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HRT Engineering Test Procedures VI A-2, 3, 4, 5;
B-1, a, b; B-2 and B-3
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HRT COOLING-WATER SYSTEM
HRT Engineering Test Procedures VI A-2, 3, 4, 5;
B-1, a, b; B-2 and B-3

1.0 Introduction

The purpose of this memo is to present experimental procedures for testing the HRT cooling-water system and its components. The cooling-water system is a closed system consisting of three parallel circuits fed by a single circulating pump fed from a forced draft cooling tower and supply reservoir. In the event of radioactive contamination of the cooling-water system the tower supply lines are equipped with block valves that confine the solutions to the reactor cell, and after shutdown, heat may be removed by discharging contaminated cooling water to the cell. Failure of the circulating pump will actuate a valve that will permit convection cooling to take place within a closed circuit.

2.0 Cooling Tower Performance Test (A-2)

Cooling tower acceptance or performance tests are based on designed conditions. The HRT cooling tower is a counterflow-type unit designed for an 800 gpm flow with a 45°F cooling range and a 10°F approach to a wet bulb temperature of 80°F . The unit should be checked during a period when weather conditions are favorable and the proper cooling-water heat load is obtainable.

2.1 Design Conditions

Designed conditions and the test conditions required for a satisfactory industrial cooling tower test are presented in Table 2.1-1.

2.2 Test Procedure

Because of the heat load required for the cooling tower (approximately 1.8×10^7 Btu/hr) at design conditions, all reactor component heat loads will have to be functioning during the test period. When all of the above conditions mentioned in Section 2.1 are within allowable ranges the tower tests can be accomplished in approximately one hour. The procedure is as follows:

a) Check the inlet and outlet temperatures of the tower by using thermometers in direct contact with the liquid. The tower inlet temperature shall be taken by inserting the thermometer in a 1/4-in. pipe tap installed in the horizontal section of line 393 after it has penetrated the tower. The pump discharge temperature shall be measured by installing a long nipple and valve in the pump discharge gauge opening and allowing liquid to trickle over the thermometer.

b) Flow rates into the tower will then be measured by timing the buildup of liquid into a calibrated pail as it is discharged from the tower nozzles. Several or all nozzles can be checked in this manner and

Table 2.1-1

HRT Cooling Water Tower Test Conditions

<u>Design</u>	<u>Test Can be Made When:</u>
Flow - 800 gpm	$\pm 10\%$ and constant within $\pm 5\%$
Inlet Temperature - 135°F	Heat load within $\pm 20\%$
Outlet Temperature - 90°F	
Wet Bulb Temperature - 80°F	$< 3^{\circ}$ above, $< 7^{\circ}$ below
Range - 45°F	$\pm 20\%$
Approach - 10°F	---
Drift - 0.2%	Not obtainable
Air Flow - $350 \text{ ft}^3/\text{min}$	---
Wind Velocity	$< 10 \text{ miles/hr}$

a flow comparison made with the circulating pump characteristic curves. Drift will be negligible under the test conditions.

c) Air flow can then be measured by traversing the tower fan throat with a standard air velocity meter mounted on a large stick.

d) Wet bulb temperatures will be obtained by a sling psychrometer.

e) Valve 398A should be closed during the test period; no additional make-up water should be going to the cooling tower reservoir.

2.3 Calculations

Tower performance may be calculated as follows¹:

Design Performance = Design gpm x Tower Test Factor x Wet Bulb Factor

Therefore,

For HRT Cooling Tower, DP = 800 x 1.0 x 1.0 = 800

Test Performance = Actual gpm x Tower Test Factor x Wet Bulb Factor

Performance ratio = $\frac{\text{Test Performance}}{\text{Design Performance}}$

If this ratio is more than one, the tower exceeds design performance; if the ratio is less, the tower may be adjudged deficient.

3.0 Valve Tests

All valves that are to be used to confine contaminated cooling water to the cell should be checked on a test stand or by breaking the discharge flange to assure complete shut-off under pressure.

