GE Nuclear Energy

General Electric Company
175 Curtner Avenue, San Jose, CA 95125

June 28, 1993 Docket No. STN 52-001

Chet Poslusny, Senior Project Manager
Standardization Project Directorate
Associate Directorate for Advanced Reactors
and License Renewal
Office of the Nuclear Reactor Regulation

Subject: Submittal Supporting Accelerated ABWR Schedule - **Containment Bypass (Issue #24)**

Dear Chet:

Enclosed are SSAR markups addressing Suppression Bypass Issue #24. The markups include Section 6.2.1 (Containment Functional Design), Appendix 18A (Emergency Procedure Guidelines), Appendix 18B (Differences Between BWROG EPG Revision 4 and ABWR EPG), and Appendix 18D (Emergency Procedure Guidelines Input Data and Calculation Results). This information will be included in Amendment 30, scheduled for transmittal to the NRC on July 8, 1993.

Please provide a copy of this transmittal to Mark Reinhart.

Sincerely,

Jack Fox

Jack Fox
Advanced Reactor Programs

cc: Alan Beard (GE)
Norman Fletcher (DOE)
John Monninger (NRC)

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above the top row of horizontal vents. The final pressure in the wetwell is lower than the reactor building pressure because more air is transferred to the drywell during wetwell pressurization than is received during wetwell depressurization.

The following assumptions are made in analyzing the above event:

(1) inerted gas behaves as a perfect gas;

(2) the temperature in the drywell remains at 57.2°C throughout the transient by means of the drywell cooler;

(3) the initial wetwell temperature is 35°C;

(4) the initial containment pressure is 1.03 kg/cm^2a;

(5) the maximum suppression pool temperature is 97.2°C;

(6) wetwell spray is from the suppression pool;

(7) the initial wetwell spray temperature is 35°C;

(8) the capacity of the RHR heat exchanger is 88.45 kcal/sec - °C;

(9) the maximum wetwell temperature is determined by the maximum wetwell spray temperature and the pool surface heat transfer to the wetwell airspace;

(10) the convective heat transfer coefficient between the suppression pool and the wetwell airspace is 9.76×10^{-4} kcal/hr-°C;

(11) the mixture of steam and air in the drywell is homogeneous such that the ratio of its partial pressures remains constant after the peak pressure is attained;

(12) the air content of the horizontal vent flow mixture increases the wetwell pressure;

(13) the drywell pressure is equal to the wetwell pressure when the peak pressure is reached;

(14) wetwell vapor pressure is equal to the saturation pressure at the wetwell temperature due to the wetwell spray;

(15) the initial relative humidity in the drywell is 20%;

(16) initially, the suppression pool is at the High Water Level point; and

(17) the wetwell spray flow rate is 31.5 l/s.

For an analysis was conducted with no PCVBS the differential pressure between the wetwell and the reactor building is determined to be negative (-)0.12 kg/cm^2d. This shows that the stuck open relief valve is a much more severe event than the post-LOCA FWLB transient during which the maximum wetwell negative pressure is only 0.06 kg/cm^2d. Therefore, the PCV negative pressure requirement on the wetwell part of 0.14 kg/cm^2 can be met without PCVBS.

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6.2.1.1.~~5~~6 Suppression Pool Dynamic Loads

The containment and its internal structures are designed to withstand all suppression pool dynamic effects, including SRV discharge, vent clearing and vent chugging. These loads are combined with those from the postulated seismic events in the load combinations specified in Subsections 3.8.2.3 and 3.8.3.3.

A diagrammatic representation of the pool swell, illustrating various states, is given in Appendix 3B.

A typical graphical representation of the dynamic loading due to SRV discharge is found in Figure 6.2-20. This diagram represents the dynamic loadings for the containment and internal structures. The dynamic pressure load due to upper vent chugging is found in Figure 6.2-21. This load is applicable for structures in the suppression pool area.

6.2.1.1.~~6~~7 Asymmetric Loading Conditions

Asymmetric loads are included in the load combination specified in subsection 3.8.2.3 and 3.8.3.3. The containment and internal structures are designed for these loads within the acceptance criteria specified in Subsections

3.8.2.5 and 3.8.3.5. Since the internal structures are not subject to external design or tornado winds, they are not designed for these loads.

Localized pipe forces, pool swell and SRV actuation are asymmetric pressure loads which act on the containment and internal structures. For magnitudes of pool swell and SRV loads, see Subsection 6.2.1.1.5.

The loads associated with embedded plates are concentrated forces and moments which differ according to the type of structure or equipment being supported. Earthquake loads (OBE and SSE) are inertial loads caused by seismic accelerations. The magnitude of these loads is discussed in Section 3.7.

6.2.1.1.~~7~~8 Containment Environment Control

The drywell ventilation system maintains temperature, pressure and humidity in the containment and its subcompartments at the normal design conditions. The safety-related containment heat removal systems described in Subsection 6.2.2 maintain required containment atmosphere conditions during accidents. Since the loss of the drywell ventilation system does not result in exceeding the design environmental conditions for the safety-related equipment inside containment, the drywell system is not classified as safety-related.

6.2.1.1.~~8~~9 Post-Accident Monitoring

Refer to Subsections 6.2.1.7, 7.2, 7.3, 7.5, 7.6.1.2, and 7.6.1.11 for discussion of instrumentation inside the containment which may be used for monitoring various containment parameters under post-accident conditions.

6.2.1.2 Containment Subcompartments

6.2.1.2.1 Design Bases

The design of the containment subcompartments is based upon the postulated DBA occurring in each subcompartment.

For each containment subcompartment in which high energy lines are routed, mass and energy release data corresponding to a postulated double ended line break are calculated. The mass and energy release data, subcompartment free volumes, vent path geometry and vent loss coefficients are used as input into an analysis to obtain the pressure/temperature transient response for each subcompartment.

6.2.1.2.2 Design Features

The upper drywell, lower drywell and wetwell subcompartment volumes are covered in depth in Subsection 6.2.1.1. The remaining containment subcompartment volumes are:

(1) Drywell Head Region

The drywell head region is covered with a removable steel head which forms part of the containment boundary. The drywell bulkhead connects the RPV flange to the containment and represents the interface between the drywell head region and the drywell.

