HOPE CREEK GENERATING STATION

HC.OP-AM.ZZ-0001(Z) - Rev. 1

SEVERE ACCIDENT GUIDELINES

REVISION SUMMARY:

Updates all attachments with the proper Revision number. Moves the list of attachments to the Table of Contents page. Revision bars were not used. This is an editorial change. (70101527-0010)

IMPLEMENTATION REQUIREMENTS **Effective Date 11/19/09**

None

SEVERE ACCIDENT GUIDELINES

TABLE OF CONTENTS

Section Title Page

NOTE

The below attchments are available in the TSC on appropriate size so that the severe Accident Evaluatore can easily read the information

ATTACHMENTS

1.0 PURPOSE

The Severe Accident Guidelines (SAG) provides guidance to respond to an emergency. The purpose of this guideline is to flood primary when the reactor core cannot be adequately cooled and SAG entry is required.

The primary containment is then flooded to:

- submerge the core
- preserve containment integrity

As primary containment water level rises due to the flooding, the RPV and primary containment are vented as necessary to:

- facilitate flooding
- maintain primary containment pressure below applicable limits

The coordination of RPV injection, primary containment flooding, and venting is known as the integrated containment flooding strategy.

The objectives of the integrated containment flooding strategy are to:

- remove heat from the RPV
- retain core debris in the RPV
- maintain primary containment integrity
- scrub fission products from the containment atmosphere
- prevent or minimize core-concrete interaction
- reestablish core submergence

These objectives are achieved through coordinated control of five functions:

- RPV injection,
- primary containment injection,
- RPV venting,
- primary containment venting,
- Containment spray.

2.0 REFERENCES

2.1 BWROG Emergency Procedure and Severe Accident Guidelines, Rev. 2 (March 2001)

2.2 BWR Owners Group Accident Management Guidelines Overview Document, Revision 1, June 1996

2.3 EPRI Severe Accident Management Guidance Technical Basis Report, Vols. 1 and 2, EPRI TR-101869, Final Report, 12/92

2.4 Closing Documents incorporated:

960912094
LR-N95018

2.5 Tech Basis / Lesson Plan - Severe Accident Guidelines NEHS-003

3.0 DEFINITIONS

Interpretations, definitions, and discussions regarding the usage of key SAG words and phrases are provided below. This information is provided to promote a uniform understanding of the actions intended by the steps in the SAGs.

Adequate Core Cooling (ACC)

Heat removal from the cladding sufficient to prevent rupturing the fuel clad.

The concept of ACC applies only in the EOPs. Once transfer is made to the SAGs, the state of the core configuration cannot be assured. Thus, RPV water level above the TAF in the SAGs is simply core submergence, not adequate core cooling.

Three viable mechanisms of adequate core cooling exist; in order of preference they are:

3.1 Core submergence
3.2 Core spray
3.3 Steam cooling

Core submergence
The mechanism of core cooling whereby each fuel element is completely covered with water. Indicated RPV water level at or anywhere above the TAF constitutes the principle means of confirming the adequacy of core cooling by this method.

It should be noted that once in the SAGs, RPV water level at or above the TAF no longer constitutes ACC since the normal core configuration cannot be assured.

Core spray
The mechanism of core cooling whereby the uncovered portion of the core is cooled by spray flow. Adequate spray cooling exists by design when at least one Core Spray loop is operating at design flow (6150 gpm) and RPV water level is at or above the elevation of the jet pump suctions (-215 in.). The covered portion of the core is then cooled by submergence while the uncovered portion is cooled by the spray flow.

While Core Spray may be preferentially operated in the SAGs to provide some cooling to any uncovered fuel, cool heated gases and internals in the RPV steam space, and scrub the RPV atmosphere, establishing design spray flow does not constitute adequate core cooling under severe accident conditions.

Steam cooling
The mechanism of core cooling whereby steam updraft through the uncovered portion of the reactor core is sufficient to prevent the temperature of the hottest fuel rod from exceeding the appropriate limiting value, which is specific to the mode of steam cooling being employed.

Two modes of steam cooling are employed in the EOPs: (1) with and (2) without injection of makeup water to the RPV. For each mode, water in the covered portion of the reactor core and lower plenum is the source of the steam. A high fuel-to-steam differential temperature is required for the steam cooling method of heat transfer to be effective.

Steam Cooling With Injection

With injection into the RPV established, adequate core cooling exists when steam flow through the core is sufficient to preclude the peak clad temperature of the hottest fuel rod from exceeding 1500°F, the threshold temperature for fuel rod perforation.

This mechanism of core cooling is employed in Alternate Level Control, the RPV Flooding evolution when the reactor may not be shutdown, and during the Level/Power control evolution when RPV water level is controlled below the top of the active fuel to reduce reactor power. RPV pressure and the number of open SRVs, or RPV water level, provide the means of confirming the adequacy of core cooling achieved via this mechanism. Assurance of continued adequate core cooling is achieved when RPV pressure can be maintained at or above the Minimum Steam Cooling Pressure (regardless of RPV water level height) or RPV water level can be maintained at or above the Minimum Steam Cooling RPV Water Level.

These two methods also provide ACC with no injection into the RPV. The limiting condition for providing steam cooling is with RPV injection. With injection, core inlet subcooling is introduced. The subcooled liquid utilizes a greater fraction of the energy to be raised to saturation that was previously available for the conversion of liquid to steam. Core inlet subcooling then reduces the steam produced, hence the cooling provided through the core.

Steam Cooling Without Injection

With no injection into the RPV established, adequate core cooling exists only as long as the covered portion of the reactor core generates sufficient steam to preclude the peak clad temperature of the hottest fuel rod from exceeding 1800°F, the threshold temperature for significant metal-water reaction, thus hydrogen production.

This mechanism of core cooling is employed in Steam Cooling. Indicated RPV water level at or above the Minimum Zero Injection RPV Water Level is the only means available for confirming the adequacy of core cooling achieved via this mechanism. The transient nature of this mechanism of adequate core cooling prevents being able to assure that it can be maintained.

This method of core cooling is not valid if RPV injection is taking place. The injected water will result in some amount of subcooling occurring at the core inlet. Energy will be used to raise the liquid to saturation that was previously available for steam production. The net result will be a reduction in the resulting steam produced for the calculation of the Minimum Zero Injection RPV Water Level.

Steam cooling (either with or without injection) is not utilized in the SAGs. If significant zirc/water reaction has begun, steam cooling is ineffective and the steam can actually accelerate any oxidation reaction taking place.

