5.4 Components and Subsystem Design

The information in this section of the reference ABWR DCD, including all subsections, tables and figures, is incorporated by reference with the following departures and supplements.

STD DEP T1 2.4-1 (Figure 5.4-10, Figure 5.4-11)

STD DEP T1 2.4-3 (Table 5.4-2, Figures 5.4-8 and 5.4-9)

STD DEP T1 2.4-4 (Table 5.4-2, Figures 5.4-9 and 5.4-11)

STD DEP T1 2.14-1 (Figure 5.4-10)

STD DEP 5B-1 (Table 5.4-4, Figure 5.4-11)

STD DEP 5.4-1 (Table 5.4-6, Figure 5.4-12, and Figure 5.4-13)

STD DEP 5.4-2 (Figure 5.4-1)

STD DEP 5.4-3 (Table 5.4-3, Table 5.4-5)

STD DEP 5.4-4 (Figure 5.4-4)

STD DEP 5.4-5 (Figure 5.4-12)

STD DEP 6C-1(Table 5.4-1a, Table 5.4-2, Figures 5.4-9 and 5.4-11)

STD DEP 7.3-11

STP DEP 10.1-3

STD DEP Vendor

5.4.1.3.1 Recirculation Motor Cooling Subsystem

STD DEP 5.4-4

The RMHX is a vertically-oriented, shell-and-tube U-tube heat exchanger with a bottom water box, as shown schematically on Figure 5.4-4. Principal approximate sizing parameters feature a carbon steel or stainless steel *shell outside diameter of approximately 400 mm and approximately 2700 mm length, 8.62 MPaG design pressure and 302°C design temperature. Tubes are stainless steel material designed for external pressure loading. Shell tube sheet and water box material is carbon steel* or stainless steel*. The RMHX stands taller than the RM motor casing, but the bottoms of each are located approximately at the same elevation. RMC Subsystem primary coolant from the RIP motor cavity flows outbound from a nozzle near the top of the motor casing, and through 63A stainless steel piping, which courses across and upward to the RMHX primary coolant inlet nozzle located near the top of the RMHX shell. This RMC flow proceeds downward, under the combined action of driving*

pressure head developed (when the RIP is running) by the RM auxiliary impeller and by buoyancy head developed by temperature (density) differences existing over the vertical closed-loop path lengths. In moving downward through the shell, this primary coolant sweeps back and fourth across the tube bundles guided by horizontal flow baffle/tube-support plates. Flow exits from the shell through a nozzle located just above the tube sheet and crosses, via 65A piping, directly back to the RIP motor casing on a piping run which is arranged primarily in a horizontal plane. Upon entering the RM casing, this primary coolant is drawn into the suction region of the RM auxiliary impeller, where it is then driven upward through the RM to begin another circuit around this RM-RMHX-RM flow loop.

5.4.5.2 Description

STP DEP 10.1-3

Two isolation valves are welded in a horizontal run of each of the four main steam pipes; one valve is as close as possible to the inside of the drywell, and the other is just outside the containment.

Figure 5.4-7 shows a main steamline isolation valve (MSIV). Each MSIV is a Y-pattern, globe valve. Rated steam flow through each valve is ~~1.918 x 10^6 kg/h~~ 1.912 x 10^6 kg/h*. The main disc or poppet is attached to the lower end of the stem. Normal steam flow tends to close the valve, and higher inlet pressure tends to hold the valve closed. The bottom end of the valve stem closes a small pressure balancing hole in the poppet. When the hole is open, it acts as a pilot valve to relieve differential pressure forces on the poppet. Valve stem travel is sufficient to give flow areas past the wide open poppet greater than the seat port area. The poppet travels approximately 90% of the valve stem travel to close the main steam port area; approximately the last 10% of the valve stem travel closes the pilot valve. The air cylinder actuator can open the poppet with a maximum differential pressure of 1.38 MPaG across the isolation valve in a direction that tends to hold the valve closed.*

A Y-pattern valve permits the inlet and outlet passages to be streamlined; this minimizes pressure drop during normal steam flow and helps prevent debris blockage.