The DBA for the drywell head region is the double ended circumferential break of the 6- inch RPV head spray line of the RWCU system at the connection to the RPV head nozzle. The other high energy line in the drywell head region is the 2-in. main steam vent line. The RPV head spray line is chosen as the DBA for this subcompartment due to the higher mass and energy release rates from a postulated break of this line.

(2) Reactor Shield Annulus

The reactor shield annulus exists between the reactor shield wall (RSW) and the RPV. The reactor shield wall is a concrete cylinder surrounding the RPV and is supported by the reactor pedestal.

The annulus surrounding the RPV is sealed at the top of the RSW by a blowout panel in the insulation that is assumed to open instantaneously following a postulated break of a high energy line inside the annulus.

Several high energy lines extend from the

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6.2.1.1.5 Steam Bypass of the Suppression Pool

6.2.1.1.5.1 Introduction

The concept of the pressure suppression reactor containment is that any steam released from a pipe rupture in the primary system will be condensed by the suppression pool and will not have an opportunity to produce a significant pressurization effect on the containment. This is accomplished by channeling the steam into the suppression pool through a vent system. If a leakage path were to exist between the drywell and the wetwell gas space, the leaking steam would produce undesirable pressurization of the containment. To mitigate the consequences of any steam which bypasses the suppression pool, operator will actuate containment sprays 30 minutes after containment pressure reaches to a defined value.

The following presents the results of calculations performed to determine the allowable leakage capacity between the drywell and wetwell gas space.

6.2.1.1.5.2 Criteria

The allowable bypass leakage is defined as the amount of steam which could bypass the suppression pool without exceeding the containment design pressure. In calculating this value, a stratified drywell atmosphere model is used to ensure a conservative result. A stratified model will allow steam only flow through the bypass leakage area, thus maximizing heatup of the wetwell gas space.

6.2.1.1.5.3 Bypass Capability Without Containment Sprays and Heat Sinks

Large primary system ruptures generate high pressure differentials across the assumed leakage paths which, in turn, give proportionately higher leakage flow rates. However, large primary system breaks also rapidly depressurize the reactor and terminate the blowdown. Once this has occurred, there will no longer be a pressure differential across the drywell leakage path, so the containment pressurization due to steam bypass leakage will cease. Since leakage into the wetwell gas space is of limited duration, the allowable area of the steam bypass leakage paths is expected to be large.

As the size of the assumed primary system rupture decreases, the magnitude of the differential pressure across any leakage path also decreases. However, smaller breaks are expected to result in an increasingly longer reactor blowdown period, which, in turn, results in longer duration of the steam bypass leakage flow. The limiting case is a sufficiently small primary system break which will not automatically result in reactor depressurization. For this case it is assumed that the response of the plant operator is to shut the reactor down in an orderly manner at 55.6° C per hour cooldown rate. This would result in the reactor being depressurized and the break flow being terminated within approximately 6 hours. During this 6-hr period, the blowdown flow from the reactor primary system would have swept all the drywell noncondensable gas over into the wetwell gas space. This continuous pressure differential, combined with a 6-hr duration, is expected to result in the most severe drywell-to-wetwell steam bypass leakage requirement.

Based on the above description of a limiting case, a simplified analysis was performed to determine the allowable leakage path area. Consistent with the above description, this analysis assumed that plant operator initiates and completes a normal plant shutdown (at a rate of 55.6° C/hr) in 6 hours, and there is continuous steam bypass leakage over the entire 6-hr period. A stratified atmosphere model, which assumed steam only flow through the leakage path, was used to ensure conservative result. For an added conservatism, no credit for structural heat sinks and actuation of drywell/wetwell sprays was taken.

Simplified end-point calculations were done to determine maximum allowable area of the leakage paths. Key steps included in this procedure are:

1. Compute, M_{NC}, mass of noncondensable gas initially in the drywell and the wetwell gas space.

2. Compute, ΔP_V, pressure difference between drywell and wetwell gas space needed to keep water level depressed to the top of upper row of vents.

3. Compute, P_{WM}, the maximum allowable pressure in the wetwell gas space.

$$P_{WM} = [P_{DES} - \Delta P_V],$$

where

P_{DES} is the containment design pressure.

4. Compute $(P_{WM})_{AIR}$, and $(P_{WM})_{STEAM}$ components of P_{WM}. Assume that wetwell gas space temperature is equal to accident maximum pool temperature, and there is complete carryover of drywell noncondensable gas into the wetwell gas space.

$$P_{WM} = [(P_{WM})_{AIR} + (P_{WM})_{STEAM}]$$

5. Compute, M_S, mass of steam corresponding to $(P_{WM})_{STEAM}$. This defines allowable steam bypass leakage mass into the wetwell gas space.

6. Compute leakage path flow rate of steam, M_{dot}, as follows:

$$M_{dot} = [(A/\sqrt{K})\sqrt{(2g_c(\Delta P_V)/v)}],$$

where

v = drywell steam specific volume, and
K = total loss coefficient of the flow path.

7. Compute the maximum allowable leakage path area, $A/\sqrt{K}$, as follows:

$$A/\sqrt{K} = [(M_{dot})/\{\sqrt{(2g_c(\Delta P_V)/v)}\}]$$
$$= [(M_S/\Delta t)/\{\sqrt{(2g_c(\Delta P_V)/v)}\}]$$

where

Δt = Accident duration

Using the procedure outlined above and assuming an accident duration of 6 hours, the maximum allowable leakage path area under these circumstances is determined to be an effective flow area ($A/\sqrt{K}$) of 5 cm^2.

6.2.1.1.5.4 Bypass Capability With Containment Spray and Heat Sinks

An analysis has been performed which evaluates the bypass capability of the containment for a spectrum of break sizes considering containment sprays and containment structural heat sinks as means of mitigating the effects of steam bypass of the suppression pool.

