RISK-INFORMED INSPECTION NOTEBOOK FOR

GENERIC BWR NUCLEAR POWER PLANT

GE, BWR–3 WITH MARK I CONTAINMENT

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Prepared for

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A-5

Table 1 - Categories of Initiating Events for Generic BWR Nuclear Power Plant

Row	Approximate Frequency	Example Event Type	Initiating Event Likelihood (IEL)		
I	> 1 per 1-10 yr	Transient (Reactor Trip) (TRAN), Loss of Power Conversion System (Loss of condenser, Closure of MSIVs, Loss of feedwater) (TPCS)	1	2	3
II	1 per 10-10^2 yr	Loss of offsite power (LOOP), Inadvertent or stuck open SRVs (IORV), Loss of Instrument Air (LOIA)	2	3	4
III	1 per 10^2 - 10^3 yr	Loss of Service Water (LOSW), Loss of an AC Bus (LOAC)	3	4	5
IV	1 per 10^3 - 10^4 yr	Small LOCA (RCS rupture) (SLOCA), Medium LOCA (RCS rupture) (MLOCA)	4	5	6
V	1 per 10^4 - 10^5 yr	Large LOCA (RCS rupture) (LLOCA), ATWS	5	6	7
VI	less than 1 per 10^5 yr	ISLOCA, Vessel rupture	6	7	8
			> 30 days	3-30 days	< 3 days
			Exposure Time for Degraded Condition		

Note:

1. The SDP worksheets for ATWS core damage sequences assume that the ATWS is not recoverable by manual actuation of the reactor trip function or by ARI (for BWRs). Thus, the ATWS frequency to be used by these worksheets must represent the ATWS condition that can only be mitigated by the systems shown in the worksheet (e.g., boration).

Table 2 Initiators and System Dependency for Generic BWR Nuclear Power Plant

Affected System		Major Components	Support Systems	Initiating Event Scenarios
Code	**Name**			
ADS	Reactor Vessel Pressure Control and Automatic Depressurization System	5 relief Valves (ADS) & 8 safety valves	IA/nitrogen, 125 V-DC	All except LLOCA
PCS	Power Conversion System	3 reactor feed pumps, 4 condensate pumps,4 condensate booster pumps	4160 V-AC, 125 V-DC, TBCCW, IA [1]	TRAN, IORV, SLOCA, ATWS
RHR	Residual Heat Removal	2 Loops, each with 2 RHR pumps & 1 RHR HX, MOVs	4160 V-AC, 125 V-DC, 480V AC, RHRSW, Pump Room HVAC	All
SBCS	Standby Coolant Supply System	2 Valves	Non-emergency ESF AC Buses, SW	LLOCA, MLOCA
AC	AC Power (non-EDG)	4160V AC, 480V AC	125V DC	All
DC	DC Power	125V DC (2 batteries & 4 battery charger), 250V DC (2 batteries & 3 battery charger) (shared between two units)	480V AC	All
EDGs	Emergency Diesel Generators	1 dedicated EDG, 1 shared EDG, & 1 SBO DG	125 V-DC, DGCW, EDG HVAC	LOOP
RHRSW	RHR Service Water	2 Loops, 2 pump-motor set per loop	HVAC, 4160 V-AC, 480 V-AC, 125 V-DC	All