Approaching

The value of an identified parameter is drawing near to a specified limit. In use, "*approaching*" is similar to "*before*," but indicates that action is to be delayed until the margin to the limit is small. If the limit has already been exceeded when the instruction is reached, the action should still be performed unless expressly prohibited.

Available

The state or condition of being ready and able to be used (placed into operation) to accomplish the stated (or implied) action or function. As applied to a system, this requires the operability of necessary support systems (electrical power supplies, cooling water, lubrication, etc.).

Before

Any time prior to. Utilized where an event-independent margin is not appropriate to assign or one cannot be defined. If the condition has already occurred when the instruction is reached, the action should still be performed unless expressly prohibited.

Can/Cannot be determined

The current value or status of an identified parameter relative to that specified in the procedure can/cannot be ascertained using all available indications (direct and indirect, singly or in combination).

Can/Cannot be maintained above/below

The value of an identified parameter is/is not able to be held within the specified limit. The determination requires an evaluation of system performance and availability in relation to parameter values and trends. An instruction prescribing action when a parameter cannot be maintained above or below a specified limit neither requires nor prohibits anticipatory action. Depending upon plant conditions, the action may be taken as soon as it is determined that the limit will ultimately be exceeded, or delayed until the limit is actually reached.

Once the parameter does exceed the limit, however, the action *must* be performed; it may not be delayed while attempts are made to restore the parameter to within the desired control band.

Can/Cannot be restored above/below

The value of an identified parameter is/is not able to be brought within the specified limit. The determination requires an evaluation of system performance and availability in relation to parameter values and trends. An instruction prescribing action when a value cannot be restored and maintained above or below a specified limit does not require immediate action simply because the current value is outside the range, but does not permit extended operation beyond the limit; the action *must* be taken as soon as it is apparent that the specified range cannot be attained.

Drywell Spray Initiation Limit

The Drywell Spray Initiation Limit (DWSIL) is the highest drywell temperature at which initiation of drywell sprays will not result in an evaporative cooling pressure drop to below the high drywell pressure scram setpoint. It is utilized to preclude containment failure or de-inertion following initiation of drywell sprays in Containment.

Drywell temperature

Bulk (average) temperature of the atmosphere in the drywell airspace.

Direct Containment Heating

The heating (and resultant pressurization) of the primary containment atmosphere that results from the direct dispersal of the core mass due to a core breach of the RPV at elevated pressure, defined as a High Pressure Melt Ejection.

Enter

Continue in the identified procedure and, unless otherwise specified, exit the present procedure.

High Pressure Melt Ejection

The high velocity discharge of molten core debris that results if a core breach of the RPV occurs while the RPV is at elevated pressure (the low end being typically in the range of 150-300 psia).

If

Logic term which indicates that taking the action prescribed in the SAG step (and associated substeps) is contingent upon the current existence of the stated condition(s). If the identified conditions do not exist, the prescribed action (step and all associated substeps) is not to be taken and execution of operator actions should proceed promptly in accordance with the following step.

Initiate

Manipulate appropriate controls in the main control room (or other areas where instruments and controls for remote operation of equipment are located) as required to establish the specified system operating mode or plant condition(s). Prolonged attempts to jumper interlocks, align alternate or backup power supplies, enter remote areas to manually operate valves, etc., are not intended by this term.

Maximum Normal Operating [parameter]

The highest value of the identified parameter expected to occur during normal plant operating conditions with all directly associated support and control systems functioning properly.

Maximum Pressure Suppression Primary Containment Water Level (124")

The maximum primary containment water level at which pressure suppression capability sufficient to accommodate an RPV breach by core debris can be maintained. MPSPCWL is the primary containment water level corresponding to the bottom of the ring header.

It is used in the SAGs to establish the cutoff point for water addition to the primary containment if pressure suppression must be maintained (i.e., if core breach of the RPV is anticipated).

Minimum Debris Retention Injection Rate (MDRIR)

The Minimum Debris Retention Injection Rate is the lowest RPV injection rate at which it is expected that core debris will be retained in the RPV when RPV water level cannot be determined to be above the bottom of active fuel.

It is utilized to ensure that injection into the RPV is sufficient to remove decay heat from core debris.

Only injection believed likely to reach the anticipated location of core debris (the lower plenum) may be credited toward the MDRIR. Injection bypassing the location of core debris will not be effective in removing decay heat and thus cannot be included in the total flow.

Minimum Drywell Spray Flow (MDSF)

The Minimum Drywell Spray Flow (MDSF) is the lowest spray flow that assures uniform circumferential spray distribution within the drywell (5000 gpm).

It is used in the SAGs to control primary containment temperature and pressure, cool unsubmerged debris in the drywell, and delay or prevent containment failure once it has been determined that core debris has breached the RPV.

Pressure Suppression Pressure (PSP)

The Pressure Suppression Pressure (PSP) is the highest suppression chamber pressure, which can occur without steam in the suppression chamber airspace.

The PSP is a function of primary containment water level. It is utilized in the SAGs to ensure that pressure suppression capability sufficient to accommodate a low pressure release of core debris is maintained when RPV breach by core debris is anticipated.

The upper bound is MPSPCWL (124”) and the lower bound is the downcomer opening (38.5”).

Primary Containment

- Drywell
- Vent system
- Suppression Chamber

Primary Containment Pressure Limit (PCPL)

PCPL-A

> Defines the maximum allowable primary containment pressure based on primary containment structural limits, primary containment vent valve operability, SRV operability and RPV vent valve operability (RPV vent valve operability is not applicable to Hope Creek).

PCPL-B

> Defines the maximum allowable primary containment pressure based on primary containment structural limits and primary containment vent valve operability (PCPL-A minus the SRV operability concern).
>
> PCPL-B is used when the RPV is depressurized, therefore SRVs not needed.

Purge

Force flow through an enclosed volume. Includes establishing both an influent (driving) and effluent (exhaust) flowpath similar to that of a "feed and bleed" process.

Reactor Coolant System

The pipes, valves, and other equipment which connect directly to the RPV such that a reduction in RPV pressure will effect a decrease in the steam or water being discharged through an unisolated break in the system.

Examples:
- leak into the reactor building from the reactor water clean-up system with a failure of the isolation valves to close
- leak into the reactor building from the HPCI system discharge where the injection valve and discharge check valve are not closing

Restore

Take the appropriate action required to return the value of an identified parameter to within applicable limits.

Secondary Containment

The airtight spaces immediately adjacent to or surrounding the primary containment.

Shutdown

As applied to the reactor, subcritical with reactor power below the heating range.

When used without any further qualifying statement (e.g., “will remain shutdown under all conditions without boron...”), no shutdown margin or future state of the reactor is implied or required.