5.4.5.4 Inspection and Testing

STD DEP 7.3-11

Leakage from the valve stem packing is collected and measured by the drywell drain system. ~~During shutdown, while the nuclear system is pressurized, the leak rate through the inner valve stem packing can be measured by collecting and timing the leakage.~~

5.4.6.2.1.3 Interlocks

STD DEP T1 2.4-3

The following defines the various electrical interlocks:

(1) Valve~~s~~ F039 ~~and F047 are two~~ is key-locked open ~~valves~~ with an individual keylock.

(2) The F001 limit switch activates when not fully closed and closes F008 and F009.

(3) The F039 limit switch activates when fully open and clears the permissive for F037 ~~and F045~~ to open.

(4) The F037 and turbine trip and throttle valve limit switches activate when not fully closed to initiate the turbine governor valve signal ramp generator and to clear permissives for F004 to open.

(5) The F037 limit switch activates when fully closed and permits ~~F031, F032,~~ F040 and F041 to open and closes F004 and F011.

(6) The turbine trip throttle valve ~~(part of C002)~~ limit switch activates when fully closed and closes F004 and F011.

(7) High reactor water level (Level 8) closes F037~~, F012, F045~~ and, subsequently, F004 and F011. This level signal is sealed in and must be manually reset. It will automatically clear if a low reactor water level (Level 2) reoccurs.

(8) High turbine exhaust pressure, low pump suction pressure, 110% turbine electrical overspeed, or an isolation signal actuates the turbine trip logic and closes the turbine trip and throttle valve. When the signal is cleared, the trip and throttle valve must be reset from the control room.

(9) Overspeed of 125% trips the mechanical trip, which is reset at the turbine.

(10) An isolation signal closes F035, F036, F048, and other valves as noted in Items (6) and (8).

(11) An initiation signal opens F001,~~and~~ F004, and F037~~, F012 and F045~~ when other permissives are satisfied, starts the gland seal system, and closes F008 and F009.

(12) High- and low-inlet RCIC steamline drain pot levels respectively open and close F058.

(13) The combined signal of low flow plus pump discharge pressure opens and, with increased flow, closes F011. Also see Items (5), (6) and (7).

5.4.6.2.2.1 Design Conditions

STD DEP T1 2.4-3

Operating parameters for the components of the RCIC System are shown in Figure 5.4-9. The RCIC components are:

(1) ~~*One 100% capacity turbine and accessories*~~One 100% capacity turbine, pump set and accessories.

~~*(2) One 100% capacity pump assembly and accessories.*~~

(2) ~~*(3)*~~ *Piping, valves, and instrumentation for:*

(a) Steam supply to the turbine

(b) Turbine exhaust to the suppression pool

(c) Makeup supply from the condensate storage tank to the pump suction

(d) Makeup supply from the suppression pool to the pump suction

(e) Pump discharge to the feedwater line, a full flow test return line, a minimum flow bypass line to the suppression pool~~*, and a coolant water supply to accessory equipment*~~

The basis for the design conditions is ASME B&PV Code Section III, Nuclear Power Plant Components.

Analysis of the net positive suction head (NPSH) available to the RCIC pump in accordance with the recommendations of Regulatory Guide 1.1 is provided in Table 5.4-1a.

5.4.6.2.5.2 Emergency Mode (Transient Events and LOCA Events)

STD DEP T1 2.4-3

Startup of the RCIC System occurs automatically either upon receipt of a reactor vessel low water level signal (Level 2) or a high drywell pressure signal. During startup, the turbine control system limits the turbine-pump speed to its maximum normal operating value, controls transient acceleration, and positions the turbine governor valve as required to maintain constant pump discharge flow over the pressure range of the system. ~~*Input to the turbine governor is from the flow controller monitoring the pump discharge flow. During standby conditions, the flow controller output is saturated at its maximum value.*~~ RCIC system utilizes a flow control system that is an integral part of the pump and turbine.

