Table 1 DHR Systems for BWR Class 1/2/3 Plants

Systems		Millstone 1		Nine Mile Point 1		Dresden		Oyster Creek	
		System Description	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**
Coolant Injection System	**High Pressure Injection**	Feedwater Coolant Injection (FWCI) System: is part of the FW system. Consists of one train of FW system (one FW pump, one condensate pump and one condensate booster pump). *Success criteria: 1FW pumpTrain*				High Pressure Core Injection (HPCI) System: consists of one train with a turbine-driven pump. *Success criteria: HPCI system operating*			
		Control Rod Drive (CRD) System: provides backup source of high-pressure injection consisting of two-trains each with a 100% capacity pump. *Success criteria: 1 of 2 pumps*		Control Rod Drive (CRD) System: provides backup source of high-pressure injection consisting of two 100% capacity pumps. *Success criteria: 1 of 2 pumps*				Control Rod Drive (CRD) System: provides backup source of high-pressure injection consisting of two-trains each with a 100% capacity pump. *Success criteria: 1of 2 pumps*	
	Low Pressure Injection	Low Pressure Coolant Injection (LPCI): consists of two trains each with two motor-driven pumps. *Success criteria: 1 of 4 pumps*	• Firewater System alignment via hoses to supply water for drywell spraying if a supply from the LPCI pumps is not available • Revise surveillance procedures to specifically verify the operability of motor-bearing lube oil cooling (increased reliability of the pumps) • Replaced pump torus suction strainers with an improved design, precluding the clogging Not known if credited in the IPE	Low Pressure Coolant Injection (LPCI mode of RHR): consists of three trains. Train A and B consist of one pump each while Train C consists of two pumps. *Success criteria: 1 of 4 pumps*		Low Pressure Coolant Injection (LPCI): consists of two trains each with two motor-driven pumps and a LPCI heat exchanger. *Success criteria: 1 of 4 pumps*	Implemented procedure to align LPCI or CS pumps to CST when suppression pool cooling cannot be established Not credited in the IPE		

Table 1 DHR Systems for BWR Class 1/2/3 Plants (Continued)

Systems		Millstone 1		Nine Mile Point 1		Dresden		Oyster Creek	
		System Description	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**
Coolant Injection Systems (cont.)	**Low Pressure Injection** (cont.)	Low Pressure Core Spray (LPCS) System: consists of two trains each with a motor-driven pump. *Success criteria: 1 of 2 pumps*	• Revise surveillance procedures to specifically verify the operability of motor-bearing lube oil cooling (increased reliability of the pumps) • Replaced pump torus suction strainers with an improved design, precluding the clogging Not known if credited in the IPE	Low Pressure Core Spray (LPCS) System: consists of two trains each with two motor-driven pumps. *Success criteria: 1 of 4 pumps*		Low Pressure Core Spray (LPCS) System: consists of two trains each with a motor-driven pump. *Success criteria: 1 of 2 pumps*	Implemented procedure to align LPCI or CS pumps to CST when suppression pool cooling cannot be established. Not credited in the IPE	Low Pressure Core Spray (LPCS) System: consists of two trains each with two redundant booster and two redundant main motor-driven pumps. *Success criteria: 1 of 4 pumps*	
		Fire Protection System (FPS): used as a possible injection source to vessel but not credited in the IPE for decay heat removal. Consist of two motor-driven and one diesel-driven pumps. *Success criteria: 1-out-of-3 pumps*		Fire Protection System (FPS): can be used to provide makeup to the Ecs and to inject to the vessel via the FW piping. Consists of a diesel driven and a motor-driven pumps. *Success criteria: 1 of 2 pumps*		Fire Protection (FP) System: is an alternate water injection source during accident conditions and can supply makeup to the shellside of the Isolation Condenser. Consist of two trains and two diesel-driven pumps. *Success criteria: 1 of 2 pumps*		Fire Protection (FP) System: is manually aligned through the CS System. The fire header is supplied by three electric-driven pumps and two diesel-driven pumps. *Success criteria: 1 of 2 pumps*	
	Isolation Condenser	Isolation Condenser (IC): provides a heat sink for the reactor if the reactor is isolated from the main condenser or if a loss of all feedwater occurs through natural circulation. Consist of one train and one heat exchanger. *Success criteria: IC operation*	- Improved reliability of the Isolation Condenser by replacing the motor operator for 1-IC-3 with a Limitorque operator, which could better handle the short stroke of the valve. - Procured a portable diesel pump and implement procedures to enable providing IC shellside makeup following fire-water system failure. Not known if credited in the IPE	Emergency Condensers (EC): provides no makeup to the vessel by itself. Thus, excessive leakage or unisolated seal LOCA can not be mitigated. consist of two trains, each with a condenser. *Success criteria: ½ trains of EC*		Isolation Condenser (IC): provides a heat sink for the reactor if the reactor is isolated from the main condenser or if a loss of all feedwater occurs through natural circulation. Consist of one train and one heat exchanger. *Success criteria: IC operation*		Isolation Condenser (IC): provides a heat sink for the reactor if the reactor is isolated from the main condenser or if a loss of all feedwater occurs through natural circulation. Consist of two trains, each with a heat exchanger. *Success criteria: 1 of 2 ICs or 2 of 2 ICs if no reactor trip has occurred*	

Table 1 DHR Systems for BWR Class 1/2/3 Plants (Continued)

Systems		Millstone 1		Nine Mile Point 1		Dresden		Oyster Creek	
		System Description	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**
Depressurization	**Automatic/Manual Depressurization**	Automatic depressurization System (ADS): consists of 6 SRVs. The SRVs can also be manually controlled. *Success criteria: 4 of 6 SRVs*		Automatic depressurization System (ADS): consists of 6 electromatic RVs. *Success criteria: 3 of 6 SRVs or 3/16 SVs*		Automatic depressurization System (ADS): consists of 5 ADS SRVs. *Success criteria: 1 of 5 SRVs*		Automatic Depressurization System (ADS): consists of 5 SRVs. *Success criteria: 3 of 5 SRVs*	
Heat Removal Systems	**Shutdown Cooling**	Suppression Pool Cooling (SPC mode of LPCI): consists of either LPCI train A or B pumps and its associated heat exchangers. *Success criteria: 1 of 4 pumps and its associated heat exchanger*		Suppression Pool Cooling (SPC mode of LPCI): consists of either train A or B pumps of RHR system with its associated heat exchangers. *Success criteria: 1 of 4 pumps and its associated heat exchanger*		Suppression Pool Cooling (SPC mode of LPCI) System: consists of two trains and four pumps and 2 heat exchangers. *Success criteria: 1 of 4 pumps and its associated heat exchanger*			
		Shutdown Cooling (SDC mode of LPCI): consist of two LPCI trains with its associated heat exchangers. *Success criteria: 1of 4 pumps and its associated heat exchanger*		Shutdown Cooling (SDC mode of LPCI): consist of either train A or B pumps of LPCI system with its associated heat exchangers. *Success criteria: 1of 4 pumps and its associated heat exchanger*					
		Alternate Shutdown Cooling (ASDC): is a procedure used to remove long term core decay heat when normal shutdown cooling is not available.. *Success criteria:* Requires proper operation of LPCI pump including a heat exchanger							

Table 1 DHR Systems for BWR Class 1/2/3 Plants (Continued)

Systems		Millstone 1		Nine Mile Point 1		Dresden		Oyster Creek	
		System Description	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**
Containment Systems	**Containment Cooling**	Containment Cooling: is a procedure following LOCA and other sequences to cool the torus and remove long term decay heat. The SR valves are not needed to be opened as the LPCI flow spills back to the torus via the break. Otherwise, it is identical to the ASDC procedure. *Success criteria:* Requires proper operation of LPCI pump including a heat exchanger	• Added Containment Spraying to the EOPs. • Replaced Drywell Spray valve motor-operators with environmentally qualified operators. Not known if credited in the IPE	Containment Spray (CS mode of LPCI) System: consist of either train A or B pumps of LPCI system. *Success criteria: 1of 4 LPCI pumps with its associated heat exchanger*		Containment Spray (CS mode of LPCI) System: consist of either train A or B pumps of LPCI system. *Success criteria: 1-out-of-4 LPCI pumps with its associated heat exchanger.*		Containment Spray (CS) System: consist of two trains, each with two 100% capacity pumps and two 50% capacity heat exchangers. *Success criteria: 1-out-of-2 CS trains with one pump and two heat exchangers and a ESW pump.*	Incorporated into operator training the role of an operator in successful initiation of the CS system. Credited in the IPE.
	Containment Venting	Containment Venting: used when suppression pool cooling and containment sprays have failed to reduce primary containment pressure. Depending on the water level in the torus, either wetwell venting or drywell venting would be used by procedure. *Success criteria: either wetwell or drywell venting*	Installed the hardened vent after the IPE was done in 1994.	Containment Venting: used when suppression pool cooling and containment sprays have failed to reduce primary containment pressure. Venting is achieved through the drywell and torus vent systems. *Success criteria: either wetwell or drywell venting*	Installed hardened vent Credited in the IPE	Containment Venting: used when suppression pool cooling and containment sprays have failed to reduce primary containment pressure. It includes the SBGT system and the Augmented Primary Containment Vent (APCV) system. The APVC system is a hardened vent *Success criteria: one of the vent paths.*		Containment Venting: used when suppression pool cooling and containment sprays have failed to reduce primary containment pressure. Uses torus vent valves. *Success criteria: one of the vent paths*	Installed hard-piped containment vent system. Credited in the IPE.

Table 2 DHR Systems for BWR Class 3/4 Plants

Systems		Quad Cities 1&2		Pilgrim		Peach Bottom 2&3		Brunswick		Fermi 2		Browns Ferry 2	
		System Description	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**
Coolant Injection Systems	**High Pressure Injection**	High Pressure Core Injection (HPCI) System: consists of one train with a turbine-driven pump. *Success criteria: HPCI system operating*		High Pressure Core Injection (HPCI) System: consists of one train with a turbine-driven pump. *Success criteria: HPCI system operating*		High Pressure Core Injection (HPCI) System: consists of one train with a turbine-driven pump. *Success criteria: HPCI system operating*		High Pressure Core Injection (HPCI) System: consists of one train with a turbine-driven pump. *Success criteria: HPCI system operating*		High Pressure Core Injection (HPCI) System: consists of one train with a turbine-driven pump. *Success criteria: HPCI system operating*		High Pressure Core Injection (HPCI) System: consists of one train with a turbine-driven pump. *Success criteria: HPCI system operating*	
		Reactor Core Isolation Cooling (RCIC) System: consist of one train with a turbine–driven pump. *Success criteria: RCIC system operating*		Reactor Core Isolation Cooling (RCIC) System: consist of one train with a turbine-driven pump. *Success criteria: RCIC system operating*		Reactor Core Isolation Cooling (RCIC) System: consists of one train with a turbine-driven pump. *Success criteria: RCIC system operating*		Reactor Core Isolation Cooling (RCIC) System: consists of one train with a turbine-driven pump. *Success criteria: RCIC system operating*		Reactor Core Isolation Cooling (RCIC) System: consists of one train with a turbine-driven pump. *Success criteria: RCIC system operating*		Reactor Core Isolation Cooling (RCIC) System: consists of one train with a turbine-driven pump. *Success criteria: RCIC system operating*	
		Safe Shutdown Makeup Pump (SSMP) System: is an alternative to RCIC system. Can be powered from either unit and aligned to either unit. *Success criteria: SSMP system operating*											
		Control Rod Drive (CRD) System: provides backup source of high-pressure injection consisting of two-trains each with a 100% capacity pump. *Success criteria: 1 of 2 pumps*		Control Rod Drive (CRD) System: provides backup source of high-pressure injection consisting of two trains each with a 100% capacity pump. *Success criteria: 1 of 2 pumps.*		Control Rod Drive (CRD) System: provides backup source of high-pressure injection consisting of two trains each with a 100% capacity pump. *Success criteria: 1 of 2 pumps*		Control Rod Drive (CRD) System: provides backup source of high-pressure injection consisting of two trains each with a 100% capacity pump. *Success criteria: 1 of 2 pumps*		Control Rod Drive (CRD) System: provides backup source of high-pressure injection consisting of two 100% capacity pumps. *Success criteria: 1 of 2 pumps*		Control Rod Drive (CRD) System: provides backup source of high-pressure injection consisting of two 100% capacity pumps. *Success criteria: 1 out of 2 pumps*	
	Low Pressure Injection	Low Pressure Coolant Injection (LPCI mode of RHR): consist of two trains each with two motor-driven pumps. *Success criteria: 1 of 4 pumps.*		Low Pressure Coolant Injection (LPCI mode of RHR): consists of two trains each with two motor-driven pumps. *Success criteria: 1 of 4 pumps*		Low Pressure Coolant Injection (LPCI mode of RHR): consist of two trains each with two motor-driven pumps. *Success criteria: 1 of 4 pumps*		Low Pressure Coolant Injection (LPCI mode of RHR): consists of two trains each with two motor-driven pumps. *Success criteria: 1 of 4 pumps*		Low Pressure Coolant Injection (LPCI mode of RHR): consist of two trains each with two motor-driven pumps. *Success criteria: 1 of 4 pumps*		Low Pressure Coolant Injection (LPCI mode of RHR): consists of two trains each with two motor-driven pumps. *Success criteria: 1 of 4 pumps*	

Table 2 DHR Systems for BWR Class 3/4 Plants (Continued)

