General Bill

FINAL

SYSTEM DESCRIPTION
(Index No. 64)

RADWASTE DISPOSAL REACTOR
COOLANT LEAKAGE RECOVERY SYSTEM
(B&R Dwg. No. 2632, Rev. 2)

JERSEY CENTRAL POWER AND LIGHT COMPANY

THREE MILE ISLAND NUCLEAR STATION

UNIT No. 2

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APPENDIX

1.0 INTRODUCTION

1.1 System Functions

The purpose of the Reactor Coolant Leakage Recovery System is to provide quenching capacity for the pressurizer relief valves blowdown, and to receive, measure, cool, and transfer leakage from the following sources:

a) Power operated valve stem leakoffs within the Reactor Coo ant pressure boundry physically located inside the Reacto Building.

b) Reactor Coolant Pump Seals

c) Pressurizer relief valves.

The Reactor Coolant Leakage recovery system interfaces with the following systems (Drawing numbers refer.to Burns and Roe, Inc. flow diagrams)

a) Reactor Coolant Coolant Makeup Purification (Dwg. 2024)

b) Demineralized Service Water, (Dwg. 2007)

c) Radwaste Disposal-Reactor Coolant Liquid (Dwg. 2027)

d) Radwaste Disposal Gas (Dwg. 2028)

e) Nitrogen for Nuclear and Radwaste (Dwg. 2036)

f) Decay Heat Closed Cooling Water (Dwg. 2035)

g) Decay Heat Removal (Dwg. 2026)

h) Reactor Coolant Pump Seal Recir. & Cooling Water (Dwg. 2601)

1.2 Summary Description of System (B&R Dwg. No. 2632, Rev. 2)

The Reactor Coolant Leakage Recovery System consists of the Reactor Coolant Drain Tank, two independent 50% transfer pu piping from the leakage sources to the Tank, from the tank

to the Drain Header, and associated valves and instrumentatic

Leakage is collected from the four Reactor Coolant Pump Leakage chambers. With normal leakage the pump Seal leakage is measured and gravity flows to the Tank.
For high leakage, the flow measuring device is bypassed.
For gross leakage some of the liquid goes to the Reactor Building Sump.

Leakoff from the annular space between the layers of valve packing similarly flows by gravity to the Reactor Coolant Drain Tank. Per se, valve stem leakoff flow is not measured however, thermocouples are located on the pipe surface so that the presence of a leak may be determined, and its severity evaluated.

The leakage in the Reactor Coolant Drain Tank is circulated by one or two of Leakage Transfer Pump (s). The circulated water is cooled by one or two of Leakage cooler(s). The cooled water flow may be divided between the Reactor Coolant Drain Header and the return to the Reactor Coolant Drain Tank. Water in the Reactor Coolant Drain Header flows to either the Reactor Coolant Bleed Holdup Tank or the Miscellaneous Waste Tank.

A minimum level of cooled water is maintained in the Drain Tank to quench pressurizer relief valve blowdown.

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To minimize small pressure transients which might inhibit gravity flow, the Reactor Coolant Drain Tank is vented to the large volumes of the Reactor Coolant Bleed Holdup Tanks. A nitrogen blanket is normally maintained on both the Drain and Bleed Holdup Tanks. The vent to the WDG System, and the nitrogen supply valve are normally closed.

1.3 System Design Requirements

The design of the Reactor Coolant Leakage Recovery System considers both the flowrate and temperature of reactor coolant leakage. The system design flowrate (leakage rate) is equal to the maximum permitted leakage rate of identified reactor coolant leakage (30 gpm).

The coolers heat removal capacity is designed to maintain the Drain Tank at 126°F with 3 gpm Reactor Coolant Pump seal leakage, 15 gpm valve stem leakage, and 15 gpm pressurizer relief valve leakage. If the three relief valves simultaneously blowdown, Tank temperature will instantaneously increase to 191°F and in two hours return to its equilbrium temperature, 126°F.