~~*When the RCIC System is shut down, the low signal select feature of the turbine control system selects the idle setting of a speed ramp generator. The ramp generator output signal during shutdown corresponds to the low limit step and a turbine speed demand of 73.3 to 104.7 rad/s.*~~

~~*On RCIC System startup, bypass valve F045 (provided to reduce the frequency of turbine overspeed trips) opens to accelerate the turbine to an initial peak speed of*~~

~~*approximately 157 rad/s; now under governor control, turbine speed is returned to the low limit turbine speed demand of 73.3 rad/s to 104.7 rad/s. After a predetermined delay (5 to 10 s), the steam supply valve leaves the full closed position and the ramp generator is released. The low signal select feature selects and sends this increasing ramp signal to the governor. The turbine increases in speed until the pump flow satisfies the controller setpoint. Then the controller leaves saturation, responds to the input error, and integrates the output signal to satisfy the input demand.*~~

The operator has the capability to select manual control of the governor, and ~~adjust~~ change *speed and flow (within hardware limitations) to match decay heat steam generation during the period of RCIC operation.*

The RCIC pump delivers the makeup water to the reactor vessel through the feedwater line, which distributes it to obtain mixing with the hot water or steam within the reactor vessel.

The RCIC turbine will trip automatically upon receipt of any signal indicating turbine overspeed, low pump suction pressure, high turbine exhaust pressure, or an autoisolation signal. Automatic isolation occurs upon receipt of any signal indicating:

(1) A high pressure drop across a flow device in the steam supply line equivalent to 300% of the steady-state steam flow at 8.22 MPaA.

(2) A high area temperature.

(3) A low reactor pressure of 0.34 MPaG minimum.

(4) A high pressure in the turbine exhaust line.

The steam supply valve F037~~, steam supply bypass valve F045 and cooling water supply valve F012~~ will close upon receipt of signal indicating high water level (Level 8) in the reactor vessel. These valves will reopen (auto-restart) should an indication of low water level (Level 2) in the reactor vessel occur. Water Level 2 automatically resets the water level trip signal. The RCIC System can also be started, operated, and shut down remote manually provided initiation or shutdown signals do not exist.

5.4.7.1 Design Basis

STD DEP T1 2.4-1

*Connections are provided to the upper pools on ~~two~~*three *loops to return shutdown cooling flow to the upper pools during normal refueling activities if necessary. These connections also allow the RHR System to provide additional fuel pool cooling capacity as required by the Fuel Pool Cooling System during the initial stages of the refueling outage.*

5.4.7.1.1.6 Wetwell and Drywell Spray Cooling

STD DEP 5.4-3

Two of the RHR loops provide containment spray cooling subsystems. Each subsystem provides both wetwell and drywell spray cooling. This subsystem provides steam condensation and primary containment atmospheric cooling following a small break LOCA by pumping water from the suppression pool, through the heat exchangers and into the wetwell and drywell spray spargers in the primary containment. The preferred method of containment spray is with both wetwell and drywell spray used simultaneously started by manual initiation. If wetwell spray is desired by itself, without drywell spray, it can be initiated by operator action, but must be used in conjunction with ~~one of the full flow modes, which are either~~ the suppression pool (S/P) cooling mode ~~or the low pressure flooder (LPFL)mode~~. To accomplish this, a full flow mode must be initiated first, then its flow is throttled back to approximately one half flow. The wetwell spray valve would then be opened, followed by re-establishing rated flow for wetwell spray operation by opening the applicable full flow mode throttle valve as required. This mode of operation is only recommended for performance of periodic surveillance required by the Technical Specifications, which would likely utilize S/P cooling for the full flow mode. The wetwell spray mode is terminated automatically by a LOCA signal. If desired, the drywell spray mode can be initiated by operator action of opening the drywell spray valves post-LOCA in the pressure of high drywell pressure. The drywell mode is terminated automatically as the RPV injection valve starts to open, which results from a LOCA and reactor depressurization. Both wetwell and drywell spray modes can also be terminated by operator action. The wetwell spray lines have a flow meter with indication in the control room.

5.4.7.1.1.8 Fuel Pool Cooling

STD DEP T1 2.4-1

~~*Two*~~ Three *of the RHR loops* can *provide supplemental fuel pool cooling during normal refueling activities and any time the fuel pool heat load exceeds the cooling capacity of the fuel pool heat exchangers. For normal refueling activities where the reactor well is flooded and the fuel pool gates are open, water is drawn from the reactor shutdown suction lines, pumped through the RHR heat exchangers and discharged through the reactor well distribution spargers. For 100% core removal, if necessary, water is drawn from the Fuel Pool Cooling (FPC) System skimmer surge tanks, pumped through the RHR heat exchangers and returned to the fuel via the FPC System cooling lines. These operations are initiated and shut down by operator action.*

5.4.7.2.2 Equipment and Component Description

STD DEP 6C-1

STD DEP Vendor

(1) System Main pumps

The main pumps must satisfy the following system performance requirements. The pump equipment performance requirements include additional margins so that the system performance requirements can be achieved. These margins are standard ~~GE~~equipment specification practice and are included in procurement specifications for flow and pressure measuring accuracy and for power source frequency variation.