Systems		Quad Cities 1&2		Pilgrim		Peach Bottom 2&3		Brunswick		Fermi 2		Browns Ferry 2	
		System Description	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**
Coolant Injection Systems	**Low Pressure Injection** (cont.)	Low Pressure Core Spray (LPCS) System: consists of two trains each with a motor-driven pump. *Success criteria: 1 of 2 pumps*		Low Pressure Core Spray (LPCS) System: consists of two trains each with a motor-driven pump. *Success criteria: 1 of 2 pumps*		Low Pressure Core Spray (LPCS) System: consists of two trains and four motor-driven pumps. *Success criteria: 1 of 4 pumps*		Low Pressure Core Spray (LPCS) System: consists of two trains each with a motor-driven pump. *Success criteria: 1 of 2 pumps*		Low Pressure Core Spray (LPCS) System: consists of two trains each with a motor-driven pump. *Success criteria: 1 of 4 pumps*		Low Pressure Core Spray (LPCS) System: consists of two trains each with two 50% motor-driven pumps. *Success criteria: 1 of 2 loops*	
				Condensate System: used as an alternate low pressure injection system provided offsite power is available and the flow path through the FW portion of the system is open. Consists of three 1/3 capacity motor-driven pumps. *Success criteria: 1 of 3 pumps*				Condensate System: used as an alternate low pressure injection system provided offsite power is available and the flow path through the FW portion of the system is open. Consist of three 1/3 capacity motor-driven pumps. *Success criteria: 1 of 3 pumps*					
		Fire Water System: can be aligned to SSMP system to allow the diesel driven fire system to inject directly into the RPV. *Success criteria: 1 of 2 D-D pumps*		Fire Water System: can be manually cross-tied to the RHR system. Consists of two fire pumps, one diesel and one motor-driven pump. *Success criteria: 1 of 2 pumps*		Fire Protection System (FPS): aligned to enable fire water to be pumped into the vessel through the feedwater injection line. Consists of one train with a motor-driven and a diesel-driven pumps. *Success criteria: 1 of 2 pumps*		Fire Protection System (FPS): can be cross-connected to RHR trains A or B. Consists of a diesel driven and a motor-driven pump. *Success criteria: 1 of 2 pumps*					
						High Pressure SW Crosstie System: used when normal source of emergency injection have failed. Consists of two trains with four pumps. *Success criteria: 1 of 4 pumps*		Service Water (SW) System: used as a backup source of low pressure injection. Consists of three trains each with a pump. Two pumps normally running. *Success criteria: 1 of 2 NSW pumps*		RHR Service Water (RHRSW) System: Train II of RHRSW can be cross tied to the RHR system and used as an emergency injection source to the reactor vessel. Consists of two pumps. *Success criteria: 1 of 2 pumps*		RHR Service Water (RHRSW) System: used as an emergency injection source to the reactor vessel. 4 of 12 SW pumps designated for RHRSW. *Success criteria: 1 of 4 pumps*	

Table 2 DHR Systems for BWR Class 3/4 Plants (Continued)

Systems		Quad Cities 1&2		Pilgrim		Peach Bottom 2&3		Brunswick		Fermi 2		Browns Ferry 2	
		System Description	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**
Depressurization	**Auto/Manual Depress**	Automatic depressurization System (ADS): consists of 5 relief valves. In addition, there are 8 safety valves. *Success criteria: 4 of 5 SRVs or 3/8 non-ADS SRVs*		Automatic Depressurization System (ADS): consists of 4 SRVs. There also 6 non-ADS SRVs. *Success criteria:3 of 4 ADS or 2/6 non-ADS SRVs.*		Automatic depressurization System (ADS): consists of 5 ADS and 6 non-ADS relief valves. *Success criteria:2 of 5 SADS or 2/6 non-ADS SRVs.*		Automatic Depressurization System (ADS): consists of 7 of 11 SRVs. *Success criteria:2 of 7 SRVs*		Automatic depressurization System (ADS): consists of 3 of 5 ADS relief valves. Additional 10 valves could be opened individually. *Success criteria:3 of 5 ADS*		Automatic depressurization System (ADS): consists of 6 of the 13 SRVs. *ADS not modeled. One SRV needed for SDC*	
Heat Removal Systems	**Shutdown Cooling**	Suppression Pool Cooling (SPC mode of RHR): consists of either train A or B pumps of RHR system. *Success criteria:1 of 4 pumps and its associated heat exchanger*		Suppression Pool Cooling (SPC mode of RHR): consists of either train A or B pumps of RHR system. A cross-connection between units exists to utilize RHR loop II. *Success criteria:1 of 4 pumps and its associated heat exchanger*		Suppression Pool Cooling (SPC mode of RHR): consists of either train A or B of RHR system. *Success criteria:1 of 4 pumps and its associated heat exchanger*		Suppression Pool Cooling (SPC mode of RHR): consists of either train A or B of RHR system. *Success criteria:1 of 4 pumps and its associated heat exchanger*		Suppression Pool Cooling (SPC mode of RHR): consists of either train A or B pumps of RHR system. *Success criteria:1 of 4 pumps and its associated heat exchanger*		Suppression Pool Cooling (SPC mode of RHR): consists of either train A or B pumps of RHR system. *Success criteria:1 of 4 pumps and its associated heat exchanger*	
		Shutdown Cooling (SDC mode of RHR): consists of two trains each with two pumps and a heat exchanger. *Success criteria:1 of 4 pumps and its associated heat exchanger*		Shutdown Cooling (SDC mode of RHR): consists of a two-train system each with two motor-driven pumps. A cross-connection between units exists to utilize RHR loop II. *Success criteria:1 of 4 pumps and its associated heat exchanger*		Shutdown Cooling (SDC mode of RHR): consists of two trains each with two pumps. *Success criteria:1 of 4 pumps and its associated heat exchanger*		Shutdown Cooling (SDC mode of RHR): consists of two trains and two pumps. *Success criteria:1 of 4 pumps and its associated heat exchanger*		Shutdown Cooling (SDC mode of RHR): consists of two trains and two pumps. *Success criteria:1 of 4 pumps and its associated heat exchanger*		Shutdown Cooling (SDC mode of RHR): consists of two trains and two pumps. *Success criteria:1 of 4 pumps and its associated heat exchanger*	

Table 2 DHR Systems for BWR Class 3/4 Plants (Continued)

Systems		Quad Cities 1&2		Pilgrim		Peach Bottom 2&3		Brunswick		Fermi 2		Browns Ferry 2	
		System Description	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**
Containment Systems	**Containment Cooling**	Containment Spray (CS mode of RHR): consists of two trains of RHR each with two pumps and a heat exchanger. *Success criteria:1 of 4 pumps and its associated heat exchanger*		Containment Spray (CS mode of RHR): consists of two trains of RHR each with two pumps and a heat exchanger. *Success criteria:1 of 4 pumps and its associated heat exchanger*		Containment Spray (CS mode of RHR): consist of two trains of RHR each with two pumps and a heat exchanger. *Success criteria:1 of 4 pumps and its associated heat exchanger*		Containment Spray (CS mode of RHR): consists of either train A or B pumps of RHR system and a heat exchanger. *Success criteria:1 of 4 pumps and its associated heat exchanger*		Containment Spray (CS mode of RHR): consists of either train A or B pumps of RHR system and a heat exchanger. *Success criteria:1 of 4 pumps and its associated heat exchanger*		Containment Spray (CS mode of RHR): consists of either train A or B pumps of RHR system and a heat exchanger. *Success criteria:1-out-of-4 pumps and its associated heat exchanger.*	
		Containment Venting: consist of Standby Gas Treatment (SBGT) system and the new augmented primary containment vent system. *Success criteria: Vent through torus or drywell paths*	Installed hardened containment vent. Credited in the IPE	Containment Venting: consists of an 8" vent line from wetwell airspace to the off-gas stack. This line bypasses the SBGT and releases directly to the stack. *Success criteria: one of the vent path.*	Installed hardened containment vent. Credited in the IPE	Containment Venting: *Success criteria: one of the vent path.*	Installed Torus hard piped vent. Credited in the IPE	Containment Venting: consists of the atmospheric control system and SBGT system. *Success criteria: Vent through torus or drywell paths*	Installed hardened wetwell vent. Not credited in the IPE	Containment Venting: consists of a 20" flow path from the torus or the drywell to the hardpipe exhaust stack or to the 5th floor of the reactor building. *Success criteria: one of the vent path but isolation of both trains of standby gas plus the reactor building exhaust line are also required*	Installed hardened vent Credited in the IPE	Containment Venting was not credited in the IPE. However, according to information, Browns Ferry installed the hardened vent after the completion of the IPE.	

Table 2 DHR Systems for BWR Class 3/4 Plants (Continued)

Systems		Vermont Yankee		Hatch 1&2		Monticello		Duane Arnold		Cooper		Limerick 1&2	
		System Description	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**
Coolant Injection Systems	**High Pressure Injection**	High Pressure Core Injection (HPCI) System: consists of one train with a turbine-driven pump. *Success criteria: HPCI system operating*		High Pressure Core Injection (HPCI) System: consists of one train with a turbine-driven pump. *Success criteria: HPCI system operating*		High Pressure Core Injection (HPCI) System: consists of one train with a turbine-driven pump. *Success criteria: HPCI system operating*	Deleted "open" signal on system initiation for HPCI and RCIC inboard isolation valves and has valves normally open. Not credited in the IPE	High Pressure Core Injection (HPCI) System: consists of one train with a turbine-driven pump. *Success criteria: HPCI system operating*		High Pressure Core Injection (HPCI) System: consists of one train with a turbine-driven pump. *Success criteria: HPCI system operating*		High Pressure Core Injection (HPCI) System: consists of one train with a turbine-driven pump. *Success criteria: HPCI system operating*	
		Reactor Core Isolation Cooling (RCIC) System: consists of one train with a turbine–driven pump. *Success criteria: RCIC system operating*		Reactor Core Isolation Cooling (RCIC) System: consists of one train with a turbine-driven pump. *Success criteria: RCIC system operating*		Reactor Core Isolation Cooling (RCIC) System: consist of one train with a turbine-driven pump. *Success criteria: RCIC system operating*		Reactor Core Isolation Cooling (RCIC) System: consists of one train with a turbine-driven pump. *Success criteria: RCIC system operating*		Reactor Core Isolation Cooling (RCIC) System: consists of one train with a turbine-driven pump. *Success criteria: RCIC system operating*		Reactor Core Isolation Cooling (RCIC) System: consists of one train with a turbine-driven pump. *Success criteria: RCIC system operating*	
		Control Rod Drive (CRD) System: provides backup source of high-pressure injection consisting of two-trains each with a 100% capacity pump. *Success criteria: 1 of 2 pumps*		Control Rod Drive (CRD) System: provides backup source of high-pressure injection consisting of two trains each with a 100% capacity pump. *Success criteria: 1 of 2 pumps*		Control Rod Drive (CRD) System: provides backup source of high-pressure injection consisting of two-trains each with a 100% capacity pump. *Success criteria: 1 of 2 pumps*		Control Rod Drive (CRD) System: provides backup source of high-pressure injection consisting of two trains each with a 100% capacity pump. *Success criteria: 1 of 2 pumps*		Control Rod Drive (CRD) System: provides backup source of high-pressure injection consisting of two 100% capacity pumps. *Success criteria: 2 of 2 or 1of 2 pumps for long term*		Control Rod Drive (CRD) System: provides backup source of high-pressure injection consisting of two 100% capacity pumps. *Success criteria: 1 of 2 pumps*	
	Low Pressure Injection	Low Pressure Coolant Injection (LPCI mode of RHR): consists of two trains each with two motor-driven pumps. *Success criteria: 1 of 4 pumps*		Low Pressure Coolant Injection (LPCI mode of RHR): consists of two trains each with two motor-driven pumps. *Success criteria: 1 of 4 pumps*		Low Pressure Coolant Injection (LPCI mode of RHR): consists of two trains each with two motor-driven pumps. *Success criteria: 1 of 4 pumps*	A cross-tie between fire water system and RHR was implemented. Not credited in the IPE	Low Pressure Coolant Injection (LPCI mode of RHR): consists of two trains with two pumps. *Success criteria: 1 of 4 pumps*		Low Pressure Coolant Injection (LPCI mode of RHR): consist of two trains each with two motor-driven pumps. *Success criteria: 1 of 4 pumps*		Low Pressure Coolant Injection (LPCI mode of RHR): consist of loop A and B of RHR system. Loops A and C and B and D are cross connected. Each loop consist of a motor-driven pump. *Success criteria: 1 of 4 pumps*	Added connection between diesel-driven fire pump and RHR system. Not known if credited in the IPE
		Low Pressure Core Spray (LPCS) System: consists of two trains each with a motor-driven pump. *Success criteria: 1 of 2 pumps*		Low Pressure Core Spray (LPCS) System: consists of two trains each with a motor-driven pump. *Success criteria: 1 of 2 pumps*	Revised procedures to allow tripping of RHR pumps upon loss of HVAC to insure operation of one pump without room cooling. Credited in the IPE	Low Pressure Core Spray (LPCS) System: consists of two trains each with a motor-driven pump. *Success criteria: 1 of 2 pumps*		Low Pressure Core Spray (LPCS) System: consists of two trains each with a motor-driven pump. *Success criteria: 1 of 2 pumps*		Low Pressure Core Spray (LPCS) System: consists of two trains each with a motor-driven pump. *Success criteria: 1 of 2 pumps*		Low Pressure Core Spray (LPCS) System: consists of two trains each with two 50% capacity motor-driven pumps. *Success criteria: 1 of 2 pump trains*	

Table 2 DHR Systems for BWR Class 3/4 Plants (Continued)

Systems		Vermont Yankee		Hatch 1&2		Monticello		Duane Arnold		Cooper		Limerick 1&2	
		System Description	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**
Coolant Injection Systems (cont.)	**Low Pressure Injection** (cont.)	Condensate Transfer System: used as an alternate low pressure injection system. Consists of two motor-driven pumps. *Success criteria: 1 of 2 pumps*				Condensate Transfer System: used as an alternate low pressure injection system. Consist of two motor-driven pumps. *Success criteria: 1 of 2 pumps*							
				Fire Protection System: can be manually cross-tied to the RHR system. Consist of a diesel-driven pump. Not credited in the IPE. *Success criteria: 1DD fire pump.*		Fire Protection System: can be manually cross-tied to the RHR system. Consist of a diesel-driven pump. *Success criteria: 1DD fire pump*		Fire Protection System: can be manually cross-tied to the RHR system. Consist of a diesel-driven pump. *Success criteria: 1 fire pump*					
		RHR SW: consists of two trains each with two motor-driven pumps. Can be cross-tied to RHR train A. *Success criteria: 1 of 4 pumps*		RHRSW: consist of two trains each with two motor-driven pumps. *Success criteria: 1 of 4 pumps*	Remove manually – operated common discharge valve in PSW system. A common discharge valve in the Unit 1 PSW system was identified as a significant contributor to loss of all PSW. Failure or blockage of this valve, as a result of disc separation or shearing of the pins that connect the disc to the stem could result in blockage of all PSW flow, except for flow to the diesels and then RHRSW pump motors. Because of the potential reduction in CDF this valve was removed.	RHR SW: consists of two trains each with two motor-driven pumps. *Success criteria: 1 of 4 pumps*		RHR SW: consists of two trains each with two motor-driven pumps. In addition, General SW system (1 of 3 pumps) can also be cross-tied to RHRSW for injection into the reactor. *Success criteria: 1 of 4 pumps*		RHR SW: consists of two trains each with two motor-driven pumps. Cross-tied with RHR loop A. *Success criteria: 1 of 4 pumps*		RHR SW: consists of two trains each with two motor-driven pumps. X-tied with RHR loop B. *Success criteria: 1 of 4 pumps*	
								Emergency Service Water (ESW) System: supplies injection flow via RHRSW. Consists of two trains each with a motor-driven pump. *Success criteria: 1 of 2 pumps*		Service Water (SW) System: supplies injection flow via LPCI. Consists of two trains each with two motor-driven pumps. *Success criteria: 1 of 4 pumps*			