TABLE 2 (cont.) BWR

Affected System		Major Components	Support Systems	Initiating Event Scenarios
DGCW	Diesel generator Cooling Water	Pumps	480 V-AC	LOOP
SW	Service water	5 pumps in Unit 1/ 2 Crib house; shared system supplying a common header	4160 V-AC, 125 V-DC, IA	LOSW
TBCCW	Turbine Building Closed Cooling Water System	2 pumps, 2 HXs, an expansion tank	SW, IA, 4160 V-AC	TRAN, TPCS, SLOCA, IORV, LOOP, ATWS
HPCI	High Pressure Coolant Injection	1 TDP, MOV	125 V-DC, 250 V-DC, Room HVAC	All except LLOCA, LOSW
LPCS	Low Pressure Core Spray	2 Trains or Loops; 1 LPCS pump per train	4160 V-AC, 480 V-AC, 125 V-DC, SW, Pump Room HVAC	All except LOSW
RCIC	Reactor Core Isolation Cooling	1 TDP, MOV	125 V-DC, Room HVAC	All except LLOCA, MLOCA, LOSW, ATWS
FPS	Fire Protection System	2 diesel fire pumps, MOV	120V AC, SW, 24V Nickel-cadmium batteries	LOSW, LOIA
CRD	Control Rod Drive Hydraulic System	2 MDP, MOV	Non-emergency ESF AC Buses, TBCCW	TRAN, TPCS, SLOCA, IORV, LOOP, ATWS
IA	Instrument Air	2 compressors for each unit plus a shared compressor supplying both units	SW, 480V AC	LOIA
SLC	Standby Liquid Control	2 MDP, 2 explosive valves	480 V-AC, 125 V-DC	ATWS
Room HVAC			DGCW	All
APCV	Augmented Primary Containment Vent	Valves, Dampers	Essential Service Bus, IA backed up by accumulators for each valve operator	All

TABLE 2 (cont) BWR

Notes:

1. IA supplies all AOVs in the FW&C system. Regulating valves fail as is on loss of IA or control signals. RFP regulating valves fail open on loss of IA and the makeup and emergency makeup valves fail closed.

2. The internal event CDF is estimated as 4.6E-6/yr (PSA Model 99A).

Table 3.1 SDP Worksheet for Generic BWR — Transients (Reactor Trip) (TRAN)

Safety Functions Needed:	Full Creditable Mitigation Capability for Each Safety Function:
Power Conversion System (PCS)	1/3 Feedpumps and 1/4 condensate/condensate booster pumps (operator action = 3)
High Pressure Injection (HPI)	HPCI (1 ASD train) or RCIC (1 ASD train)
Depressurization (DEP)	1/5 ADS valves (RVs) manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/4 RHR pumps in 1/2 trains in LPCI Mode (1 multi-train system) or 1/2 LPCS trains (1 multi-train system)
Containment Heat Removal (CHR)	1/4 RHR pumps in 1/2 trains with heat exchangers and 1/4 RHRSW pumps in SPC (1 multi-train system)
Containment Venting (CV)	Venting through 8" drywell or wetwell APCV (operator action = 2)
Late Inventory Makeup (LI)	2/2 CRD pumps (operator action = 2)

Circle Affected Functions		IEL	Remaining Mitigation Capability Rating for Each Affected Sequence	Recovery Credit	Results
1 TRAN - PCS - CHR - CV (5, 9) **1 + 3 + 3 + 2**	**9**				
2 TRAN - PCS -CHR - LI (4, 8) **1 + 3 + 3 + 2**	**9**				
3 TRAN - PCS - HPI - DEP (11) **1 + 3 + 2 + 2**	**8**				
4 TRAN - PCS - HPI - LPI (10) **1 + 3 + 2 + 6**	**12**				

3.1 TRAN BWR

Identify any operator recovery actions that are credited to directly restore the degraded equipment or initiating event:
If operator actions are required to credit placing mitigation equipment in service or for recovery actions, such credit should be given only if the following criteria are met: 1) sufficient time is available to implement these actions, 2) environmental conditions allow access where needed, 3) procedures exist, 4) training is conducted on the existing procedures under conditions similar to the scenario assumed, and 5) any equipment needed to complete these actions is available and available and ready for use.

Notes:

1. A credit of 3 for operator action to use feed pumps is assigned based on data from other BWR plants.
2. The HEP for DEP is 7E-04. A credit of 2 is assigned based on a survey of similar BWR plants.
3. The HEP for failure to initiate SPC is 2.0E-04. This function is defined as a multi-train system, because the hardware failure dominates.
4. The HEP for initiating containment venting is 3.2E-03. A credit of 2 is assigned based on a survey of similar BWR plants.