Number of pumps	*3*
Pump type	*Centrifugal*
Drive unit type	*Constant Speed Induction Motor*
Design flow rate	*954 m^3/h*
Total discharge head at design flow rate	*125m*
Maximum bypass flow	*147.6 m^3/h*
Minumum total discharge head at maximum bypass flow rate	*220m Max* *195m Min*
Maximum runout flow	*1130 m^3/h*
Maximum pump brake horse power	*550 kw*
Net positive suction head ~~(HPSH)~~(NPSH) at 1m ~~about~~ above the pump floor setting	~~2.4m~~2.0m
Process fluid temperature range	*10 to 182°C*

STD DEP 5B-1

(2) Heat Exchangers

(c) Safe Shutdown—The RHR System brings the reactor to a cold shutdown condition of less than 100°C within 36 hours of control rod insertion with two out of the three divisions in operation. The RHR System is manually activated into the shutdown cooling mode below a nominal vessel pressure of 0.93 MPaG.

The RHR heat exchanger capacity is required to be sufficient to meet each of these functional requirements. The limiting function for the RHR heat exchanger capacity is reactor shutdown. *~~post LOCA containment cooling.~~ The heat exchanger capacity, K, is* 4.27×10^5 W/°C *~~370.5kJ/°C-s~~ per heat exchanger.*

The performance characteristics of the heat exchangers are shown in Table 5.4-4.

5.4.7.2.6 Manual Action

STD DEP T1 2.4-1

(6) Fuel Pool Cooling

Three*~~Two~~ of the RHR loops* can *provide supplemental fuel pool cooling during normal refueling activities and any time the fuel pool heat load exceeds the cooling capacity of the fuel pool heat exchangers. For normal refueling activities where the reactor well is flooded and the fuel pool gates are open, water is drawn from the reactor shutdown suction lines, pumped through the RHR heat exchangers and discharged through the reactor well distribution spargers. For 100% core removal, if necessary, water is drawn from the Fuel Pool Cooling (FPC) System skimmer surge tanks, pumped through the RHR heat exchangers and returned to the fuel pool via the FPC System cooling lines. These operations are initiated and shut down by operator action.*

5.4.8.2 System Description

STD DEP 5.4-1

The total capacity of the system, as shown on the process flow diagram in Figure 5.4-13, is equivalent to 2% of rated feedwater flow. ~~Each pump, NRHX, and F/D is capable of 50% system capacity operation, with the one RHX capable of 100% system capacity operation.~~ Each pump and F/D is capable of 100% system capacity operation. Each of two NRHX is capable of 50% system capacity operation, with the one RHX capable of 100% system capacity operation.

5.4.15 COL License Information

5.4.15.1 Testing of Main Steam Isolation Valves

The following site-specific supplement addresses COL License Information Item 5.7.

Testing of the Main Steam Isolation valves under operating conditions will be performed during the Initial Test Program as described in Subsections 14.2.12.2.26 and 14.2.12.2.34. ITAAC 6 from Table 2.1.2, Nuclear Boiler System, will ensure the MSIVs meet their design basis.

5.4.15.2 Analysis of Non-Design Basis Loss of AC Coping Capability

The following site-specific supplements listed in this section address COL License Information Item 5.8.