Table 2 DHR Systems for BWR Class 3/4 Plants (Continued)

Systems		Vermont Yankee		Hatch 1&2		Monticello		Duane Arnold		Cooper		Limerick 1&2	
		System Description	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**
Coolant Injection System (cont.)	**Low Pressure Injection** (cont.)							General Service Water (GSW) System: used an alternate injection source through the RHR SW flow paths. Consists of three trains with a 50% capacity pump each. *Success criteria: 1 of 3 pumps*					
Depressurization	**Auto/Manual Depressur-ization**	Automatic depressurization System (ADS): consists of 4 ADS SRVs. *Success criteria:2 of 4 SRVs*		Automatic Depressurization System (ADS): consists of 7 SRVs for ADS and 4 non-ADS. *Success criteria:3 of 7 ADS*		Automatic depressurization System (ADS): consists of 3of 11 safety/relief valves are ADS. *Success criteria:2 of 3 ADS*	Modified to power SRV solenoid valves from DC instrument bus. Not credited in the IPE	Automatic depressurization System (ADS): consists of 4 ADS SRVs and 2 SVs. *Success criteria:2 of 6 SRVs*		Automatic Depressurization System (ADS): consists of 6 SRVs for ADS and 5 non-ADS. *Success criteria:3 of 6 ADS*		Automatic depressurization System (ADS): consists of 5 ADS and 9 non-ADS SRVs. *Success criteria:2 of 5 ADS*	
Heat Removal Systems	**Shutdown Cooling**	Suppression Pool Cooling (SPC mode of RHR): consists of either train A or B pumps of RHR system. *Success criteria:1 of 4 RHR pumps with its associated heat exchanger*		Torus Cooling (SPC mode of RHR): consist of either train A or B pumps of RHR system. *Success criteria:1 of 4 RHR pumps with its associated heat exchanger*		Suppression Pool Cooling (SPC mode of RHR): consist of either train A or B pumps of RHR system. *Success criteria:1 of 4 RHR pumps with its associated heat exchanger*		Torus Cooling (SPC mode of RHR): consists of either train A or B pumps of RHR system. *Success criteria:1 of 4 RHR pumps with its associated heat exchanger*		Suppression Pool Cooling (SPC mode of RHR): consists of either train A or B pumps of RHR system. *Success criteria:1 of 4 RHR pumps with its associated heat exchanger*		Suppression Pool Cooling (SPC mode of RHR): consist of either train A or B pumps of RHR system. Each train consists of two motor-driven pumps and a heat exchanger *Success criteria:1-out-of-4 RHR pumps with its associated heat exchanger.*	
		Shutdown Cooling (SDC mode of RHR): consists of two trains each with two pumps and a heat exchanger. *Success criteria:1 of 4 RHR pumps with its associated heat exchanger*		Shutdown Cooling (SDC mode of RHR): consist of two trains each with two pumps and a heat exchanger. *Success criteria:1 of 4 RHR pumps with its associated heat exchanger*		Shutdown Cooling (SDC mode of RHR): consist of two trains each with two pumps and a heat exchanger. *Success criteria:1 of 4 RHR pumps with its associated heat exchanger*		Shutdown Cooling (SDC mode of RHR): consists of two trains with two pumps and two heat exchangers in parallel. *Success criteria:1 of 4 RHR pumps with its associated heat exchanger*		Shutdown Cooling (SDC mode of RHR): consists of two trains each with two pumps and a heat exchanger. *Success criteria:1 of 4 RHR pumps with its associated heat exchanger*		Shutdown Cooling (SDC mode of RHR): consists of two trains each with two pumps and a heat exchanger. *Success criteria:1 of 4 RHR pumps with its associated heat exchanger*	

Table 2 DHR Systems for BWR Class 3/4 Plants (Continued)

Systems		Vermont Yankee		Hatch 1&2		Monticello		Duane Arnold		Cooper		Limerick 1&2	
		System Description	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**
Containment Systems	**Containment Cooling/ Venting**	Containment Spray (CS mode of RHR): consists of two trains of RHR each with two pumps. *Success criteria:1 of 4 RHR pumps with its associated heat exchanger*		Containment Spray (CS mode of RHR): consist of two trains of RHR each with two pumps. *Success criteria:1 of 4 RHR pumps with its associated heat exchanger*		Containment Spray (CS mode of RHR): consists of two trains of RHR each with two pumps. *Success criteria:1 of 4 RHR pumps with its associated heat exchanger*		Containment Spray (CS mode of RHR): consists of two trains with two pumps and two heat exchangers in parallel. *Success criteria:1 of 4 RHR pumps with its associated heat exchanger*		Containment Spray (CS mode of RHR): consists of two trains of RHR each with two pumps. *Success criteria:1 of 4 RHR pumps with its associated heat exchanger*		Containment Cooling (mode of RHR): consists of two trains of RHR each with two pumps. *Success criteria:1-out-of-4 RHR pumps with its associated heat exchanger*	Modified procedure to relax restriction on drywell spray initiation curve. Not known if credited in the IPE
		Containment Venting: Hard piped torus vent. 8" vent line discharges to the exhaust of the SBGT. *Success criteria: availability of a vent path*	Installed hardened wetwell vent. Credited in the IPE	Containment Venting: Through the 18" torus vent path or through the 18" drywell vent path. *Success criteria: torus or drywell vent paths available*	Installed hardened wetwell vent. Credited in the IPE	Containment Venting: Two 18" vent lines from the drywell and wetwell airspace to the SBGT. *Success criteria: torus or drywell vent paths available*	Installed a hard pipe containment vent from the torus to outside the containment building. Not credited in the IPE	Containment Venting: consists of a 2" piped SBGT line and a hard piped torus vent. *Success availability of one of the vent paths*	Installed hardened wetwell vent. Credited in the IPE	Containment Venting: hard piped vent from the torus directing primary containment effluent directly out of the reactor building, rather than through the SBGT. *Success availability of one of the vent paths*	Hardened vent was installed but not credited in the IPE.	Containment Venting: through the 18" or 24" containment purge line. *Success availability one of the two vent paths.*	

Table 2 DHR Systems for BWR Class 3/4 Plants (Continued)

Systems		Hope Creek		Susquehanna	
		System Description	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**
Coolant Injection Systems	**High Pressure Injection**	High Pressure Core Injection (HPCI) System: consists of one train with a turbine-driven pump. *Success criteria: HPCI system operating*		High Pressure Core Injection (HPCI) System: consists of one train with a turbine-driven pump. *Success criteria: HPCI system operating*	
		Reactor Core Isolation Cooling (RCIC) System: consists of one train with a turbine–driven pump. *Success criteria: RCIC system operating*		Reactor Core Isolation Cooling (RCIC) System: consists of one train with a turbine-driven pump. *Success criteria: RCIC system operating*	
		Control Rod Drive (CRD) System: provides backup source of high-pressure injection consisting of two trains each with a 100% capacity pump. *Success criteria: 2 of 2 pumps*		Control Rod Drive (CRD) System: provides backup source of high-pressure injection consisting of two trains each with a 100% capacity pump. *Success criteria: 2 of 2 pumps*	
	Low Pressure Injection	Low Pressure Coolant Injection (LPCI mode of RHR): consists of two trains each with two motor-driven pumps. *Success criteria: 1 of 4 pumps*		Low Pressure Coolant Injection (LPCI mode of RHR): consists of two trains each with two motor-driven pumps. *Success criteria: 1 of 4 pumps*	
		Low Pressure Core Spray (LPCS) System: consists of two trains each with two 50% capacity motor-driven pump. *Success criteria: 1 of 2 trains*		Low Pressure Core Spray (LPCS) System: consists of two trains each with two 50% capacity motor-driven pump. *Success criteria: 1 of 2 trains*	

Table 2 DHR Systems for BWR Class 3/4 Plants (Continued)

Systems		Hope Creek		Susquehanna	
		System Description	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**
Coolant Injection Systems (cont.)	**Low Pressure Injection** (cont.)	Condensate Transfer System: used as an alternate low pressure injection system. Consists of two motor-driven pumps. *Success criteria: 1 of 2 pumps*		Condensate Transfer System: used as an alternate low pressure injection system, cross-connected to CS. Consists of two motor-driven pumps. *Success criteria: 1 of 2 pumps*	
		Fire Protection System: can be manually cross-tied to the RHR system. Consists of a diesel-driven pump. *Success criteria: 1DD fire pump*		Fire Protection System: can be manually cross-tied to the RHR and RHRSW systems. Consist of two diesel-driven pumps. *Success criteria: 1 of two DD fire pumps*	
		Station SW (SSW) System: consists of two motor-driven pumps cross-tied to RHR system. *Success criteria:2 of 2 pumps*		RHR SW: consist of two trains each with two motor-driven pumps x-tied to RHR system. *Success criteria: 1 of 4 pumps*	
				RWCU Blowdown Mode: consists of two pumps. *Success criteria:2 of 2 pumps*	
Depressurization	**Auto/Manual Depress.**	Automatic depressurization System (ADS): consists of 5 ADS SRVs and 9 non-ADS SRVs. *Success criteria:2 of 5 ADS*		Automatic Depressurization System (ADS): consists of 6 SRVs for ADS and 10 non-ADS. *Success criteria:2 of 6 ADS*	

Table 2 DHR Systems for BWR Class 3/4 Plants (Continued)

Systems		Hope Creek		Susquehanna	
		System Description	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**
Heat Removal Systems	**Shutdown Cooling**	Suppression Pool Cooling (SPC mode of RHR): consists of either train A or B pumps of RHR system. *Success criteria:1 of 2 RHR trains*		Torus Cooling (SPC mode of RHR): consists of either train A or B pumps of RHR system. *Success criteria:1 of 4 RHR pumps with its associated heat exchanger*	
Heat Removal Systems (cont.)	**Shutdown Cooling** (cont.)	Shutdown Cooling (SDC mode of RHR): consists of two trains each with two pumps and a heat exchanger. *Success criteria:1 of 2 RHR trains*		Shutdown Cooling (SDC mode of RHR): consists of two trains each with two pumps and a heat exchanger. *(not addressed in the IPE)*	
Containment Systems	**Containment Cooling/ Venting**	Containment Spray (CS mode of RHR): consists of two trains of RHR each with two pumps and a heat exchanger. *Success criteria:1-out-of-2 RHR trains*		Containment Spray (CS mode of RHR): consists of two trains of RHR each with two pumps. *Success criteria:1 of 4 RHR pumps with its associated heat exchanger*	
		Containment Venting: Hard piped torus vent. 12” and 6” vent lines. *Success criteria: one of the two vent lines*	Installed hardened wetwell vent and credited it in the IPE	Containment Venting: via SGTS duct (18”) or Nitrogen makeup line (hard pipe, 8”). *Success criteria: one of the two vent lines*	

Table 3 DHR Systems for BWR Class 5/6 Plants

Systems		Clinton		River Bend		Perry 1		Grand Gulf		Nine Mile Point 2		Washington Nuclear Power 2	
		System Description	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**
Coolant Injection Systems	**High Pressure Injection**	High Pressure Core Spray (HPCS) System: consists of one train with a motor-driven pump. *Success Criteria: HPCS system operating*		High Pressure Core Spray (HPCS) System: consists of one train with a motor-driven pump. *Success Criteria: HPCS system operating*		High Pressure Core Spray (HPCS) System: consists of one train with a motor-driven pump *Success Criteria: HPCS system operating*	The maintenance activities for the HPCS were revised as a result of the schedule optimization prior to the third operating cycle. Credited in the IPE	High Pressure Core Spray (HPCS) System: consists of one train with a motor-driven pump. *Success Criteria: HPCS system operating*		High Pressure Core Spray (HPCS) System: consists of one train with a motor-driven pump and a system pressure pump. *Success Criteria: HPCS system operating*		High Pressure Core Spray (HPCS) System: consists of one train with a motor-driven pump. *Success Criteria: HPCS system operating*	
		Reactor Core Isolation Cooling (RCIC) System: consists of one train with a turbine–driven pump. *Success Criteria: RCIC system operating*		Reactor Core Isolation Cooling (RCIC) System: consists of one train with a turbine-driven pump. *Success Criteria: RCIC system operating*		Reactor Core Isolation Cooling (RCIC) System: consist of one train with a turbine-driven pump. *Success Criteria: RCIC system operating*		Reactor Core Isolation Cooling (RCIC) System: consists of one train with a turbine-driven pump. *Success Criteria: RCIC system operating*	Bypass RCIC steam tunnel high temperature signal when PSW is unavailable and no steam line break has occurred.	Reactor Core Isolation Cooling (RCIC) System: consists of one train with a turbine–driven pump and a system pressure pump. *Success Criteria: RCIC system operating*		Reactor Core Isolation Cooling (RCIC) System: consists of one train with a turbine–driven pump. *Success Criteria: RCIC system operating*	
		Control Rod Drive (CRD) System: provides backup source of high-pressure injection consisting of two 100% capacity pumps that supply water to the HCUs. *Success Criteria: Alignment of standby pump and opening of flow control valves*		Control Rod Drive (CRD) System: provides backup source of high-pressure injection consisting of two trains each with a 100 % capacity pump. *Success Criteria: 1 of 2 pumps*				Control Rod Drive (CRD) System: provides backup source of high-pressure injection consisting of two trains each with a 100% capacity pump. *Success Criteria: 2 of 2 pumps at the start of accident; 1 of 2 after coolant injection has been provided for a period of time*		Control Rod Drive (CRD) System: provides backup source of high-pressure injection consisting of two trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*			
	Low Pressure Injection	Low Pressure Coolant Injection (LPCI mode of RHR): consists of three trains each with a motor-driven pump. *Success Criteria: Not available*		Low Pressure Coolant Injection System (LPCI mode of RHR): consists of three-trains each with a motor-driven pump. *Success Criteria: 1 of 3 pumps*		Low Pressure Coolant Injection (LPCI mode of RHR) System: consists of three trains each with a motor-driven pump. Trains A and B each have two heat exchangers. Train C does not have heat exchangers. *Success Criteria: 1 of 3 pumps*		Low Pressure Coolant Injection (LPCI) System: consists of three trains each with a motor-driven pump. *Success Criteria: 1 of 3 pumps*		Low Pressure Coolant Injection (LPCI mode of RHR): consists of three trains with one pump each. *Success Criteria: 1 of 3 pumps*		Low Pressure Coolant Injection (LPCI mode of RHR): consists of three trains with one pump each. *Success Criteria: 1 of 3 pumps*	
		Low Pressure Core Spray (LPCS) System: consists of a four-stage vertical motor-driven pump. *Success Criteria: Not available*		Low Pressure Core Spray (LPCS) System: consists of one train with a motor-driven pump. *Success Criteria: 1 of 1 pump*		Low Pressure Core Spray (LPCS) System: consists of one train with a motor-driven pump. *Success Criteria: 1 of 1 pumps*		Low Pressure Core Spray (LPCS) System: consists of one train with a motor-driven pump. *Success Criteria: 1 of 1 pumps*		Low Pressure Core Spray (LPCS) System: consists of one train with a motor-driven pump and a system pressure pump. *Success Criteria: 1 of 1 pumps*		Low Pressure Core Spray (LPCS) System: consists of one train with a motor-driven pump. *Success Criteria: 1 of 1 pumps*	