The Tank instrumentation is sufficently sensitive to measure a leakage rate of one gpm in one hour.

Admittance to the Reactor Building is not required because pump and remote valve status is controlled from the Control Room.

The stainless steel system is Seismic Class II and class C cleanliness. The piping is fabricated in accordance with ANSI B31.7.0.

2.0 DETAILED DESCRIPTION OF SYSTEM

2.1 Components

2.1.1 Reactor Coolant Drain Tank, WDL-T-3

The 7,240 gallon Reactor Coolant Drain Tank (Table 1) collects leakage, and quenches a blowdown of the pressurizer relief valve. To ensure sufficient quenching capability the tank temperature is normally maintained below 126° and water level is maintained above 75 3/8" full.

The tank is normally nitrogen blanketed. The vapor space is connected ot the Reactor Coolant Bleed Holdup Tanks to absorb pressure changes. The tank may be vented to the WDG system. The tank is protected by a 150 psi relief valve. which relieves to the Reactor Building Sump and a 200 ± 25 ps rupture disc. If it is necessary to completely drain the tank, the contents may be manually drained to the Reactor Building Sump.

The Reactor Coolant Drain Tank is located in the Reactor Building at the 289'-0" level.

2.1.2 Leakage Transfer Pumps, WDL-P-9A and WDL-P-9B

The single stage centrifugal pumps (Table 2) are rated at 400 gpm with a Total Dynamic Head of 150 feet. The pumps take their suction from the Reactor Coolant Drain Tank, and discharge to their individual coolers.

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The two pumps are located at 282'-6" adjacent to the Reactor Coolant Drain Tank Cubicle. WDL-P-9A and 9B are powered from MCC 2-34 and 2-44 respectively, and are controlled locally or from Panel 8A.

2.1.3 Leakage Coolers, WDL-C-1A and WDL-C-1B

The leakage is pumped through the tube side of the Coolers (Table 3). The horizontal heat exchanger shell is cooled by the Decay Heat Closed Water Cooling (DHCCW) system. The DHCCW system has two pumps which maintain circulation through the coolers during normal operation. For a further explaination of operation on the shell side of this cooler, see the Decay Heat Closed Water Cooling System Description, Index No. 29.

2.1.4 Major System Valves

Pumpout Control Valve, WDL-V1118

This 4" stainless steel 150 psi valve is located off of the cooler discharge header. By throttling this valve on Panel 8A, the relative recirculation/transfer ratio for the Bleed Holdup Tanks may be varied. To ensure sufficient quenching capacity the valve will automatically shut before minimum the level falls below its specified minimum.

Reactor Drain Tank/Reactor Bleed Tank Interconnect (Inside Containment) WDL-V1095.

WDL-V1095, is normally open to equalize pressure between the Drain Tank in the Reactor Building and the Bleed Hold-up Tank in the Auxiliary Building. The two inch 600 psi valve will shut with an ES signal. To protect the Bleed

Holdup Tanks from overpressurization, the valve will close with high pressure in the Drain Tank. It will automatically reopen with decreasing pressure.. The valve is controlled from Panel 8A with an AUTO-CLOSE switch. Indication is on Panels 8A, 13, and 15.

Reactor Drain Tank/Reactor Bleed Tank Interconnect Valve (Outside Containment Isolation), WDL-V1092

WDL-V1092 is similar to WDL-V1092 except that it is controlled by an OPEN-CLOSE pusbutton, and it does not automatically close with high Drain Tank pressure. Both containment isolation valves close with and ES signal.

Containment Isolation Valves WDL-V127, and WDL-V126

WDL-V127 and WDL-V126 are one inch, 600 psi, normally shut valves to the WDG System. They have indication and control on Panel 301B.

2.2 Instruments, Controls, Alarms, and Protective Devices

2.2.1 Instruments and Controls

To nonquantitatively evalute leakage, twelve thermocouples are on the pressurizer relief valve piping, and two on the piping form each of the 27 valve stem leakoffs. Generally the thermocouples for the valve leakoff piping are on the pipe surface 2 and 7 feet from the valve.