The containment system design provides two RHR spray loops, and each loop consists of both wetwell and drywell sprays. In operation of RHR in spray mode, the wetwell and drywell sprays activate simultaneously. Per loop, the design flow rate of drywell spray is about 800 m^3/hour, and that of wetwell spray is about 114 m^3/hour. In this analysis it is assumed that spray is to be initiated no sooner than 30 minutes after the wetwell gas space pressure is reached to 1.05 kg/cm^2 g. This assumed value of spray initiation pressure set point, which is higher than the EPGs pressure set point of 0.7 kg/cm^2 g, is expected to produce slightly conservative results. The suppression pool water passes through the RHR heat exchanger and is then injected into the drywell and wetwell spray headers located respectively in the upper region of drywell and wetwell gas space. The spray will rapidly condense the stratified steam, creating a homogeneous air-steam mixture in the containment. Structural heat sinks (drywell and wetwell boundary surfaces) were considered with variable convective heat transfer coefficients based on Uchida correlation. The reactor vessel shutdown rate was assumed to be 55.6° C/hr, and the maximum design service water temperature was used. This shutdown rate corresponds to the maximum rate which does not thermally cycle the reactor vessel. This analysis results in an allowable maximum steam bypass leakage capability of $A/\sqrt{K}$ of 50 cm^2, meeting the criterion that calculated maximum containment pressure remain below the containment design pressure. Maximum steam bypass capability vs primary system break area is shown in Figure 6.2-~~xx~~ 42.

The key assumptions for allowable steam bypass calculations utilizing structural heat sinks are summarized as follows:

(1) Following the occurrence of a pipe line break within the drywell, air is purged through the vents into the wetwell.

(2) Flow through the postulated leakage path is pure steam. For a given leakage path, if the leakage flow consists of mixture of liquid and vapor, the total leakage mass flow rate is higher, but the steam flowrate is less than for the case of pure steam leakage. Since the steam entering the wetwell air space results in the additional pressurization, this is considered as a conservative assumption.

(3) The containment sprays are manually actuated 30 minutes after the wetwell airspace pressure reaches to 1.05 kg/cm^2 g.

(4) Credit for wetwell spray only was taken. Considering that wetwell spray is more effective in mitigating consequences of steam bypass leakage, credit for drywell spray was not taken to produce conservative results.

(5) The efficiency of the sprays is dependent upon the local steam-to-air ratio. A conservative constant value of 0.7 was used in this analysis.

(6) Heat is transferred to exposed drywell/wetwell concrete walls (with steel liner) in the drywell and wetwell gas space regions. The Uchida convective heat transfer coefficients used are based on the local steam-to-air ratio.

(7) No energy is assumed to leave the containment except through the RHR heat exchangers.

The following is an illustration of the methods employed in calculating steam condensing capability under typical post-LOCA conditions. The condensation capability is calculated using the following equation:

$$M_c = M_s \times N_s \times [(T_c - T_s)/H_{fg}] \times C_p$$

where

M_c	=	steam condensation rate;
M_s	=	spray flow rate;
N_s	=	spray efficiency;
T_c	=	containment temperature;
T_s	=	spray temperature at the spray nozzles;
H_{fg}	=	latent heat of vaporization of water; and
C_p	=	constant pressure specific heat of water.

The spray water temperature is calculated from:

$$T_s = T_p - KHX \times [(T_p - T_{sw}) /(M_s \times C_p)]$$

where

T_p	=	suppression pool temperature;
KHX	=	RHR heat exchanger effectiveness; and
T_{sw}	=	service water temperature

Containment sprays have a significant effect on the allowable steam bypass capability. Use of sprays increases the maximum allowable bypass leakage by an order of magnitude and represents an effective backup means of condensing bypass steam.