Table 3 DHR Systems for BWR Class 5/6 Plants (Continued)

Systems		Clinton		River Bend		Perry 1		Grand Gulf		Nine Mile Point 2		Washington Nuclear Power 2	
		System Description	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**
Coolant Injection Systems (cont.)	**Low Pressure Injection** (cont.)					Condensate Transfer System: used as an alternate source of water injection into the reactor vessel when the primary injection systems such as ECCS, Feedwater and RCIC fail to maintain RPV level. Consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps*							
		Fire Protection System (FPS): it is cross-connected to the WS system. This cross connection allows the fire pumps to be uses as a source of injection into the reactor pressure vessel. Consists of three diesel-driven fire pumps. *Success Criteria: Not available*		Fire Protection Water (FPW): has 3 possible cross-ties with service water/standby service water system as a backup water supply. To inject water into the reactor, the LPCI injection is used. Consists of three pumps, one motor-driven and two diesel-driven pumps. *Success Criteria: A single FPW pump through any one cross-connect path should be sufficient for success*		Fire Protection System (FPS): aligned to enable fire water to be pumped into the vessel through the feedwater injection line. Consists of one train with a motor-driven and a diesel-driven pumps. *Success Criteria: 1 of 1 pumps*	A design of the " fast" fire protection connection involving the addition of a flange equipped with a fire hose compatible fitting to a HPCS fill and vent line was installed and incorporated into the Plant Emergency Instructions (PEI) Improvement Plan. Credited in the IPE	Fire Water System: is used as a last resort source of low-pressure coolant injection to the reactor vessel. Consists of three trains, one motor-driven pump and two diesel-driven pumps. *Success Criteria: 1 of 3 pumps*		Fire Water Cross Tie to RHR: hose connection to RHR Train A or B. Consists of diesel-driven and motor-driven pumps. *Success Criteria: 1 of 2 pumps*		Fire Protection System (FP) System: hose connection to condensate booster pump Ar. Consists of four pumps. *Success Criteria: 1 of 4 pumps*	
		Shutdown Service Water (SSW) System: consists of three independent subsytems each with a motor-driven pump. *Success Criteria: Not available*	Reviewed and revised the procedures to improve the likelihood of successfully responding to a failure of the Shutdown Service Water System. Not known if credited in the IPE	Standby Service Water (SSW) System: connection with the RHR system is provided to one of the two SSW supply to supply service water to the reactor vessel in an emergency situation using both pumps. Consist of two trains each with 2 50% capacity motor-driven SSW pumps. *Success Criteria: 1 of 2 pumps for train A and 2 of 2 pumps for train B*		Emergency Service Water (ESW): crosstie providing cooling to the RHR heat exchangers. One train provides an alternate injection path to the RHR train B. Consist of two trains with one pump each. *Success Criteria: ESW must supply water for 24 hours following a LOCA or transient. Number of trains required depends on alignment.*		Standby Service Water (SSW) System: crosstie system provides coolant makeup source to the reactor vessel during accidents in which normal sources of emergency injection have failed. Consists of one train and one pump for crosstie. *Success Criteria: Train B pump of SSW required*		Service Water (SW) System: used to inject water to RPV/containment through a cross-connection with RHR train B. Consists of two train each with three motor-driven pumps. *Success Criteria: Depends on whether cross-tie is open or closed AND whether Reactor/Turbine Building isolation valves are open or closed.*			

Table 3 DHR Systems for BWR Class 5/6 Plants (Continued)

Systems		Clinton		River Bend		Perry 1		Grand Gulf		Nine Mile Point 2		Washington Nuclear Power 2	
		System Description	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**
Depressurization	**Auto/Manual Depress.**	Automatic depressurization System (ADS): consists of 7 SRVs. *Success Criteria: Not available*	Emphasized the importance of manual and automatic depressurization in training and evaluated whether any changes were appropriate to be made to the training program.	Automatic Depressurization System (ADS): consists of 7 of the 16 SRVs *Success Criteria: 3 of 7 ADVs*		Automatic depressurization System (ADS): consist of 8 of the 19 SRVs. In addition there are 11 non-ADS relief valves. *Success Criteria: 4 of 8 ADVs and 4 of 11 non ADS valves*		Automatic Depressurization System (ADS): consists of 8 SRVs. In addition there are 12 non-ADS SRVs. *Success Criteria: 4 of 8 ADVs*		Automatic depressurization System (ADS): consists of 7 of the 18 SRVs. *Success Criteria: 2 of 7 ADVs*		Automatic depressurization System (ADS): consists of 7 of the 18 SRVs. *Success Criteria: For a transient – 3 SRVs + other systems For small LOCA – 3 SRVs + other systems For intermediate LOCA – 2 SRVs + other systems*	
Heat Removal Systems	**Shutdown Cooling**	Suppression Pool Cooling (SPC mode of RHR): consists of either train A or B pumps of RHR system. *Success Criteria: Requires manual initiation*		Suppression Pool Cooling (SPC mode of RHR): consists of either train A or B pumps of RHR system. *Success Criteria: 1 of of 2 pumps and its associated heat exchanger.*		Suppression Pool Cooling (SPC mode of RHR): consists of either train A or B of RHR system. *Success Criteria: 1 of 2 pumps and its associated heat exchanger*		Suppression Pool Cooling (SPC) System: consists of two trains and two pumps. *Success Criteria: 1 of 2 pumps and its associated heat exchanger*		Suppression Pool Cooling (SPC mode of RHR): consists of either train A or B pumps of RHR system. *Success Criteria: 1 of 3 pumps and its associated heat exchanger*		Suppression Pool Cooling (SPC mode of RHR): consists of either train A or B pumps of RHR system.	
		Shutdown Cooling (SDC mode of RHR): consists of two trains and two pumps. *Success Criteria: Requires manual initiation*		Shutdown Cooling (SDC mode of RHR): consists of a two train system each with a motor-driven pump. *Success Criteria: 1 of 2 pumps and its associated heat exchanger*				Shutdown Cooling (SDC mode of RHR): consists of two trains and two pumps. *Success Criteria: 1 of 2 pumps and its associated heat exchanger*		Shutdown Cooling (SDC mode of RHR): consists of either train A or B pumps of RHR system. *Success Criteria: 1 of 3 pumps and its associated heat exchanger*		Shutdown Cooling (SDC mode of RHR): consists of either train A or B pumps of RHR system.	

Table 3 DHR Systems for BWR Class 5/6 Plants (Continued)

Systems		Clinton		River Bend		Perry 1		Grand Gulf		Nine Mile Point 2		Washington Nuclear Power 2	
		System Description	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**	**Systems Description**	**A-45 Modifications**
Containment Systems	**Containment Cooling/ Venting**	Containment Spray (CS mode of RHR): consists of either train A or B pumps of RHR system. *Success Criteria: 1 of 2 pumps*				Containment Spray (CS mode of RHR): consists of either train A or B pumps. *Success Criteria: 1 of 2 pumps*		Containment Spray (CS mode of RHR): consist of two trains and two pumps. *Success Criteria: 1 of 2 pumps and associated heat exchanger*		Containment Spray (CS mode of RHR): consists of either train A or B pumps of RHR system. *Success Criteria: 1 of 2 trains*		Containment Spray (CS mode of RHR): consists of either train A or B pumps of RHR system.	
		Containment Venting: initiated when containment pressure approaches 45 psig and suppression pool level is less than 54 feet. If containment pressure exceeds this limit then the operator is directed to vent via all available paths. *Success Criteria: Only 3 of 6 vent paths are of sufficient size to vent containment when pressurized due to decay heat up to 40 hours following a SCRAM.*		Containment Venting: manually initiated and performed if the containment pressure exceeds 20 psig. *Success Criteria: No credit taken in the River Bend IPE for the vent*	Installation of a 10-inch diameter vent to prevent over pressure failure of the RBS containment given a failure of all containment heat removal was considered. However, the submittal performed a sensitivity calculation indicating that this modification will reduce the CDF by only 1% and therefore, was not implemented.	Containment Venting: manually initiated. *Success Criteria: 1 of 2 vent paths*	Performed a sensitivity analysis of installing a passive containment vent. However, the modification was never implemented.	Containment Venting: manually initiated consists of 4 AOVs and a 20 inch diameter purge exhaust line that discharges containment atmosphere to the roof of the auxiliary building. *Success Criteria: All 4 AOVs opening*		Containment Venting: manually initiated. *Success Criteria: Manual alignment to 20" pipe*		Containment Venting: initiated when containment pressure approaches 45 psig.	

Table 4 DHR Systems for PWR B&W Plants

Systems		Oconee 1,2&3		Arkansas Nuclear 1		Crystal River 3		Three Mile Island 1		Davis Besse	
		Systems/Functions Description	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**
Coolant Injection System	**High Pressure Injection**	High Pressure Safety Injection (HPSI) System: consists of three pump trains. *Success criteria: 1 of 3 pumps*		High Pressure Safety Injection (HPSI) System: consists of three pump trains. *Success criteria: 1 of 3 pumps injecting to 2 of 4 injection paths for all accident conditions*		High Pressure Makeup (HPMU) System: consists of three pumps. *Success criteria: 1 of 3 pumps for all accident conditions*		High Pressure Makeup (HPMU) System: consists of three pumps. *Success criteria: 1 of 3 pumps for all accident conditions*		High Pressure Safety Injection (HPSI) System: consists of 2 motor-driven pumps. *Success criteria: 1 of 2 pumps for all accident conditions.*	
	Low Pressure Injection	Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. A third train installed a spare pump. *Success Criteria: 1 of 2 pumps for all accident conditions*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*	
Secondary Side Feed	**Secondary Side Feed**	Emergency Feedwater (EFW) System: consists of two motor-driven pumps and a turbine-driven pump. In addition to MFW/CD pumps, Aux. SW from Standby Shutdown Facility (SSF) can pump lake water at high pressure into SGs. *Success Criteria: 1 of 2 EFW or 1 AFW pump to any or both SGs*		Auxiliary/Emergency Feedwater (A/EFW) System: AFW consists of one motor-driven pump. EFW system consists of two trains one with a motor-driven pump and the other with a turbine-driven pump. *Success Criteria: 1 of 2 EFW or 1 AFW pump to any or both SGs*		Emergency Feedwater (EFW) System: consists of two trains one with a motor-driven pump and the other with a turbine-driven pump. *Success Criteria: 1 of 2 trains to any or both SGs*		Emergency Feedwater (EFW) System: consists of two motor-driven pumps and a turbine-driven pump. The T-D pump uses mechanical linkage for control, requiring no support system. *Success Criteria: 1 of 3 pumps to any or both SGs*		Auxiliary Feedwater (AFW) System: consists of a motor-driven pump and two turbine-driven pumps. *Success Criteria: any 1 of 3 AFW pumps to 1 of 2 SGs*	
Depressurization	**Primary Side Depressurization**	Feed & Bleed (F&B): feed consists of HPI and bleed consists of PORV or SRVs. *Success Criteria: 1 HPI pump and PORV*		Feed & Bleed (F&B): feed consists of HPI and bleed consists of PORV or SRVs. *Success Criteria: 1 HPI pump and PORV or either of the SRV*		Feed & Bleed (F&B): feed consists of HPI and bleed consists of PORV or SRVs. *Success Criteria: 1 HPI pump and PORV or either of the SRVs*		Feed & Bleed (F&B): feed consists of HPI and bleed consists of PORV or SRVs. *Success Criteria: 1 HPI pump and PORV or either of the SRVs*		Feed & Bleed (F&B): feed consists of HPI and bleed consists of PORV or SRVs. *Success Criteria: 1 HPI pump and PORV or either of the SRVs*	

Table 4 DHR Systems for PWR B&W Plants (Continued)

Systems		Oconee 1,2&3		Arkansas Nuclear 1		Crystal River 3		Three Mile Island 1		Davis Besse	
		Systems/Functions Description	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**
Depressurization (cont.)	**Secondary Side Depressurization**	Atmospheric Dump Valves (ADVs)/TBVs in conjunction with Low Pressure Auxiliary SW pumps can be used when SGs are depressurized. *Success Criteria: 1 ADVs; 1TBVs and 1 of 2 pumps.*		2Atmospheric Dump Valves (ADVs), 4 TBVs and 8 MSSVs per SG used for pressure relief only and not for depressurization.		2Atmospheric Dump Valves (ADVs), 2 TBVs, 8 MSSVs per SG used for pressure relief only and not for depressurization. (not modeled in the IPE, assumed that the likelihood of these valves remining closed when needed is negligble)		2Atmospheric Dump Valves (ADVs), 6 TBVs and 9 MSSVs per SG used for pressure relief only and not for depressurization.		2 Atmospheric Dump Valves (ADVs), 6 TBVs and 9 MSSVs per SG used for pressure relief only and not for depressurization.	
Heat Removal Systems	**Shutdown Cooling**	Decay Heat Removal (DHR) system: consists of the LPI system pumps. Provides cooling to the core via the DHR heat exchangers. *Success Criteria: 1 of 2 pumps and 1 flow train for all accident conditions*		Decay Heat Removal (DHR) system: consists of the LPI system pumps. Provides cooling to the core via the DHR heat exchangers. *Success Criteria: 1 of 2 pumps and 1 flow train for all accident conditions*		Decay Heat Removal (DHR) system: consists of the LPI system pumps. Provides cooling to the core via the DHR heat exchangers. *Success Criteria: 1 of 2 pumps and 1 flow train for all accident conditions*		Decay Heat Removal (DHR) system: consists of the LPI system pumps. Provides cooling to the core via the DHR heat exchangers. *Success Criteria: 1-out-of-2 pumps and 1 flow train for all accident conditions.*		Decay Heat Removal (DHR) system: consists of the LPI system pumps. Provides cooling to the core via the DHR heat exchangers. *Success Criteria: 1 of 2 pumps and 1 flow train for all accident conditions*	
Containment Systems	**Containment Cooling**	Reactor Building Cooling (RBC) System: consists of 3 fan units. *Success Criteria: 2 of 3 fan units*		Reactor Building Cooling (RBC) System: consists of 4 fan units. *Success Criteria: 2 of 4 fan units and 1 of 2 RBS system trains successful*		Reactor Building Cooling (RBC) System: consists of 3 fan units. *Success Criteria: 3 of 3 fan units*		Reactor Building Emergency Cooling (RBEC) System: consists of 3 cooling units. *Success Criteria: 2-out-of-3 fan units.*		Containment Air Coolers (CAC): consists of 3 fan units. *Success Criteria: 1 of 3 fans*	
		Reactor Building Spray (RBS) System: consists of two trains, each with a motor-driven pump. *Success Criteria: 1 of 2 pumps*		Reactor Building Spray (RBS) System: consists of two trains, each with a motor-driven pump. *Success Criteria: 1 of 2 pumps*		Reactor Building Spray (RBS) System: consists of two trains, each with a motor-driven pump. *Success Criteria: 2 of 2 pumps, or 3 RB cooling fans, or 1 RB cooling fan and RBS system operating at ½ capacity*		Reactor Building Spray (RBS) System: consists of two trains, each with a motor-driven pump. *Success Criteria: 1-out-of-2 pumps.*		Containment Spray (CS) System: consists of three half capacity motor-driven pumps. *Success Criteria: 1 of 2 pumps*	