Table 3.2 SDP Worksheet for Generic BWR — Transients without PCS (TPCS)

Safety Functions Needed:	Full Creditable Mitigation Capability for Each Safety Function:
High Pressure Injection (HPI)	HPCI (1 ASD train) or RCIC (1 ASD train)
Depressurization (DEP)	1/5 ADS valves (RVs) manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/4 RHR pumps in 1/2 trains in LPCI Mode (1 multi-train system) or 1/2 LPCS trains (1 multi-train system)
Containment Heat Removal (CHR)	1/4 RHR pumps in 1/2 trains with heat exchangers and 1/4 RHRSW pumps in SPC (1 multi-train system)
Containment Venting (CV)	Venting through 8" drywell or wetwell APCV (operator action = 2)
Late Inventory Makeup (LI)	2/2 CRD pumps (operator action = 2)

Circle Affected Functions		IEL	Remaining Mitigation Capability Rating for Each Affected Sequence	Recovery Credit	Results
1 TPCS - CHR - CV (4, 8) **1 + 3 + 2**	**6**				
2 TPCS - CHR - LI (3, 7) **1 + 3 + 2**	**6**				
3 TPCS - HPI - DEP (10) **1 + 2 + 2**	**5**				
4 TPCS - HPI - LPI (9) **1 + 2 + 6**	**9**				

3.2 BWR

Identify any operator recovery actions that are credited to directly restore the degraded equipment or initiating event:
If operator actions are required to credit placing mitigation equipment in service or for recovery actions, such credit should be given only if the following criteria are met: 1) sufficient time is available to implement these actions, 2) environmental conditions allow access where needed, 3) procedures exist, 4) training is conducted on the existing procedures under conditions similar to the scenario assumed, and 5) any equipment needed to complete these actions is available and available and ready for use.

Notes:

1. The HEP for DEP is 7E-04. A credit of 2 is assigned based on a survey of similar BWR plants.
2. The HEP for failure to initiate SPC is 2.0E-04. This function is defined as a multi-train system, because the hardware failure dominates.
3. The HEP for initiating containment venting is 3.2E-03. A credit of 2 is assigned based on a survey of similar BWR plants.

Table 3.3 SDP Worksheet for Generic BWR — Transients with Loss of Service Water (LOSW)[1]

Safety Functions Needed:	**Full Creditable Mitigation Capability for Each Safety Function:**
Depressurization (DEP)	1/5 ADS valves (RVs) manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/4 RHR pumps in 1/2 trains in LPCI Mode (1 multi-train system)
Containment Heat Removal (CHR)	1/4 RHR pumps in 1/2 trains with heat exchangers and 1/4 RHRSW pumps in 1/2 trains in SPC (1 multi-train system)
Containment Venting (CV)	Venting through 8" drywell or wetwell APCV (operator action = 2)

Circle Affected Functions		**IEL**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Recovery Credit**	**Results**
1 LOSW - CHR (2) **3 + 3**	**6**				
2 LOSW - LPI (3) **3 + 3**	**6**				
3 LOSW - DEP (4) **3 + 2**	**5**				

Identify any operator recovery actions that are credited to directly restore the degraded equipment or initiating event:

If operator actions are required to credit placing mitigation equipment in service or for recovery actions, such credit should be given only if the following criteria are met: 1) sufficient time is available to implement these actions, 2) environmental conditions allow access where needed, 3) procedures exist, 4) training is conducted on the existing procedures under conditions similar to the scenario assumed, and 5) any equipment needed to complete these actions is available and available and ready for use.

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Notes:

1. Service Water (SW) system provides cooling water to major components like HPCI/RCIC, and CS room coolers, instrument air compressors, and turbine-generator. It acts as the ultimate heat sink for the TBCCW and RBCCW systems. It also supplies makeup to the fire water system and main condenser hotwell. Accordingly, in a loss of SW, HPCI, RCIC, and CS are assumed to be lost. CRD is not available as a late injection source. LOSW frequency in the PRA is 2.35E-3.