5.4.15.2.1 Analysis to Demonstrate the Facility has 8 Hour Non-Design SBO Capability

The capability of the RCIC System to operate for 8 hours as discussed in Subsection 5.4.6 and NUREG-1503 will be demonstrated during the Initial Test Program as described in section 14.2.12.1.9. A best estimate analysis will be available for NRC review by the end of preoperational testing demonstrating that the RCIC system can function for 8 hours in an SBO event. This analysis will reflect Class 1E loadings based on expected plant and operator response during this event. Additionally, an evaluation of room temperature response during the transient will ensure that equipment remains within its qualification envelope. Similar evaluations have been satisfactorily performed on other ABWRs. (COM 5.4-1)

5.4.15.2.2 Analysis to Demonstrate that the DC Batteries and SRV/ADS Pneumatics have Sufficient Capacity

A best estimate analysis demonstrating adequate DC battery and pneumatic supply capacity based on the as purchased equipment configuration will be completed and available for NRC review prior to the commencement of the Preoperational Test Program. This analysis will reflect Class 1E bus loadings based on expected plant response during the 8-hour SBO event. Additionally, an evaluation of room temperature response will ensure that the batteries remain within their qualification envelope. Similar evaluations have been satisfactorily performed on other ABWRs. (COM 5.4-2)

5.4.15.3 ACIWA Flow Reduction

The following site-specific supplement addresses COL License Information Item 5.9.

A hydraulic analysis will be performed to determine if a flow reduction device is needed based on the actual flow rate capacities, pressure, and hose size of the diesel driven pump. This analysis will be available for NRC review prior to the commencement of the Preoperational Test Program. (COM 5.4-3)

5.4.15.4 RIP Installation and Verification During Maintenance

The following site-specific supplement addresses COL License Information Item 5.10.

Procedures address RIP installation and verification for motor bottom cover, as well as visual monitoring of the potential leakage during impeller-shaft and plug removal. A contingency plan assures that core and spent fuel cooling can be provided in the event of loss of coolant during Reactor Internal Pump (RIP) maintenance.

This contingency plan will address the following items:

- Worst case scenario evaluated
- Impact on personnel and plant
- Assumptions made in respect to contingency plan
- Response time of plant and personnel in regard to contingency plan
- Worst case flow rate of drain down of vessel
- Number of pumps plant procedures allow to perform concurrent maintenance activities with the potential to drain the vessel
- Recovery phase

Table 5.4-1a Net Positive Suction Head (NPSH) Available to RCIC Pumps

A Suppression pool is at its minimum depth, El. -3740 mm.

B. ~~Centerline of pump suction~~NPSH Reference level is at El. -7200 mm.*

C. Suppression pool water is at its maximum temperature for the given operating mode, 77°C.

D. Pressure is atmospheric above the suppression pool.

E. Minimum suction strainer area as committed to by Appendix 6C methods.

NPSH available = $H_{ATM} + H_S - H_{VAP} - \cancel{H_F} (H_F + H_{ST})$

where:

H_{ATM}	=	Atmospheric head
H_S	=	Static head
H_{VAP}	=	Vapor pressure head
H_F	=	Maximum frictional head ~~including strainer~~excluding strainer frictional head

H_{ST} = Strainer frictional head

Minimum Expected NPSH
RCIC pump flow is 182m^3/h

The maximum suppression pool temperature is 77°C. However, for conservatism, 100°C is used to calculate the following values.

H_{ATM}	=	~~10.62m~~10.77m
H_S	=	3.46m
H_{VAP}	=	~~4.33m~~4.39m
~~H_F~~	=	~~2.10m~~

NPSH available = ~~10.26~~10.77+3.46 - ~~4.33-2.10=7.65m~~4.39 - (H_F + H_{ST})

NPSH available = 9.84-(H_F + H_{ST})

NPSH required = ~~7.3m~~7.0 m

Margin** = ~~0.35m~~2.84m - (H_F + H_{ST}) = $NPSH_{available} - NPSH_{required}$

*NPSH Reference ~~Point~~level is 1m above the pump floor level

**The final system design will meet the required NPSH with adequate margin.

Table 5.4-2 Design Parameters for RCIC System Components	
(1) RCIC Pump Operation (C001)	
Flow rate	*Injection flow - 182 m^3/h*
	~~Cooling water flow - 4 to 6 m^3/h~~
	~~Total pump discharge - 188 m^3/h (includes no margin for pump wear)~~
Water temperature range	*10°to 60°C, continuous duty* *40°to 77°C, short duty*
NPSH	7.0m*~~7.3m~~ minimum*
Developed head	*900m at 8.22 MPaA reactor pressure*
	186 m at 1.14 MPaA reactor pressure
Maximum pump	*675 kW at 900m developed head* *125 kW at 186m developed head*
Design pressure	*11.77 MPaG*
~~(3) RCIC leakoff orifices (D017, D018)~~	*~~Sized for 3.2 mm diameter minimum to 4.8 mm diameter maximum~~*
(3) Flow element (FE007)	