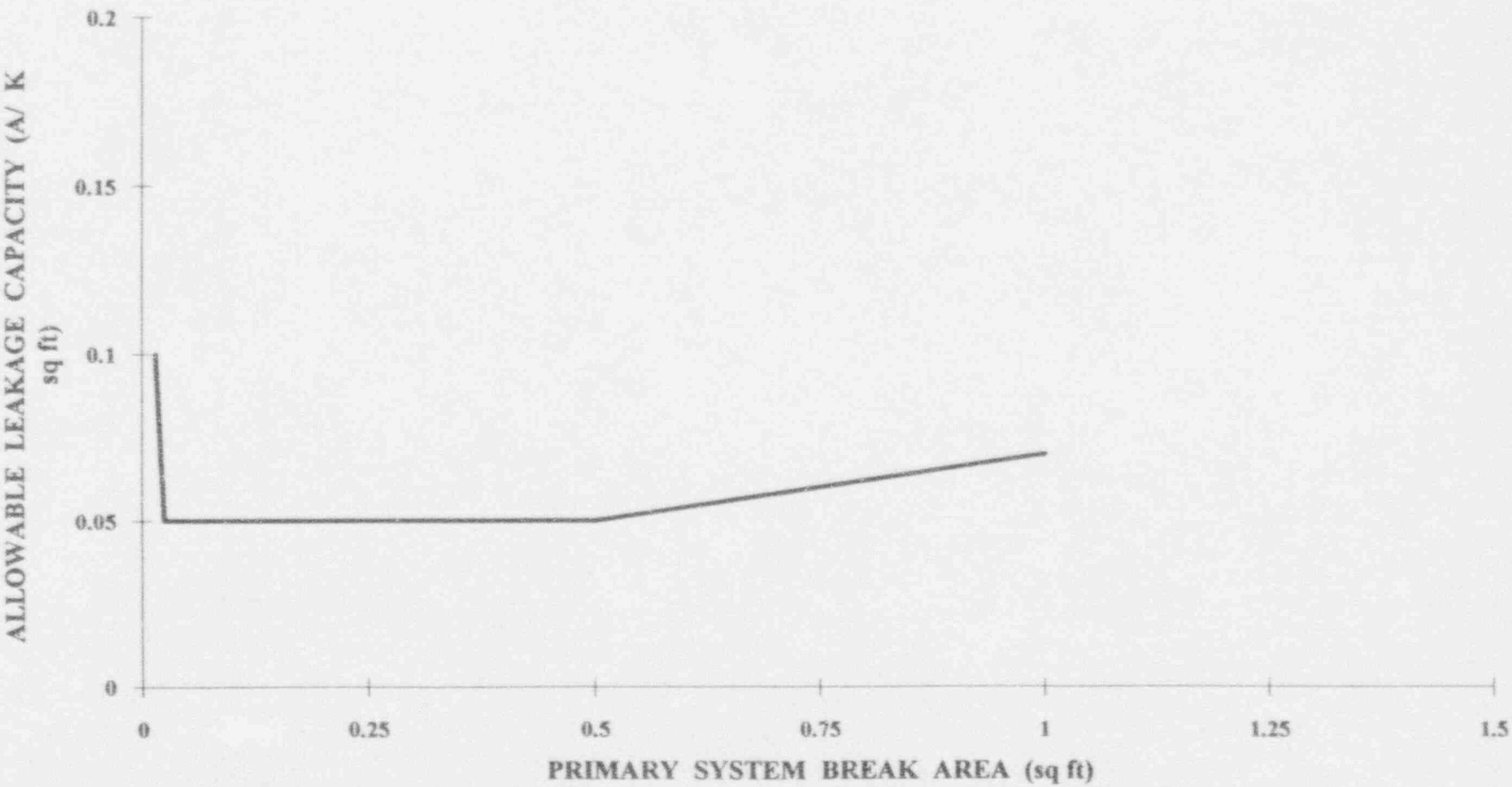

Figure 6.2-~~xxx:~~ 42 Allowable Steam Bypass Leakage Capacity

DW/T Monitor and control drywell temperature below [57.2 °C (drywell temperature LCO or maximum normal operating temperature, whichever is higher)] using available drywell cooling.

When drywell temperature cannot be maintained below [57.2 °C (drywell temperature LCO or maximum normal operating temperature, whichever is higher)], shutdown the reactor. ☞ #1

DW/T-1 Operate all available drywell cooling, defeating isolation interlocks if necessary.

When drywell temperature cannot be maintained below [103°C (Saturation temperature corresponding to high drywell pressure scram setpoint)], enter [procedure developed from the RPV Control Guideline] at [Step RC-1] and execute it concurrently with this procedure.

> If while executing the following steps ~~drywell~~ containment sprays have been initiated and drywell pressure drops below [0.12 kg/cm2 g (high drywell pressure scram setpoint)], terminate ~~drywell~~ containment sprays.

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DW/T-2 Before drywell temperature reaches [171 °C (maximum temperature at which ADS qualified or drywell design temperature, whichever is lower)] but only if suppression pool water level is below [11.70 m (elevation of bottom of suppression pool–to–lower–drywell vent)] and drywell temperature and pressure are within the Drywell Spray Initiation Limit, shut down drywell cooling fans and initiate containment ~~drywell~~ sprays using only those RHR subsystems (RHR(B), RHR(C)) not required to assure adequate core cooling by continuous operation in the LPCF mode.

If RHR(B) ~~and~~ containment RHR(C) are not available for containment ~~drywell~~ sprays, initiate ~~drywell~~ sprays using the fire protection system and firewater additon mode of RHR(C).

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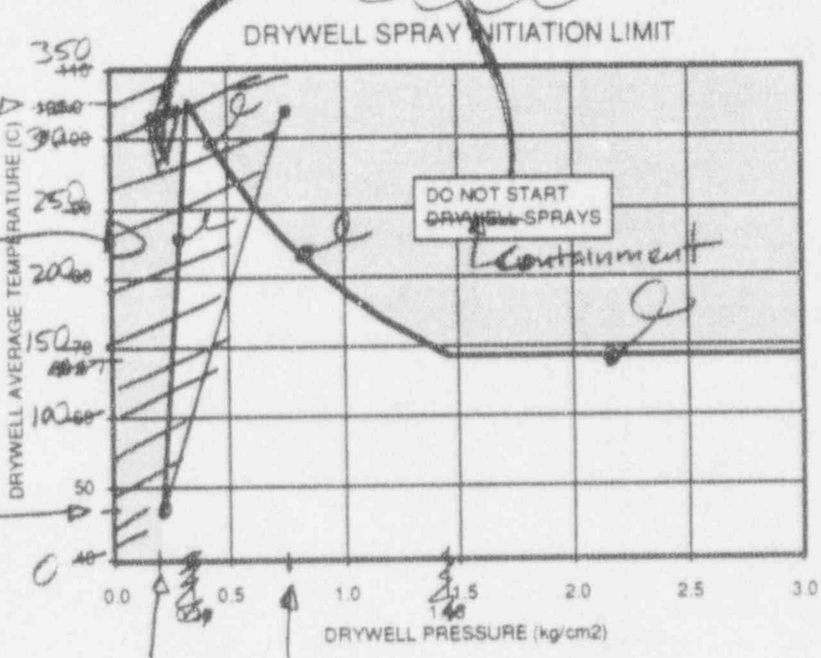

Shade this area

move box to shaded area

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PC/P Monitor and control primary containment pressure below [0.12 kg/cm² g (high drywell pressure scram setpoint)] using the following systems:

- SGTS, RBHVAC, and nitrogen vent and purge only if containment pressure is less than [0.14 kg/cm2 g (SGTS and RBHVAC design pressure)]; use [containment vent and purge operating procedures].

When primary containment pressure cannot be maintained below [0.12 kg/cm² g (high drywell pressure scram setpoint)], or the offsite radioactivity release rate reaches the offsite release rate LCO, isolate the primary containment vent and purge.

~~If while executing the following steps suppression pool sprays have been initiated and suppression chamber pressure drops below [0.12 kg/cm² g (high drywell pressure scram setpoint)], terminate suppression pool sprays.~~

~~PC/P-1 Before suppression chamber pressure reaches [0.728 kg/cm² g (Suppression Chamber Spray Initiation Pressure)], but only if suppression pool water level is below [18.90 m (elevation of suppression pool spray nozzles)], initiate suppression pool sprays using only those RHR subsystems (RHR(B), RHR(C)) not required to assure adequate core cooling by continuous operation in the LPCF mode.~~

~~If RHR(B) and RHR(C) are not available for suppression pool sprays, initiate suppression pool sprays using the fire protection system and the firewater addition mode of RHR(C).~~

