FINAL

SYSTEM DESCRIPTION
(Index No. 20)

DECAY HEAT REMOVAL SYSTEM
(B&R Dwg. No.2026, Rev.18)

JERSEY CENTRAL POWER & LIGHT COMPANY

THREE MILE ISLAND NUCLEAR STATION

UNIT NO. 2

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DECAY HEAT REMOVAL SYSTEM

1.0 INTRODUCTION

1.1 System Functions

The functions of the Decay Heat Removal System (DHRS) are as follows:

(1) Remove core decay heat after reactor coolant has reached the minimum temperature possible with condensate/feedwater cooling (250°F). Heat is removed from both the core and pressurizer.

(2) Fill, recirculate, purify (via the Spent Fuel System), and drain the fuel transfer canal for refueling.

(3) Minimize the consequences of a loss of Coolant Accident (LOCA) in the following manner:

(a) Inject borated water and sodium hydroxide solutions into the core at a low reactor pressure.

(b) Provide long term cooling after a LOCA by recirculating water from the Reactor Building Sump to the core.

(c) Supply the suction of the high pressure injection Makeup Pumps for long term cooling after a LOCA.

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(d) Supply the Building Spray Pumps with water from either the BWST/Sodium Hydroxide Tanks, or from the Reactor Building Sump.

(4) Circulate the contents of the Borated Water Storage Tank for mixing and sampling.

The DHRS has an interface with the following systems and in conjunction with these systems performs its primary and secondary functions: (Numbers refer to Burns and Roe flow diagrams.)

1. Condensate Polishing (Dwg. 2006)
2. Demineralized Service Water (Dwg. 2007)
3. Reactor Coolant Make-up Purification (Dwg. 2024)
4. Chemical Addition (Dwg. 2025)
5. Spent Fuel Cooling (Dwg. 2026)
6. Radwaste Disposal Liquid (Dwg. 2027)
7. Nuclear Sampling (Dwg. 2031)
8. Reactor Building Spray (Dwg. 2034)
9. Core Feeding (Dwg. 2034)
10. Decay Heat Closed Cooling Water (Dwg. 2035)
11. Nitrogen for Nuclear and Radwaste (Dwg. 2036)
12. Radwaste Miscellaneous Liquid (Dwg. 2045)
13. Radwaste Disposal Reactor Coolant Leakage Recovery (Dwg. 2632)

1.2 Summary Description of System (Refer to B&R Dwg. No. 2026, Rev. 18)

During reactor cooldown, the steam generators are utilized as heat sinks to reduce the reactor coolant from its normal operating temperature of 582 F to approximately 250 F. The Decay Heat Removal System then further reduces the coolant temperature and maintains the coolant at a temperature suitable for cold shutdown conditions. The system may be placed in operation at 320 psig and 250 F.

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The DHRS takes suction from the "B" loop reactor outlet (hotleg) and returns the coolant back to the reactor through the core flooding injection nozzles after it passes through the Decay Heat Removal pumps and coolers. The system is comprised of two parallel circuits from the point where the reactor outlet supply line connects to the DHRS at the pump suction supply headers within the Auxiliary Building. Both circuits share a common suction from the reactor. Each of the two DHRS pumps discharge the coolant into the tube side of its associated cooler. The reactor coolant, after passing through the coolers returns to the reactor vessel through two separate core flooding nozzles. By circulating the reactor coolant in this manner, the coolant temperature is reduced and the decay heat of the reactor core is transferred to the Decay Heat Closed Cooling Water System (DHCCWS).

Provision is made to utilize the DHRS to collapse the pressurizer bubble concurrently with core cooldown by lining up the DHRS cooler outlet line to the pressurizer spray line. This permits cooled water to be injected into the pressurizer, cooling it and reducing reactor plant pressure.

The DHRS may also be utilized to fill, recirculate, purify, and drain the coolant in the fuel transfer canal during refueling operations after the reactor head has been removed. Normally, the Spent Fuel Cooling System is utilized to fill the fuel transfer canal, however, filling can also be accomplished using the DHRS by taking suction from the borated water storage tank (BWST) with the DHRS pumps. The pumps discharge the borated water through the system piping into the reactor vessel. With the reactor head removed, the borated water over flows into the fuel transfer canal. Direct discharge into the fuel transfer canal via the Spent Fuel Cooling System is also possible. Recirculation of the water in the

fuel transfer canal is accomplished by mixing of the coolant in the reactor vessel and the fuel transfer canal during normal refueling operations. Purification is accomplished by passing a side stream of the coolant from downstream of the DHR coolers through the purification loop in the Spent Fuel Cooling System and returning the purified coolant into the DHR pump suction supply headers to be returned to the reactor vessel with the recirculating coolant. Purification and cooling are normally accomplished by the Spent Fuel Cooling System. The DHRS also affords a means for draining the fuel transfer canal to approximately the level of the reactor head flange, and returning the water to the BWST. A line at the outlet of each cooler connects to the BWST via a common header for this purpose. This same line may be used as a recirculation line for testing the operation of DHRS components. Further draining of the fuel transfer canal is performed using the Spent Fuel Cooling System.

Sodium hydroxide is injected into the reactor (and the Building Spray Pump Suction) to change the coolant pH, thus making the conditions more favorable for iodine removal.

When the DHRS is operating in the Engineered Safety Features mode, water from the BWST and Sodium Hydroxide Storage Tank is injected by the pumps into the reactor vessel after the reactor pressure has fallen below the maximum discharge pressure of the pumps. When the BWST water level has been reduced to 6 ft., the operator in the Control Room manually shifts the DH Pump Suction from the BWST to the Reactor Building Sump which has been filled by leakage from the pipe rupture.

The outlet of the two coolers may be cross connected by opening two cross tie valves. Both pump/coolers may flow into one nozzel inlet if the pipe break is near the other core inlet.

One of two recirculation pumps continuously circulate the content of the Borated Water Storage Tank to ensure a representative sample.

1.3 System Design Requirements

The DHRS is designed to reduce the reactor temperature to 140°F within 20 hours after shutdown. The major contribution to heat generation is the decay of fission products. Core decay heat generation dependent on the time after shutdown, the power level of the reactor before shutdown, and the length of time that the reactor has been operating at power. The requirement to be able to shutdown to 140°F within 20 hours is based on the following assumption:

1. 800 days of 100% power operation before shutdown.
2. Cooldown from normal operating temperature to 250°F in 6 hours by steaming.
3. 3000 gpm flow through both DHR Coolers (Shell and tube side).
4. The Decay Heat Closed Water Cooling System temperature of 95°F and a Nuclear Service River Water temperature of 85°F.

Each loop of the DHRS is capable of removing the system design heat load and supplying borated water to the core and associated safety systems during a design basis LOCA.

The BWST may be sampled at any time. Because one of the two BWST Recirculation Pumps is in operation at all times, the sample is considered representative.

The portion of the system not subject to normal reactor operating pressure is designed to operate at a temperature of 280 F and a pressure of 370 psig. All system piping is of stainless steel and is classified as Nuclear Piping (Symbol N), designed, fabricated, inspected and erected in accordance with ANSI B31.7, Nuclear Power Piping. The seismic requirements of Class I apply to the entire system including all components.

2.0 DETAILED DESCRIPTION OF SYSTEM

2.1 Components

2.1.1 Decay Heat Removal Pumps, DH-P-1A and DH-P-1B

The Decay Heat Removal pumps (see Table 1) are single-stage, centrifugal pumps rated at 3000 gpm each with a total discharge head of 350 ft. They are located on the 280'level of Auxiliary/Fuel Handling Building, and are designed in accordance with the Nuclear Pump and Valve Code Section C. A pipe and associated flow orfice to the pump suction are in the pump discharge to provide minimum flow when a discharge valve is closed. For non ES actuated, non-emergency, operation, an interlock prevents the motor running without Decay Heat Closed Cooling Water flow through the motor and pump coolers.