Suppression chamber

The structure enclosing the suppression pool water and the atmosphere (air or nitrogen) above it.

Suppression chamber pressure

The pressure of the atmosphere (air or nitrogen) in the suppression chamber.

Suppression pool

The volume of water intended to condense steam discharged from a primary system break inside the drywell.

Suppression pool temperature

Bulk (average) temperature of the suppression pool.

Terminate

Take the appropriate action required to stop the stated action, process, or evolution. Generally, the most direct action, which will stop the stated action/process/evolution, is preferred; however, a wide variety of actions may be employed.

Until

Indicates that the associated prescribed action is to proceed only so long as the identified condition does not exist.

Vent

Open an effluent (exhaust) flowpath from an enclosed volume.

Verify

Use available indications (status lights, direct and indirect presentations of the values of associated plant and system parameters, etc.) and/or physical observation to establish that, as applicable, the specified action has occurred, conditions are as stated, etc. Does not include an implied requirement to take any corrective action if the identified conditions do not exist.

When

Wait until the identified condition occurs, then take the action prescribed in the step. Execution of subsequent operator actions is not permitted until the identified condition exists.

4.0 ACRONYMS AND ABBREVIATIONS

ACC	Adequate Core Cooling
BAF	Bottom of Active Fuel
CSBW	Cold Shutdown Boron Weight
DHRP	Decay Heat Removal Pressure
DWSIL	Drywell Spray Initiation Limit
HPME	High Pressure Melt Ejection
MDRIR	Minimum Debris Retention Injection Rate
MDSF	Minimum Drywell Spray Flow
MPSPCWL	Maximum Pressure Suppression Primary Containment Water Level
MNO	Maximum Normal Operating
MSCP	Minimum Steam Cooling Pressure
MSCRWL	Minimum Steam Cooling RPV Water Level
MSO	Maximum Safe Operating
PC Primary	Containment
PCPL	Primary Containment Pressure Limit
PSP	Pressure Suppression Pressure
SAG	Severe Accident Guideline
SC Secondary	Containment
SCSIP	Suppression Chamber Spray Initiation Pressure
TAF	Top of the Active Fuel
TSG	Technical Support Guideline

5.0 RESPONSIBILITIES

5.1 Technical Support Supervisor (TSS) utilize attachments 6.1-6.5

- Evaluate, trend plant conditions, confirms SAG strategies.
- Directs plant operations by providing specific instructions directly to shift personnel, after SAG transition has been made.

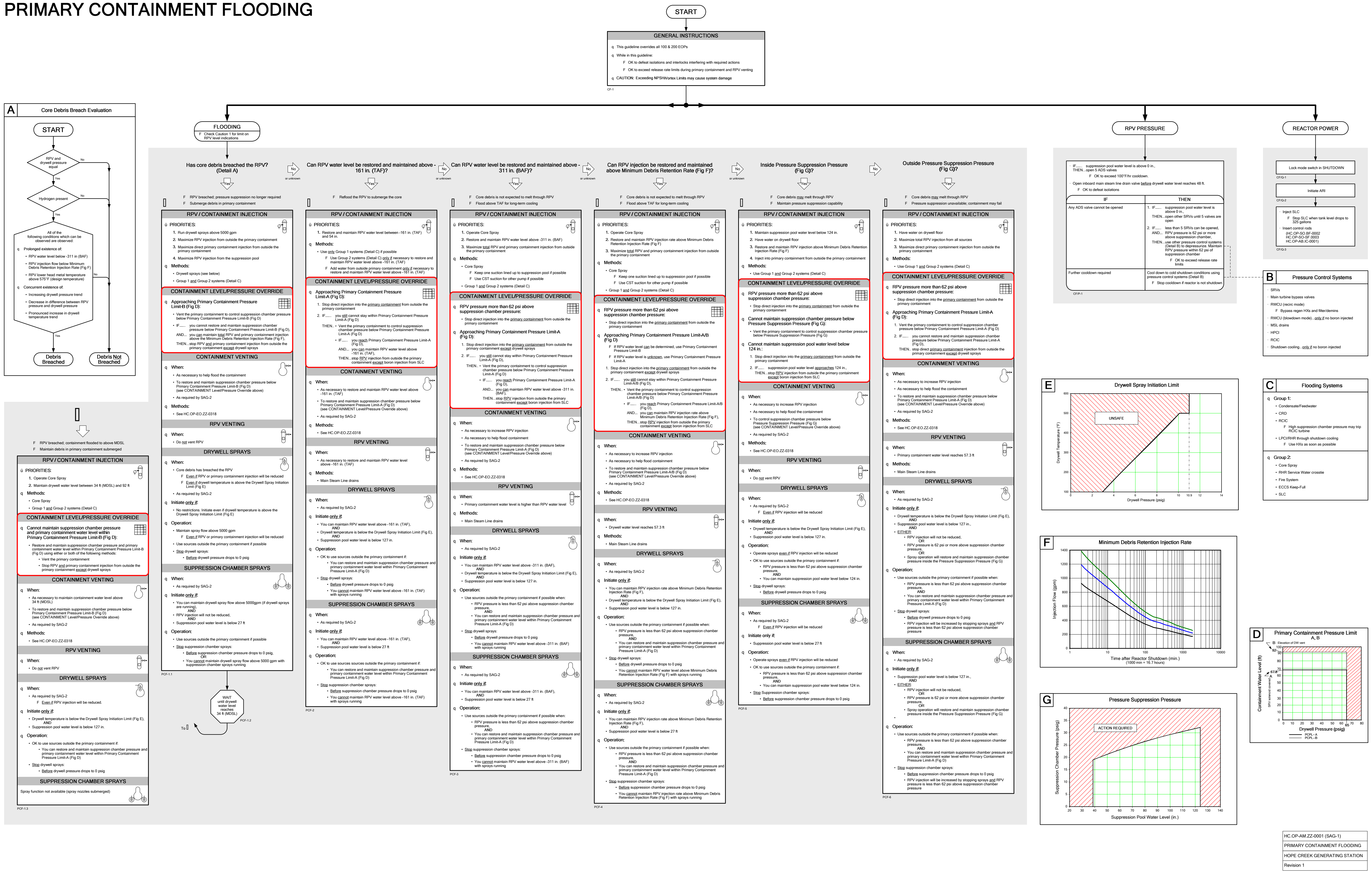
5.2 Mechanical Engineer utilizing attachments 6.1 – 6.5

- Forecast future values of EOP and SAG control parameters (parameter trending).
- Identify plant conditions as they relate to EOP and SAG control parameters and specify the state of the plant in respect to those parameters.
- Evaluate plant conditions, control room indications, and control parameters to determine if a signature event has occurred.
- Develop a methodology to determine systems availability.
- Develop a methodology to restore a system.
- Recommend appropriate EOP/SAG action leg to follow based on trends, indications, or calculations.
- Identify RPV breach signature.