The thermocouples supply signals to Multipoint Recorder, YM-TR-7167 on Panel 10. The recorder enables the operator to observe trends and abnormalities in temperature readings

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which might be indicative of leakage.

Leakage from the Reactor Coolant Pump Seal flows into an eccentricly mounted catch basin. A full catch basin dumps its fluid and actuates a proximity switch. Thus flowrate is directly proportional to the flowswitch actuation rate. If the maximum flowrate of the catch basin is exceeded, the leakage bypasses the catch basin. Separate indication is provided for each pump on Panel 8A.

Level instrumentation, provided on Panel 8A, is used to determine leakage into the tank, and to evaluate the requirements for additional tank pumpdown.

The amount of liquid pumped out of Drain Tank to the Reactor Coolant Drain Header is monitored by flowrecorder, WDL-FR-7100, on Panel 8A and controlled by WDL-V1118 hand switch, WDL-FHC-7101, on the same Panel.

For a specific description of these and other instruments and controls, see Table 4.

2.2.2 Alarms and Protective Devices

For a list of the alarms see Talbe 5. As noted previously, WDL-V1118, Tank Pumpout valve, is interlocked to shut and prevent the Tank level from falling below the minimum level required for quenching the relief valve blowdown. Bleed Holdup Tank/Drain Tank interconnect valves, WDL-V1095 is shut with high pressure in the Drain Tank. If a Pressurizer Relief valve lifted and failed to reset, the Bleed Holdup

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Tank is protected from rupture by shutting WDL-V1095. The Auxiliary Building is thus protected against contamination which might result from a Reactor Bleed Holdup Tank failure. The Drain Tank itself is protected by a 150 psig relief valve and a 200 ± 25 psig rupture disc which would fail if a Pressurizer relief valve failed to reseat.

3.0 PRINCIPAL MODES OF OPERATION

3.1 Startup

For intitial startup, the discharge valves of each Transfer Pump, WDL-V1105A and B, and the loop throttled valve, WDL-V1119, are positioned so that each pump discharges 400 gpm when both are operating, and so that one pump will discharge less than 600 gpm when operating singlely Oxygen is purged from the Tank by Nuclear Nitrogen.

For normal startup, one or two Leakage Transfer Pumps are started with the corresponding DHCCW Leakge Closed Cooling Pumps. The Pumpout Valve, WDL-V1118, is positioned Leakage water is recirculated and pumped out of the Drain Tank as required by leakage conditions.

3.2 Normal Operation

The flow from the Reactor Coolant Pump Seals, and the temperature of the system drain piping is recorded to determine abnormal leakage in system components.
For design leakage conditions both Transfer Pumps, both coolers, and the corresponding Leakage DHCCW Pumps are in operation. The position of the Pumpout Control Valve, WDL-V1118, is determined by the Tank Level and the pump-out flow recorders, WDL-FR-7100. The Transfer Pumps

discharge 800 gpm of 126°F liquid through the coolers. Twenty four (24) gpm is directed to the Reactor Coolant Drain Header, and the remaining 776 gpm of cooled leakage is returned to the Drain Tank. For conditions less than maximum design, one pump may be run, or if leakage is small one pump may ocassionally run to pump-down and cool the Drain Tank. Under these conditions, the Tank Temperature should be maintained below 150°F. If level measurements are required, WDL-V1118 is shut, and the Drain Tank Leakage recirculated without discharge. The multipoint temperature recorded runs as required. The normal operating level should be maintained between 74 1/16" and 77 7/8" (303 gallons).

The discharge of the Dfain Tank is normally directed to one of the Bleed Holdup Tanks. It may also be directed to the Miscellaneous Waste Holdup Tank.

3.3 Shutdown

The Leakage Transfer Pumps and the associated Leakage DHCCW Pumps are stopped manually.