Control and indication are available locally. Panel No. 3 has a control switch, ammeter and run, stop, and power available lights. DH-P-1A and DH-P-1B are powered from 2-1E and 2-2E respectively.

2.1.2 Borated Water Storage Tank Recirculation Pumps DH-P-2A and DH-P-2B

The Borated Water Storage Tank Recirculation Pumps (see Table 5) ensure that the BWST contents are mixed and that a sample is considered representative of the entire tank. Both pumps are located outside, adjacent to the BWST. The single stage centrifugal pumps are rated at 100 gallons per minute with a discharge head of 100 feet. One pump is normally running and the other in idle stand by, ready to start if the running pump trips. The pumps are controlled locally from Panel No. 8 by a MAN-STOP-AUTO switch. DH-P-2A and DH-P-2B are powered from 2-32A and 2-42A respectively.

2.1.3 Decay Heat Removal Coolers, DH-C-1A and DH-C-1B

The Decay Heat Removal Coolers (Table 2) transfers heat from the DHS to the Decay Heat Closed Cooling Water System. coolers are two pass shell and tube type with the Decay Heat Closed Cooling water on the shell side and the reactor coolant on the tube side. The shell is designed in accordance with the ASME Code, Section VIII, and the tubes in accordance with Section III-C lethal, due to the nature of the fluid being carried. Tubes are seal welded into the tube sheet. The coolers are located in the Auxiliary Fuel Handling Building at elevation 280'. The Decay Closed Water Cooling, shell side, has radiation monitor and surge tank which could be used to detect a tube leak.

2.1.4 Borated Water Storage Tank (BWST), DH-T-1

The Borated Water Storage Tank (see Table 3) is a vertical cylinder tank of 472,964 gallon capacity and is normally filled with water at a concentration of 2270 ppm boron used for emergency injection into the reactor vessel following a reactor coolant piping rupture and to furnish water to the fuel transfer canal during refueling. A vacuum breaker and pressure relief valve is fitted to the tank. (See Table 6 for settings), Strip heaters are powered from two Class IE Buses, (2-11EA and 2-21EA). The insulated Tank will maintain a water temperature of greater than 45°F. The tank is designed to withstand an internal pressure equal to a column of water 10 ft. above the normal liquid level in the tank, a vertical line load of 30 psf with a concentrated load of 250 psi. The tank is located outside of the Auxiliary Building in the yard area.

2.1.5 Sodium Hydroxide Storage Tank DH-T-2

The Sodium Hydroxide Storage Tank (see Table 4) is a vertical cylinder tank of 14,285 gallon capacity and is normally filled with a solution of 20 weight percent NaOH used for pH control during emergency injection following a reactor coolant piping rupture. Strip heaters are powered from two Class IE Buses C 2-11EA and 2-21EA). The insulated Tank will maintain a temperature of greater than 45°F. Nitrogen pressure is maintained in the tank to provide an inert atmosphere. A vacuum breaker and pressure relief valve is fitted to the tank. (See Table 6 for settings). The tank is located outside of the Auxiliary Building in the yard area.

2.1.6 Major System Valves

Reactor to DHRS Suction Header Valve, DH-V1

One 2500 psi, 650F, 12 inch SS, electric motor operated gate valve is provided in the Reactor Building between the reactor outlet (loop B) and the DH pump suction header. The valve is shut (except during Decay Heat Removal Cooling) to separate the low pressure DHRS and high pressure reactor coolant. DH-V1 may be open when reactor pressure decreases to 320 psig, the operating pressure of the DHRS . It will automatically close above that pressure. DH-V1 like the other major DH Valves may be controlled locally by push button or from Panel 3 by a C-N-O Close-Neutral-Open) switch. Indication is available locally and on Panel 3.

At MCC 2-11EB on the DH-V1/DH-V171 Unit Compartment is a selector switch which determines whether DH-V1 or its bypass DH-V171 is powered from this Unit Compartment.

Normally the selector switch is positioned to DH-V1. In this case the above discussed control switch, indicating lights, and logic,control DH-V1. The cable from MCC 2-11EB to DH-V171 would be unpowered. If DH-V1 were to be repaired, the Unit Compartment Selector switch would be positioned to DH-V171. The control switch, indicating light, and logic formerly associated with DH-V1 would then be used for DH-V171. The cable associated with DH-V1 would then be unpowered.

DH-V1 By-Pass Valve, DH-V171

One 2500 psi, 650F, 8 inch, SS, electric motor operated gate valve is installed in the by-pass line around the DHRS supply valve, DH-V1, to provide suction to the Decay Heat Removal System in the event that DH-V1 is in-operative. DH-V171 is opened only when the DH System is needed and DH-V1 is inoperative. By positioning a selector switch on DH-V1/DH-V171 Unit Compartment, DH-V171 may be to control the system and DH-V1 control deactivated.

Reactor to DHRS Suction Header and Containment Isolation Valve (Indside), DH-V2

One 2500 psi, 300F, 12 inch, SS, electric motor operated gate valve is provided in the Decay Heat Removal line downstream of DH-V1, to additionally isolate the high pressure Reactor Coolant System and the low pressure Decay Heat Removal System, and as a containment isolation. Control and indication are available locally and on Panel 3. Indication only is available on Panel 13 and 15. The valve will close (if open) with either an ES signal or with reactor pressure above 320 psig. The motor operator is powered from 2-21EA.

Reactor to Decay Heat Removal Pump Suction Valve, DH-V100A and 100B

One 520 psi, 300F. 12 inch, SS, electric motor operated valve is provided from the reactor cooldown supply header to each Decay Heat Removal pump suction header. In order to open DH-V100A (B) the corresponding supply valve from the BWST/ Reactor Building Sump, DH-V102 A (B), must be closed. DH-V100A and 100B will automatically close if there is an ES signal and DH-V102A (B) is open. Control and indication is available locally and on Panel 8. Indication only is on Panel 8. DH-V100A and 100B are powered from 2-11EA and 2-?1EA respectively.

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Reactor to DHRS Suction Header and Containment Isolation Valve (Outside), DH-V3

One 370 psi, 300F, 12 inch, SS, electric motor operated gate isolation valve is provided in the Decay Heat Removal Suction header outside the containment. The valve is in series with DH-V1, and DH-V2 and is closed except during the Decay Heat Removal Cooling. The valve will close with an ES signal, but unlike DH-V1 and DH-V2 it has no signal to close with a reactor pressure greater than 320 psig. Control and indication are available locally and on Panel 3. Indication only is available on Panel 13 and 15. The motor is powered from 2-11EA.

DHRS Returns to Reactor Vessel Valves, DH-V4A/DH-V4B

One 2500 psi, 300F, 10 inch, SS, electric motor operated gate valve is provided outside the containment in each of the discharge headers from the DH Pumps to the core flood tank inlet line. The valves are closed during normal operation and open during Decay Heat Removal Cooling. The valves will open with an ES signal and provide a flowpath for borated water from the tanks into the core. Control and indication are available locally and from Panel 15. Indication only is on Panel 13. DH-V4A and DH-V4B are powered from 2-11EA and 2-21EA respectively.

BWST/Reactor Building Sump to Decay Heat Removal Pump Suction Valve, DH-V102A and 102B

One 520 psi, 300F, 14 inch, SS, electric motor operated valve is to each DHR Pump Suction header from BWST/Reactor

Building sump supply line. The valves open with an ES signal, thus lining up the DH Pump Suction to the BWST. DC-V102A and 102B are interlocked with DC-V100A and 100B respectively as previously discussed. This interlock prevents the reactor from being lined up to the BWST or Reactor Building Sump. Control and indication are available locally and on Panel 8. Indication only is on Panel 13. DC-V102A and 102B are powered from 2-11EA and 2-21EA respectively.