Table 5.4-2 Design Parameters for RCIC System Components (Continued)	
(4) Valve Operation Requirements	
~~*Cooling water pressure control valve (F013)*~~	~~*Self-contained downstream sensing control valve capable of maintaining constant downstream pressure of 0.52 MPa*~~
~~*Cooling water relief valve (F030)*~~	~~*Sized to prevent overpressuring piping, valves, and equipment in the coolant loop in the event of failure of pressure control valve F013*~~
~~*Barometric condenser condensate drain Line isolation valves (F031 & F032)*~~	~~*These valves operate only when RCIC System is shutdown, allowing drainage to CUW System and they must operate against a differential pressure of 0.52 MPa*~~
~~*Cooling loop shutoff valve (F012)*~~	~~*This valve allows water to be passed through the auxiliary equipment coolant loop and must operate against a differential pressure of 9.65 MPa*~~
~~*Steam supply bypass valve (F045)*~~	~~*Open and/or close against full differential of 8.12 MPa within 5 seconds*~~
~~*Vacuum pump discharge isolation valve (F047)*~~	~~*Open and/or close against 0.314 MPa differential pressure at a temperature of 170°C.*~~
~~*Vacuum pump discharge check valve (F046)*~~	~~*Located at the highest point in the line.*~~
(10) Suction Strainer Sizing	
The suppression pool suction shall be sized so that:	
(a) *Pump NPSH requirements are satisfied when strainer is* ~~*50% plugged*~~ blocked in accordance with RG 1.82 analysis methods~~*; and particles over 2.4 mm diameter are restrained from passage into the pump and feedwater sparger.*~~	

Table 5.4-3 RHR Pump/Valve Logic

Valve Number	Valve Function	Normal Position	Automatic Logic or Permissives		
			Condition	Automatic Action	
F017 B,C	Drywell Spray Valves	Closed	Note *D* **D**	Close	Permissive: To open requires high drywell pressure and F005 fully closed, or to open for test requires F018 fully closed.
F018 B,C	Drywell Spray Isolation Valves	Closed	Note *H* **H**	Close	Permissive: To open requires high drywell pressure and F005 fully closed, or to open fully requires F017 fully closed.
F019 B,C	Wetwell Spray Isolation Valves	Closed	Note *A* **A**	Close	Permissive: To open requires F012 fully closed and either the absence of LOCA or F005 fully closed.
C002	N/A	Run	Note *A* **A**	Stop	

NOTES:

C. ~~*Pump is running*~~ Pump discharge pressure high and low loop flow signal

G. High suppression pool temperature. ~~***(when activated by suppression pool cooling mode)***~~

H. ~~*LOCA condition as indicated by a not-fully-closed injection valve F005.*~~ **LOCA condition as indicated by a not fully closed injection valve F005.**

J. *High loop flow signal.*

Table 5.4-4 RHR Heat Exchanger Design and Performance Data

Design Point Function	~~*Post-LOCA Containment*~~ **Reactor Shutdown**

Table 5.4-5 Component and Subsystem Relief Valves

MPL No.	Service	Relief Route	Relief Pressure (MPaG)	Relief Flow (m^3 /h)
E11-F028A-C	Reactor Water	A	~~*3.44*~~3.43	
E11-F051A-C	Reactor Water	A	~~*3.44*~~3.43	