3.4 Special or Infrequent Operation

After a pressurizer relief valve has blowndown to the tank excessive backpressure may cause RC Pump Seal Water to temporarily overflow to the Reactor Building Sump. The both Transfer Pumps and both Leakage DHCCW Pumps should be started with maximum recirculation flow. The Tank Level should be permitted to increase to maximum operating limit (77 7/8") before pumpout of the Tank is resumed.

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A malfunctioning pump may be repaired while operation continues with one pump.

3.5 Emergency

The Containment Isolation Valve shut with an ES signal The Leakage Transfer Pumps are unpowered and idle during a Loss of Coolant Accident (ES signal) and during a Loss of Power Accident.

4.0 HAZARDS AND PRECAUTIONS

To ensure that a quenching capacity is maintained, the maximum temperature and normal level conditions should be meet at all times there is a bubble in the pressurizer (the reactor coolant systmm is pressurized). The Leakage is radioactive and should be treated accordingly.

When entering or venting a nitrogen blanketed tank, the area should be ventilated to ensure that the air contains a minimum amount of oxygen.

There is no interlock which ensures that the Leakgge DHCCW Pumps are running when the Leakage Transfer Pumps are running. There will be no heat transfer unless there is flow on both sides of the same cooler.

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TABLE 1

REACTOR COOLANT DRAIN TANK

Identification	WDL-T-3
Manufacturer	Richmond Engineering Co., Inc.
Capacity - gallons	7240
Installation	Horizontal
Outside diameter & Length, Ft.	8, 23
Shell Material	SA-264
Shell Thickness, in.	2-1/16
Design Temperature, ^{o}F	500
Design pressure, psig	550
Corrosion Allowance, in.	0
Design Code	1968 ASME Code, Sec. III, Class C
Code Stamp Required	Yes

Classification	Level
Code	N-2
Quality Control	2
Seismic	I
Cleanliness	B

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TABLE 2

LEAKAGE TRANSFER PUMPS

PUMP DETAILS	
Identification	WDL-P-9A, WDL-P-9B
Number Installed	2
Manufacturer	Crane-Deming
Model No.	VA-40E
Type	Single Stage Vertical In-Line
Rated Speed, rpm	1800
Rated Capacity, gpm	400
Rated total dynamic head, ft.	150
NPSH, ft.	6
Design pressure, psig	150
Design Temperature, ^{o}F	250
Lubricant/Coolant	oil/air
MOTOR DETAILS	
Manufacturer	U.S. Motors
Type	Squirrel Cage Induction
Enclosure	Enclosed
Rated, Horsepower	40
Speed, rpm	1800
Lubricant/Coolant	oil /Air
Power requirements	460v/3Ø/ 60 HZ, Full Load Current
Power Source	480v MCC 2-34 for WDL-P-9A 480v MCC 2-44 for WDL-P-9B
Classification	Level
Code	C
Quality Control	Q-4
Seismic	II
Cleanliness	B

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TABLE 3

LEAKAGE COOLERS

Identification	WDL-C-1A WDL-C-1B
Number Installed	2
Manufacturer	Struthers Wells
Cleanliness Factor	0.8
Heat Transfer, Btu-hr	5.82×10^6
Tube Side	
Fluid Flow, lb/hr-source	2×10^5
Design Pressure, psig	150
Design Temperature, ^oF	250
Material	304SS
Pressure Drop, psi	10
Shell Side	
Fluid Flow, lb/hr-source	2×10^5
Design Pressure, psig	150
Design Temperature, ^oF	200
Material	CS
Pressure drop, psi	10

	Level	
Classification	Shell	Tube
Code	ASME VIII	ASME VIII
Quality Control	Q-4	Q-4
Seismic	II	II
Cleanliness	D	B

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TABLE NO. 4
INSTRUMENTATION AND CONTROLS