BWST (DH-T-1) Supply to DHRS Suction Header Valves, DH-V5A/ DH-V5B

One 200 psi, 300F, 14 inch, SS, electric motor operated gate valve is provided from the BWST to a suction supply line for the DH Removal Pump Makeup Pump, and Building Spray Pump Suction. The valves open with an ES Signal to provide water from the BWST during the initial phase of a LOCA (DHR Pump Suction is later shifted to the Reactor Building Sump). Control and Indication are available locally and from Panel 8. Indication only is on Panel 13. DC-V5A and 5B are powered from 2-11EA and 2-21 EA respectively.

Reactor Building Sump to DHRS Suction Header Valves, DH-V6A/DH-V6B

One 200 psi, 150F, 18 inch, SS, electric motor operated gate valve is provided in the suction line from the Reactor Building Sump to each DHR pump to permit post-LOCA circulation from the Reactor Building Sump through the DHR Cooler to the reactor. Each valve and the suction line from the sump liner attachment to the valve outlet, including the packing gland is jacketed to provide a barrier against leakage from

the sump to outside of the Reactor Building should a leak occur which could not be isolated by closing the valve. The jacketing consists of a pipe enclosing the suction line from the sump to the valve with a split "T" enclosing the valve. A connection is fitted for leak testing the jacket and accessibility for valve maintenance has been provided. Control and indication are available locally and from Panel 15. The normally shut valve does not have an ES signal to close and is the single containment isolation valve in the line. DH-V6A and 6B are powered from 2-11EA and 2-21EA respectively.

DHRS to High Pressure Makeup Pumps Valves, DH-V7A/ DH-V7B

One 520 psi, 300F, 4 inch, SS, electric motor operated gate valve is provided at the outlet line from each DHR cooler to the Makeup Pump suction. When the BWST is nearly empty, the Makeup Pump Suction is shifted from the BWST to the DH Cooler outlet in order to continue high pressure injection into the reactor. In this post LOCA phase, the DHR Pump suction is shifted from the BWST to the Reactor Building Sump. Control and indication are available locally and from Panel 8. DC-V7A and 7B are powered from 2-11EA and 2-21EA respectively.

Sodium Hydroxide Storage Tank (DH-T-2) Supply to DHRS Suction Header Valves, DH-V8A/DH-V8B

One 200 psi, 300F, 4 inch, SS, electric motor operated gate valve is provided in the supply line from the Sodium Hydroxide Storage Tank to the suction header of each DHR pump. Upon receipt of an ES Signal the valves open and provide sodium

hydroxide to the suction of the DHR pumps to be added to the injected water for pH control of the spilled reactor coolant. Control and indication are available locally and from Panel 8. Indication only is on Panel 13. DH-V8A and 8B are powered from 2-11EA and 2-21EA respectively.

DHRS to Spent Fuel Demineralizer Valve, DH-V106A/DH-V106B

One 520 psi, 300F, 2 inch, SS, diaphragm operated stop valve is provided in the line from the DHR coolers outlet to the Spent Fuel System between the SF Demineralizers and SF Pump. Opening the valve would enable borated water from the reactor outlet piping (hotleg) to pass through the DHR Pump and coolers to the SF System. From the SF System inlet, the water may be purified and/or directed back to the reactor vessel cavity. Control and indication are on Panel 8. The valves fail closed with a loss of Instrument Air.

DHRS Cooler Outlet Flow Control Valve, DH-V128A/DH-V128B

One 520 psi, 300F, 10 inch, SS electric motor operated globe flow control valve is provided in the outlet line from each DHR. The valve is throttled to avoid runout during a post-LOCA (taking suction from the Reactor Building Sump). It could be used to control cooldown rate, however, this is normally achieved by the Decay Heat Closed Cooling Water throttle valve, DC-V73A and 73B. Jog control and open/closed lights are available locally and on Panel 8. A throttle position indicator is on Panel 8. DH-V128A and 128B are powered from 2-11EA and 2-21EA respectively.

DHRS Sampling to Station Chemistry Laboratory Valve, DH-V112A and 112B

One 520 psi, 300F, 3/8 inch, SS, diaphragm operated stop valve is provided in the DHR cooler inlet line for sampling of the coolant. Remote control of the valve is provided on the Unit 2 Sample Panel (329) which is located in the Unit 1 sample room. Indication is available on Panel 8. The valve fails closed with a loss of Instrument Air.

Decay Heat Pump Discharge Cross-Connect Valves DH-V193A and 193B

Two 520 psi, 300F, 8 inch, motor operated gate valves are provided in the 8 inch Decay Heat Removal Pump discharge. The valves cross connect the outlets of two coolers. If one reactor inlet pipe ruptured, the outlet of both DHR Pump/Coolers could be directed through the other inlet pipe. Control and indication are available locally and from Panel 8. DH-V193A and 193B are powered from 2-32B and 2-42B repsectively.

Borated Water Storage Tank Supply to the Spent Fuel System, DH-V157

One 125 psi, 250^{o}F, 8 inch motor operated gate valve is provided to connect the BWST to the Spent Fuel (SF) Cooling and Borated Water Recirculation Pump Suctions. By opening this valve, the BWST may be lined up to the SF System and the SF pools filled.

Control and Indication is available on Panel 8. The valve is powered from MCC 2-32B.

2.1.7 Miscellaneous Valves

In general, manual valves are provided in the system for circuit and component isolation and for maintenance purposes. Check valves are provided at points where reverse flow is not tolerable. No check valves, however, are fitted in the Reactor Building sump lines as the allowable friction losses in these lines are limited for proper DHRS pump operation during emergency recirculation. Relief valves are installed as necessary to protect components and piping from over pressurization. Recirculation lines are provided to permit continuous pump operation against closed valves.

2.2 Instrumentation, Controls, Alarms and Protective Devices

As indicated on Tables 7 and 8, the system is largely controlled from Auxiliary System Control Console Panel 3, and observed from the Coolant Monitoring Panel 8. Additionally, System pump/motor variables are recorded and alarmed on the BOP and B&W computers. System alarms are annunciated on Panel 8.

The "BWST Level Hi/Lo" alarm indicates that the tank is in its normal operation condition (nearly full). During a LOCA the "BWST Lo/Lo Level" alarm indicates, that the tank is nearly exhausted and DHR Pump Suction must manually be shifted by the operator from the BWST to the Reactor Building Sump.

Each DHR Loop has a "Low Pressure Injection Hi/Lo Flow" alarm. The low flow signals are interlocked to annunciate only with an ES signal. Additionally for the Decay Heat Removal mode, there is a single "DH Removal Low Flow" alarm. The "DH Removal Low Flow" setpoint is less than the "Low Pressure Injection Lo Flow" setpoint. The alarm has no interlock. The "Decay Heat Removal Cooler Outlet Temperature Lo" annunciator is interlocked so that it will not alarm when the pump for that associated cooler is idle.

The System components are protected by vacuum breakers for the tanks only and relief valves for all system components (Table 6). As described in Section 2.1.5, DH-V100A (B), suction valves from the reactor, and DH-V102A (B) suction valves from the BWST, are interlocked to prevent lining up the reactor to the BWST or the Reactor Building Sump. The system is protected from being overpressurized to the normal reactor operating pressure. The DHR System Supply Valves from the reactor outlet pipe, DH-V1 and V2, will not open if reactor pressure is greater than 320 psig.