5.3 Ops Advisor utilizing attachments 6.1 – 6.5

- Identify when the Integrated Containment Flooding Strategy should be entered.
- Determine if Pressure Suppression Function is required.
- Forecast future values of EOP and SAG control parameters (parameter trending).
- Recommend appropriate EOP/SAG action leg to follow based on trends, indications, or calculations.

SAG-1
PRIMARY CONTAINMENT FLOODING



SAG-2 CONTAINMENT AND RADIOACTIVITY RELEASE CONTROL

START

GENERAL INSTRUCTIONS

- q This guideline overrides all 100 & 200 EOPs
- q CAUTION: Exceeding NPSH/Vortex Limits may cause system damage

CR-1

HYDROGEN / OXYGEN

IF	THEN
H_2/O_2 monitors are unavailable	Sample the drywell and suppression chamber for hydrogen and oxygen (HC.RP-TI.SP-0006, NC.CH-CA.ZZ-0069)

DRYWELL

		Drywell O_2			
		< 5%	≥ 5% or unknown		
			Suppression Chamber H_2		
			None	< 6%	≥6% or unknown
Drywell H_2	None	No action	No action	▯	▯
	< 6%	▯			
	≥ 6% or unknown	▯			

CR/H-2

1

- q IF........ within limits for recombiner operation,
  THEN...1. Operate recombiners
  2. Stop recombiners when outside operating limits
- q IF........ offsite release rate is expected to stay below 1.2E+04 µCi/sec Total Noble Gas and 1.7E+01 µCi/sec I-131,
  THEN...vent and purge the drywell:
  - F OK to defeat isolations except high radiation
  1. Sample the containment atmosphere for radioactivity (HC.RP-TI.SP-0006, NC.CH-CA.ZZ-0069)
  2. Vent the drywell (HC.OP-EO.ZZ-0318)
  3. IF........ the drywell can be vented,
     THEN...purge the drywell with nitrogen (HC.OP-SO.GS-0002)
  4. Stop drywell vent and purge (if not required by other SAG steps) when:
     - Hydrogen in no longer detected in the drywell,
       OR
     - Offsite release rate reaches 1.2E+04 µCi/sec Total Noble Gas or 1.7E+01 µCi/sec I-131

CR/H-3

2

- q IF........ within limits for recombiner operation,
  THEN...1. Operate recombiners
  2. Stop recombiners when outside operating limits
- q IF........ offsite release rate is expected to stay below 7.6E+08 µCi/sec Total Noble Gas,
  OR...... RPV water level cannot be maintained above -161 in. (TAF),
  THEN...vent and purge the drywell:
  - F OK to defeat all isolations
  1. Vent the drywell (HC.OP-EO.ZZ-0318)
  2. IF........ the drywell can be vented,
     THEN...purge the drywell with nitrogen at max flow (HC.OP-SO.GS-0002)
  3. Stop drywell vent and purge (if not required by other SAG steps) when:
     - Hydrogen in no longer detected in either the drywell or the suppression chamber,
       OR
     - Hydrogen is no longer detected in the drywell and drywell oxygen is less than 5%,
       OR
     - RPV water level can be maintained above -161 in. (TAF) and offsite release rate reaches 7.6E+08 µCi/sec Total Noble Gas

CR/H-4

3

- q Stop recombiners
- q Vent and purge the drywell:
  - F OK to defeat all isolations
  - F OK to exceed release rate limits
  1. Vent the drywell (HC.OP-EO.ZZ-0318)
  2. IF........ the drywell can be vented,
     THEN...purge the drywell with air or nitrogen at max flow (HC.OP-SO.GS-0002)
     - F Use whichever will reduce hydrogen below 6% or oxygen below 5% faster
  3. IF........ permitted by SAG-1,
     THEN...operate drywell sprays

CR/H-5

SUPPRESSION CHAMBER

		Suppression Chamber O_2			
		< 5%	≥ 5% or unknown		
			Drywell H_2		
			None	< 6%	≥6% or unknown
Suppression Chamber H_2	None	No action	No action	⑤	▯
	< 6%	▯			
	≥ 6% or unknown	▯			

CR/H-6

4

- q IF........ offsite release rate is expected to stay below 1.2E+04 µCi/sec Total Noble Gas and 1.7E+01 µCi/sec I-131,
  THEN...vent and purge the suppression chamber:
  - F OK to defeat isolations except high radiation
  1. Sample the containment atmosphere for radioactivity (HC.RP-TI.SP-0006, NC.CH-CA.ZZ-0069)
  2. IF........ suppression pool water level is below 29 ft,
     THEN...vent the suppression chamber (HC.OP-EO.ZZ-0318)
  3. IF........ the suppression chamber can be vented,
     THEN...purge the suppression chamber with nitrogen (HC.OP-SO.GS-0002)
  4. Stop suppression chamber vent and purge (if not required by other SAG steps) when:
     - Hydrogen in no longer detected in the suppression chamber,
       OR
     - Offsite release rate reaches 1.2E+04 µCi/sec Total Noble Gas or 1.7E+01 µCi/sec I-131

CR/H-7

5

- q IF........ offsite release rate is expected to stay below 7.6E+08 µCi/sec Total Noble Gas,
  OR...... RPV water level cannot be maintained above -161 in. (TAF),
  THEN...vent and purge the suppression chamber:
  - F OK to defeat all isolations
  1. IF........ suppression pool water level is below 29 ft,
     THEN...vent the suppression chamber (HC.OP-EO.ZZ-0318)
  2. IF........ the suppression chamber can be vented,
     THEN...purge the suppression chamber with nitrogen (HC.OP-SO.GS-0002)
  3. Stop suppression chamber vent and purge (if not required by other SAG steps) when:
     - Hydrogen in no longer detected in either the drywell or the suppression chamber,
       OR
     - Hydrogen is no longer detected in the suppression chamber and suppression chamber oxygen is less than 5%,
       OR
     - RPV water level can be maintained above -161 in. (TAF) and offsite release rate reaches 7.6E+08 µCi/sec Total Noble Gas