IDENTIFICATION	DESCRIPTION	FUNCTION	LOCATION	TYPE	INPUT RANGE	OUTPUT RANGE	SETPOINT
MDL-TE-1200	Temperature Element	Measure Reactor Coolant Drain Tank Temperature	RCDT	Dual RTD	0-220°F	93.02-147.15 Ω	N/A
MDL-TT-1200	Temperature Transmitter	Transmit signal to MDL-TI-1200	Pnl 3018	Solid State	10-50 mAdc	93.02-147.15 Ω	N/A
MDL-TI-1200,6-1	Temperature Indicator	Indicate the RCDT temp.	Pnl 3018 & Pnl 6A respect.	Millimeter Vert	10-50 mAdc	0-320°F	N/A
MDL-PT-1202	Pressure Transmitter	Measure RCDT Pressure	Rack 433	Bellows	0-75 psig	10-50 mAdc	N/A
MDL-PI-1202,6-1	Pressure Indicator	Indicator RCDT Pressure	Pnl 3018 & Pnl 6A respectively	Millimeter Vert	10-50 mAdc	0-75 psig	N/A
MDL-PS-1203-1	Pressure Switch	Provide signal for Hi/Lo RCDT Pressure, MDL-PA-1203 & 1.	Rack 433	Diaphragm	100-1000 psig	N/A	315 psi
MDL-PS-1203-2	Pressure Switch	Signal to shut/open MDL-V1095	Rack 433	Diaphragm	0-100 psig	N/A	10 psi shut 6 psi open
MDL-PS-1203-3	Pressure Switch	Signal for Hi/Lo RCDT Pressure, MDL-PA-1203A-1	Rack 433	Diaphragm	1-6 psig	N/A	3 psig
MDL-LG-1205	Level Gauge	Measure RCDT Level	RCDT	Gauge Glass	0-96"	0-96"	N/A
MDL-LS-1206	Level Switch	Provide signal for RCDT Hi/Lo Level Alarm, MDL-LA-1206 and-1.	RCDT	Float Cage	N/A	N/A	77 7/8" from Tk. Bottom.
MDL-LS-1208	Level Switch	Provide signal for RCDT Hi/Lo Level Alarm, MDL-LA-1206	RCDT	Float Cage	N/A	N/A	75 3/8" from Tk. Bottom

TABLE NO. 4
INSTRUMENTATION AND CONTROLS

IDENTIFICATION	DESCRIPTION	FUNCTION	LOCATION	TYPE	INPUT RANGE	OUTPUT RANGE	REMARKS
WDL-LS-1307	Level Transmitter	Provide signal for/to Wh Level Alarm WDL-IALL-1307 and Indicator WDL-LI-1307A1	RCBP	Diaphragm	70-85'	10-50 madc	N/A
WDL-LI-1307A1	Level Indicator	Indicator RCBP Level	Pnl 3012 & Pnl 04 respectively	Milliameter	0-8'	10-50 madc	N/A
WDL-FE-7100	Flow Element	Provide Signal for WDL-FR-7100	Pipe	orfice	0-150 gpm	0-100" H_2O	N/A
WDL-FT-7100	Flow Transmitter	Transmit signal to WDL-FR-7100	Rack 431	solid state	0-100" H_2O	10-50 madc	N/A
WDL-FR-7100	Flow Recorder	Record Pumped flow	Pnl. 08	Ninetyre single pen	10-50 . madc	0-150 gpm	N/A
WDL-FIC-7101	Hand switch	Control Pumped control valve, WDL-V1110	Pnl. 08	Solid State Man.	N/A	N/A	N/A
WDL-TE-7102	Temperature Elem.	Provide signal for WDL-TI-7102	Pipe	RTD	0-250°F	92.93-147.61 Ω	N/A
WDL-TT-7102	Temperature Transmitter	Provide signal for WDL-TI-7102	Rack 432	solid state	92.93-147.61 Ω	10-50 madc	N/A
WDL-TI-7102	Temperature Indicator	Cooler Outlet temperature	Pnl 3012	milliameter	10-50 madc	0-250°F	N/A
WDL-FE-7103&4	Flow Element	Flow measurement for system balancing on discb of WDL-P-9A&B respectively	Pipe	orfice	400 gpm	0-100" H_2O	N/A
WDL-PT-7105, & 7106	Pressure Transmitter	Provide signal for WDL-PI-1705 & 1706	Rack 433	Bellows	0-150 psig	10-50 madc	N/A