The containment isolation valves in the DHR Pump suction will automatically close with an ES signal to prevent pumping down the reactor core during a LOCA. The DH System valves will open with an ES signal to provide a flowpath from the BWST/sodium hydroxide tanks, through the pump, cooler, and containment isolation valves, into the core.

normal DHR Pump operation, i.e., without an ES signal, the motor will not start unless there is Decay Heat Closed Cooling water flow through the motor and its associated pump oil coolers. The DHR Pump will automatically start with an ES signal, regardless of motor cooling flow. There are alarms on Panel 8 to annunciate this no flow condition.

The standby idle BWST Recirculation Pump will automatically start if the running pump trips.

3.0 PRINCIPAL MODES OF OPERATION

3.1 Startup

After reactor shutdown when the reactor pressure and temperature are less than 320 psig and 250 F respectively, the system is placed in operation to further reduce the coolant temperature to approximately 140F and to maintain this temperature during the shutdown.

Both Decay Heat Closed Cooling Water Systems are first placed in their cooldown mode (see System Description Index No. 29). This will require operation of both Nuclear Service River Water loops (Index No. 27) and stopping Leakage Recovery System Cooling (Index No. 64). One BWST Recirculation Pump is running with its control switch in MAX and the other pump is in standby with its switch in AUTO.

3.2 Normal Operation

The Decay Heat Removal System has no function during normal plant power operation. The system is normally operated to effect reactor plant cooldown and to maintain the reactor in cold shutdown. During normal refueling operation, coolant is taken from the 36 inch reactor outlet line through a 12 inch line fitted with two high pressure electric motor operated valves in series, DH-V1 and DH-V2, and exits the Reactor Building through penetration R-525. Immediately downstream of the building penetration, a low pressure electric motor operated valve, DH-V3, is provided to permit building isolation in the event of a LOCA. The line then connects to each of two 14 inch Decay Heat Removal pump suction headers through electric motor operated valves, DH-V100A and DH-V100B, at each connection. At this point, two parallel, separate circuits are established. Each Decay Heat Removal pump, DH-P-1A/DH-P-1B, discharges through a

10 inch line into the tube side of its associated cooler, DH-C-1A/DH-C-1B, where the heat of the reactor coolant is transferred to the Decay Heat Closed Cooling Water System in the shell side of the cooler. Control valve DH-V128A/ DH-V128B may be used to throttle the outlet of each cooler (see explanation below). Each 10 inch cooler outlet line is fitted with an isolation valve, DH-V4A/DH-V4B, prior to its re-entry into the Reactor Building through penetrations R-589 and R-590 respectively. Within the Reactor Building, each line connects into one of two 14 inch reactor core flooding lines. The heat removal rate is normally controlled by throttling Decay Heat Closed Cooling Water Flow, DC-V73A and 73B. The rate may also be changed by running only one set of DH Removal and Decay Heat Closed Cooling Water Pumps. The above flowpath may also be used when the reactor loops are drained for Steam Generator or Reactor Coolant Pump repairs. Special care should be used to maintain the core outlet nozzle below water. This prevents an air bubble from forming and a subsequent flow blockage. The Decay Heat Removal System connects to the pressurizer spray line from either circuit piping outside the Reactor Building. A 3" branch taps off each Decay Heat Removal Cooler outlet header, upstream of containment isolation valves DH-V4A and 4B respectively. Each branch contains a 3" stop valve (DH-V186A and 186B), a 3" check valve (DH-V185A and 185B) and then combine in a tee. Downstream of the tee, the flow is through 3" Reactor Building isolation valve (DH-V187), into the Reactor Building, through a 3" check valve (DH-V190), past a 3/4" drain connection to the pressurizer auxiliary

spray valve, RC-V149. This permits pressurizer spray down and cooldown which will reduce the reactor plant pressure and temperature. Spray flow to the pressurizer is provided by manually opening valve DH-V187 and electric motor operated valve RC-V149 located inside the Reactor Building.

A ½" line at the outlet of each coolers pass through DH-V112A or DH-V112B to the chemistry laboratory. The sample line is used during system operation. A BWST Recirculation Pump is continuously in operation so that the BWST may always be sampled (locally).

3.3 Shutdown

During system shutdown all lines and components must remain filled with borated water to avoid water hammer during system startup. There is no automatic indication if the system has drained down since the last time the pumps were used. An astute operator should observe system pressure high, sump level, and borated water on the floor.

Surveilance testing is conducted by opening the suction valve, DH-V5A/DH-V5B, from the BWST, starting the pump in corresponding circuit, and opening the appropriate circuit test valve DH-V108A/DH-V108B, and DH-V116 which returns the water from the cooler outlet to the BWST.

3.4 Special or Infrequent Operation

3.4.1 Filling the Fuel Transfer Canal

After the reactor head has been removed, the DHR System, in conjunction with the Spent Fuel Cooling System, may be used to fill the transfer canal. This is accomplished by adding water to the system from the BWST while normal decay

heat removal is in progress. Either or both of the DHRS pumps may be used for the filling operation by opening the electric motor operated valves, DH-V5A/DH-V5B, and DH-V102A/DH-V102B in their respective 14 inch pump suction line from the BWST. Care must be taken during this operation to maintain the reactor water at a level consistent with normal recirculation. The SF System and associated pools may also be filled by opening DH-V157 and lining up the BWST to the SF System Pumps.

3.4.2 Recirculating and Purifying the Coolant in the Fuel Transfer Canal

The recirculation and purification operation is accomplished in conjunction with the purification loop in the Spent Fuel (SF) Cooling system. The Decay Heat Removal pump(s) discharges a portion from its reactor cooling loop to the SF System. The DHR Pumps discharge through the DHR cooler(s), a diaphragm operated globe valve (DH-V106A/106B), into a 2" line leading to the purification loop in the Spent Fuel Cooling system. The coolant, after passing through the spent fuel filters and demineralizer in the purification loop, may be directed through 3" diaphragm operated globe valve, SF-V122, 3" check valve SF-V123 and 3" gate valve DH-V188 in a 3" line which connects to the suction of the DHR pump(s) downstream of the Reactor Building isolation valve, DH-V3. The DHR pump(s) then discharges the purified coolant through the system piping into the open reactor vessel and fuel transfer canal. This mode of operation is also discussed in the Spent Fuel Cooling System Description (Index No. 19).

3.4.3 Draining the Fuel Transfer Canal

The fuel transfer canal can be drained to the level of the reactor outlet nozzles using the DHRS. A line connects from each of the cooler outlet lines through manual valves, DH-V108A/DH-V108B, to an 8 inch line leading to the BWST. At the completion of a reactor refueling with the DHRS operating in its normal mode, a portion of the cooler outlet flow is directed back into the BWST, thereby, lowering the level in the Fuel Transfer Canal. Care should be taken during this operation to ensure that the reactor water level is maintained above the outlet nozzles to prevent air from entering the system. When the water level has been lowered to the approximate level of the reactor outlet nozzle, use of the DHRS for draining the canal must be suspended. The remaining water is removed by use of the Spent Fuel Cooling System (Index No. 19).

3.5 Emergency Operation

The DHRS is an engineered safety features system which is capable of injecting borated water from the Borated Water Storage Tank (BWST) into the reactor and accomplishing long-term core cooling after LOCA through two circuits, each capable of performing its safety features function independently.