Table 3.4 SDP Worksheet for Generic BWR — Loss of Instrument Air (LOIA)[1,2]

Safety Functions Needed:	Full Creditable Mitigation Capability for Each Safety Function:
High Pressure Injection (HPI)	HPCI (1 ASD train) or RCIC (1 ASD train)
Depressurization (DEP)	1/5 ADS valves (RVs) manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/4 RHR pumps in 1/2 trains in LPCI Mode (1 multi-train system) or 1/2 LPCS trains (1 multi-train system)
Containment Heat Removal (CHR)	1/4 RHR pumps in 1/2 trains with heat exchangers and 1/4 RHRSW pumps in SPC (1 multi-train system)
Containment Venting (CV)	Venting through 8" drywell or wetwell APCV (operator action = 2)

Circle Affected Functions		IEL	Remaining Mitigation Capability Rating for Each Affected Sequence	Recovery Credit	Results
1 LOIA - CHR (2,4) **2 + 3**	**5**				
2 LOIA - HPI - LPI (5) **2 + 2 + 6**	**10**				
3 LOIA - HPI - DEP (6) **2 + 2 + 2**	**6**				

Identify any operator recovery actions that are credited to directly restore the degraded equipment or initiating event:

If operator actions are required to credit placing mitigation equipment in service or for recovery actions, such credit should be given only if the following criteria are met: 1) sufficient time is available to implement these actions, 2) environmental conditions allow access where needed, 3) procedures exist, 4) training is conducted on the existing procedures under conditions similar to the scenario assumed, and 5) any equipment needed to complete these actions is available and available and ready for use.

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Notes:

1. Loss of instrument air (LOIA) results in closure of the MSIV and loss of control of the feedwater regulating valves. This is similar to transients without the PCS. In addition, at Generic BWR Nuclear Power Plant, the HPCI and RCIC steamline drain valves require IA, but they reposition for HPCI/RCIC initiation on loss of IA. The valves in the APCV system are all air-operated supplied from IA, but accumulators on each valve is assumed to allow actuations on LOIA. CRD is assumed to be lost due to loss of TBCCW as the cooling source. With HPCI/RCIC injection, failure of SPC leads to core damage since CRD is not available as a late injection source.

2. LOIA initiating frequency is estimated as 1.75E-2.

Table 3.5 SDP Worksheet for Generic BWR — Loss of an AC Bus (LOAC)

Safety Functions Needed:	**Full Creditable Mitigation Capability for Each Safety Function:**
High Pressure Injection (HPI)	HPCI (1 ASD train) or RCIC (1 ASD train)
Depressurization (DEP)	1/5 ADS valves (RVs) manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/2 RHR pumps in 1/1 train in LPCI Mode (1 train) or 1/1 LPCS train (1 train)
Containment Heat Removal (CHR)	1/2 RHR pumps in 1/1 train with heat exchangers and 1/2 RHRSW pumps in 1/1 train in SPC (1 train)
Containment Venting (CV)	Venting through 8" drywell or wetwell APCV (operator action = 2)
Late Inventory Makeup (LI)	1/2 condensate (operator action = 2)

Circle Affected Functions		**IEL**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Recovery Credit**	**Results**
1 LOAC - CHR - CV (4,8) **3 + 2 + 2**	**7**				
2 LOAC - CHR - LI (3,7) **3 + 2 + 2**	**7**				
3 LOAC - HPI - DEP (10) **3 + 2 + 2**	**7**				
4 LOAC - HPI - LPI (9) **3 + 2 + 4**	**9**				

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Identify any operator recovery actions that are credited to directly restore the degraded equipment or initiating event:
If operator actions are required to credit placing mitigation equipment in service or for recovery actions, such credit should be given only if the following criteria are met: 1) sufficient time is available to implement these actions, 2) environmental conditions allow access where needed, 3) procedures exist, 4) training is conducted on the existing procedures under conditions similar to the scenario assumed, and 5) any equipment needed to complete these actions is available and available and ready for use.