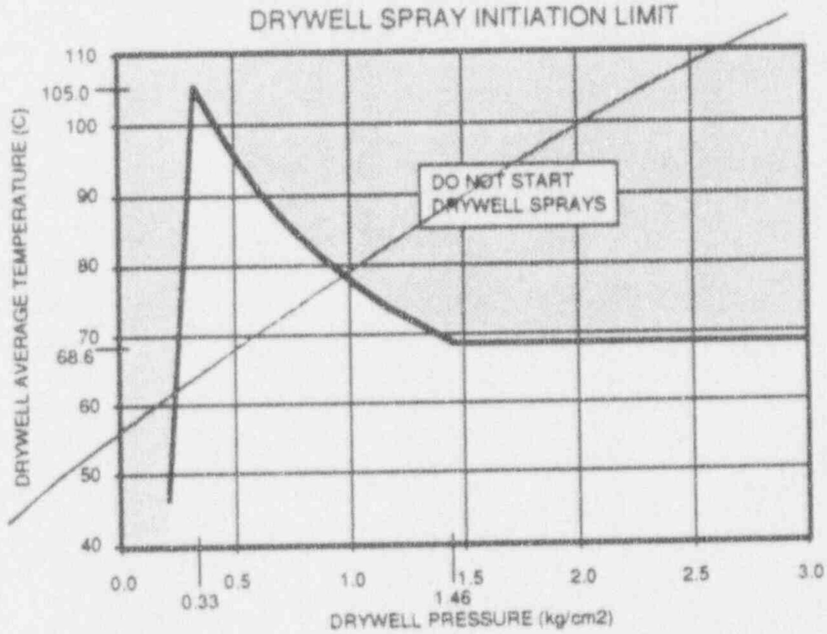
(PC/P-1 Deleted - not applicable to ABWR)

If while executing the following steps ~~drywell~~ containment sprays have been initiated and suppression chamber or drywell pressure drops below [0.12 kg/cm2 g (high drywell pressure scram setpoint)], terminate ~~drywell~~ containment sprays.

PC/P-2 When suppression chamber pressure exceeds [0.728 kg/cm2 g (Suppression Chamber Spray Initiation Pressure)] but only if suppression pool water level is below [11.70 m (elevation of bottom of suppression pool–to–lower–drywell vent)] and drywell temperature and pressure are within the Drywell Spray Initiation Limit, shutdown drywell cooling fans and initiate ~~drywell~~ containment sprays using only those RHR subsystems (RHR(B), RHR(C)) not required to assure adequate core cooling by continuous operation in the LPCF mode.

If RHR(B) and RHR(C) are not available for ~~drywell~~ containment sprays, initiate ~~drywell~~ containment sprays using the fire protection system and the firewater addition mode of RHR(C).

DRYWELL SPRAY INITIATION LIMIT



see revised DSIL on page PC-5

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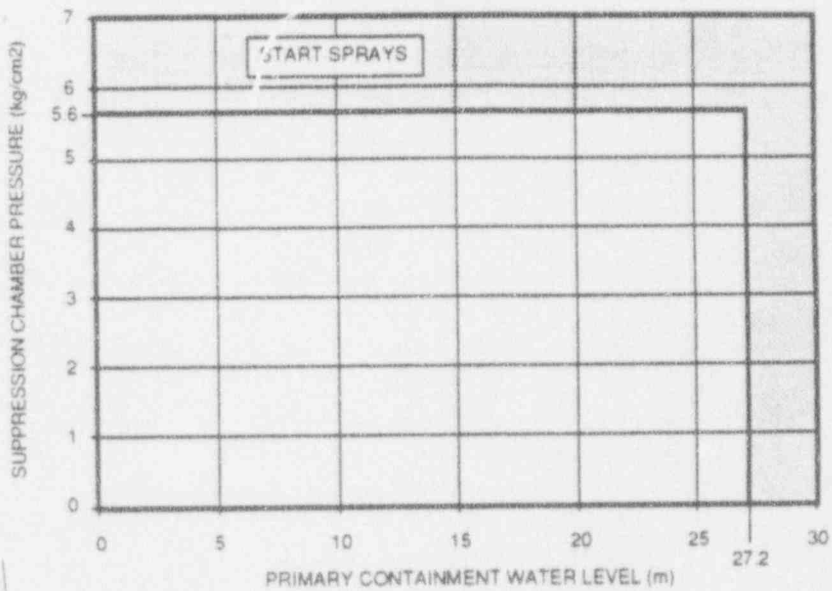
PC/P-6 When suppression chamber pressure cannot be maintained below [(the Primary Containment Pressure Limit)], then irrespective of whether adequate core cooling is assured:

PRIMARY CONTAINMENT PRESSURE LIMIT



- If suppression pool water level is below [18.90 m (elevation of suppression pool spray nozzles)] initiate suppression pool sprays. Suppression pool sprays may be augmented by the fire protection system and the firewater addition mode of RHR(C).

- If suppression pool water level is below [11.70 m (elevation of bottom of suppression pool-to-lower-drywell vent)] and drywell temperature and pressure are within the Drywell Spray Initiation Limit, shut down drywell cooling fans and initiate ~~drywell~~ Containment sprays. ~~Drywell~~ Containment spray may be augmented by the fire protection system and the firewater addition mode of RHR(C).

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PC/H-4 When drywell or suppression chamber hydrogen concentration reaches 6% and drywell or suppression chamber oxygen concentration is above 5%, EMERGENCY RPV DEPRESSURIZATION IS REQUIRED.

If while executing the following steps containment ~~suppression pool or drywell~~ sprays have been initiated and ~~:~~

~~•~~ Suppression chamber or drywell pressure drops below [0.12 kg/cm2 g (high drywell pressure scram setpoint)], terminate ~~suppression pool~~ containment sprays.

~~• Drywell pressure drops below [0.12 kg/cm2 g (high drywell pressure scram setpoint)], terminate drywell sprays.~~

PC/H-4.1 ~~If suppression pool water level is below [18.90 m (elevation of suppression pool spray nozzles)], initiate suppression pool sprays using only those RHR subsystems (RHR(B), RHR(C)) not required to assure adequate core cooling by continuous operation in the LPCF mode.~~

~~If RHR(B) and RHR(C) are not available for suppression pool sprays, initiate suppression pool sprays using the fire protection system and the firewater addition mode of RHR(C).~~

(Deleted - not applicable to ABWR.)