3.1 Valves 402A, FCV-932

One function of these valves is to permit cooling water to be discharged into the reactor cell in the event of a radioactive leak into the cooling water circuit. Two rupture discs set for 50 psi and mounted in parallel will allow flow to the cell should the valves fail.

Valve 402A is a standard 1-in. relief valve that should be removed from the system, installed on a test stand, and set for 35 psi.

Valve FCV-932 along with valve FCV-933 should be checked by de-energizing the control circuit and visually observing the action of both valves.

¹Cooling Tower Institute Test Procedure Form No. TSC-101.

Valve FCV-931 through which the convection cooling water circuit is established, may be checked by shutting down the cooling tower circulating pump.

4.0 Cooling Water Pre-Heater for Fuel Sample Cooler

Valve TV-665, the automatic steam supply to the fuel sample cooler, can be adjusted by placing the temperature bulb in a beaker of water maintained at 160°F and adjusting the tension spring screw to open valve 1/2 way. By pouring in small quantities of hot and cold water the action of the valve can be observed as well as the temperature of the heated water. Preheater capacity measurements will be made by actual flow measurements through the sample unit by measuring the quantity of liquid discharged per unit time. Flow measurements of this stream should be made on the discharge of the sampler unit (line 428 or 400) because of the high head loss expected through the sampler unit and associated lines (approximately 40 ft at 0.55 gpm).

5.0 Reactor Thermal Shield Cooling

Cooling water at 90°F is supplied to four sections of the reactor thermal shield through a 1-1/2 line (489) from the main water supply (line 497). The flow is controlled through valve 489A. A total flow of 40 gpm is proportioned to the various shield sections through four manually-operated valves as follows:

Top Section (East)	- 4 gpm
Top Section (West)	- 2 gpm
Side Section	- 30 gpm
Bottom	- 4 gpm

5.1 Test Procedure

(a) Close block valve FCV-934, this may be done by removing air supply to valve diaphragm.

(b) Open process water jumper line (line 475) when cooling water system is shut down. Check all valves on main cooling water supply header (498); all valves should be closed.

(c) Remove 1-in. pipe cap on bottom of cooling water discharge manifold (line 401). Install a temporary gate valve.

(d) Close valves 489 (1), (2), (3), and (4).

(e) Open valve 489A wide open.

(f) Open valve 489 (1) to east side of top thermal shield slightly. By timing the volume of water accumulated in a 4 liter graduate the flow can be adjusted to 4 gpm. Record valve setting (number of turns open).

(g) Close valve 489 (1).

(h) Repeat Step (f) for valve 489 (2) delivering water to west side of top thermal shield and set for 2 gpm.

(i) Repeat Step (f) for valve 489 (4) and adjust flow to 4 gpm.

(j) The setting of valve 489 (3) to yield a flow rate of 30 gpm will be accomplished by weighing the volume of liquid accumulated during a given period.

(k) The above procedure should be repeated and a check made of the total flow with all valves at the proper settings.

An attempt should be made to maintain the same pressure on the cooling-water header (498) as noticed during cooling-water system shakedown tests.

6.0 Convection Cooling

Convection flow through the cooling-water system can be checked by installing two conductivity cells in the circulating pump discharge line (394). Tri-sodium phosphate will be used as the electrolyte and will be added via a pressure pot mounted in the circulating pump discharge. The conductivity cells will receive a signal set up by the slug of solution passing the probes and record the signal on a 2-pen Brush Recorder. A schematic drawing of the equipment required for this test is presented in Fig. 6.0-1.

R. E. Brooksbank

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FIG. 6.0-1
CONVECTION FLOW MEASUREMENT

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8.

Time Test Started _____, Time Test Completed _____

[illegible]

- 1 Every 10 minutes, wet bulb taken away from direct influence of the sun and tower.
- 2 Every 10 minutes
- 3 Every 20 minutes

537 008