Notes:

1. Loss of an AC Bus (Bus 13, 14, 18, 19) results in loss of one loop RHR and one loop of CS systems. The IE frequency for each of Bus 13 and 18 is 1.2E-3. The IE frequency for other buses is estimated at 1.2E-4.

2. No separate event tree is provided. Please refer to the TPCS tree.

Table 3.6 SDP Worksheet for Generic BWR — Small LOCA (SLOCA)

Safety Functions Needed:	Full Creditable Mitigation Capability for Each Safety Function:
Early Containment Control (EC)	Passive operation of SP, 7/8 vacuum breakers remain closed and 1/8 open, when needed (1 multi-train system)
Power Conversion System (PCS)	1/3 Feedwater pumps and 1/4 condensate/ condensate booster pumps (operator action = 3)
High Pressure Injection (HPI)	HPCI (1 ASD train) or RCIC (1 ASD train)
Depressurization (DEP)	1/5 ADS valves manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/4 RHR pumps in 1/2 trains in LPCI Mode (1 multi-train system) or 1/2 LPCS trains (1 multi-train system)
Containment Heat Removal (CHR)	1/4 RHR pumps in 1/2 trains with heat exchangers and 1/4 RHRSW pumps in SPC (1 multi-train system)
Containment Venting (CV)	Venting through 8" drywell or wetwell APCV (operator action = 2)
Late Inventory Makeup (LI)	1/4 Condensate or 2/2 CRD pumps (operator action = 2)

Circle Affected Functions:		IEL	Remaining Mitigation Capability Rating for Each Affected Sequence	Recovery Credit	Results
1 SLOCA - PCS - CHR- CV (5,9) **4 + 3 + 3 + 2**	**12**				
2 SLOCA - PCS - CHR - LI (4, 8) **4 + 3 + 3 + 2**	**12**				
3 SLOCA - PCS - HPI - LPI (10) **4 + 3 + 2 + 6**	**15**				
4 SLOCA - PCS - HPI - DEP (11) **4 + 3 + 2 + 2**	**11**				
5 SLOCA - EC (12) **4 + 3**	**7**				

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Identify any operator recovery actions that are credited to directly restore the degraded equipment or initiating event:
If operator actions are required to credit placing mitigation equipment in service or for recovery actions, such credit should be given only if the following criteria are met: 1) sufficient time is available to implement these actions, 2) environmental conditions allow access where needed, 3) procedures exist, 4) training is conducted on the existing procedures under conditions similar to the scenario assumed, and 5) any equipment needed to complete these actions is available and available and ready for use.

Notes:

1. A credit of 3 for operator action to use feed pumps is assigned based on data from other BWR plants.
2. The HEP for DEP is 7E-04. A credit of 2 is assigned based on a survey of similar BWR plants.
3. The HEP for failure to initiate SPC is 2.0E-04. This function is defined as a multi-train system, because the hardware failure dominates.
4. The HEP for initiating containment venting is 3.2E-03. A credit of 2 is assigned based on a survey of similar BWR plants.

Table 3.7 SDP Worksheet for Generic BWR — Inadvertent Opening of Relief Valve (IORV)

Safety Functions Needed:	Full Creditable Mitigation Capability for Each Safety Function:
Power Conversion System (PCS)	*1/3 Feedwater pumps and 1/4 condensate / condensate booster pumps (operator action = 3)*
High Pressure Injection (HPI)	HPCI (1 ASD train) or RCIC (1 ASD train)
Control Rod Drive (CRD)	Operator initiates 2/2 CRD pumps (operator action = 2)
Low Pressure Injection (LPI)	1/4 RHR pumps in 1/2 trains in LPCI Mode (1 multi-train system) or 1/2 LPCS trains (1 multi-train system)
Containment Heat Removal (CHR)	1/4 RHR pumps in 1/2 trains with heat exchangers and 1/4 RHRSW pumps in 1/2 trains in SPC (1 multi-train system)
Containment Venting (CV)	Venting through 8" drywell or wetwell APCV (operator action = 2)