3.5 Emergency Operation(continued)

When an ES signal is received, both DHR loops are automatically lined up for injecting water from the BWST and Sodium Hydroxide Storage Tank into the core. If the core outlet valves are open (i.e. if the DHR System were in the Decay Heat Removal Mode), the associated valves (DH-V2, 3, 101A, and 101B) would close. Similarly the DH valves which would line up the BWST and Sodium Hydroxide Tank to the DHR, Makeup, and Building Spray Pumps (DH-V5A, 8B, 5A, 5B, 102A and 102B) would open. The gate valves in the discharge path to the reactor (DH-V4A and 4B) would open, although the reactor pressure might be substantially above DHR System pressure. Check valves DH-102A and 102B would remain seated and the DHR Pumps would start, circulating through the minimum flow line. Simultaneously, the DHR Support Systems (Nuclear Services River Water and Decay Heat Closed Cooling Water) would start to provide cooling to the DHR Heat Exchangers. As reactor pressure decreased to the discharge pressure of the DHR Pumps, the check valves DH-V102A and 102B would unseat and borated water would be injected into the core.

Before the BWST and Sodium Hydroxide Storage Tanks were exhausted, Makeup Pump suctions would be shifted from those tanks to the discharge of the DHR Pumps. The suction of the DH Removal Pumps (and the Building Spray Pumps) would be shifted from the BWST/Sodium Hydroxide Tank, to the Reactor Building Sump. The supply valves from the Tanks (DH-V5A, 5B, 8A and 8B) would remain open,

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and the suction supply valves from the Reactor Building Sump, DC-V6A and 6B, would be manually opened from the Control Room. Check valves in the lines downstream of the Tanks prevent flow from the sump to the tanks.

As Reactor Building (pump suction) and reactor pressure (pump discharge) gradually equalize, flow is throttled with DH-V128A and 128B to avoid pump runout and caviatation. If no action is taken a high flow alarm will annunciate. A high flow alarm might also be indicative of a rupture in that reactor supply line. Post LOCA mode suction from sump) could continue indefinitely by taking water from the sump, cooling it, and pumping it to the core via the core flooding nozzles. The Building Spray Makeup Pumps can similarly indefinitely operate in this mode by taking their suction from the Reactor Building sump and DHR Pump discharge respectively. The Operation of the Makeup and Building Spray Pumps are discussed in greater detail in their respective System Descriptions (Index No. 17 and respectively 28A respectively).

4.0 Hazards and Precautions

The DHR System has no makeup or pressure maintenance during normal power operation when it is isolated and shutdown. There is no automatic alarm is the system drained down through the chemical sample line or to a sump. Secondary indications, such as the lack of head pressure on the pump gages, excessive liquid radwaste, and borated water on the floor, would be the prime symptoms of an inadvertent system drain down.

To avoid excessive temperature transcients in the Decay Heat Closed Cooling Water System, cooldown should normally be varied by throttling DC-V73A and 73B. DHR and Decay Heat Closed Cooling Water temperatures should be closely monitored. If DH-V128A or V128B is opened, DH-V73A or V73B should be opened simultaneously to prevent high closed cooling water temperatures.

To avoid DH Pump runout and/or pump cavitation, throttle system flow with valves DH-V128A and 128B.

Nuclear Services River Water and Decay Heat Closed Cooling Water should be started and lined up to the DHR Cooler, before the DHR Pump is started. For non-emergency starting there is no interlock or automatic operation to prevent starting the DH Removal and Decay Heat Closed Water Cooling System before initiating flow Nuclear Service River Water flow through the associated cooler.

When both DHR Coolers are in operation, both Decay Heat Closed Water Systems are in their Decay Heat Removal Mode. Limited cooling is available to the Reactor Coolant Drain Tank. The maximum Drain Tank temperature is limited to 150°F because the tank is used to quench the pressurizer relief valves. Normal Tank discharge and demineralized water (for a cold water supply) are available.

During normal operation, the DHR Pump is not lined up to either of its three suction sources (Reactor Vessel, BWST/Sodium Hydroxide Tank, and the Reactor Building Sump). If the pump inadvertently started, without a suction supply, it would run for a short time before destroying itself.

Avoid DHR System air binding by maintaining the reactor outlet nozzles below the water level when the reactor vessel is drained.

The DHR System contains reactor coolant and is therefore contaminated. Care should be used when handling the radioactive liquid and components.

The BWST and Sodium Hydroxide Storage are nitrogen blanketed. Do not enter the tank without breathing apparatus.

The DHR Pump suction strainer differential pressure should be periodically monitored during pump operation. This is especially important when the suction is taken from the Reactor Building Sump.

During a LOCA, the suction of the DHR Pump Suctions (and Building Spray) must be manually shifted from the BWST/ Sodium Hydroxide Tank to the Reactor Building Sump. If the manual transfer is not made, the DHR, Makeup, and Building Spray Pumps will quickly destroy themselves. Additionally, the Makeup Pump Suction must be manually shifted to the DHR Pump discharge.

TABLE 1

DECAY HEAT REMOVAL PUMPS

Pump Details	
Identification	DH-P-1A, DH-P-1B
Number installed	Two
Vendor	Babcock and Wilcox Co.
Manufacturer	Babcock and Wilcox Ltd., Canada
Type	Single-stage, horizontal shaft, single suction, centrifugal
Rated Capacity, gpm	3000
Rated TDH, ft.	350 (min.)
NPSH, ft.	14
Speed, rpm	1750
Design Pressure and Design Temperature	520 psig @ 200F and 495 psig @ 300F
Lubricant/Coolant	Oil/DHCCWS (water)

Motor Details	
Manufacturer	Westinghouse Electric Corp.
Type	LLD Horizontal
Enclosure	Drip-proof
Rated Horsepower, hp	350
Speed, rpm	1750
Power	4160v 45 amps (full load) 3Ø 60 hz.
Source	DH-P-1A 2-1E DH-P-1B 2-2E
Lubricant/Coolant	Sealed Bearing/DHCCWS (water)

Classification	Level
Code	ASME Code for Pumps and Valves for Nuclear Service 1968
Quality Control	2
Seismic	I
Cleanliness	B

TABLE 2

DECAY HEAT REMOVAL COOLERS

Identification	DH-C-1A, DH-C-1B
Number Required	Two
Vendor	Babcock & Wilcox Co.
Manufacturer	Whitlock Mfg. Co.
Cleanliness factor	0.85
Heat Transfer, BTU/hr	30×10^6

Tube Side:

Fluid	Reactor Coolant
Fluid Flow, lbs/hr	1.5×10^6
Design Press.	520 psig @ 250F and
Design Temp.	495 psig @ 300F
Material	304 SS
Pressure Drop, psig	5.5

Shell Side:

Fluid	Decay heat closed cooling water system
Fluid Flow, lbs/hr-Source	1.5×10^6
Design Press. psig	150
Design Temp, F	200
Material	CS
Pressure Drop, psig	4.5

Classification	Level Shell	Tube
Code	ASME VIII	ASME III (Lethal)
Quality Control	2	2
Seismic	I	I
Cleanliness	C	B

TABLE 3

BORATED WATER STORAGE TANK

Identification	DH-T-1
Manufacturer	Pittsburg-Des Moines Steel Works
Capacity, gallons	472,964
Installation	Vertical
Outside diameter & length, ft.	35x51
Shell material	304 S.S.
Shell thickness, in. @ 0' El. @ 51' El.	1/2 1/4
Design temperature, F	150
Design pressure, psig	3
Corrosion allowance, in.	0
Design code	AWWA-D100
Code stamp required	None Required

Classification	Level
Code	AWWA-D 100-67
Quality Control	3
Seismic	I
Cleanliness	B

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TABLE 4

SODIUM HYDROXIDE STORAGE TANK

Identification	DH-T-2
Manufacturer	Buffalo Tank Div.
Capacity, gallons	14,285
Installation	Vertical
Outside diameter & length, ft.	7 x52
Shell material	A-283-C
Shell thickness, in.	7/16 to 1/4
Design temperature, ^{o}F	150
Design pressure	10' Column of H_2O above top of tank
Corrosion allowance, in.	1/16"
Design code	ASME Sec VIII (1971)
Code stamp required	None required