Table 5.4-6 Reactor Water Cleanup System Equipment Design Data

Pumps		
System Flow Rate (kg/h)	152,500	
Type	Vertical Sealless centrifugal pump	
Number Required	2 **(One Pump is required running at 100% capacity)**	
Capacity (% of CUW System flow each)	~~*50*~~ **100**	
Design Temperature (°C)	66	
Design pressure (MPaG)	~~*10.20*~~ **10.65**	
Discharge head at shutoff (m)	~~*160*~~ **182**	
Heat Exchangers	Regenerative	Nonregenerative
Number Required	1 (3 shells per unit)	2 (2 shells per unit)
Capacity (% CUW System flow each)	100	50
Shell design pressure (MPaG)	~~*10.20*~~ **10.65**	***1.37***
Shell design temperature (°C)	302	85
Tube design pressure (MPaG)	***8.83***	***8.83***
Tube design temperature (°C)	302	302
Type	Horizontal U-tube	Horizontal U-tube
Exchange Capacity (kJ/h) (per unit)	~~*1.15 x 10*~~^{8} **1.15x10**^{8}	~~*2.01x 10*~~^{7} **2.01x10**^{7}
Filter-Demineralizers		
Type	pressure precoat	
Number Required	2 **(One F/D train is required running at 100% capacity)**	
Capacity (% of CUW System flow each)	~~*50*~~ **100**	
Flow rate per unit (kg/h)	~~*76,250*~~ **152,500**	
Design Temperature (°C)	66	
Design pressure (MPaG)	~~*10.20*~~ **10.65**	
Linear velocity (m/h)	~~*~2.5*~~ **~5.0**	
Differential Pressures (MPa)		
Clean	0.034	
Annunciate	0.17	
Backwash	0.21	
Containment Isolation Valves		
Closing time (s)	<30	
Maximum differential pressure (MPa)	8.62	