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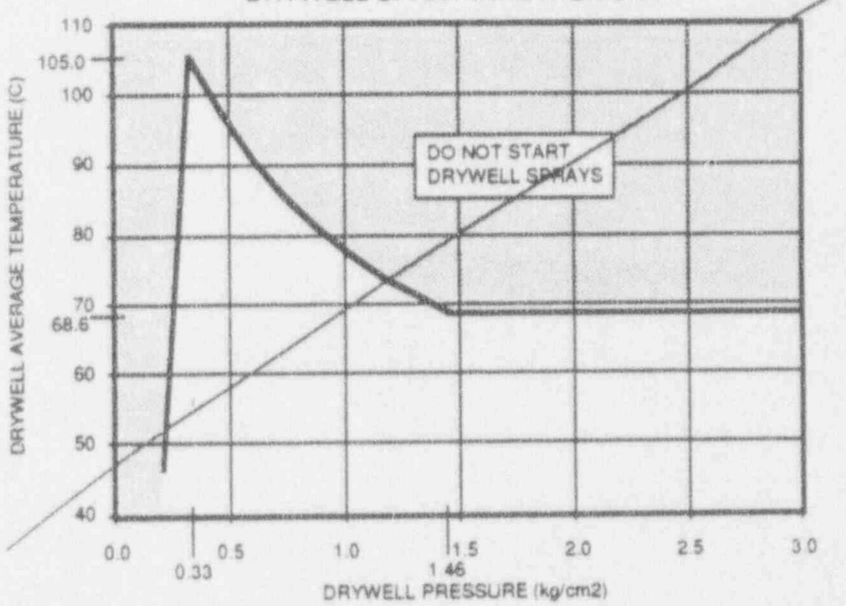
PC/H-4.2 (Deleted - not applicable to ABWR.)

PC/H-4.3 (Deleted - not applicable to ABWR.)

PC/H-4.4 If suppression pool water level is below [11.70 m (elevation of bottom of suppression pool–to–lower–drywell vent)] and drywell temperature, and pressure are within the Drywell Spray Initiation Limit, shut down drywell cooling fans and initiate Containment ~~drywell~~ sprays using only those RHR subsystems (RHR(B), RHR(C)) not required to assure adequate core cooling by continuous operation in the LPCF mode.

If RHR(B) and RHR(C) are not available for containment ~~drywell~~ sprays, initiate containment ~~drywell~~ sprays using the fire protection system and the firewater addition mode of RHR(C).

DRYWELL SPRAY INITIATION LIMIT



see revised DSIL on page PC-5

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PC/H-5 When drywell or suppression chamber hydrogen concentration cannot be restored and maintained below 6% and drywell or suppression chamber oxygen concentration cannot be restored and maintained below 5%, then irrespective of whether adequate core cooling is assured:

> If while executing the following steps containment ~~suppression pool or drywell~~ sprays have been initiated and:
>
> Suppression chamber or drywell pressure drops below [0.12 kg/cm2 g (high drywell pressure scram setpoint)], terminate containment ~~suppression pool~~ sprays.
>
> - ~~Drywell pressure drops below [0.12 kg/cm2 g (high drywell pressure scram setpoint)], terminate drywell sprays.~~

PC/H-5.1 ~~If suppression pool water level is below [18.90 m (elevation of suppression pool spray nozzles)], initiate suppression pool sprays.~~

(Deleted - not applicable to ABWR.)

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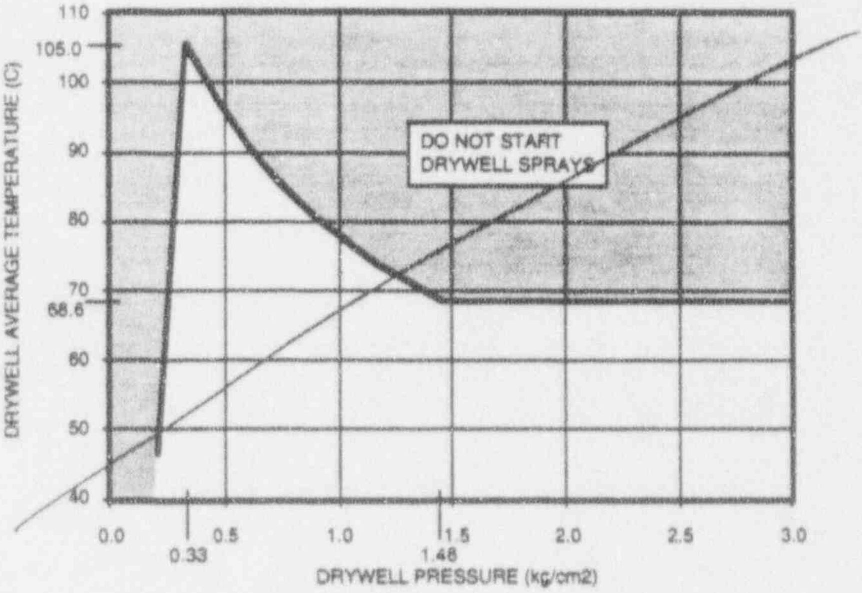
PC/H-5.2 If suppression pool water level is below [11.70 m (elevation of bottom of suppression pool–to–lower–drywell vent)] and drywell temperature and pressure are within the Drywell Spray Initiation Limit, shut down drywell cooling fans and initiate ~~drywell~~ containment sprays.

DRYWELL SPRAY INITIATION LIMIT



see Revised DSIL on page PC-5

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TABLE 18B–1 (Cont'd)

DIFFERENCES BETWEEN BWROG EPG REVISION 4 AND ABWR EPG

Replaced "drywell sprays with "containment" sprays.