Circle Affected Functions:		IEL	Remaining Mitigation Capability Rating for Each Affected Sequence	Recovery Credit	Results
1 IORV - PCS - CHR - CV (4) **2 + 3 + 3 + 2**	**10**				
2 IORV - PCS - CRD - CHR (6) **2 + 3 + 2 + 3**	**10**				
3 IORV - PCS - CRD - LPI (7) **2 + 3 + 2 + 6**	**13**				
4 IORV - PCS - HPI - CHR (9) **2 + 3 + 2 + 3**	**10**				
5 IORV - PCS - HPI - LPI (10) **2 + 3 + 2 + 6**	**13**				

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Identify any operator recovery actions that are credited to directly restore the degraded equipment or initiating event:
If operator actions are required to credit placing mitigation equipment in service or for recovery actions, such credit should be given only if the following criteria are met: 1) sufficient time is available to implement these actions, 2) environmental conditions allow access where needed, 3) procedures exist, 4) training is conducted on the existing procedures under conditions similar to the scenario assumed, and 5) any equipment needed to complete these actions is available and available and ready for use.

Notes:

1. One relief valve can relieve about 558,000 lbm/hr at 1135 psig. It will result in depressurization of the reactor vessel pressure due to the initiating event. Accordingly, depressurization is not a safety function in this worksheet. IORV frequency in the PRA is 3.3E-2.
2. The HEP for DEP is 7E-04. A credit of 2 is assigned based on a survey of similar BWR plants.
3. The HEP for failure to initiate SPC is 2.0E-04. This function is defined as a multi-train system, because the hardware failure dominates.
4. The HEP for initiating containment venting is 3.2E-03. A credit of 2 is assigned based on a survey of similar BWR plants.

Table 3.8 SDP Worksheet for Generic BWR — Medium LOCA (MLOCA)

Safety Functions Needed:	Full Creditable Mitigation Capability for Each Safety Function:
Early Inventory (EI)	HPCI (1 ASD train)
Early Containment Control (EC)	Passive operation of SP, 7/8 vacuum breakers remain closed and 1/8 open, when needed (1 multi-train system)
Depressurization (DEP)	Operator opens 1/ 5 ADS valves (operator action = 2)
Low Pressure Injection (LPI)	1/4 RHR pumps in 1/2 trains in LPCI mode (1 multi-train system) or 1/2 LPCS trains (1 multi-train system)
Containment Heat Removal (CHR)	1/4 RHR pumps with heat exchangers and 1/4 RHRSW pumps in 1/2 trains in SPC mode (1 multi-train system)
Containment Venting (CV)	Venting through 8" drywell or wetwell APCV (operator action = 2)
Late Inventory (LI)	Operator action to add water using SBCS and feedwater system (operator action = 2)

Circle Affected Sequences:		IEL	Remaining Mitigation Capability Rating for Each Affected Sequence	Recovery Credit	Results
1 MLOCA - CHR - LI (3, 8) **4 + 3 + 2**	**9**				
2 MLOCA - CHR - CV (4, 9) **4 + 3 + 2**	**9**				
3 MLOCA - LPI (5, 10) **4 + 6**	**10**				
4 MLOCA - EI - DEP (11) **4 + 1 + 2**	**7**				
5 MLOCA - EC (12) **4 + 3**	**7**				

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Identify any operator recovery actions that are credited to directly restore the degraded equipment or initiating event:
If operator actions are required to credit placing mitigation equipment in service or for recovery actions, such credit should be given only if the following criteria are met: 1) sufficient time is available to implement these actions, 2) environmental conditions allow access where needed, 3) procedures exist, 4) training is conducted on the existing procedures under conditions similar to the scenario assumed, and 5) any equipment needed to complete these actions is available and available and ready for use.

Notes:

1. Operator action to initiate standby coolant supply (SBCS) is assigned a credit of 2. PRA assigns a failure probability of 1.6 E-2.