Table 5 DHR Systems for PWR CE Plants

Systems		San Onofre 2&3		Millstone 2		St. Lucie 1&2		Palisades		Fort Calhoun 1	
		Systems/Functions Description	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**
Coolant Injection Systems	**High Pressure Injection**	High Pressure Safety Injection (HPSI) System: consists of two trains each with a 100% capacity pump. One pump is running and one pump is in standby. There is also a 3rd spare motor-driven pump. *Success Criteria: 1 of 3 pumps*		High Pressure Safety Injection (HPSI) System: consists of two trains each with a 100% capacity pump. One pump is running and one pump is in standby. There is also a 3rd swing motor-driven pump. *Success Criteria: 1of 3 pumps*		High Pressure Safety Injection (HPSI) System: consists of two trains each with a 100% capacity pump. The 3rd pump (1C) has been abondoned. *Success criteria: 1 of 2 pumps for all accident conditions*		High Pressure Safety Injection (HPSI) System: consists of two trains each with a 100% capacity pump. *Success criteria: 1 of 2 pumps for all accident conditions*		High Pressure Safety Injection (HPSI) System: consists of 3 motor-driven pumps. *Success criteria: 1 of 3 pumps for all accident conditions*	
	Low Pressure Injection:	Low Pressure Safety Injection (LPSI mode of RHR): consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*		Low Pressure Safety Injection (LPSI mode of RHR): consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*	Increased testing of LPSI check valves for reverse flow. Credited in IPE	Low Pressure Safety Injection (LPSI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*		Low Pressure Safety Injection (LPSI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*		Low Pressure Safety Injection (LPSI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*	
Secondary Side Feed	**Secondary Side Feed**	Auxiliary Feedwater (AFW) System: consists of two 100% capacity motor-driven and one 100% capacity turbine-driven pumps. *Success Criteria: 1 of 3 pumps to 1 of 2 or both SGs.* In the event MFW and AFW are not available, the Condensate pumps can be used.		Auxiliary Feedwater (AFW) System: consists of two 100% capacity motor-driven and one 200% capacity turbine-driven pumps. *Success Criteria: 1-out-of-3 pumps.* Fire water system pumps used as an alternate source of AFW suction supply when CST is depleted. EOPs direct operators to use condensate pumps for feedwater flow in the event main and auxiliary feedwater are unavailable.	- Revised EOP to isolate intact SG so that AFW flow goes to faulted SG or its associated feed or steam lines. - Added accumulators for AFW regulating valves. - Restored steam supply to steam-driven AFW pump from SG # 1. Credited in IPE	Auxiliary Feedwater (AFW) System: consists of two 100% capacity motor-driven and one 100% capacity turbine-driven pumps. *Success Criteria: any one AFW flow to 1 of 2 SGs.*	Implemented new AO procedure to have operators fill CST from treated water storage tank when using AFW system. Credited in IPE	Auxiliary Feedwater (AFW) System: consists of two trains. The primary train has a motor-driven pump and a turbine-driven pump. The secondary train has a motor-driven pump. Fire water is used as an alternative source of water supply. *Success Criteria: any one AFW flow to 1 of 2 SGs*		Auxiliary Feedwater (AFW) System: consists of two trains with a motor-driven pump, a turbine-driven pump and a diesel-driven pump. Fire water is used for long-term makeup to the AFW suction. *Success Criteria: any one AFW flow to 1 of 2 SGs*	
Depressurization	**Primary Side Depressurization**			Feed & Bleed (F&B): feed consists of two HPSI/Charging pumps and bleed consists of two PORVs. *Success Criteria: Feed: 1 of 3 pumps. Bleed: 2 of 2 PORVs.*	- Increased training on Bleed and Feed operation. - Modified the PORV control circuit logic. Credited in IPE	Feed & Bleed (F&B): feed consists of two HPSI and bleed consists of 2 PORVs. *Success Criteria: 1 of 2 HPSI pumps and 2 of 2 PORVs for Unit 1 and 1 of 2 for Unit 2.*		Feed & Bleed (F&B): feed consists of 2 HPSI pumps and bleed consists of 2 PORVs. *Success Criteria: 1 of 2 PORV and 1 of 2 HPSI pumps*	Revised procedure using PORVs to depressurize the PCS following core damage. Not credited in IPE	Feed & Bleed (F&B): feed consists of 3 HPSI pumps and bleed consists of 2 PORVs. *Success Criteria: 1 of 2 PORV and 1 of 3 HPSI pumps*	

Table 5 DHR Systems for PWR CE Plants (Continued)

Systems		San Onofre 2&3		Millstone 2		St. Lucie 1&2		Palisades		Fort Calhoun 1	
		Systems/Functions Description	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**
Depressurization (cont.)	**Secondary Side Depressurization**	2 Atmospheric Dump Valves (ADVs, one on each SG. 5 SBCVs, 18 MSSVs used for pressure relief only and not for depressurization.		2 Atmospheric Dump Valves (ADVs) with Condensate pumps. *Success Criteria: 2 of 2 ADVs and 1 CD pump*		2 Atmospheric Dump Valves (ADVs), 8 MSSV per SG and 5 SDBVs used for pressure relief only and not for for depressurization.		4 Atmospheric Dump Valves (ADVs), 2 ADVS per SG and 1 TBV together with Condensate pumps. *Success Criteria: 1 ADV or the TBV with 1 CD pump*		Consists of 4 steam dump valves, 1 ADVs and 10 MSSVs used only for pressure relief and not for depressurization.	
Heat Removal Systems	**Shutdown Cooling**			Shutdown Cooling (SDC): consists of part of the LPSI system (pumps A & B). Provides cooling to the CS system via the shutdown heat exchangers. *Success Criteria: 1 of 2 pumps for all accident conditions*		Shutdown Cooling (SDC): consists of the LPSI system (pumps A & B). Provides cooling to the core via the shutdown heat exchangers. *Success Criteria: 1 of 2 pumps for all accident conditions*		Shutdown Cooling (SDC): consists of the LPSI system (pumps A & B). Provides cooling to the core via the shutdown heat exchangers. *Success Criteria: 1 of 2 pumps and 1 of 2 heat exchangers for all accident conditions*		Shutdown Cooling (SDC): consists of the LPSI system (pumps A & B). Provides cooling to the core via the shutdown heat exchangers. *Success Criteria: 1 of 2 pumps and 1 of 2 heat exchangers for all accident conditions*	
Containment Systems	**Containment Cooling**	Containment Emergency Fan Coolers (CEFCs): consists of 4 emergency fan cooling units.		Containment Air Recirculation (CAR) Fans: consists of two trains each comprised of 2 CAR fans. *Success Criteria: 1 of 4 CAR fans*		Containment Cooling System (CCS): consists of two trains each comprised of 2 fan coolers. *Success Criteria: 4 of 4 fans, or 1 of 2 CS pumps and 2 of 4 CCS fans*		Containment Air Coolers (CAC): consists of four containment air handling and cooling units. *Success Criteria: 1 of 4 CAC*		Containment Air Coolers (CAC): consists of two containment air coolers. *Success Criteria: 1 of 2 fans or 2 of 2 depending on the success path*	
		Containment Spray (CS) System: consists of two trains, each with a motor-driven pump and one shutdown cooling heat exchanger. *Success Criteria: 1 of 2 CS trains*		Containment Spray (CS) System: consists of two trains, each with a motor-driven pump and one shutdown cooling heat exchanger. *Success Criteria: 1 of 2 CS trains*		Containment Spray (CS) System: consists of two trains, each with a motor-driven pump and one shutdown cooling heat exchanger. *Success Criteria: 1 of 2 pumps*		Containment Spray (CS) System: consists of three half capacity motor-driven pumps and two shutdown cooling heat exchangers. *Success Criteria: 1 of 3 pumps*		Containment Spray (CS) System: consists of three half capacity motor-driven pumps and two shutdown cooling heat exchangers. *Success Criteria: 1 of-3 pumps*	

Table 5 DHR Systems for PWR CE Plants (Continued)

Systems		Palo Verde		Waterford 3		ANO 2[(1)]		Calvert Cliffs 1&2	
		Systems/Functions Description	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**
Coolant Injection Systems	**High Pressure Injection**	High Pressure Safety Injection (HPSI) System: consists of two trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*		High Pressure Safety Injection (HPSI) System: consists of three trains each with a 100% capacity pump. *Success Criteria: 1 of 3 pumps*		High Pressure Safety Injection (HPSI) System: consists of three trains each with a 100% capacity pump. Including a swing pump. *Success Criteria: 1 of 3 pumps*		High Pressure Safety Injection (HPSI) System: consists of three trains each with a 100% capacity pump. Normally, two pumps are aligned to auto start. *Success Criteria: 1 of 3 pumps*	
	Low Pressure Injection	Low Pressure Safety Injection: consists of two trains each with a motor-driven pump. *Success Criteria: 1of 2 pumps for all accident conditions*		Low Pressure Safety Injection : consists of two trains each with a motor-driven pump. Can also be used to provide the recirc spray in case of failure of the Spray pumps. *Success Criteria: 1 of 2 pumps for all accident conditions*		Low Pressure Safety Injection: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*		Low Pressure Safety Injection (LPSI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*	
Secondary Side Feed	**Secondary Side Feed**	Auxiliary Feedwater (AFW) System: consists of two 100% capacity motor-driven and one 100% capacity turbine-driven pumps. There is also a 100% capacity non-essential motor-driven pump. *Success Criteria: any one AFW flow to 1 of 2 SGs*	- Provide backup source of control power for train N AFW pump circuit breaker. - Change the source of power for the main steam and feedwater isolation valve logic cabinets. These modifications were based on a mid-1990 PRA and credited in the IPE.	Auxiliary/Emergency Feedwater (A/EFW) System: AFW consists of one 100% capacity motor-driven pump. EFW system consists of two motor-driven pumps and a turbine-driven pump. *Success Criteria: any one A/EFW flow to 1 of 2 SGs*		Emergency Feedwater (EFW) System: EFW system consists of one motor-driven pump and a turbine-driven pump. SW system is used as a backup to EFW pumps suction. *Success Criteria: any one EFW flow to 1 of 2 SGs.*	- Installed a new AFW pump in response to GI-124. AFW consists of one 100% capacity motor-driven pump. Not credited in IPE	Auxiliary Feedwater (AFW) System: consists of two motor-driven and one turbine-driven pumps. Two cross-connect lines are provided between the two units motor-driven pumps discharge lines. The X-connect lines allow the motor-driven AFW pump in one unit to supply FW to the AFW system in the other unit *Success Criteria: any one AFW flow to 1 of 2 SGs*	- Provided surveillance on AFW condensate related manual valves to ensure supply of water for AFW if the CST is lost or is depleted. - Operator training on inadvertant actuation of ESFAS. Credited in IPE
Depressurization	**Primary Side Depressurization**					Feed & Beed (F&B): feed consists of two HPSI pumps and bleed consists of the PZR ECCS vent valves or LTOP valves. *Success Criteria: 2 of 2 Vent/LTOP valves and 1 HPSI pump*		Feed & Beed (F&B): feed consists of HPSI and bleed consists of 2 PORVs. *Success Criteria: 2 of 2 PORVs and 1 HPSI pump*	

Table 5 DHR Systems for PWR CE Plants (Continued)

Systems		Palo Verde		Waterford 3		ANO 2[(1)]		Calvert Cliffs 1&2	
		Systems/Functions Description	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**
Depressurization (cont.)	**Secondary Side Depressurization**	2 Atmospheric Dump Valves (ADVs), 8 Turbine Bypass Valves (TBVs) and Alt. FW system. Alternate Feedwater (AltFW) System: consist of one of the three low pressure, non-class powered condensate pumps, which operates to deliver flow to a depressurized SG via the downcomer feedwater lines. *Success Criteria: 1 of 2 ADVs, or 1of 8 TBV and 1 pump*		2 Atmospheric Dump Valves (ADVs). 6 Turbine Bypass Valvess (TBVs) and 3 Condensate System. Condensate (CD) System: CD pumps maybe used to provide FW to the SGs provided the secondary system has been depressurized to 500 psia. The system consist of 3 pumps. Success Criteria: *1 of 2 ADVs, or 1 of 6 TBV and 1 pump*		4 Atmospheric Dump Valves (ADVs), one on each side of the MSIV, 3 TBVs, 2 lines of LTOP and one line of ECCS vent valves. 10 MSRVs, 5 for each MS line. Condensate (CD) System: CD pumps maybe used to provide FW to the SGs provided the secondary system has been depressurized. Success Criteria: *1 of 2 ADVs, or 1 TBV and 1 pump*		2 Atmospheric Dump Valves (ADVs), 16 SRVs used for pressure relief only and not for depressurization.	
Heat Removal Systems	**Shutdown Cooling**	Shutdown Cooling (SDC): consists of the LPSI system (pumps A & B) or the CS pumps. Provides cooling to the core via the shutdown heat exchangers. *Success Criteria: 1 of 2 pumps and heat exchangers for all accident conditions*		Shutdown Cooling (SDC): consists of the LPSI system (pumps A & B) or the CS pumps. Provides cooling to the core via the shutdown heat exchangers. *Success Criteria: 1-out-of-2 pumps and heat exchangers for all accident conditions.*		Shutdown Cooling (SDC): consists of the LPSI system (pumps A & B). Provides cooling to the core via the shutdown heat exchangers. *Success Criteria: 1 of 2 pumps and heat exchangers for all accident conditions*		Shutdown Cooling (SDC): consists of the LPSI system (pumps A & B). Provides cooling to the core via the shutdown heat exchangers. *Success Criteria: 1 of 2 pumps for all accident conditions*	
Containment Systems	**Containment Cooling**			Containment Cooling System (CCS): consists of two trains each comprised of 2 fan coolers. *Success Criteria: 4 of 4 fans*		Containment Cooling System (CCS): consists of two trains each comprised of 4 RBCUs.		Containment Air Coolers (CAC): consists of two trains each with two containment air coolers. *Success Criteria: 3 of 4 fans*	
		Containment Spray (CS) System: consists of two trains, each with a motor-driven pump and a shutdown cooling heat exchanger. *Success Criteria: 1 of 2 pumps*		Containment Spray (CS) System: consists of two trains, each with a motor-driven pump and a shutdown cooling heat exchanger. *Success Criteria: 1 of 2 pumps and heat exchangers*		Containment Spray (CS) System: consists of two trains, each with a motor-driven pump and one shutdown cooling heat exchanger.		Containment Spray (CS) System: consists of two trains, each with a motor-driven pump and one shutdown cooling heat exchanger. *Success Criteria: 1 of 2 pumps*	

Note:

(1) The information provided are based on the IPEEE analysis.