ABWR EPG STEP	BWROG EPG REV. 4 STEP	DIFFERENCES FROM BWROG REV. 4 EPG	BASIS FOR DIFFERENCES
DW/T–2	DW/T–2	• Replaced phrase, "elevation of bottom of internal suppression chamber to drywell vacuum breakers less vacuum breaker opening pressure in feet of water", with the phrase, "elevation of the bottom of suppression pool–to–lower–drywell vent".	In the ABWR, drywell and suppression pool sprays are initiated simultaneously. They may not be independently operated. • In the ABWR containment, vents are provided connecting the upper drywell to the lower drywell. When the wetwell–to–drywell vacuum breakers open, flow is from the wetwell to the lower drywell and then from the lower drywell to the upper drywell through these vents. The vaccum breakers are located above the vents. Water can also spill to the lower drywell from the suppression pool if pool level reaches the vents. Water can also flow from the lower drywell to the suppression pool if lower drywell is flooded to the elevation of thse vents. For these reasons, it is appropriate to spray the drywell only when suppression pool water level is below the bottom of the upper drywell to lower drywell vents to preclude drywell differential pressure capability to be exceeded.
		• Deleted phrase "recirculation pumps" from instruction to shutoff recirculation pumps and drywell cooling fans prior to ~~drywell~~ containment spray initiation.	• The ABWR has internal recirculation pumps, driven by motors located below the RPV in the lower portion of the drywell. Drywell spray only sprays the upper portion of the drywell. An explicit instruction to shut down the recirculation pumps is not required.
		• Specify RHR pumps used for ~~drywell~~ containment spray as "RHR subsystems B and C".	• RHR subsystems B and C provide simultaneous drywell and ~~wetwell~~ suppression pool spray capability. Initiation of containment sprays is by manual control action. It is possible to initiate spray when RHR B or C is operating in other modes by opening spray valves.
		• Specified the use of the firewater addition system if RHR(B) and RHR(C) are not available for ~~drywell~~ containment sprays.	• The firewater addition system is described in Subsection 5.4.7.1.1.10. The specific purpose of the fire addition system is to provide makeup to the RPV to extend the station blackout capability of the ABWR, but it can be used for drywell and wetwell sprays if no other systems are available for sprays.

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TABLE 18B-1 (Cont'd)

DIFFERENCES BETWEEN BWROG EPG REVISION 4 AND ABWR EPG

ABWR EPG STEP	BWROG EPG REV. 4 STEP	DIFFERENCES FROM BWROG REV. 4 EPG	BASIS FOR DIFFERENCES
DW/T-3	DW/T-3	• Deleted phrase: "enter [procedure developed from the RPV Control Guideline] at [Step RC-1 and execute it concurrently with this procedure".	• This phrase has been moved to Step DW/T-1. Reactor scram is specified under the same instruction in DW/T-1 prior to reaching the temperature as stated in Step DW/T-2.
PC/P	PC/P	• Added instruction to permit venting through SGTS and RBHVAC only if containment pressure is less than the design pressure of these systems. Also, venting through these systems is to be terminated if containment pressure exceed the design pressure of these systems or if offsite release rate exceed the release rate LCO.	• Venting is performed only if containment pressure is less than the design pressure of these "soft vent" systems to preclude damage to these system equipment, and venting through these system for pressure control is allowed if radioactivity release rate is less than the LCO limit.
PC/P-1	PC/P-1	• ~~Delete "[the Pressure Suppression Pressure]" and [Suppression chamber pressure is above 2.2 psig ... Limit]~~ • ~~Specify RHR pumps used for drywell spray as "RHR subsystems B and C" and specified using the Firewater Addition System for sprays if RHR B & C are not available for sprays.~~	• ~~These phrases are only applicable to BWRs with a Mark III containment.~~ In the ABWR, drywell and suppression pool sprays are initiated simultaneously. They may not be independently operated. The containment spray initiation instruction is contained in Step PC/P-2 which follows. • ~~See bases for DW/T-2 above.~~

• Deleted entire step.

• Combined overrides to terminate sprays based on suppression chamber or drywell pressure

• See bases for Step PC/P-1.

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TABLE 18B–1 (Cont'd)

DIFFERENCES BETWEEN BWROG EPG REVISION 4 AND ABWR EPG

Replaced "drywell" sprays with "containment" sprays.

ABWR EPG STEP	BWROG EPG REV. 4 STEP	DIFFERENCES FROM BWROG REV. 4 EPG	BASIS FOR DIFFERENCES
PC/P–2	PC/P–2	• Replaced phrase, "elevation of bottom of internal suppression chamber to drywell vacuum breakers less vacuum breaker opening pressure in feet of water", with the phrase, "elevation of the bottom of suppression pool–to–lower–drywell vent". • Deleted phrase "recirculation pumps" from instruction to shutoff recirculation pumps and drywell cooling fans prior to ~~drywell~~ containment spray initiation. • Specify RHR pumps used for ~~drywell~~ spray as "RHR subsystems B and C" and specified using the Firewater Addition System for sprays if RHR B & C are not available for sprays.	• See bases for DW/T–2 above.

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TABLE 18B-1 (Cont'd)

DIFFERENCES BETWEEN BWROG EPG REVISION 4 AND ABWR EPG

ABWR EPG STEP	BWROG EPG REV. 4 STEP	DIFFERENCES FROM BWROG REV 4 EPG	BASIS FOR DIFFERENCES
PC/P-6	PC/P-6	• Specified that containment sprays may be augmented by the fire water addition system.	• In the ABWR, venting the containment is not to be performed since containment integrity is assured by the rupture diaphragms as discussed above under basis for PC/P-4. In the unlikely event that the rupture diaphragms have not been actuated when containment pressure exceeds the Primary Containment Pressure Limit [pressure at which the diaphragms are expected to actuate], then it is appropriate to spray the wetwell and the drywell in an attempt to reduce containment pressure to maintain containment integrity. The firewater addition system may be aligned to spray the wetwell and the drywell.

• Combined suppression pool and drywell spray initiation steps into one step.

• In the ABWR, drywell and suppression pool sprays are initiated simultaneously. They may not be independently operated. The lower of the elevation of the bottom of suppression pool-to-lower-drywell vent (11.70m) and the elevation of the suppression pool spray nozzles (18.90m) is used as the allowable pool water elevation for containment spray initiation.