2. Containment venting (CV) is assigned a credit of 2, based on survey of other BWR plant. PRA assigns a failure probability of 3.2E-3.

Table 3.9 SDP Worksheet for Generic BWR — Large LOCA (LLOCA)

Safety Functions Needed:	Full Creditable Mitigation Capability for Each Safety Function:
Early Inventory (EI)	1/4 RHR pumps in 1/2 trains in LPCI mode (1 multi-train system) or 1/2 LPCS trains (1 multi-train system)
Early Containment Control (EC)	Passive operation of SP, 7/8 vacuum breakers remain closed and 1/8 open, when needed (1 multi-train system)
Containment Heat Removal (CHR)	1/4 RHR pump with heat exchangers and 1/4 RHRSW pumps in 1/2 trains in SPC mode (1 multi-train system)
Containment Venting (CV)	Venting through 8" drywell or wetwell APCV (operator action = 2)
Late Inventory (LI)	Operator action to add water using SBCS and feedwater system (operator action = 2)

Circle Affected Functions:		IEL	Remaining Mitigation Capability Rating for Each Affected Sequence	Recovery Credit	Results
1 LLOCA - CHR - LI (3) **5 + 3 + 2**	**10**				
2 LLOCA - CHR- CV (4) **5 + 3 + 2**	**10**				
3 LLOCA - EI (5) **5 + 6**	**11**				
4 LLOCA - EC (6) **5 + 3**	**8**				

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Identify any operator recovery actions that are credited to directly restore the degraded equipment or initiating event:
If operator actions are required to credit placing mitigation equipment in service or for recovery actions, such credit should be given only if the following criteria are met: 1) sufficient time is available to implement these actions, 2) environmental conditions allow access where needed, 3) procedures exist, 4) training is conducted on the existing procedures under conditions similar to the scenario assumed, and 5) any equipment needed to complete these actions is available and available and ready for use.

Notes:

1. Operator action to initiate standby coolant supply (SBCS) is assigned a credit of 2. PRA assigns a failure probability of 1.6 E-2.

2. Containment venting (CV) is assigned a credit of 2, based on survey of other BWR plant. PRA assigns a failure probability of 3.2E-3.

Table 3.10 SDP Worksheet for Generic BWR — Loss of Offsite Power (LOOP)

Safety Functions Needed:	Full Creditable Mitigation Capability for each Safety Function:
Emergency Power (EAC)	1/1 EDGs (1train) or 1/1 SBO or cross-tie DG (operator action = 1)
Recovery of LOOP in 45 min (RLOOP 45 M)	Recovery of LOOP (operator action = 1)
Recovery of LOOP in 4 hrs (RLOOP 4 HR)	Recovery of LOOP in 4 hrs (operator action = 1)
High Pressure Injection (HPI)	HPCI (1 ASD train) or RCIC (1 ASD train)
Depressurization (DEP)	1/5 ADS valves manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/4 RHR trains in 1/2 trains in LPCI Mode (1 multi-train system) or 1/2 LPCS trains (1 multi-train system)
Containment Heat Removal (CHR)	1/4 RHR pumps with heat exchangers and 1/4 RHRSW pumps in 1/2 trains in SPC (1 multi-train system)
Containment Venting (CV)	Venting through 8" drywell or wetwell APCV (operator action = 2)
Late Inventory (LI)	2/2 CRD pumps (operator action = 2)

Circle Affected Functions:		IEL	Remaining Mitigation Capability Rating for Each Affected Sequence	Recovery Credit	Results
1 LOOP - EAC - HPI - RLOOP 45 M (25) **2 + 3 + 2 + 1**	**8**				
2 LOOP - EAC - RLOOP 4 HR (26) **2 + 3 + 1**	**6**				
3 LOOP - HPI - DEP (10, 20) **2 + 2 + 2**	**6**				
4 LOOP - HPI - LPI (9, 19) **2 + 2 + 6**	**10**				
5 LOOP - CHR - CV (4, 8, 14, 18, 24) **2 + 3 + 2**	**7**				