Table 6 DHR Systems for PWR W 2-LOOP Plants

Systems		Prairie Island 1&2		Ginna		Kewannee		Point Beach	
		Systems/Functions Description	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**
Coolant Injection Systems	**High Pressure Injection**	High Pressure Safety Injection (HPSI) System: consists of two trains with one pump each. *Success criteria: 1 of 2 pumps for all accident conditions*		High Pressure Safety Injection (HPSI) System: consists of two trains with three pumps. *Success criteria: 1 of 3 pumps for all accident conditions*		High Pressure Safety Injection (HPSI) System: consists of two trains, each with a pump. *Success criteria: 1 of 2 pumps for all accident conditions*		High Pressure Safety Injection (HPSI) System: consists of two trains, each with a pump . *Success criteria: 1 of 2 pumps for all accident conditions*	
	Low Pressure Injection	Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*	Revised training programs to emphasize switchover to high and low head recirculation Not credited in IPE	Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*	Changed TS to align pumps to RWST rather than Boric Acid Storage Tank while in standby. Credited in IPE	Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*	Revised EOPs on Containment Sump Recirculation Credited in IPE
Secondary Side Feed	**Secondary Side Feed**	Auxiliary Feedwater (AFW) System: consists of two trains, one with a motor-driven and the other with a turbine-driven pump. The motor-driven pump from one unit can be cross connected to supply the SGs of the other unit. *Success Criteria: 1 of 3 trains to any or both SGs*	Revised training programs to emphasize cross tying MDAFW pumps. Not credited in IPE	Auxiliary Feedwater (AFW) System: consists of three trains with two motor-driven and one turbine-driven pump. *Success Criteria: 1 of 3 AFW pumps to any or both SGs*		Auxiliary Feedwater (AFW) System: consists of three trains with two motor-driven and one turbine-driven pump. *Success Criteria: 1 of 3 AFW pumps to any of the two SG.*	- Modifications to improve reliability of turbine-driven AFW pumps. Credited in IPE	Auxiliary Feedwater (AFW) System: consists of three trains with two motor-driven and one turbine-driven pumps. The two motor-driven pumps are shared between the units. *Success Criteria: 1 of 3 AFW pumps to any or both SGs*	- Revised EOPs for aligning alternate AFW water sources from fire water system. - Added quick connect mechanism to hook fire water hoses to CST Credited in IPE
				Standby Auxiliary Feedwater (SAFW) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 SAFW pumps to any or both SGs*					
Depressurization	**Primary Side Depressurization**	Feed & Bleed (F&B): feed consists of HPI and bleed consists of PORVs. *Success Criteria: 1 HPI pump and 1 of 2 PORVs*	Revised training programs to emphasize feed and bleed. Not credited in IPE	Feed & Bleed (F&B): feed consists of HPI and bleed consists of PORVs. *Success Criteria: 1 HPI pump and 2 of 2 PORVs*		Feed & Bleed (F&B): feed consists of HPSI and bleed consists of PORVs. *Success Criteria: 1 HPSI pump and 1 of 2 PORVs* .		Feed & Bleed (F&B): feed consists of Charging or high head SI and bleed consists of PORVs. *Success Criteria: 1 pump and 1 of 2 PORVs*	

Table 6 DHR Systems for PWR W 2-LOOP Plants (Continued)

Systems		Prairie Island 1&2		Ginna		Kewannee		Point Beach	
		Systems/Functions Description	A-45 Modifications	Systems/Functions Description	A-45 Modifications	Systems/Functions Description	A-45 Modifications	Systems/Functions Description	A-45 Modifications
Depressurization (cont.)	**Secondary Side Depressurization**	4 Stem Dump Valves (SDVs), two on each SG used for pressure relief and not for depressurization.		2 Atmospheric Relief Valves (ARVs), one per SG and Condensate pumps. *Success Criteria: 1 of 2 ARVs and 1 CD pump*		4 Stem Dump Valves (SDVs), two on each SG used only for pressure relief and not for depressurization.		2 Atmospheric Dump Valves (ADVs), one per SG and Condensate pumps. *Success Criteria: 1 of 2 ADVs and 1 CD pump*	
Heat Removal Systems	**Shutdown Cooling**	Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and 1 flow train for all accident conditions*		Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and 1 flow train for all accident conditions*		Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and 1 flow train for all accident conditions*		Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and 1 flow train for all accident conditions*	
Containment Systems	**Containment Cooling**	Reactor Building Cooling (RBC) System: consists of 4 containment fan cooling units. *Success Criteria: 2 of 4 fan units*		Reactor Building Cooling (RBC) System: consists of 4 containment recirculation fan cooler units. *Success Criteria: 2 of 4 fan units*		Containment Air Cooling (CAC) System: consists of two trains, each with two fan coil units. *Success Criteria: 2 of 4 fan units*		Reactor Building Cooling (RBC) System: consists of 4 containment recirculation fan cooling units. *Success Criteria: 1 of 4 fan units*	
		Containment Building Spray (CS) System: consists of two trains, each with a motor-driven pump and a RHR cooling heat exchanger. *Success Criteria: 1 of 2 pumps*		Containment Building Spray (CS) System: consists of two trains, each with a motor-driven pump and a RHR cooling heat exchanger. *Success Criteria: 1 of 2 pumps*		Containment Spray (CS) System: consists of two trains, each with a motor-driven pump and one shutdown cooling heat exchanger. *Success Criteria: 1 of 2 pumps*		Containment Building Spray (CS) System: consists of two trains, each with a motor-driven pump and a RHR cooling heat exchanger. *Success Criteria: 1 of 2 pumps*	

Table 7 DHR Systems for PWR W 3-LOOP Plants

Systems		Beaver Valley 1		Beaver Valley 2		Robinson 2		Turkey Point 3&4		Shearon Harris	
		Systems/Functions Description	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**
Coolant Injection Systems	**High Pressure Injection**	High Head Safety Injection (HHSI)/Charging (CH) System: consists of two trains with one pump each and a swing pump. *Success criteria: 1 of 3 pumps for all accident conditions*		High Head Safety Injection (HHSI)/Charging (CH) System: consists of three pumps. *Success criteria: 1 of 3 pumps for all accident conditions*		High Head Safety Injection (HHSI)/Charging (CH) System: consists of two trains, each with a pump. *Success criteria: 1 of 2 pumps for all accident conditions*		High Head Safety Injection (HHSI) System: consists of two trains per unit, each with a pump. *Success criteria: 2 of 4 pumps for all accident conditions*		High Head Safety Injection (HHSI)/Charging (CH) System: consists of three 100% capacity motor-driven pumps. *Success criteria: 1 of 3 pumps for all accident conditions*	
	Low Pressure Injection	Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*	- Walk-through and revision of long-term ECCS recirculation procedure - Revise SI and CV spray system valve test procedure. Not credited in IPE	Low Pressure Injection (LPI) System: consists of two trains per unit each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*	
Secondary Side Feed	**Secondary Side Feed**	Auxiliary Feedwater (AFW) System: consists of two motor-driven and a turbine-driven pump. A dedicated pump also exists. The MFW motor-driven pumps can be realigned to provide Feedwater. Long term makeup consists of river water in addition to CST. *Success Criteria: 1 of 3 pumps*		Auxiliary Feedwater (AFW) System: consists of three trains with two motor-driven and one turbine-driven pumps. SW is used as a backup to CST. MFW/CD can be aligned when AFW is not available. *Success Criteria: 1 of 3 AFW pumps*		Auxiliary Feedwater (AFW) System: consists of three trains with two motor-driven and one turbine-driven pumps. MFW can also be established for feedwater. SW as well as Deep Well Pumps and Fire Water can be used as backup to CST. *Success Criteria: 1 of 3 AFW pumps*		Auxiliary Feedwater (AFW) System: consists of three turbine-driven pumps for both units. Also uses the Standby SG Feedwater sytem pumps. MFW can also be established for feedwater. *Success Criteria: 1 of 3 pumps to 1 of 3 SG of one or both units*		Auxiliary Feedwater (AFW) System: consists of three trains with two motor-driven and one turbine-driven pumps. 2 motor-driven MFW and Condensate pumps can also be established for feedwater. ESW can be used as backup to CST. *Success Criteria: 1 of 3 AFW pumps*	
Depressurization	**Primary Side Depressurization**	Feed & Bleed (F&B): feed consists of CH/HHSI and bleed consists of PORVs. *Success Criteria: 1 CH/HHSI pump and 1 of 3 PORVs*	Depressurize RCS earlier when HHSI is unavailable. Credited in IPE	Feed & Bleed (F&B): feed consists of CH/HHSI and bleed consists of PORVs. *Success Criteria: 1 CH/HHSI pump and 1 of 3 PORVs*		Feed & Bleed (F&B): feed consists of HPSI and bleed consists of PORVs. *Success Criteria: 1 HHSI pump and 2 of 2 PORVs*		Feed & Bleed (F&B): feed consists of high head SI and bleed consists of PORVs. *Success Criteria: 1 Pump and 2 of 2 PORVs*		Feed & Bleed (F&B): feed consists of high head SI and bleed consists of PORVs. *Success Criteria: 1 Pump and 2 of 2 PORVs or 1 SRV*	
Depressurization (cont.)	**Secondary Side Depressurization**	3 Atmospheric Steam Dump Valves (ADVs). *Success Criteria: 1 of 3 ADVs*	Gag closed a failed open SG safety valve during SGTR sequence to isolate ruptured SG. Credited in IPE	3 Atmospheric Steam Dump Valves (ADVs). *Success Criteria: 1 of 3 ADVs*	Update EOP and training to depressurize the intact SGs during a SGTR sequence or small LOCA when, in either case all HHSI is failed Not credited in IPE	3 SG PORVs (or ADVs), one for each SG and 4 Safety Valves. *Success Criteria: 1 of 3 SG PORV or 1 of 4 SRVs*		3Atmospheric Dump Valves (ADVs), one per SG and 12 SRVs (4 per SG). *Success Criteria: 2 of 3 ADVs or4 of 4 condenser dump valves*		3 SG PORVs (or ADVs), one for each SG. *Success Criteria: 1 of 3 SG PORVs*	

Table 7 DHR Systems for PWR W 3-LOOP Plants (Continued)

Systems		Beaver Valley 1		Beaver Valley 2		Robinson 2		Turkey Point 3&4		Shearon Harris	
		Systems/Functions Description	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**
Heat Removal Systems	**Shutdown Cooling**	Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and heat exchangers for all accident conditions*		Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and 1 flow train for all accident conditions*		Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and 1 flow train for all accident conditions*		Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and 1 flow train for all accident conditions*	.	Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and 1 flow train for all accident conditions*	
Containment Systems	**Containment Cooling**	Quench Spray(QS) System: consist of two spray trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*		Quench Spray (QS) System: consist of two spray trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*	EOP modifications based on the frequency of containment overpressurization sequences. Not credited in IPE	Containment Air Cooling (CAC) System: consists of four air handling units. *Success Criteria: 3 of 4 fan units*		Emergency Containment Coolers (ECCs): consists of 3 ECCs per unit. *Success Criteria: 2 of 3 fan units and 1CS pump*	.	Containment Fan Coolers (CFCs): consists of 4 air handling units. *Success Criteria: 2 of 4 fan units*	
		Recirculation Spray (RS) System: consist of four spray trains, including inside and outside recirculation pumps (2 outside and 2 inside). Two Outside Recirculation System (ORS) trains can be aligned to discharge to LHSI for long term cooling of core. *Success Criteria: 2 of 4 recirc spray pumps. 1 of 2 ORS and 1 of 2 IRS*		Recirculation Spray (RS) System: consist of four spray trains, including inside and outside recirculation pumps (2 outside and 2 inside). Two Outside Recirculation System (ORS) trains can be aligned to discharge to LHSI for long term cooling of core. *Success Criteria: 2 of 4 recirc spray pumps. 1 of 2 ORS and 1 of 2 IRS*		Containment Spray (CS) System: consists of two 50% capacity motor-driven pumps. *Success Criteria: 1 of 2 pumps*		Containment Spray (CS) System: consists of two trains, each with a motor-driven pump. *Success Criteria: 1 of 2 pumps and 2/3 ECCS.*	.	Containment Spray (CS) System: consists of two trains, each with a motor-driven pump. *Success Criteria: 1 of 2 pumps*	

Table 7 DHR Systems for PWR W 3-LOOP Plants (Continued)