CR/H-8

6

- q Vent and purge the suppression chamber:
  - F OK to defeat all isolations
  - F OK to exceed release rate limits
  1. IF........ permitted by SAG-1,
     THEN...operate suppression chamber sprays
  2. IF........ suppression pool water level is below 29 ft,
     THEN...vent the suppression chamber (HC.OP-EO.ZZ-0318)
  3. IF........ the suppression chamber can be vented,
     THEN...purge the suppression chamber with air or nitrogen at max flow (HC.OP-SO.GS-0002)
     - F Use whichever will reduce hydrogen below 6% or oxygen below 5% faster

CR/H-9

PRIMARY CONTAINMENT

SUPPRESSION POOL TEMPERATURE

- q Control suppression pool temperature below 95°F
  - F Use RHR for suppression pool cooling only if:
    - Neither RPV nor primary containment injection will not be reduced,
      OR
    - RPV water level can be maintained above -161 in. (TAF)

DRYWELL TEMPERATURE

- q Control drywell temperature below 135°F using drywell cooling
  - F OK to defeat isolations
- q **Before 340°F:**
  IF........ permitted by SAG-1,
  THEN...operate drywell sprays

PRIMARY CONTAINMENT PRESSURE

- q **Before 9.5 psig in suppression chamber:**
  IF........ permitted by SAG-1,
  THEN...operate suppression chamber sprays
- q **Above 9.5 psig in suppression chamber:**
  IF........ permitted by SAG-1,
  THEN...operate drywell sprays
- q **Before 65 psig:**
  Vent the primary containment to control pressure below 65 psig (HC.OP-EO.ZZ-0318)
  - F OK to defeat all isolations
  - F OK to exceed release rate limits

PRIMARY CONTAINMENT RADIATION

- q **Before 28,000 R/hr in drywell:**
  IF........ permitted by SAG-1,
  THEN...operate suppression chamber and drywell sprays

CR/PC-1

SECONDARY CONTAINMENT RADIOACTIVITY RELEASE

RB TEMPERATURE

- q Operate area coolers
- q IF........ Reactor Building HVAC exhaust radiation is below 1 E-3 µCi/cc,
  THEN...operate Reactor Building HVAC
  - F OK to defeat high drywell pressure and low RPV water level isolations
- q **Above any max normal temperature:**
  Isolate all discharges into affected areas except systems needed for:
  - Fire fighting
  - Other SAG steps

RB RADIATION

- q **Above any max normal radiation level:**
  Isolate all discharges into affected areas except systems needed for:
  - Fire fighting
  - Other SAG steps
- q **Above 1 E-3 µCi/cc in Reactor Building HVAC exhaust:**
  - Verify Reactor Building HVAC isolation
  - Verify FRVS start

RB WATER LEVEL

- q **Above any max normal floor drain sump or area water level:**
  Operate sump pumps to restore and maintain levels below max normal
  IF........ you cannot restore and maintain a floor drain sump or area water level below max normal,
  THEN...isolate all discharges into affected sumps and areas except systems needed for:
  - Fire fighting
  - Other SAG steps

RADIOACTIVITY RELEASE

- q Isolate all primary system discharges outside primary and secondary containments except systems needed for other SAG steps
- q IF........ Turbine Building HVAC is shutdown or isolated due to high radiation,
  THEN...restart Turbine Building HVAC
  - F OK to defeat isolation interlocks

CR/SC-1

HC.OP-AM.ZZ-0001 (SAG-2)
CONTAINMENT AND RADIOACTIVITY RELEASE CONTROL
HOPE CREEK GENERATING STATION
Revision 1

TSG - 1
HOPE CREEK
TECHNICAL SUPPORT GUIDELINES

START

ACTION LEVELS

- ☐ **Provide support for key EOP / SAG decisions.** [A]
  - If RPV water level cannot be restored and maintained above -311 in. (BAF), monitor for RPV breach by core debris
  - If primary containment or RPV venting may be required, determine the containment source term.
- ☐ **Evaluate the optimum timing of EOP / SAG actions** [B]

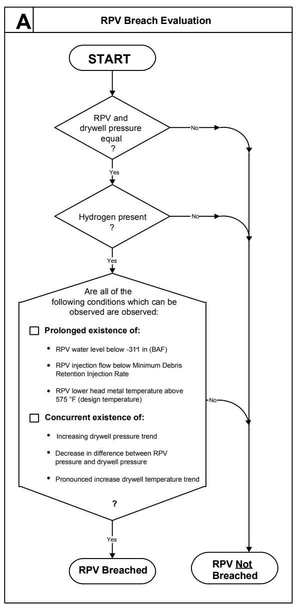
PARAMETERS

- ☐ **Monitor key EOP / SAG parameters** [C]
  - Compensate for off - calibration conditions as required.
- ☐ **Evaluate effects of plant conditions and operator actions on instruments being used.**
  - Evaluate instrument availability using questions in Detail [D]
  - Watch for conditions listed in Detail [E]
  - If direct indications are unavailable, identify alternative methods.
- ☐ **Forecast future values as required.**
  - Use linear extrapolation

SYSTEMS

- ☐ **Monitor EOP / SAG systems** [F]
  - Evaluate system availability using questions in Detail [G]
  - Evaluate the effects of changing plant conditions upon future system availability.
- ☐ **Determine priorities for returning systems to service.**
  - Use criteria listed in Detail [H]

A — RPV Breach Evaluation



B — Timing of EOP / SAG Actions

"Yes" answers to the following questions favor taking action now:

- Has an action level been reached or is it likely that an action level will be reached before the meter trend can be reversed ?
- Does the action level challenge core cooling, RPV integrity, or containment integrity ?
- Is there a potential benefit to the action ?
  - Will the action reverse the parameter trend ?
  - Will the action place the plant in a safe condition ?
  - Will the action facilitate control of other parameters ?
- Is it possible to perform the action now ?
  - Are the necessary systems and equipment available ?
  - Are the necessary personnel available ?
  - Is the area where the action is taken be inaccessible later ?
  - Are all prerequisites satisfied ?
- Is it more likely that the actions will be successful or of greater benefit now rather than later ?
  - Will the necessary systems or equipment be unavailable later ?
  - Will the necessary personnel be available later ?
  - Will the area where the action is taken be inaccessible later ?
  - Will prerequisites not be satisfied later ?
- Will any undesirable effects of the action be reduced by taking the action now rather than later ?
  - Will the offsite radioactivity release be reduced ?
  - Will personnel exposure be reduced ?
- Are plant and environmental conditions more favorable to taking the action now rather later ?
  - Will the offsite radioactivity release be reduced ?
  - Will personnel exposure be reduced ?