Classification	Level
Code	ASME VIII
Quality Control	3
Seismic	I
Cleanliness	C

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TABLE 5

BORATED WATER STORAGE TANK RECIRCULATION PUMPS

Pump Details	
Identification	DC-P-2A, DC-P-2B
Number Installed	2
Manufacturer	Crane Deming
Model No.	AA
Type	Process
Rated Speed, rpm	3500
Rated Capacity, gpm	100
Rated total dynamic head, ft.	100
NPSH, ft.	10
Design pressure, psig	150
Design Temperature, ^{o}F	250
Lubricant/Coolant	Oil/Air
Motor Details	
Manufacturer	Reliance
Type	Squirrel Cago Induction
Enclosure	Totally Enclosed
Rated, Horsepower	7.5
Speed, rpm	3600
Lubricant/Coolant	Oil/Air
Power requirements	460V/3Ø/60 Hz
Power Source	DC-P-2A MCC 2-32A
Power Source	DC-P-2B MCC 2-42A
Classification	
Code	N-3
Quality Control	Q-3
Seismic	I
Cleanliness	B

TABLE 6

Decay Heat Removal System

Relief Valve and Vacuum Breaker Listing

Valve Identification	Service	Location of Valve	Setpoint	Back Pressure
DH-R1	Relief	Decay heat removal line from reactor vessel	370 psig	Atmos.
DH-R2A/B	Relief	Decay heat removal pumps, DH-P-1A/B, suction	370 psig	Atmos.
DH-R3A/B	Relief	Decay heat removal pumps, DH-P-1A/B, discharge	520 psig	Atmos.
DH-R5	Relief	Borator water storage tank, DH-T-1	3.0 psig	Atmos.
DH-R6	Relief	Sodium hydroxide storage tank, DH-T-2	3.0 psig	Atmos.
DH-R7A/B	Relief	Decay heat removal circuit "A" & "B" return to reactor vessel	520	Atmos.
DH-R8A/B	Relief	Borated water storage tank supply to decay heat removal pumps, DH-P-1A/B	225	Atmos.
DH-R9A/B	Relief	Decay heat to make-up pumps	350 psig	Atmos.
DH-V119	Vacuum	Borated water storage tank, DH-T-1	1 oz/sq. in.2	Atmos.
DH-V146	Vacuum	Sodium hydroxide storage tank, DH-T-2	1 oz/sq. in.2	Atmos.

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TABLE 7

INSTRUMENTATION AND CONTROLS

NOTE: For Reference to I&C Logic System refer to I&C Dwg. 3090

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
DH-PS-463	Pressure switch	Sends signal to DH-PAL-463 for low suction pressure of decay heat removal pump DH-P-1A	Rack 442	diaphragm	0.25-16 psig	N/A	6.5 psig
DH-PT-464	Pressure Transmitter	Sends signal to DH-PI-464 for discharge pressure of decay heat removal pump DH-P-1A (I&C Sheet 9)	Rack 442	Gage	0-600 psig	10-50 ma DC	N/A
DH-PI-464	Pressure Indicator	Indicates discharge pressure of decay heat removal pump DH-P-1A	Panel B	Millimeter Vertical	10-50 ma DC	0-600 psig	N/A
DH-PS-465	Pressure switch	Sends signal to DH-PAL-465 for low suction pressure of decay heat removal pump DH-P-1B	Rack 441	diaphragm	0.25-16 psig	N/A	6.5 psig
DH-PT-466	Pressure Transmitter	Sends signal to DH-PI-466 for discharge pressure of decay heat removal pump DH-P-1B (I&C Sheet 9)	Rack 441	Gage	0-600 psig	10-50 ma DC	N/A
DH-PI-466	Pressure Indicator	Indicates discharge pressure of decay heat removal pump DH-P-1B	Panel B	Millimeter Vertical	10-50 ma DC	0-600 psig	N/A
DH-LI-1445	Level Indicator	Indicates water level in borated water storage tank (DH-T-1)	Tank	D/P Cell	0-56ft., H_2O	0-56 ft. H_2O	N/A
DH-DPI-1446	Differential Pressure Indicator	Indicates differential pressure across decay heat removal pump 1B suction strainer (DH-U1B)	Rack 441	D/P Cell	0-100 in. H_2O	0-125 in. H_2O	N/A
DH-DPI-1447	Differential Pressure Indicator	Indicates differential pressure across decay heat removal 1A suction on strainer (DH-U1A)	Rack 442	D/P Cell	0-100 in. H_2O	0-125 in. H_2O	N/A
DH-FHS-3478	Hand switch	Operates DH-V8A	Panel B	E-30 Push Button	N/A	N/A	N/A
DH-FHS-3479	Hand switch	Operates DH-V8B	Panel B	E-30 Push Button	N/A	N/A	N/A
DH-FHS-3491	Hand switch	Operates DH-V171	Panel 3	GE CR 2940	N/A	N/A	N/A
DH-FHC-3492 & 93	Hand flow control	Operates DH-V128A & 128B respectively	Panel B	E-30	N/A	N/A	N/A
DH-ZT-3492 & 3493	Position Switch	Transmits DC-V128A & 128B respectively	Local	Pos. Trans.	0-100 Ω	0-1, Ma&c	N/A
DH-FHS-3494	Hand switch	Operates DH-V106A	Panel B	E-30	N/A	N/A	N/A
DH-ZI-3492 & 3493	Position Indicator	Indicates DC-V128A & 128B position	Panel B	Dual	0-1 Mada	0-100%	N/A

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TABLE 7 (Continued)

INSTRUMENTATION AND CONTROLS

Identification	Description	Function	Location	Type	Input Range	Output Range	Setpoint
DH-FHS-3495	Hand switch	Operates DH-V106B	Panel 8	E-30 Push Button	N/A	N/A	N/A
DH-FHS-3496	Hand switch	Operates DH-V112A	Panel 329	E-30 Push Button	N/A	N/A	N/A
DH-EL-3496	Indicating Lights	Indicates position of DH-V112A	Panel 8	Ind. Light	N/A	N/A	N/A
DH-FHS-3499	Hand switch	Operates DH-V112B	Panel 329	E-30 Push Button	N/A	N/A	N/A
DH-EL-3499	Indicating Lights	Indicates position of DH-V112B	Panel 8	Ind. Light	N/A	N/A	N/A
DH-FHS-3507	Hand switch	Operates DH-V157	Panel 8	E-30 Push Button	N/A	N/A	N/A
DH- LI-3733	Level Indicator	Indicates level in sodium hydroxide tank (DH-T-2)	Tank	Diff. Pressure	0-45'6" H_2O	0-50' H_2O	N/A
DH-FHS-3823	Hand switch	Operates DH-V102A	Panel 8	E-30 Push Button	N/A	N/A	N/A
DH-FHS-3824	Hand switch	Operates DH-V102B	Panel 8	E-30 Push Button	N/A	N/A	N/A
DH-FHS-3825	Hand switch	Operates DH-V100A	Panel 8	E-30 Push Button	N/A	N/A	N/A
DH-FHS-3826	Hand switch	Operates DH-V100B	Panel 8	E-30 Push Button	N/A	N/A	N/A
DH-FHS-3964 &3965	Hand switch	Operates DH-V193A & DH-V193B	Local at valve	E-30 Push Button	N/A	N/A	N/A
DH-FHS-4084 &4085	Hand switch	Operates DH-V5A & 5B	Panel 8	CE ET-16	N/A	N/A	N/A

