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CONTROL SYSTEM FOR HRT COOLING WATERI. SUMMARY

The circuits described herein and shown functionally in Fig. 1 are to be added to the HRT control circuit to provide control and protection for the revised HRT cooling water system.

The circuitry will provide protection against excess pressure in the demineralized cooling water loop and cooling water activity, will initiate action to insure containment of activity in event of an explosion and will provide emergency cooling water from the tower basin when required.

II. CONTROL ACTION (General)

- (1) High pressure in demineralized cooling water loop will open drain valves and relieve pressure. Drain valves will reclose automatically after pressure is relieved.
- (2) Low level in the demineralized water surge tank will open the fill valve and fill system from the storage tank provided gravity head exceeds cooling water system pressure.
- (3) Recombiner-condenser cooling water activity will block return line from the recombiners, open the associated drain valve and open the fill valve. Demineralized water will flow from the storage tanks, through the recombiner coolers, to the cell. When supply of demineralized water is exhausted, the valve connecting the demineralized water system to the cooling tower will open and water will flow from the cooling tower, through the cooler, to the cell. Normal cooling water flow (through the pump) will continue in the high pressure system cooling water loop.
- (4) General steam pit activity (steam and cooling water) will initiate the same action as the recombiner-condenser cooling water activity except that the high pressure system cooling water block and drain valve will be operated instead of the recombiner-condenser cooling water block and drain valves. Dependent on the activity level and the relative settings of the monitors, the recombiner-condenser block and drain valves may also operate on high steam pit activity; however, this action does not appear to be objectionable.
- (5) High shield pressure will close (or block closed) the demineralized water fill valve and the valve connecting the cooling tower to the demineralized water system.

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3

- (6) Loss of cooling water flow in either the tower or demineralized cooling water loops for any reason other than manual (intentional) shut-off of the pumps will open the demineralized water drain and fill valves and close the block valves. Demineralized water will flow from the storage tanks through the coolers to the cell. When the supply of demineralized water is exhausted, the valve connecting the demineralized water loop to the cooling tower will open and water will flow from the tower through the coolers to the cell.

Valve and solenoid actions have been selected to give "fail safe" action with reactivity containment considerations given precedence over system operation and equipment protection. This necessitates the use of an air-to-open (fail close) valve for the block valve in the connecting line between the tower and the demineralized water loop. Under conditions of complete failure of the pneumatic system (including the nitrogen standby system), this valve would be closed, and since it is conceivable that it might be desirable to open the valve at this time, this valve will be equipped with a handwheel for manual operation.

The circuitry shown has been arranged to minimize the possibility of false operation of the valve connecting the demineralized water loop to the tower basin.

The following conditions will not open the cooling tower valve:

- (a) Loss of cooling water flow in either loop, for any reason, when the pumps are intentionally shut off by means of the manual stop button.
- (b) Loss of D.C. Power
- (c) Momentary loss of cooling water flow.

III. CIRCUIT OPERATION

1. Steam and Cooling Water Activity (RE-560A, RE-560B)

Opens contacts (ckt 7B), de-energizing LCW relay. Contact LCW-1 (ckt 7C) closes high pressure cooling water block valve (FCV-934) and opens high pressure cooling water drain valve (FCV-927). Contact LCW-3 (ckt 7E) opens fill valve (FCV-649). Water drains from storage tank through high pressure coolers and drain valve to cell. Circulating pump continues circulation through recombiner-condenser unless recombiner-condenser cooling water monitors (RE-860 A&B) trips, in which case the recombiner-condenser cooling water block valve (FCV-933) will close and the drain valve (FCV-932) will open. Dependent on relative settings and the activity level, the recombiner-condenser cooler water monitor (RE-860) will probably trip at or below the general activity level which trips the steam and cooling water monitors (RE-560). After demineralized water supply is exhausted, the demineralized storage level interlock will open the cooling tower valve (FCV-635) and admit cooling tower water to the demineralized system.

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4

2. Recombiner-Condenser Cooling Water Activity (RE-860A & RE-860B)

Opens contacts (ckt 7B), de-energizing the 2CW relay. Contact 2CW-1 (ckt 7D) closes recombiter-condenser block valve (FCV-933) and opens drain valve (FCV-932). Demineralized water drains from storage tank through coolers and drain valve to cell. Circulating pump continues circulating through high pressure coolers. When demineralized water supply is exhausted, low level contact on storage tank opens cooling tower valve (FCV-635) and admits cooling tower water to the demineralized system.

3. High Cooling Water Pressure

Pressure switch (PX-639) opens contacts in circuits 7C and 7D. Both cooling water drain valves open. Pressure switch to have differential. Open at 75 psig. Close at 10 psig.

4. High Shield Pressure (explosion)

Shield pressure switches (PX-5010 D&E) open contacts in circuit 7E. Cooling tower and fill valves close or are blocked closed.

5. Pump Stoppage (other than manual)

Flow contact (PX-555 or P_aX-640) opens de-energizing CWT timer (ckt 7A). Annunciator alarms immediately. CWT contact (ckt 7B) opens after time delay, de-energizing 1CW and 2CW relays. Contacts on relays 1CW and 2CW open in circuits 7C and 7E and close in circuit 7E with the result that:

- a. high pressure C. W. drain valve, recombiter-condenser C.W. drain valve and demineralized water fill valve open.
- b. high pressure cooling water block valve and recombiter-condenser block valve close. Demineralized water flows through system until low level interlock on demineralized water storage tank (ckt 7E) opens cooling tower valve, admitting cooling tower water to the demineralized system.

6. A.C. Power Failure

Same as (5) above unless pumps are cut off by manual "start-stop" buttons. During shutdown, when pumps are off, A.C. power failure will not initiate valve operation as flow switches are bypassed by stop button contacts.

7. Manual Pump Stoppage

Does not produce any action as stop button contacts close around flow contacts (ckt 7A).

8. D.C. Bus Failure

Both cooling water block valves close. Drain valves open. Cooling tower and fill valve close or remain closed.

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5

9. Momentary A.C. Power Interruption

The delay period of the cooling water timer (ckt 7A) will prevent momentary power interruptions and loss of cooling water flow from causing operation of valves. This delay period is also necessary to prevent operation of the valves during pump startup, i.e., during the period between operation of the start button and closing of the flow switch.

10. Low Level Demineralized Water Storage Tank (LX-648A)

Opens cooling tower valve provided high shield pressure contact and either 1CW-2 or 2CW-2 contacts are closed. During normal operations of the system the 1CW-2 and 2CW-2 contacts will be open and low storage tank level will not open the cooling tower valve. Low storage tank level will be annunciated.

11. Low Level in Surge Tank (LX-649A)

Low level interlock (ckt 7E) opens fill valve on low surge tank level and raises level. High shield pressure will override the interlock and close valve.

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NOTES:

1. Contacts shown in OPERATING POSITION not necessarily de-energized or "On-Shift" position.
2. LEGEND:
J indicates Bypass Jumper Around Contact.
XB indicates Series Block.
H.P.C.W. - High Pressure Cooling Water
D.C.W. - Demineralized Cooling Water
T.C.W. - Cooling Water (Tower Loop)
Ry - Relay

Figure 1

D-6

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March 14, 1957

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