C — Key EOP / SAG Parameters

- ☐ **RPV Parameters**
  - RPV water level
  - RPV pressure
  - Reactor power
  - RPV injection flow
  - RPV metal temperature
- ☐ **Primary Containment Parameters**
  - Suppression pool temperature
  - Drywell temperature
  - Containment temperature
  - Primary containment pressure
  - Primary containment water level
  - Primary containment H_2/O_2
  - Primary containment radiation level
  - Primary containment injection flow
  - Drywell spray flow
- ☐ **Secondary Containment Parameters**
  - Secondary containment temperature
  - Secondary containment radiation
  - Secondary containment water level
- ☐ **Site Parameters**
  - Offsite radioactivity release rate

D — Instrument Availability

If the answer to any of the following questions is "no" the instrument may be inaccurate or unavailable.

- Is the parameter value within the instrument indicating range ?
- Is power available to all instrument components ?
- Is the instrument calibrated for use under the existing conditions ?
- Is the instrument reading consistent with other indications and expected trend ?
- Are the readout locations accessible ?
- Are all instrument components undamaged ?
- Can the instrument function in the existing environment ?

E — Conditions Affecting Parameter Indications

Condition	Effects
Rapid RPV depressurization	Invalid heated reference leg RPV water level indications during rapid depressurization below 500 psig. Inaccurate or invalid cold reference leg RPV water level indications due to gases coming out of solution.
High drywell or secondary containment temperature near RPV water level instrument runs	Inaccurate or invalid RPV water level indications.
Rising primary containment water level	Flooding of electrical equipment in the primary containment. Increased hydrostatic head on submerged pressure taps.

F — EOP / SAG Systems

- ☐ **Injection Systems**
  - Condensate / Feedwater
  - CRD
  - ECCS Keep - Full
  - Fire system
  - HPCI
  - Core Spray
  - RCIC
  - RHR
  - Service Water
- ☐ **RPV Pressure Control Systems**
  - SRVs
  - RPV Head Vent
  - Turbine Bypass Valves
  - MSL drains
  - RWCU
  - Shutdown Cooling
- ☐ **Reactivity Control Systems**
  - ARI
  - RPS
  - RSCS
  - RWM
  - SLC
  - Alternate boron injection
- ☐ **Electrical Systems**
  - Emergency Diesel Generator
- ☐ **Ventilation**
  - FRVS
  - Reactor Building HVAC
  - Turbine Building HVAC
- ☐ **Primary Containment Systems**
  - Torus Cooling
  - Drywell coolers
  - Vent and purge systems
  - Hydrogen Recombiners
  - Hydrogen mixers (drywell fans ?)

G — System Availability

If the answer to any of the following questions is "no" system availability may be limited:

- Is power available to all system components ?
- Is the system unisolated ?
- Are all required support systems available ?
  - Control power
  - Motive power
  - Pneumatics
  - Cooling water
  - Lube oil, etc.
- Are all operating interlocks satisfied ?
- Are all necessary prerequisites satisfied ?
- Can the necessary valve lineups be established ?
- Are plant parameters within allowable ranges ?
- Are all necessary system controls undamaged ?
- Can the system function in the existing environment ?
- Is it expected that all required conditions will continue to exist ?

H — System Prioritization

"Yes" answers to the following questions indicate higher priority.

- Is the system needed for establishing or maintaining control of an EOP or SAG parameter ?
- Is the parameter controlled by the system at or near an EOP or SAG action level ?
  - Does the action level challenge core cooling, RPV integrity, or containment integrity ?
  - Does the action level require an undesirable response ?
- Is it expected that the system will be effective if restored to service ?
  - Will the system be usable under the expected plant conditions ?
  - Will the system be capable of controlling the parameter of concern ?
- Is there a possibility that the system can be returned to service ?
  - Is any damage repairable ?
  - Are replacement components and repair material available ?
  - Are the locations where work must be performed accessible ?
  - Are the necessary personnel available ?
- Can the system be returned to service in time to be of value ?

