily isothermally with the following important exceptions:

1. The maximum observed flow to the fuel sample cooler was 3.8 gpm. The flowsheet specifies a maximum flow of 8 gpm.
2. The maximum observed flow to the blanket sample cooler was 5.4 gpm. The required flow is 8 gpm.

Larger inlet and exit lines to these coolers would permit more flow. It is recommended that these line sizes be increased from 1/2-in. to 1-in.

Of less importance is that the maximum flows to the fuel and blanket dump coolers were 4.1 and 21 gpm, respectively, compared to 10 and 30 gpm specified by the flowsheet.

Procedure and Results

Initially, the cooling water circuit was flushed with water to remove foreign material that had accumulated during construction. Water was pumped from the cooling tower basin through lines 394, 389, 397, 497 and 498. Lines 497 and 498 were equipped with fire hose through which contaminated water was discharged to waste. Upon completion of the flush, 2,000 gallons of 1% TSP solution was re-circulated through the system followed by two 5,000 gallon water rinses.

Rotameters with a capacity less than 7 gpm were calibrated by measuring the buildup of liquid per unit time in a 4-liter graduate. The space cooler and recombiner condenser rotameters, with maximum flows of 61 and 85 gpm, respectively, were calibrated by weighing the solution discharged to a 55-gal drum. Calibration curves have been prepared for the Reactor Calibration Manual.

Maximum cooling water rates through all equipment and associated lines were checked by inserting a calibrated flow meter in the lines leaving the cooling water manifolds (497 and 498). The test was conducted with maximum flows going to all units. A total flow of 706 gpm was being pumped from the cooling tower basin, with 185 gpm of the total being discharged to the charcoal pit. Make-up water, normally provided by the space coolers, was provided through line 398.

Each cooling water line equipped with a "bull's eye" indicator was checked for maximum flow and an approximate flow value was established for several valve settings. Some reactor heat balance calculations will require

information of this type. Maximum flows through all reactor cooling jackets and associated lines are presented in Table 1, Appendix.

Reactor thermal shield cooling flows were established and adjusted to 40 gpm¹ in the following manner:

a) Process water was pumped into the cooling water manifold (497) and maintained at 60 psi.

b) Valve 489A was opened and water was allowed to discharge to the reactor cell through line 401 once it had passed through the thermal shield.

c) Each of the four manual valves within the cell on line 489 were adjusted to give the following flows to the various sections of the thermal shield:

Top section (east)	- 4 gpm
Top section (west)	- 2 gpm
Side Section	- 30 gpm
Bottom section	- 4 gpm

d) All flows were measured by weighing the solution discharged to a 55-gal drum during a time period.

e) After the valve settings had been established and the total flow was checked, the valve packing nuts were tightened and the valve handles removed. Center-punch marks were placed on the nuts and valve stems.

The cooling water block valves (FCV-932, 928, 934) were allowed to slam shut by releasing the supply air to the valve operators simultaneously during the period when the total cooling water system was operating. A pressure gauge mounted in line 508, normally operating with a pressure of 15 psi, increased to 58 psi three seconds after the valves had closed. Relief valve 402A was removed from the system, mounted on a test stand, and a relief pressure of 45 psi was observed. The rupture discs in lines 404 and 402 were removed during the test.

Valve TV-665, the automatic steam supply valve to the fuel sample cooler, was adjusted by removing the temperature bulb from line 663, placing it in a beaker of water at 160°F, and adjusting the valve tension nut to give half stroke. Small quantities of hot and cold water were poured into the beaker and the action of the valve with respect to the water temperature was noted.

1. C. L. Segaser, "HRT Thermal Shield Systems," ORNL CF 55-11-166, Nov. 9, 1955.

TABLE I
MAXIMUM COOLING WATER FLOW RATES

Test Conditions

Pump Pressure - 50 psi
Manifold Pressure - 60 psi
Steam Pit Discharge Lines - 15

Item	Line No.	Maximum(a) Flowsheet (GPM)	Maximum(a) Observed Flow (GPM)
Fuel Sample Cooler	419	8	3.8
Fuel Gas Cooler	425	Blanked	---
Entrainment Separator	453	5	2.8
Circulating Pump	421	5	6.9
Fuel Dump Cooler	427	10	4.1
Reflux Condenser	413	20	22.5
Thermal Shield	489	40	40.0
Fuel Feed Cooler	417	5	6.6
Fuel Purge Pump Cooler	457	1	1.3
Let-down Heat Exchanger	423	5-10, 2.5	7.3 ^(b)
Recombiner Condenser	408	80 (on dump)	32.5 ^(c)
Recombiner Condenser	432	150 (on dump)	---
Let-down Heat Exchanger	447	5-10, 2.5	6.8 ^(b)
Purge Pump Cooler	406	1	1.4
Blanket Feed Cooler	441	5	6.6
Reactor Vessel	499	20	66.0
Blanket Reflux Cond.	437	20	23.0
Blanket Dump Cooler	451	30	21.0
Circ. Pump	445	5	4.8
Entrainment Separator	455	2	3.0
Gas Cooler	449	Blanked	---
Sample Cooler	443	8	5.4
Turbine Condenser	389	318	350 ^(d)
Turbine Oil Cooler	384	---	~20
Vent Condenser	396	28	+35.0
Refrigeration System	491	5	+ 5
Total (Actual)	705.8		
Pump Curve	750.0		

- (a) Cooling water system flowsheet, Dwg. 18240, Rev. c.
 (b) By-passed flow switch; only 4.8 gpm could be obtained through switch.
 (c) Normal flow with by-pass and valve FCV-929 closed.
 (d) Flow limited by instrumentation (0-100-in. D/P cell).

Cooling tower performance tests and convection cooling tests will be conducted when a heat load can be obtained during the summer months.

R. E. Brooksbank

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