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6 LOOP - CHR - LI (3, 7, 13, 17, 23) **2 + 3 + 2**	**7**				

Identify any operator recovery actions that are credited to directly restore the degraded equipment or initiating event:

If operator actions are required to credit placing mitigation equipment in service or for recovery actions, such credit should be given only if the following criteria are met: 1) sufficient time is available to implement these actions, 2) environmental conditions allow access where needed, 3) procedures exist, 4) training is conducted on the existing procedures under conditions similar to the scenario assumed, and 5) any equipment needed to complete these actions is available and available and ready for use.

Notes:

1. A dual unit LOOP is assumed. Each unit has a dedicated EDG. It is conservatively assumed that the shared diesel is aligned to the other unit. A operator action credit of 1 is assigned for use of the shared or SBO diesel.

2. PRA defines battery depletion at 4 hrs.

3. In sequences 3 and 4, either EAC or recovery of LOOP in 45 mins is successful. Failure to recover offsite power in 45 mins is assigned an operator action credit of 1.

4. In sequences 5 and 6, either EAC or recovery of LOOP in 4 hrs is successful. In PRA, failure to recover offsite power in 4 hrs in estimated at 1.6E-01. An operator action credit of 1 is assigned.

Table 3.11 SDP Worksheet for Generic BWR — Anticipated Transients without Scram (ATWS)

Safety Functions Needed:	Full Creditable Mitigation Capability for Each Safety Function:
Over Pressure Protection (OVERP)	11/13 RVs/SRVs (1 multi-train system)
Reactivity Control (SLC)	1/2 SLC train (operator action = 2)
Recirculation Pump Trip (RPT)	Manual or automatic trip of recirculation pumps (1 multi-train system)
High Pressure Injection (HPI)	HPCI (1 ASD train) or 1/3 Feedwater pumps (1 multi-train system)
Depressurization (DEP)	1/5 ADS valves manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/4 RHR pumps in 1/2 trains in LPCI mode (1 multi-train system) or 1/2 LPCS train (1 multi-train system)
Inhibit ADS and LVI Control (INH)	Operator inhibits ADS and controls RPV level (operator action = 2)
Containment Heat Removal (CHR)	1/4 RHR pumps with heat exchangers and 1/4 RHRSW pump in 1/2 trains in SPC (1 multi-train system)
Containment Venting (CV)	containment venting through 8" drywell or wetwell APCV (operator action = 2)
Late Inventory (LI)	2/2 CRD pumps (operator action=2)

Circle Affected Functions:		IEL	Remaining Mitigation Capability Rating for Each Affected Sequence	Recovery Credit	Results
1 ATWS - OVERP (14) **5 + 3**	**8**				
2 ATWS - SLC (11) **5 + 2**	**7**				
3 ATWS - RPT (13) **5 + 3**	**8**				
4 ATWS - HPI - DEP (10) **5 + 4 + 2**	**11**				
5 ATWS - HPI - LPI (9) **5 + 4 + 6**	**15**				

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6 ATWS - INH (12) **5 + 2**	**7**				
7 ATWS - CHR - CV (4,8) **5 + 3 + 2**	**10**				
8 ATWS - CHR - LI (3, 7) **5 + 3 + 2**	**10**				

Identify any operator recovery actions that are credited to directly restore the degraded equipment or initiating event:

If operator actions are required to credit placing mitigation equipment in service or for recovery actions, such credit should be given only if the following criteria are met: 1) sufficient time is available to implement these actions, 2) environmental conditions allow access where needed, 3) procedures exist, 4) training is conducted on the existing procedures under conditions similar to the scenario assumed, and 5) any equipment needed to complete these actions is available and available and ready for use.

Notes:

1. The standby liquid control system (SLC) is manually operated. PRA assigns a human error probability of 4.7 E-2. A credit of 2 is assigned.
2. Operator failure to inhibit ADS is estimated at 1.4E-02. An operator action credit of 2 is assigned.