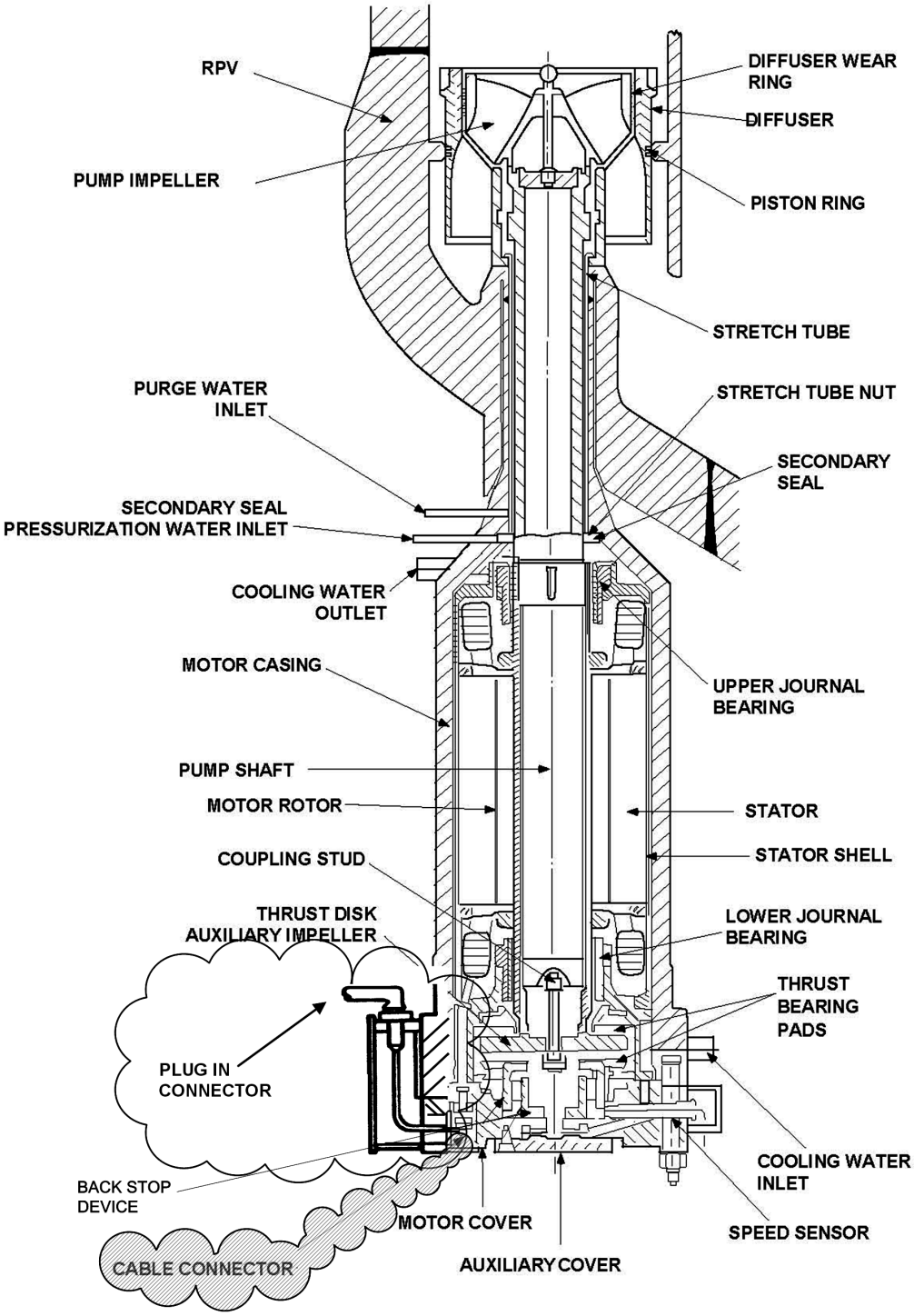

Figure 5.4-1 Reactor Internal Pump Cross Section

Figures located in Chapter 21:

Figure 5.4-4 Reactor Recirculation System P&ID

STD DEP 5.4-4

The Recirculation Motor Heat Exchanger (RMHX) shell, tube sheet and water box material is carbon steel or stainless steel. Material description of connection points between RMHX shell, tube sheet and water box are deleted to permit both of these materials.

Figure 5.4-8 Reactor Core Isolation Cooling System P & ID (Sheet 1, 2, and 3)

STD DEP T1 2.4-3

Replacement of separate pump and turbine assembly with an integrated turbine-pump monoblock device is incorporated in these figures in Chapter 21.

Figure 5.4-9 Reactor Core Isolation Cooling System PFD (Sheet 1 & 2)

STD DEP T1 2.4-3

Replacement of separate pump and turbine assembly requires changes to process conditions for support subsystems.

STD DEP 6C-1

Reduced minimum NPSH available is incorporated in this figure (Sheet 2) in Chapter 21.

STD DEP T1 2.4-4

50% suction strainer blockage is changed to blockage in accordance with RG 1.82 Rev. 3

Figure 5.4-10 Residual Heat Removal System P&ID (Sheet 1, 4 and 6)

STD DEP T1 2.14-1

Removal of the Hydrogen Recombiners

Figure 5.4-11 Residual Heat Removal PFD (Sheet 1)

STD DEP 2.4-1, STD DEP 5B-1 and STD DEP 6C-1

The capability to use RHR division A in the Fuel Pool Cooling Assist Mode, increase Heat Exchanger K Valve, and reduced minimum NPSH available are incorporated in this figure in Chapter 21.

Figure 5.4-11 Residual Heat Removal System PFD (Sheet 2)

STD DEP T1 2.4-1

The capability to use RHR division A in the Fuel Pool Cooling Assist Mode is incorporated in this figure in Chapter 21

STD DEP T1 2.4-4

50% Blockage is changed to blockage in accordance with RG 1.82 analysis

Figure 5.4-12 Reactor Water Cleanup System P&ID (Sheet 1 of 4)

STD DEP 5.4-1

CUW piping pressure change to be consistent with Table 5.4-6 is incorporated in this figure in Chapter 21.

Figure 5.4-12 Reactor Water Cleanup System P&ID (Sheet 2 of 4)

STD DEP 5.4-1

CUW piping pressure change to be consistent with Table 5.4-6 is incorporated in this figure in Chapter 21.

STD DEP 5.4-5

A vent line down to main steam line is provided on the top of the RPV head spray return line, in order to avoid accumulation of hydrogen generated by radiolysis of reactor water during normal reactor operation.

Figure 5.4-12 Reactor Water Cleanup System P&ID (Sheet 3 of 4)

STD DEP 5.4-1

CUW piping pressure change to be consistent with Table 5.4-6 is incorporated in this figure in Chapter 21.

Figure 5.4-13 Reactor Water Cleanup System PFD (Sheet 2 of 2)

STD DEP 5.4-1

The consistency change to CUW pump and filter demineralizer flow is incorporated in this figure in Chapter 21.