B&W INSTRUMENTS

Identification	Description	Function	Location	Input Range	Output Range	Setpoint
DH-1-FE1	Flow Element	Measures Flow Rate in D.H. Removal "A" Circuit	Piping	0-5000 GPM	0-600" H_2O	N/A
DH-1-FE2	Flow Element	Measures Flow Rate in D.H. Removal "B" Circuit	Piping	0-5000 GPM	0-600" H_2O	N/A
DH-1-DPT1	Differential Pressure Transmitter	Converts DP Signal from DH-1-FE1 to Flow Signal	Rack 442	0-600" H_2O	±10VDC	N/A

TABLE 7 (Continued)

Identification	Description	Function	location	Input Range	Output Range	Setpoint
DH-1-DPT2	Differential Pressure Transmitter	Converts DP Signal from DH-1-FE2 to Flow Signal for DH-1-FS1	Rack 441	0-600" H_2O	±10VDC	N/A
DH-1-FI1	Flow Indicator	Indicates Flow in D.H. Removal "A" Circuit	Panel 8	±10VDC	0-5000 gpm	N/A
DH-1-FI2	Flow Indicator	Indicates Flow in D. H. Removal "B" Circuit	Panel 8	±10VDC	0-5000 gpm	N/A
DH-1-FS1	Flow Switch	Provides Hi/Low Flow Alarm in D.H. Removal A Circuit	Cable Room	±10VDC	0-5000 gpm	3750 GPM (H) 2800 GPM (L)
DH-1-FS2	Flow Switch	Provides Hi/Low Flow Alarm in D.H. Removal A Circuit	Cable Room	±10VDC	0-5000 gpm	3750 GPM (H) 2800 GPM (L)
DH-1-FS3	Flow Switch	Provides Low Flow Alarm in D.H. Removal A Circuit	Cable Room	±10VDC	0-5000 gpm	1500 GPM
DH-1-FS4	Flow Switch	Provides Low Flow Alarm in D.H. Removal B Circuit	Cable Room	±10VDC	0-5000 gpm	1500 GPM
DH-2-TE1	Temperature Element	Measures D.H. Removal "A" Cooler Outlet Temperature for DH-2-TT1	Piping	0-300 F	100 OHM @ 0°C	N/A
DH-2-TE2	Temperature Element	Measures D.H. Removal "B" Cooler Outlet Temperature for DH-2-TT2	Piping	0-300 F	100 OHM @ 0°C	N/A
DH-2-TT1	Temperature Transmitter	Transmits Signal from DH-2-TE1 to DH-2-TI1 and DH-2-TS2	Cable Room	100 OHM @ 0°C	±10VDC	N/A
DH-2-TT2	Temperature Transmitter	Transmits Signal from DH-2-TE2 to DH-2-TI2 and DH-2-TS2	Cable Room	100 OHM @ 0°C	±10VDC	N/A
DH-2-TI1	Temperature Indicator	Indicates DH Cooler "A" Outlet Temp.	Panel 8	±10VDC	0-300 F	N/A
DH-2-TI2	Temperature Indicator	Indicates DH Cooler "B" Outlet Temp.	Panel 8	±10VDC	0-300 F	N/A
DH-3-LT 1	Level Transmitter	Measures Level in the Bor.St. Tk. for DH-3-LI1 and DH-3-LS1	Panel 8	0-56 ft.	±10VDC	N/A
DH-3-LT2	Level Transmitter	Measures Level in the Bor.St. Tk. for DH-3-LS2, LI3, and LS1	Panel 8	0-56 ft.	±10VDC	N/A
DH-3-LI 1	Level Indicator	Indicates Level of Bor. St.Tk. (DH-T-1)	Panel 8	±10VDC	0-56 ft.	N/A
DH-3-LS1	Level Alarm	Alarms Hi and Low Level in Bor.Water St. Tk. (DH-T-1)	Cable Room	±10VDC	0-56 ft.	Hi-55.8 ft(Increasing Lo-55 ft. (Decreasing
DH-3-LS2	Level Alarm	Alarms Lo-Lo Level in Bor. Water St. Tk. (DH-T-1) and shuts off tank heaters	Cable Room	±10VDC	0-56 ft.	6 ft. (Decreasing)

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TABLE 7 (Continued)

Identification	Description	Function	Location	Input Range	Output Range	Setpoint
DH-4-TE	Temperature Element	Measures Temperature of Borated Water Storage Tank DH-4-TT input	Tank	0-200 F	100 Ohm @ 0°C	N/A
DH-4-TT	Temperature Transmitter	Transmits Signal from DH-4-TE to DH-4-TI and DH-4-TS1	Cable Room	100 OHM @ 0°C	±10VDC	N/A
DH-4-TI	Temperature Indicator	Indicates Temperature of Borated Water Storage Tank (DH-T-1)	Panel 8	±10VDC	0-200° F	N/A
DH-4-TT	Temperature Trans.	BWST Temperature for DH-4-TS1 and DH-4-TS2	Panel 8	±10VDC	100 ohm @ 0°C	N/A
DH-4-TS1	Temperature Switch	Provides Temperature Alarm on Borated Water Storage Tank	Cable Room	±10VDC	N/A	45° F (L) 110° F (H)
DH-4-TS2	Temperature Switch	Provides Temperature Control for Water Storage Tank Heaters	Cable Room	±10VDC	N/A	50° F (On) 55° F (Off)
DH-5-PI1	Pressure Indicator	Indicates Discharge Pressure of DH-P-1A	Rack 442	0-600 psig	0-600 psig	N/A
DH-5-PI2	Pressure Indicator	Indicates Discharge Pressure DH-P-1B	Rack 441	0-600 psig	0-600 psig	N/A
DH-6-TE1	Temperature Element	Measures Inlet Temperature of DH-P-1A	Piping	0-350 F	0-350 F	N/A
DH-6-TE2	Temperature Element	Measures Inlet Temperature of DH-P-1B	Piping	0-350 F	0-350 F	N/A
DH-6-TT1	Temperature Transmitter	Transmits Signal from DH-6-TT1 to DH-6-TS1 and DH-6-TI1	Cable Room	0-350 F	±10VDC	N/A
DH-6-TT2	Temperature Transmitter	Transmits Signal from DH6-TT2 to DH-6-TS2 and DH-6-TI1	Cable Room	0-350 F	±10VDC	N/A
DH-6-TS1	Temperature Switch	Provides Temperature alarm for DH-P-1A inlet	Cable Room	±10VDC	N/A	300°F
DH-6-TS2	Temperature Switch	Provides Temperature alarm for DH-P-1B inlet	Cable Room	±10VDC	N/A	300°F
DH-6-TI1	Temperature Indicator	Indicates temperature for DH-P-1A inlet	Panel 8	±10VDC	0-350 F	N/A
DH-6-TI2	Temperature Indicator	Indicates Temperature for DH-P-1B inlet	Panel 8	±10VDC	0-350 F	N/A
DH-7-LT	Level Transmitter	Measures Level in the Sodium Hydroxide Storage Tank (DH-T-2)	Tank	0-50 ft.	0-50 ma dc	N/A
DH-7-LS	Level Alarm	Alarms Hi and Lo Level in Sodium Hydroxide Storage Tank	Cable Room	0-50 ma	N/A	44.5' (LO 46.5' (H)
DH-7-LI	Level Indicator	Indicates Level in Sodium Hydroxide Storage Tank	Panel 8	±10VDC	0-50 ft.	N/A

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TABLE 7 Continued)