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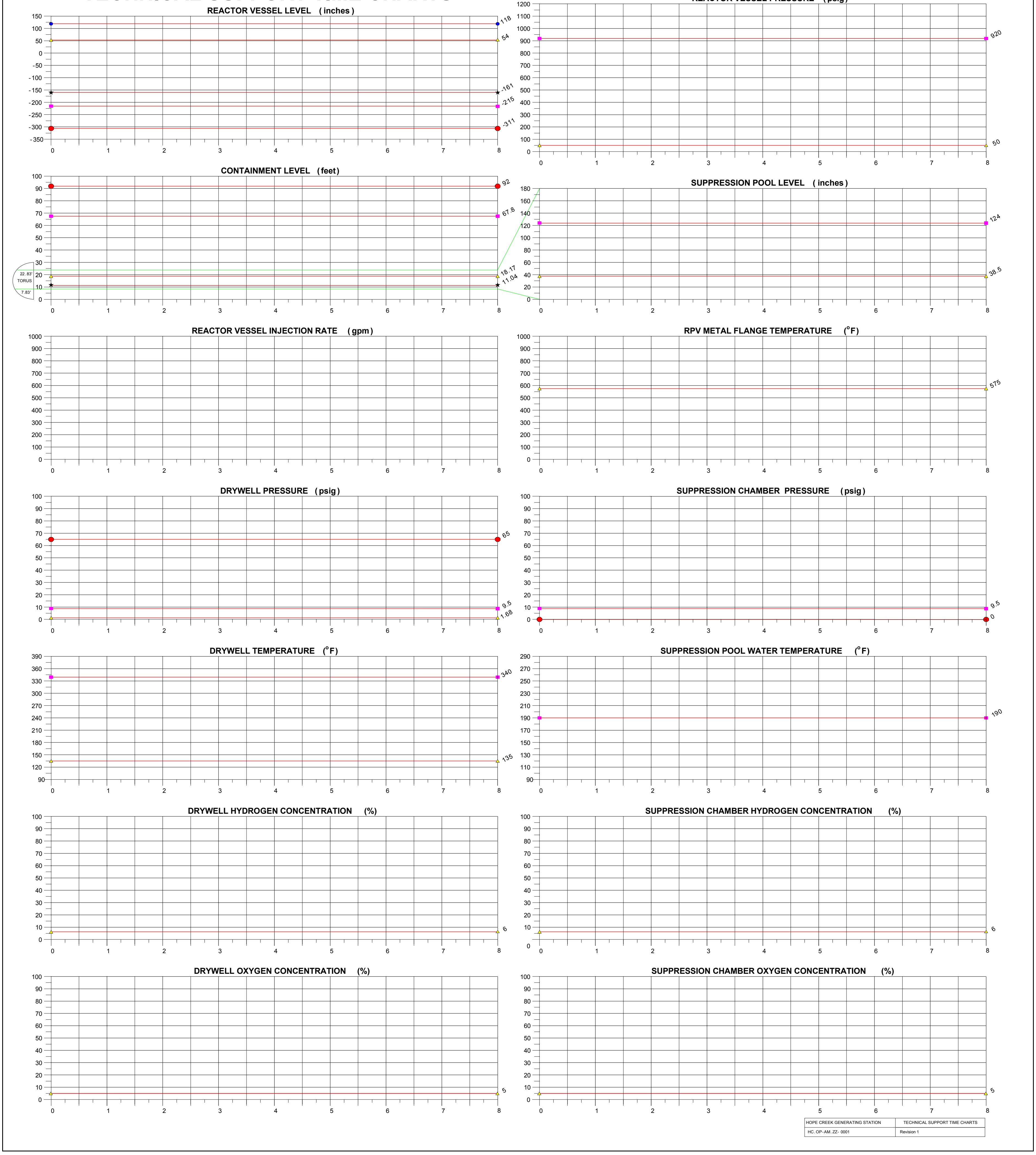
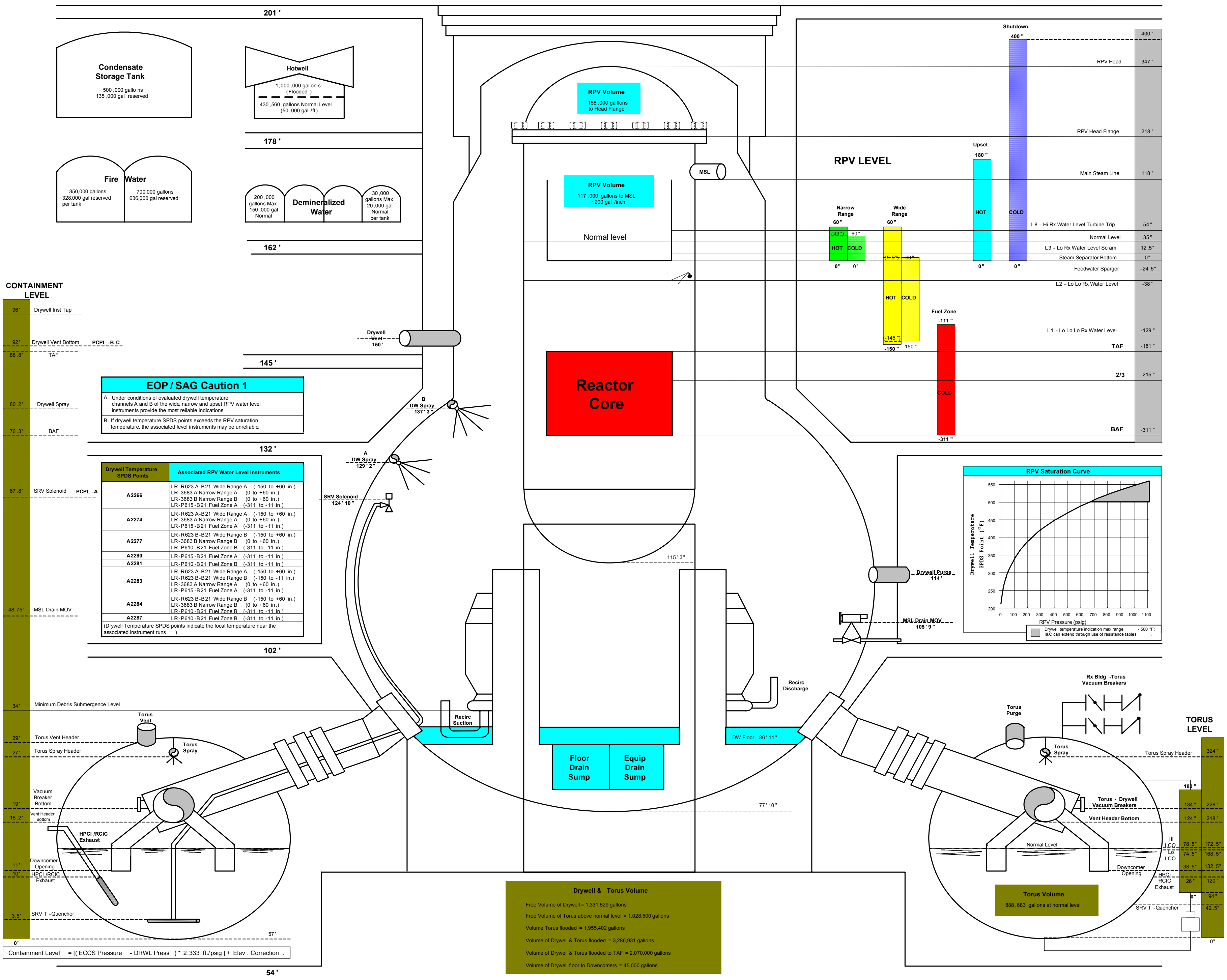
TECHNICAL SUPPORT TIME CHARTS



RPV & CONTAINMENT SAG SUPPORT INFORMATION



EOP / SAG Caution 1

A. Under conditions of evaluated drywell temperature channels A and B of the wide, narrow and upset RPV water level instruments provide the most reliable indications.

B. If drywell temperature SPDS points exceeds the RPV saturation temperature, the associated level instruments may be unreliable

Drywell Temperature SPDS Points	Associated RPV Water Level Instruments
A2266	LR-R623 A-B21 Wide Range A (-150 to +60 in.) LR-3683 A Narrow Range A (0 to +60 in.) LR-3683 B Narrow Range B (0 to +60 in.) LR-P615-B21 Fuel Zone A (-311 to -11 in.)
A2274	LR-R623 A-B21 Wide Range A (-150 to +60 in.) LR-3683 A Narrow Range A (0 to +60 in.) LR-P615-B21 Fuel Zone A (-311 to -11 in.)
A2277	LR-R623 B-B21 Wide Range B (-150 to +60 in.) LR-3683 B Narrow Range B (0 to +60 in.) LR-P610-B21 Fuel Zone B (-311 to -11 in.)
A2280	LR-P615-B21 Fuel Zone A (-311 to -11 in.)
A2281	LR-P610-B21 Fuel Zone B (-311 to -11 in.)
A2283	LR-R623 A-B21 Wide Range A (-150 to +60 in.) LR-R623 B-B21 Wide Range B (-150 to -11 in.) LR-3683 A Narrow Range A (0 to +60 in.) LR-P615-B21 Fuel Zone A (-311 to -11 in.)
A2284	LR-R623 B-B21 Wide Range B (-150 to +60 in.) LR-3683 B Narrow Range B (0 to +60 in.) LR-P610-B21 Fuel Zone B (-311 to -11 in.)
A2287	LR-P610-B21 Fuel Zone B (-311 to -11 in.)