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TABLE 18B-1 (Cont'd)

DIFFERENCES BETWEEN BWROG EPG REVISION 4 AND ABWR EPG

ABWR EPG STEP	BWROG EPG REV. 4 STEP	DIFFERENCES FROM BWROG REV. 4 EPG	BASIS FOR DIFFERENCES
SP/L-3.1	SP/L-3.1	• Replaced the phrase "terminate injection into the RPV from sources external to the primary containment" with the phrase, "terminate injection into the primary containment from sources external to the primary containment".	• A system is injecting water into the primary containment if all the following criteria are satisfied: (1) The suction source of the system is outside the primary contaiment, and (2) The system penetrates the primary contaiment, and (3) The system discharge is adding to the primary containment water inventory (i.e., a system is injecting into the RPV and either the RPV has an unisolated leak inside the primary containment or the safety relief valves are open to the primary containment. The function of the Primary Containment Water Limit is to preclude containment failure. Systems that inject into the RPV is a subset of those systems that can inject into the primary containment. It has always been the intent of the existing wording to direct the termination of all injection into the primary containment from sources external to the primary containment. The new wording of the injectin termination statement is also intended to allow RPV injection to continue if no water is leaving the RPV into the primary containment.

TABLE 18B-1 (Cont'd)

DIFFERENCES BETWEEN BWROG EPG REVISION 4 AND ABWR EPG

ABWR EPG STEP	BWROG EPG REV. 4 STEP	DIFFERENCES FROM BWROG REV 4 EPG	BASIS FOR DIFFERENCES
PC/H-4	PC/H-4	• Deleted instruction for vent and purging of the primary containment when oxygen and hydrogen concentrations reaches the level specified in this step. • Deleted phrase, "enter [procedure developed from the RPV Control Guideline] at [Step RC-1 and execute it concurrently with this procedure".	• Venting at this step through SGTS and RBHVAC ("soft vents") with high oxygen and hydrogen concentrations is not to be performed to preclude potential structural damage to these equipment due to combustion or explosions. • This phrase has been moved to Step PC/H-2.1. Refer to the bases for Step PC/H-2.1.
PC/H-4.1	PC/H-4.1	• Specify RHR pumps used for suppression pool sprays as RHR subsystems B & C and to use FAS if RHR B and C are not available.	• ~~See bases for Step DW/T-2.~~ In the ABWR, drywell and suppression pool sprays are initiated simultaneously. They may not be independently operated. The containment spray initiation instruction is contained in Step PC/H-4.4.
PC/H-4.2	PC/H-4.2	• Deleted step.	• Venting is not to be performed as discussed above under basis for Step PC/H-4.
PC/H-4.3	PC/H-4.3	• Deleted step.	• Purging is not applicable because the venting instructions have been deleted.

• Deleted step.

• Combined overrides to terminate sprays based on suppression chamber or drywell pressure.

• See bases for Step PC/H-4.1.

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TABLE 18B-1 (Cont'd)

DIFFERENCES BETWEEN BWROG EPG REVISION 4 AND ABWR EPG

ABWR EPG STEP	BWROG EPG REV. 4 STEP	DIFFERENCES FROM BWROG REV 4 EPG	BASIS FOR DIFFERENCES
PC/H-4.4	PC/H-4.4	• Deleted reference to recirculation pumps and specified RHR pumps used for ~~drywell~~ containment spray as RHR subsystems B and C; added instruction to use FAS if RHR B and C are not available. • Replaced phrase, "elevation of bottom of internal suppression chamber to drywell vacuum breakers less vacuum breaker opening pressure in feet of water", with the phrase, "elevation of the bottom of suppression pool-to-lower-drywell vent".	• See discussion of basis for step DW/T-2. • See discussion of basis for step DW/T-2.
INSERT A			
PC/H-5.2	PC/H-5.2	• Deleted reference to recirculation pumps. • Replaced phrase, "elevation of bottom of internal suppression chamber to drywell vacuum breakers less vacuum breaker opening pressure in feet of water", with the phrase, "elevation of the bottom of suppression pool-to-lower-drywell vent". • Changed "drywell" sprays to "containment" sprays	• See discussion of basis for step DW/T-2. • See discussion of basis for step DW/T-2. • See bases for Step PC/H-5.

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Insert (A)

PC/H-5	PC/H-5	• Combined overrides to terminate sprays based on suppression chamber or drywell pressure	• See bases for Step PC/H-5.1.
PC/H-5.1	PC/H-5.1	• Deleted step.	• In the ABWR, drywell and suppression chamber sprays are initiated simultaneously. They may not be independently operated. The containment spray initiation instruction is contained in Step PC/H-5.2.

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TABLE 18D.2-1 (Cont.)
BWROG EPG REV. 4 APPENDIX C RESULTS FOR ABWR

PARAMETER	VALUE		PARAMETER DEFINITION
MARFP	SRVs (#)	MARFP (kg/cm2)	Minimum Alternate RPV Flood Pressure
	8 or more	9.48	
	7	10.98	
	6	12.98	
	5	15.78	
	4	19.99	
	3	27.00	
	2	40.99	
MCFI	SRVs (#)	MCFI (min)	Minimum Core Flooding Interval
	8 or more	43.9	
	7	59.9	
	6	84.8	
WLI_1	Highest DW Run Temp. (°C) Low High	Minimum Indicated Level (cm)	Water Level Instrument Number 1: Shutdown (345.3 to 1272.3 cm)
	— 65.6	426.5	
	65.6 121.1	439.9	
	121.1 176.7	458.2	
	176.7 232.2	482.1	
	232.2 287.8	514.6	
WLI_2	Highest DW Run Temp. (°C) Low High	Minimum Indicated Level (cm)	Water Level Instrument Number 2: Narrow Range (345.3 to 497.8 cm)
	— 65.6	389.6	
	65.6 121.1	382.5	
	121.1 176.7	372.9	
	176.7 232.2	360.7	
	232.2 287.8	345.3	
DWSIL	Drywell Pressure (kg/cm2)	Drywell Temperature (°C)	Drywell Spray Initiation Limit (See Figure in Section 18A.5)
	0.21	46.3	
	0.28	81.9	
	0.33	105.4	
	~~0.47~~ 0.40	~~97.2~~ 139.1	
	~~0.61~~ 0.47	~~90.6~~ 173.1	
	~~0.75~~ 0.54	~~85.3~~ 207.9	
	~~0.89~~ 0.61	~~80.8~~ 243.8	
	~~1.03~~ 0.68	~~77.1~~ 280.9	
	~~1.17~~ 0.75	~~73.9~~ 319.5	
	~~1.31~~	~~71.1~~	
	~~1.46~~	~~68.6~~	
	~~2.00~~	~~68.6~~	

[illegible]
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