Identification	Description	Function	Location	Input Range	Output Range	Setpoint
DH-8-TE	Temperature Element	Measures Temperature of Sodium Hydroxide Storage Tank	Tank	0-200 F	100 OHM @ 0°C	N/A
DH-8-TT	Temperature Transmitter	Transmits signal from DH-8-TE to DH-8-TSI & DH-8-TI	Cable Room	100 OHM @ 0°C	±10VDC	N/A
DH-8-TI	Temperature Indicator	Indicates temperature of Sodium Hydroxide Storage Tank (DH-T-2)	Panel 8	@ 10VDC	0-200°F	N/A
DH-8-TSI	Temperature Switch/Alarm	Controls Temperature in Sodium Hydroxide Storage Tank and actuates heaters	Cable Room	±10VDC	N/A	45°F (On) 55°F (OFF)
DH-8-TS2	Temperature Switch/Alarm	Provides Temperature alarm in Sodium Hydroxide Storage Tank	Cable Room	±10VDC	N/A	110°F (H) 50°F (L)
DH-9-PI	Pressure Indicator	Indicates Pressure of Sodium Hydroxide Storage Tank (DH-T-2)	MTG Y3	0-1 psig	0-5 psig	N/A
DH-10-PSI	Pressure Switch	Alarms Hi pressure in D.H. supply line	Panel 8		0-600 psig	330 psig
DH-P1A-MIS	Hand Switch	Controls DH-P-1A	Panel 3	N/A	N/A	N/A
DH-P1B-MIS	Hand Switch	Controls DH-P-1B	Panel 3	N/A	N/A	N/A
DH-V1-MIS	Hand Switch	Controls DH-V1	Panel 3	N/A	N/A	N/A
DH-V2-MIS	Hand Switch	Controls DH-V2	Panel 3	N/A	N/A	N/A
DH-V3-MIS	Hand Switch	Controls DH-V3	Panel 3	N/A	N/A	N/A
DH-V4A-MIS	Hand Switch	Controls DH-V4A	Panel 15	N/A	N/A	N/A
DH-V4B-MIS	Hand Switch	Controls DH-V4B	Panel 15	N/A	N/A	N/A
DH-2-TE1A	Temp. Element	DH-C-1A outlet Temperature piping Input to YM-TR-1922 on Panel 10	Piping	0-300°F	100 ohm @ 0°C	N/A
DH-2-TE2A	Temp. Element	DH-C-1B outlet Temperature Input to YM-TR-1922 on Panel 10	Piping	0-300°F	100 ohm @ 0°C	N/A
DH-V6A-MIS	Hand Switch	Controls DH-V6A	Panel 15	N/A	N/A	N/A
DH-V6B-MIS	Hand Switch	Controls DH-V6B	Panel 15	N/A	N/A	N/A
DH-V7A-MIS	Hand Switch	Controls DH-V7A	Panel 8	N/A	N/A	N/A
DH-V7B-MIS	Hand Switch	Controls DH-V7B	Panel 8	N/A	N/A	N/A
DH-6-TE6A	Temp. Element	DH-P-1A Temperature Input to YM-TR-1922 Panel 10	Piping	0-350°F	100 ohm @ 0°C	N/A
DH-6-TE6B	Temp. Element	DH-P-1B Temperature Input to YM-TR-1922 on Panel 10	Piping	0-350°F	100 ohm @ 0°C	N/A

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TABLE 8

PANEL MOUNTED ANNUNCIATORS AND COMPUTER INPUTS

PANEL MOUNTED ANNUNCIATORS

Identification	Measured Variable Units	Alarm Setpoints High	Alarm Setpoints Low	Input Source	Variable Range	Panel Name and No
DH-PAL-0463	2A Decay Heat Removal Pump Suction Pressure Lo, psig	N/A	6.5	DH-PS-463	0.25-16 psig	Coolant Sys. Monitori: Panel No. 8
DH-PAL-0465	2B Decay Heat Removal Pump Suction Pressure Lo, psig	N/A	6.5	DH-PA-465	0.25-16 psig	Coolant Sys. Monitori: Panel No. 8
DH-TA-4548	Borated Water Storage Tank Level Hi/Lo, ft.	55.8	55	DH-3-LS3	0-56 ft.	Coolant Sys. Monitori: Panel No. 8
DH-LALL-4549	Borated Water Storage, Tank Level Lo/Lo, ft.	N/A	6	DH-3-LS2	0-56 ft.	Coolant Sys. Monitori: Panel No. 8
DH-TA-4547	Borated Water Storage Tank Temp. F°	110	45	DH-6-TS1	0-200	Coolant Sys. Monitori: Panel No. 8
DH-TAH-4550	Decay Heat Removal Pump Suction Temp. Hi	300	N/A	DH-6-TS1 DH-6-TS2	0-350 °F	Coolant Sys. Monitori: Panel No. 8
DH-LA-4544	Sodium Hydroxide Tank Level Hi/Lo, ft.	46.5	44.5	DH7-LS	0-50 ft.	Coolant Sys. Monitori: Panel No. 8
DH-TA-4545	Sodium Hydroxide Tank Temp. Hi/Lo	110	50	DH8-TS2	0-200 °F	Coolant Sys. Monitori: Panel No. 8
DH-EA-4551	Decay Heat Removal Pump Overload	N/A	N/A	OLX	N/A	Coolant Sys. Monitori: Panel No. 8
DH-TAH-4550	Decay Heat Removal Pump Suction Temp. Hi, F	300	N/A	DH-6-TS2 DH-6-TS1	0-350 °F	Coolant Sys. Monitori: Panel No. 8
DH-EA-7187	Borated Water Storage Tank Recirculation Pumps Trouble	N/A	N/A	OLX	N/A	Coolant Sys. Monitori: Panel No. 8
DH-TAL-4555	Decay Heat Removal Cooler Outlet Temp. Lo, Ft.	N/A	180	DH-2-TS1 DH-2-TS2	0-350 °F	Coolant Sys. Monitori: Panel No. 8
DH-FAL-4546	Decay Heat Removal Flow Lo, gpm	N/A	1500	DH1-FS3 DH1-FS4	0-5000 gpm	Coolant Sys. Monitori: Panel No. 8
DH-FA-4542	Low Pressure Injection Loop A Flow Hi/Lo, gpm (During ES)	3750	2800	DH1-FS1	0-5000 gpm	Coolant Sys. Monitori: Panel No. 8
DH-FA-4543	Low Pressure Injection Loop B Flow Hi/Lo, gpm (During ES)	3750	2800	DH1-FS2	0-5000 gpm	Coolant Sys. Monitori: Panel No. 8

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TABLE 6 (Cont'd)

PANEL MOUNTED ANNUNCIATORS AND COMPUTER INPUTS

COMPUTER INPUTS

Identification	Measured Variable. Units	Alarm Setpoints High	Alarm Setpoints Low	Input Source	Variable Range
0115	Decay Heat removal pump (DH-P-1A) Disch. Press.	N/A	135	DH-PT-464	0-600 psig
0116	Decay Heat removal pump (DH-P-1B) Disch. Press.	N/A	135	DH-PT-466	0-600 psig

B&W Computer Inputs

0336	D.H. removal pumps (DH-P-1A & 1B) pump bearing temperature-motor end, °F	N/A	160	DH-50-TE2 DH-50-TE4	40-190°F
0338	D.H. removal pumps (DH-P-1A & 1B) pump bearing temperature-pump end, °F	N/A	160	DH-50-TE1	100-200°F
0340	D.H. removal pumps (DH-P-1A & 1B) motor bearing temperature - pump end, °F	N/A	180	DH- 51 -TE1 DH- 51 -TE3	100-200°F
0342	D.H. removal pumps (DH-P-1A & 1B) motor bearing temperature, °F	N/A	180	DH- 51 -TE2 DH- 51 -TE4	100-200°F
0344	D.H. removal pumps (DH-P-1A & 1B) motor stator temperature, °F	N/A	266	DH- 52 -TE5 DH- 52 -TE6	100-275°F
	BMST Level, ft.	N/A	6	DH-LT-1445	0-56'

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