(Drywell Temperature SPDS points indicate the local temperature near the associated instrument runs)

RPV POWER CONTROL

Power (%)	Items of interest	Significance
118 %	Hi Power Scram.	Maximum power
24 %	Bypass Valve Capacity	Maximum power that can be handled through the bypass valves. Other steam loads may handle an additional 5 % power.
14 %	Low Power Scram	Scram with the Mode Switch out of RUN.
4%	APRM Downscales	Power below which level will not be lowered to control power during ATWS Level / Power Control.
All Rods Inserted to at least Position 02	Minimum Subcritical Banked withdrawal Position	Reactor is Shutdown under all conditions.

CONTAINMENT LEVEL CONTROL

Level (ft.)	Items of interest	Significance
96'	Drywell Instrument Tap	Highest Containment level that can be measured
92'	Bottom of Drywell Vent	Elevation of Drywell Vent, cannot Flood past this point
88.8'	Top of Active Fuel	TAF relative to Primary Containment Water Level.
76.3'	Bottom of Active Fuel	May delay or prevent vessel failure
34'	Minimum Debris Submergence Level	Covers core debris on the drywell floorl
19'	Bottom of Torus - Drywell Vacuum Breakers	Allows non - condensable gases to return to the Drywell
18.2'	Ring Header Bottom	Maximum Pressure Suppression Primary Water Level Limit
11'	Downcomers Opening	Downcomer breach

RPV LEVEL CONTROL

Level (inches)	Items of interest	Significance
54"	Hi Level Trip (L8) Main Turbine, RFPs, HPCI & RCIC Turbine trips.	Loss of High Pressure Injection (FW, HPCI, RCIC) Loss of 100 % heat load.
-12.5"	Low Level Scram (L3)	Closes S/D cooling suction valves
-38"	High Pressure Injection ARI, PCIS Isolations, NSSS Isolation	HPCI / RCIC start
-129"	ECCS signal	MSIVs close ECCS pumps start Containment Isolation
-161"	Top of Active Fuel	Loss of adequate Core Cooling from Core Submergence, Depressurize if Low Pressure Injection is available.
-311"	Bottom of Active Fuel	Vessel failure may result

CONTAINMENT PRESSURE CONTROL

Pressure (psig)	Items of interest	Significance
65 psig	Primary Containment Pressure Limit (PCPL)	When PCPL is reached, containment venting is required. If venting is not successful, then operate sprays irrespective of Adequate Core Cooling
9.5 psig	Drywell Spray	Drywell Spray may be initiated if within DW Spray Limit & Torus level <180"l
1.68 psig	Drywell Hi Pressure Scram & ECCS setpoint	ECCS initiation, Isolations & Scram
0 psig	stop drywell sprays	Prevents Drywell from becoming negative
-5 psig	Tech Specs	Negative limit for the Drywell

RPV PRESSURE CONTROL

Pressure (psig)	Items of interest	Significance
1108, 1120, 1130 psig	Safety Relief Valves lift settings	The Reactor is in an overpressure condition.
1071 psig	RRCS Hi Pressure Actuation	ARI
1047 psig	Arms Lo Lo Set	H & P SRVs open H cycles 1017 - 905 psig P cycles 1047 - 935 psig
1037 psig	Hi Pressure Scram	Control pressure below scram signal
920 psig	Bypass valve control pressure	Minimum pressure for bypass valves
905 psig	Lo Lo SET setpoint	H SRV closes
461 psig	Core Spray Permissive	CS Injection Valves Open
450 psig	LPCI Permissive	LPCI Injection Valves Open
82 psig	Shutdown Cooling permissive	Closes S/D cooling suction valves if pressure is exceeded
50 psig	Min D/P for SRVs	ADS valves close

DRYWELL TEMPERATURE CONTOL

TEMP (Deg °F)	Items of interest	Significance
340 °F	Design Temperature	Drywell Strength is not analyzed above this temperature. Initiate Drywell Sprays prior to 340°F, if permitted by SAG - 1
135 °F	Tech Spec Hi Temperature	EOP entry condition

INJECTION SOURCES

System	Pumps	Capacity (gpm)	Shutoff Head (psig)	Motive Force
HPCI	1	3,000 gpm to Core 2,600 gpm Outside Shroud	1250 psig	Steam
RCIC	1	625 gpm	1120	Steam
CRD	2	98 gpm	1360 psig	10 B430 10 B440
Feedwater	3	13,000 gpm	1250 psig	Steam
Secondary Condensate	3	11,400 gpm @ 567 psig	737 psig	10 A110 (7.2 kv) 10 A120 (7.2 kv) 10 A104 (4160 v)
Core Spray	4	3,175 @ 293 psig 6,350 gpm per Loop	380 psig	10 A401 10 A402 10 A403 10 A404
RHR (LPCI)	4	10,000 gpm @ 170 psig	340 psig	10 A401 10 A402 10 A403 10 A404
Primary Condensate	3	12,000 gpm @ 152 psig	202 psig	10 A110 (7.2 kv) 10 A120 (7.2 kv) 10 A102 (4160 v)

TORUS TEMPERATURE CONTOL

Temp (Deg °F)	Items of interest	Significance
150 °F	Initiate SLC Power less than 4%	Reactor will shutdown before Heat Capacity Temperature Limit is reached
110 °F	Initiate SLC Power greater than 4%	Reactor will shutdown before Heat Capacity Temperature Limit is reached
105 °F	Tech Spec Testing Hi Limit	Stop testing that inputs energy into the torus
95 °F	Tech Spec Hi Limit	EOP entry condition

ALTERNATE INJECTION SOURCES

System	Pumps	Capacity (gpm)	Shutoff Head (psig)	Motive Force
Fire Water	2	2,500 gpm @ 90 psig	125 psig	Diesel & 10 B590
Condensate Transfer	2	600 gpm @ 160 psig	187 psig	10 B170 10 B180
SLC	2	43 gpm @ 1235 psig	1250 psig	10 B222 10 B212
Service Water	4	21,000 gpm @ 44.5 psig	67 psig 155 ft.	10 A401 10 A402 10 A403 10 A404

CONTAINMENT H_2 CONTROL

H_2 Conc (%)	Items of interest	Significance
<6%	High Hydrogen	Actions required
≥6%	Deflagration limit	Minimum H_2 concentration required to support an explosion (with O_2 of 5%)

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