Systems		Farley 1&2		Summer		North Anna 1&2		Surry 1&2	
		Systems/Functions Description	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**
Coolant Injection Systems	**High Pressure Injection**	High Head Safety Injection (HHSI)/Charging (CH) System: consists of three pumps. *Success criteria: 1 of 3 pumps to 2/3 SGs*		High Head Safety Injection (HHSI)/Charging (CH) System: consists of two trains each with a pump. A third pump can be aligned to any of the two trains. *Success criteria: 1 of 2 pumps for all accident conditions*	Changed procedure to provide alternate cooling to the charging pumps from the preferred Demineralized Water System or the Fire Service Water System. Not known if credited in the IPE	High Head Safety Injection (HHSI)/Charging (CH) System: consists of three pumps. *Success criteria: 1 of 3 pumps for all accident conditions*		High Head Safety Injection (HHSI)/Charging (CH) System: consists of three pumps. *Success criteria: 1 of 3 pumps for all accident conditions*	
	Low Pressure Injection	Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*	- Revise test procedures to verify the full flow recirc valves are closed. - Stagger LHSI pump testing about 45 days apart. Credited in IPE	Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps for all accident conditions*	
Secondary Side Feed	**Secondary Side Feed**	Auxiliary Feedwater (AFW) System: consists of two motor-driven and a turbine-driven pump. The MFW and Condensate motor-driven pumps can be realigned to provide Feedwater. Long term makeup consists of SW in addition to CST. *Success Criteria: 1 of 3 pumps*		Emergency Feedwater (EFW) System: consists of three trains with two motor-driven and one turbine-driven pumps. SW is used as a backup to CST. MFW/CD not credited in the IPE. *Success Criteria: 1 of 3 AFW pumps*		Auxiliary Feedwater (AFW) System: consists of three trains with two motor-driven and one turbine-driven pumps. MFW can also be established for feedwater. Can take suction from an additional CST, the SW system and the firemain. *Success Criteria: 1 of 3 AFW pumps*		Auxiliary Feedwater (AFW) System: consists of three trains with two motor-driven and one turbine-driven pumps. MFW can also be established for feedwater. Can take suction from an additional CST, the SW system and the firemain. *Success Criteria: 1 of 3 AFW pumps*	
Depressurization	**Primary Side Depressurization**	Feed & Bleed (F&B): feed consists of CH/HHSI and bleed consists of PORVs. *Success Criteria: 1 CH/HHSI pump and 1 of 2 PORVs*		Feed & Bleed (F&B): feed consists of CH/HHSI and bleed consists of PORVs. *Success Criteria: 1 CH/HHSI pump and 2 of 3 PORVs*	- EOP modification, directing Ops to reenergize any PPORV block valves that were closed and racked-out to isolate a leaking PORV. This allows ops more time for F&B before complete loss of heat sink. (not known if credited in the IPE). - Re-establish reactor building IA supply to allow opening the minimum 2 of 3 PORVs during an RCS F&B. (Not credited in IPE)	Feed & Bleed (F&B): feed consists of HPSI and bleed consists of PORVs. *Success Criteria: 1 HHSI pump and 1 of 2 PORVs*		Feed & Bleed (F&B): feed consists of HPSI and bleed consists of PORVs. *Success Criteria: 1 HHSI pump and 1 of 2 PORVs* .	

Table 7 DHR Systems for PWR W 3-LOOP Plants (Continued)

Systems		Farley 1&2		Summer		North Anna 1&2		Surry 1&2	
		Systems/Functions Description	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**
Depressurization (con.t)	**Secondary Side Depressurization**	3 Atmospheric Dump Valves (ADVs). *Success Criteria: 1 of 3 ADV, and 2 of 8 Steam Dump Valves*		3 Atmospheric Dump Valves (ADVs), 3 PORVs, 5 SG SVs per SG. *Success Criteria: 1 of 3 ADVs or 1 of 3 PORVs or 1 of 5 SVs*		3 SG PORVs (ADVs), one for each SG and 4 Safety Valves. *Success Criteria: 1 of 3 SG PORVs*		3 SG PORVs (ADVs), one for each SG and 4 Safety Valves. *Success Criteria: 3 of 3 PORVs*	
Heat Removal Systems	**Shutdown Cooling**	Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and heat exchangers for all accident conditions*		Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and 1 flow train for all accident conditions*		Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and 1 flow train for all accident conditions*		Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and 1 flow train for all accident conditions*	
Containment Systems	**Containment Cooling**	Containment Fan Coolers (CACs): consists of four air handling units, two per train. *Success Criteria: 2 of 4 fan units*		Reactor Building Cooling Units (RBCUs): consists of 4 air handling units, two per train. *Success Criteria: 2 of 4 fan units*		Quench Spray (QS) System: consist of two spray trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*		Quench Spray(QS) System: consist of two spray trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*	
		Containment Spray (CS) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps*		Reactor Building Spray (RBS) System: consists of two motor-driven pumps. *Success Criteria: 1 of 2 pumps*		Recirculation Spray (RS) System: consist of four spray trains, including inside and outside recirculation pumps (2 outside and 2 inside). Two Outside Recirculation System (ORS) trains can be aligned to discharge to LHSI for long term cooling of core. *Success Criteria: 1 of 4 recirc spray pump or. 1 of 2 ORS*	Revise procedures to verify that Quench Spray or Recirculation Spray piping is restored after testing. Credited in IPE	Recirculation Spray (RS) System: consist of four spray trains, including inside and outside recirculation pumps (2 outside and 2 inside). Two Outside Recirculation System (ORS) trains can be aligned to discharge to LHSI for long term cooling of core. *Success Criteria: 1 of 4 recirc spray pump or. 1 of 2 ORS*	

Table 8 DHR Systems for PWR W 4-LOOP Plants

Systems		Braidwood 1&2		Comanche Peak 1&2		Indian Point 2		Salem 1&2		Vogtle 1&2	
		Systems/Functions Description	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**
Coolant Injection Systems	**High Pressure Injection**	High Head Safety Injection (HHSI)/ Charging (CH) System: consists of two SI pumps and two CH pumps. *Success criteria: 1 of 2 SI/CH pumps*		High Head Safety Injection (HHSI)/ Charging (CH) System: consists of two SI pumps and three CH pumps. *Success criteria: 1 of 3 CH pumps or 1 of 2 SI pumps*		High Head Safety Injection (HHSI)/ System: consists of three SI pumps. *Success criteria: 1 of 3 SI pumps*		High Head Safety Injection (HHSI)/ Charging (CH) System: consists of two pumps. *Success criteria: 1 of 2 pumps*		High Head Safety Injection (HHSI)/ Charging (CH) System: consists of two SI pumps and two CH pumps. *Success criteria: 1 of 2 CH pumps or 1 of 2 SI pumps*	
	Low Pressure Injection	Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps*	
Secondary Side Feed	**Secondary Side Feed**	Auxiliary Feedwater (AFW) System: consists of two motor-driven and a turbine-driven pump. MFW, startup FW Condensate/condensate booster pumps can be realigned to provide Feedwater if AFW is not available. CST can be supplemented by Unit 2 CST and essential SW can be used as a backup source of water to AFW pumps. *Success Criteria: 1 of 3 pumps.*	ESF Bus Cross-Tie procedure change. This directly impacts AFW availability This modification affects SBO. However, it is mentioned in the DHR evaluation but not credited in the IPE. The IPE states that this procedural change provides an approximate 61% reduction in total CDF and reduces contribution of AF and ECCS recirculation failures by ~ 25% each. The total CDF reduces from 2.74E-05 to 1.07E-05.	Auxiliary Feedwater (AFW) System: consists of two motor-driven and a turbine-driven pump. MFW/Condensate pumps can be realigned to provide Feedwater if AFW is not available. SW can be used as a backup source of water to AFW pumps. *Success Criteria: 1 of 3 pumps*	- Revised procedure for manual control of TDAFWP - Revise procedure for re-establishing MFW upon loss of AFW - Revise procedure so as to start standby chilled water train upon auto-start of MDAFW Credited in IPE	Auxiliary Feedwater (AFW) System: consists of two motor-driven and a turbine-driven pump. MFW/Condensate pumps can be realigned to provide Feedwater if AFW is not available. Secondary City Water can be used as a backup source of water to AFW pumps. *Success Criteria: 1 of 3 pumps*		Auxiliary Feedwater (AFW) System: consists of two motor-driven and a turbine-driven pump. Demineralized water storage tank and fresh water as well as Fire Water Storage tanks can be used as backup sources of water to AFW pumps. *Success Criteria: 1 of 3 pumps*		Auxiliary Feedwater (AFW) System: consists of two motor-driven and a turbine-driven pump. MFW can be aligned if AFW is not available. CST 2 is used as a backup to CST 1. However, CST 2 is not modeled as CST 1 assumed to have large capacity. *Success Criteria: 1 of 3 pumps*	Revised procedure to have operator manually operate AFW turbine driven pump upon loss of DC power. Credited in IPE
Depressurization	**Primary Side Depressurization**	Feed & Bleed (F&B): feed consists of CH/HHSI and bleed consists of 2 PORVs. *Success Criteria: 1 pump and 1 of 2 PORV*		Feed & Bleed (F&B): feed consists of CH/HHSI and bleed consists of 2 PORVs. *Success Criteria: 1 pump and 1 of 2 PORV*		Feed & Bleed (F&B): feed consists of HHSI and bleed consists of 2 PORVs. *Success Criteria: 1 pump and 2 of 2 PORV*	Emphasize risk importance of closing a PORV block valve. Not credited in IPE	Feed & Bleed (F&B): feed consists of HHSI and bleed consists of 2 PORVs. *Success Criteria: 1 pump and 2 of 2 PORV for transients and 1 of 2 PORVs for SLOCA.*		Feed & Bleed (F&B): feed consists of HHSI and bleed consists of 2 PORVs. *Success Criteria: 1 pump and 1 of 2 PORVs*	

Table 8 DHR Systems for PWR W 4-LOOP Plants (Continued)

Systems		Braidwood 1&2		Comanche Peak 1&2		Indian Point 2		Salem 1&2		Vogtle 1&2	
		Systems/Functions Description	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**
Depressurization (con.t)	**Secondary Side Depressurization**	4 PORVs used for discharge to atmosphere and 12 SDVs used for steam relief to condenser. Condensate is used when the secondary side pressure is reduced. *Success Criteria: 1 of 4 PORVS*		4 ARVs or 5 SRVs per SG used for discharge to atmosphere and 12 SDVs used for steam relief to condenser. Condensate is used when the secondary side pressure is reduced. *Success Criteria: 1 of 4 PORVS or 1 of 5 RVs*		ARVs or SRVs used for discharge to atmosphere and 12 SDVs used for steam relief to condenser. However, no mention of whether Condensate system can be used when secondary side pressure is reduced. *Success Criteria: 1 ARV or 1 of 5 RVs and 1 CD pump*		ARVs or SRVs used for discharge to atmosphere and 12 SDVs used for steam relief to condenser. Condensate is used when the secondary side pressure is reduced. *Success Criteria: 1 ARV or 1 of 5 RVs and 1 CD pump*		ARVs or SRVs used for discharge to atmosphere and 12 SDVs used for steam relief to condenser. Condensate is used when the secondary side pressure is reduced. *Success Criteria: 1 of 4 PORVS or 1 of 5 RVs and 1 CD pump*	
Heat Removal Systems	**Shutdown Cooling**	Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and heat exchangers*		Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and heat exchangers*		Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and heat exchangers*		Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and heat exchangers*			
Containment Systems	**Containment Cooling**	Reactor Containment Fan Cooler (RBFC) System: consists of 4 fan units. *Success Criteria: 3 of 4fan units*				Containment Fan Cooler (CFC) System: consists of 5 fan units. *Success Criteria: 3 of 5 fan units*		Containment Fan Cooler (CFC) System: consists of 5 fan units. *Success Criteria: 3 of 5 fan units*		Containment Cooling Unit (CCU) System: consists of two trains with 4 fan units per train. *Success Criteria: 1 of 2 trains or 4 of 8 fan units*	
		Containment Spray (CS) System: consist of two spray trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*		Containment Spray (CS) System: consist of two spray trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*		Containment Spray (CS) System: consist of two spray trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*		Containment Spray (CS) System: consist of two spray trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*		Containment Spray (CS) System: consist of two spray trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*	

Table 8 DHR Systems for PWR W 4-LOOP Plants (Continued)

Systems		Byron 1&2		DC Cook 1&2		Indian Point 3		Seabrook		Watts Bar 1	
		Systems/Functions Description	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**
Coolant Injection Systems	**High Pressure Injection**	High Head Safety Injection (HHSI)/Charging (CH) System: consists of two SI pumps and two CH pumps. *Success criteria: 1 of 2 SI/CH pumps*		High Head Safety Injection (HHSI)/Charging (CH) System: consists of two SI and two CH pumps. *Success criteria: 1 of 2 SI pumps or 1 of 2 Charging pumps*		High Head Safety Injection (HHSI)/Charging (CH) System: consists of three SI and three CH pumps. *Success criteria: 1 of 3 SI pumps or 1 of 3 Charging pumps*		High Head Safety Injection (HHSI)/Charging (CH) System: consists of two SI and two CH pumps. *Success criteria: 1 of 2 SI pumps or 1 of 2 Charging pumps*		High Head Safety Injection (HHSI)/Charging (CH) System: consists of two SI and two CH pumps. *Success criteria: 1 of 2 SI pumps or 1 of 2 Charging pumps*	
	Low Pressure Injection	Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps*	
Secondary Side Feed	**Secondary Side Feed**	Auxiliary Feedwater (AFW) System: consists of two trains, one with a 100% capacity motor-driven pump and the other train with a turbine-driven pump. MFW, startup FW Condensate/condensate booster pumps can be realigned to provide Feedwater if AFW is not available. CST can be supplemented by Unit 2 CST and essential SW can be used as a backup source of water to AFW pumps. *Success Criteria: 1 of 2 pumps*	- ESF Bus Cross-Tie procedure change. This change impacts the availability of the AFW system. This modification affects SBO. However, it is mentioned in the DHR evaluation but not credited in the IPE. The IPE states that this procedural change provides an approximate 61% reduction in total CDF and reduces contribution of AF and ECCS recirculation failures by ~ 20% each. Credit for SW flow through an idle AF to SG	Auxiliary Feedwater (AFW) System: consists of two motor-driven pumps and a turbine-driven pump. MFW, Condensate as well as other units M-D FW can be realigned to provide Feedwater if AFW is not available. CST can be supplemented by Unit 2 CST or essential SW *Success Criteria: 1 of 3 pumps*		Auxiliary Feedwater (AFW) System: consists of two motor-driven pumps and a turbine-driven pump. CST can be supplemented by City Water *Success Criteria: 1 of 3 pumps*	- Revise procedure to have operator open roll-up door upon failure of AFW pump room ventilation. - Modify EOP to align city water supply to AFW pumps if CST outlet valves fail. Credited in IPE	Emergency Feedwater (EFW) System: consists of two trains, one with a motor-driven pump and the other with a turbine-driven pump. CST can be supplemented by normal demineralized water or Fire Water Systems. *Success Criteria: 1 of 2 pumps*		Auxiliary Feedwater (AFW) System: consists of two motor-driven pumps and a turbine-driven pump. CST can be supplemented Essential Raw Cooling Water System. *Success Criteria: 1 of 3 pumps*	