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IDENTIFICATION	DESCRIPTION	FUNCTION	LOCATION	TYPE	INPUT RANGE	OUTPUT RANGE	SETPOINT
WDL-PI-7105, 7106	Pressure Indicator	Indicate Disch. Press of WDL-P-2A &2B respect.	Pnl. 8A	Millometer	10-30 Hnds	0-150 psig	N/A
WDL-FE-7107, 7109, 7109 & 7110	Flow Element	Provide signal for WDL-FS/FTM-7107, 7108, 7109 & 7110.	Local	catch basin	0-6 gpm	0-10 gpm	N/A
WDL-FS-7107, 7108, 7109 7110	Flow Switch	Provide signal for WDL-FIM-7109.	Local	Electrical Timer	0-10 gpm	N/A	7.5 gpm (2.7 gpm)
WDL-FIT-7107, 7109, 7108, & 7109	Flow Indicating switch	Seal leakage, indication for RC-P-1A, RC-P-2A, RC-P-1B RC-P-2B respectively.	Pnl 8A	Electrical Timer	0-15 gpm	0 gpm	N/A
WDL-TE-7113 thru 7166	Temperature Element	Provide signal for valve leak-off piping surface temp. Input for YN-TR-7167.	Pipe	thermocouple	0-700°F	-5.867 to 22.896 MV	N/A
WDL-TSH-7112	Handswitch	Control RCDT/Blood Holdup Tank interconnect, WDL-V1098	Pnl 8A	3-30 Pushbutton	N/A	N/A	N/A
WDL-FE-7199	Flow Element	Restrict flow and provide signal for balancing	Pipe	orfice	0-900 gpm	0-791.28"	N/A
WDL-TE-7201 thru 7212	Temperature Element	Provide signal for Pressurizer heads temperature Input for YN-TR-7167.	Pipe	thermocouple	0-700°F	-5.867 to 22.896 MV	N/A
YN-TR-7167	Temperature Recorder	Monitor leakup Pnl 10 drain pipe temperature	Pnl 10	Multipoint	-5.867 to 22.896 MV	0-700°F	N/A

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TABLE NO. 5
PANEL MOUNTED ANNUNCIATORS AND COMPUTER INPUTS

IDENTIFICATION	MEASURED VARIABLES UNITS	ALARM SET HIGH	ALARM SET LO	INPUT SOURCE	VARIABLE RANGE	PANEL
WDL-PA-1203 & 1	RC Drain Tank Hi/Lo Pressure, psi	215	3	WDL-PE-1203-1 WDL-PE-1203-3	100-1000 1-8	Pnl. 3018 & Pnl.-8A respectively.
WDL-LA-1205 & 1	RC Drain Tank Hi/Lo Level	77 7/8	75 3/8	WDL-LE-1206 WDL-LE-1208	N/A	Pnl. 3018 & Pnl. 8A respectively.
WDL-LALA-1207	RC Drain Tank Level Lo Lo, in	NA	74	WDL-LE-1207	N/A	Pnl. 8A
WDL-FAH-7099	RC Pump Seal Leakage Flow Hi, gpm	2.7	NA	WDL-FE-7107 7109, 7108 & 7110	0-4	Pnl. 8A
WDL-8A-7097	Leakage Transfer Pump Trip	NA	NA	WDL-P-9A OLX WDL-P-9B OLX	NA NA	Pnl. 8A

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3654 B	WDL-P-9A Trip, overload	NA	NA	OLX	NA
3655 B	WDL-P-9B Trip, overload	NA	NA	OLX	NA

Form BR 8560 3A