Table 8 DHR Systems for PWR W 4-LOOP Plants (Continued)

Systems		Byron 1&2		DC Cook 1&2		Indian Point 3		Seabrook		Watts Bar 1	
		Systems/Functions Description	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**
Depressurization	**Primary Side Depressirization**	Feed & Bleed (F&B): feed consists of CH and bleed consists of 2 PORVs. *Success Criteria: 1 CH pump and 1 of 2 PORVs*		Feed & Bleed (F&B): feed consists of CH/SI pumps and bleed consists of 3 PORVs. *Success Criteria: 1 CH/SI pump and 2 of 3 PORVs*		Feed & Bleed (F&B): feed consists of SI pumps and bleed consists of 2 PORVs. *Success Criteria: 1 pump and 1 of 2 PORVs (for SLOCA) or 2 of 2 PORVs for transients*		Feed & Bleed (F&B): feed consists of SI/CH and bleed consists of 2 PORVs. *Success Criteria: 1 Pump and 2 of 2 PORVs*		Feed & Bleed (F&B): feed consists of SI/CH and bleed consists of 2 PORVs. *Success Criteria: 1 Pump and 2 of 2 PORVs*	
	Secondary Side Depressurization	4 PORVs used for discharge to atmosphere and 12 SDVs used for steam relief to condenser. Condensate is used when the secondary side pressure is reduced. *Success Criteria: 1 of 4 PORVS*		4 PORVs used for discharge to atmosphere and 12 SDVs used for steam relief to condenser. Condensate is used when the secondary side pressure is reduced. *Success Criteria: 1 of 4 PORVS*		4 ADVs or 5 RVs per SG used for discharge to atmosphere and SDVs used for steam relief to condenser. Condensate is used when the secondary side pressure is reduced. *Success Criteria: 1 of 4 ADVs or 1 of 5 RVs*		4 ADVs or 5 RVs per SG used for discharge to atmosphere and SDVs used for steam relief to condenser. However, use of Condensate is not credited when the secondary side pressure is reduced. .		PORVs or S RVs used to relief SG secondary sid pressure to atmosphere and uses SDVs to direct steam to condenser. However, use of Condensate is not credited when the secondary side pressure is reduced.	
Heat Removal Systems	**Shutdown Cooling**	Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and heat exchangers*		Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and 1 flow trains*		Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and 1 flow trains*		Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and 1 flow trains*	.	Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and 1 flow trains.*	
Containment Systems	**Containment Cooling**	Contaiment Spray (CS) System: consist of two spray trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*		Containment Spray (CS) System: consist of two spray trains each with a 100% capacity pump. *Success Criteria: 1-out-of-2 pumps.*		Containment Spray (CS) System: consists of two spray trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*		Containment Spray (CS) System: consist of two spray trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*	.	Containment Spray (CS) System: consists of two spray trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*	
		Reactor Containment Fan Cooler (RBFC) System: consists of 4 fan units. *Success Criteria: 3 of 4 fan units*		Containment Air Recirculation (CAR) System: consists of 2 trains, each with a fan unit. *Success Criteria: 1 of 2 fan units*		Containment Air Recirculation (CAR) System: consists of 5 fan cooler units. *Success Criteria: 3 of 5 fan units*		Emergency Air Handling (EAH): provides ventilation and component cooling to permit continuous operation of ECCS and CBS pumps. *Success Criteria: To be verified*	.	Containment Air Recirculation (CAR) System: consists of 2 trains, each with an air return fan unit. *Success Criteria: 1 of 2 fan units*	

Table 8 DHR Systems for PWR W 4-LOOP Plants (Continued)

Systems		Callaway		Diablo Canyon 1&2		McGuire 1&2		Sequoyah 1&2		Wolf Creek	
		Systems/Functions Description	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**
Coolant Injection Systems	**High Pressure Injection**	High Head Safety Injection (HHSI)/Charging (CH) System: consists of two SI pumps and two CH pumps. *Success criteria: 1 of 4SI/CH pumps*	Procedure for running charging and SI pumps without CCW. Not credited in IPE	High Head Safety Injection (HHSI)/Charging (CH) System: consists of two SI pumps and two CH pumps. *Success criteria: 1 of 4SI/CH pumps*	- SI pump suction valve control switch replacement. Credited in IPE	High Head Safety Injection (HHSI)/ harging (CH) System: consists of two SI pumps and two CH pumps. *Success criteria: 1 of 4SI/CH pumps*		High Head Safety Injection (HHSI)/ harging (CH) System: consists of two SI pumps and two CH pumps. *Success criteria: 1 of 4SI/CH pumps*		High Head Safety Injection (HHSI)/ harging (CH) System: consists of two SI pumps and two CH pumps. *Success criteria: 1 of 4SI/CH pumps*	
	Low Pressure Injection	Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps*	
Secondary Side Feed	**Secondary Side Feed**	Auxiliary Feedwater (AFW) System: consists of two motor-driven and a turbine-driven pump. MFW/Condensate can be aligned by operators to feed the SGs. Essential SW can be used as a backup source of water to AFW pumps. *Success Criteria: 1 of 3 pumps*	Modification to feed SGs with diesel-driven firewater pump Not credited in IPE	Auxiliary Feedwater (AFW) System: consists of two motor-driven and a turbine-driven pump. MFW/Condensate can be aligned by operators to feed the SGs. Several backup sources, but IPE only takes credit for CST. *Success Criteria: 1 of 3 pumps*	Digital control of FW system Not credited in IPE	Auxiliary Feedwater (AFW) System: consists of two motor-driven and a turbine-driven pump. MFW/Condensate is credited as recovery to loss of Feed to SGs. In addition to CST, Condensate hotwell is used as a backup source of water to AFW pumps. *Success Criteria: 1 of 3 pumps*		Auxiliary Feedwater (AFW) System: consists of two motor-driven and a turbine-driven pump. MFW/Condensate can be restored if AFW is not available. In addition to CST, Demin, WST and Essential Raw Cooling Water can be used as backups to AFW pump supply water. *Success Criteria: 1 of 3 pumps*		Auxiliary Feedwater (AFW) System: consists of two motor-driven and a turbine-driven pump. MFW/Condensate can be restored if AFW is not available. In addition to CST, Essential SW is used as a backups to AFW pump supply water. *Success Criteria: 1 of 3 pumps*	
Depressurization	**Primary Side Depressurization**	Feed & Bleed (F&B): feed consists of CH/HHSI and bleed consists of 2 PORVs. *Success Criteria: 1 pump and 2 of 2 PORV*		Feed & Bleed (F&B): feed consists of CH/HHSI and bleed consists of 3 PORVs. *Success Criteria: 1 CH/HHSI pump and 2 of 3 PORVs*		Feed & Bleed (F&B): feed consists of CH/HHSI and bleed consists of 3 PORVs. *Success Criteria: 1 pump and 2 of 3 PORVs*		Feed & Bleed (F&B): feed consists of CH/HHSI and bleed consists of 2PORVs. *Success Criteria: 1 pump and 2 of 2 PORVs*		Feed & Bleed (F&B): feed consists of CH/HHSI and bleed consists of 2PORVs. *Success Criteria: 1 pump and 2 of 2PORVs*	

Table 8 DHR Systems for PWR W 4-LOOP Plants (Continued)

Systems		Callaway		Diablo Canyon 1&2		McGuire 1&2		Sequoyah 1&2		Wolf Creek	
		Systems/Functions Description	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**
Depressurization (cont.)	**Secondary Side Depressurization**	4 PORVs used for discharge to atmosphere and 12 SDVs used for steam relief to condenser. Condensate is used when the secondary side pressure is reduced. However, diesel-driven fir pump, which can also be used to feed the SGs, is not credited in the IPE. *Success Criteria: 1 of 4 PORVS*		ADVs used for discharge to atmosphere and 12 SDVs used for steam relief to condenser. Condensate is used when the secondary side pressure is reduced. *Success Criteria: 1 of 4 PORVS*		Due to the redundancy in steam relief paths, it was assumed that the prob. Of failure of a suitable relief path is negligible. FW can be supplied to the SGs by the hotwell and Condensate booster pumps if SG pressure is reduced.		4 PORVs used for discharge to atmosphere and 12 TBVs used for steam relief to condenser. Condensate is used when the secondary side pressure is reduced. *Success Criteria: 1 of 4 PORVS*		4 PORVs used for discharge to atmosphere and 12 SDVs used for steam relief to condenser. Condensate is used when the secondary side pressure is reduced. *Success Criteria: 1 of 4 PORVS*	
Heat Removal Systems	**Shutdown Cooling**	Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and heat exchangers*	Procedure to provide RHR pump room cooling during ECCS recirculation. Not credited in IPE.	Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and heat exchangers*	Add check valves to each RHR train Not credited in IPE.	Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and heat exchangers*		Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and heat exchangers*		Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and heat exchangers*	
Containment Systems	**Containment Cooling**	Containment Spray (CS) System: consist of two spray trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*		Containment Spray (CS) System: consist of two spray trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*		Containment Spray (CS) System: consist of two spray trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*		Containment Spray (CS) System: consist of two spray trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*		Containment Spray (CS) System: consist of two spray trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*	
		Containment Cooling System (CCS): consists of two trains with two units per train. *Success Criteria: 2 of 4 fan units*		Containment Fan Cooling Units (CFCUs): consists of 5 fan units. *Success Criteria: 2 of 5 fan units*		Containment Air Return and Hydrogen Skimmer System: consists of two headers, each with a 100% fan unit. *Success Criteria: 1 of 2 headers*		Air Return Fans: used to enhance the ice condenser and the CS heat removal operation by circulating air from the upper containment to the lower containment through the ice condenser. *Success Criteria: 1 of 2 fans*		Containment Air Coolers (CACs) System: consists of 4 fan coolers. However, this system was not modeled in the IPE.	

Table 8 DHR Systems for PWR W 4-LOOP Plants (Continued)

Systems		Catawba 1&2		Millstone 3		South Texas 1&2	
		Systems/Functions Description	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**
Coolant Injection Systems	**High Pressure Injection**	High Head Safety Injection (HHSI)/Charging (CH) System: consists of two SI pumps and two CH pumps. *Success criteria: 1 of 4SI/CH pumps*		High Head Safety Injection (HHSI)/Charging (CH) System: consists of two SI pumps and two CH pumps. *Success criteria: 1 of 4SI/CH pumps*		High Head Safety Injection (HHSI)/Charging (CH) System: consists of three SI pumps and two CH pumps. *Success criteria: 1 of 5SI/CH pumps*	
	Low Pressure Injection	Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps*		Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps*	Design change to improve cold leg recirculation. Credited in IPE.	Low Pressure Injection (LPI) System: consists of two trains each with a motor-driven pump. *Success Criteria: 1 of 2 pumps.*	
Secondary Side Feed	**Secondary Side Feed**	Auxiliary Feedwater (AFW) System: consists of two motor-driven and a turbine-driven pump. MFW, can be realigned to provide Feedwater if AFW is not available. Preferred supply sources are: UST, CST and condenser hotwell. Nuclear SW and Circulating Cooling Water System can be used as backups. *Success Criteria: 1 of 3 pumps*		Auxiliary Feedwater (AFW) System: consists of two motor-driven and a turbine-driven pump. MFW, can be realigned to provide Feedwater if AFW is not available. No credit was taken for other sources of supply other than the CST. *Success Criteria: 1 of 3 pumps*	Increase training on AFW system, recovery of MFW procedures. Credited in IPE.	Auxiliary Feedwater (AFW) System: consists of four pump trains, three motor-driven and a turbine-driven. MFW, Startup FW pump/Condensate can be realigned to provide Feedwater if AFW is not available. AFWST is used as a water source to AFW pumps. *Success Criteria: 1 of 4 pumps*	
Depressurization	**Primary Side Depressurization**	Feed & Bleed (F&B): feed consists of CH/HHSI and bleed consists of 3 PORVs. *Success Criteria: 1 of 2 CH pumps or 2 of 2 SI pumps and 2 of 3 PORVs*	Provide the loss of IA procedure to provide guidance about which valves must be manipulated to align backup nitrogen to the PPORV. Not known if credited in IPE.	Feed & Bleed (F&B): feed consists of CH/HHSI and bleed consists of PORVs. *Success Criteria: 1 pump and 1 PORV*	Increase training on feed and bleed procedure. Credited in IPE.	Feed & Bleed (F&B): feed consists of CH/HHSI and bleed consists of 2 PORVs. *Success Criteria: 1 of 3 SI pumps and 2 of 2 PORVs*	
	Secondary Side Depressurization	4 PORVs and SRVs used for discharge to atmosphere and 12 SDVs used for steam relief to condenser. However, no mention of using the Condensate when the secondary side pressure is reduced.		PORVs or and SRVs used for discharge to atmosphere and SDVs used for steam relief to condenser. Condensate is not used when SGs are depressurized.		PORVs or and SRVs used for discharge to atmosphere and SDVs used for steam relief to condenser. Condensate is used when the secondary side pressure is reduced.	

Table 8 DHR Systems for PWR W 4-LOOP Plants (Continued)

Systems		Catawba 1&2		Millstone 3		South Texas 1&2	
		Systems/Functions Description	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**	**Systems/Functions Description**	**A-45 Modifications**
Heat Removal Systems	**Shutdown Cooling**	Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and heat exchangers*		Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and heat exchangers*		Residual Heat Removal (RHR) system: consists of the LPI system pumps. Provides cooling to the core via the RHR heat exchangers. *Success Criteria: 1 of 2 pumps and heat exchangers*	
Containment Systems	**Containment Cooling**	Containment Spray (CS) System: consist of two spray trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*		Quench Spray(QS) System: consist of two spray trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*		Containment Spray (CS) System: consist of two spray trains each with a 100% capacity pump. *Success Criteria: 1 of 2 pumps*	
		Containment Air Return (CAR) System: consists of two headers each with a 100% capacity fan. *Success Criteria: 1 of 2 headers*		Recirculation Spray (RS) System: consist of four spray trains, including inside and outside recirculation pumps (2 outside and 2 inside *Success Criteria: 1 of 4 recirc spray pump or 1 of 2 ORS*		Containment Fan Cooler (CFC) System: consists of three trains with each train consisting of two cooler units. *Success Criteria: 2 of 6 units*	