Accident Progression and Critical Issues During Reactor Accidents - an End User Perspective

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Why are enhanced tools needed for EOP/SAG Implementation?

- **Assistance in EOP/SAG implementation requires knowledge of:**
  - Plant Procedures
  - Plant Responses
  - Available mitigative equipment and actions
  - Limitations on actions
  - Accident phenomena
  - Accident progression signatures
  - Accident progression timing
- **Many decisions have introduced a substantial degree of Engineering evaluation to optimize the decisions**

Perception of Accident Management

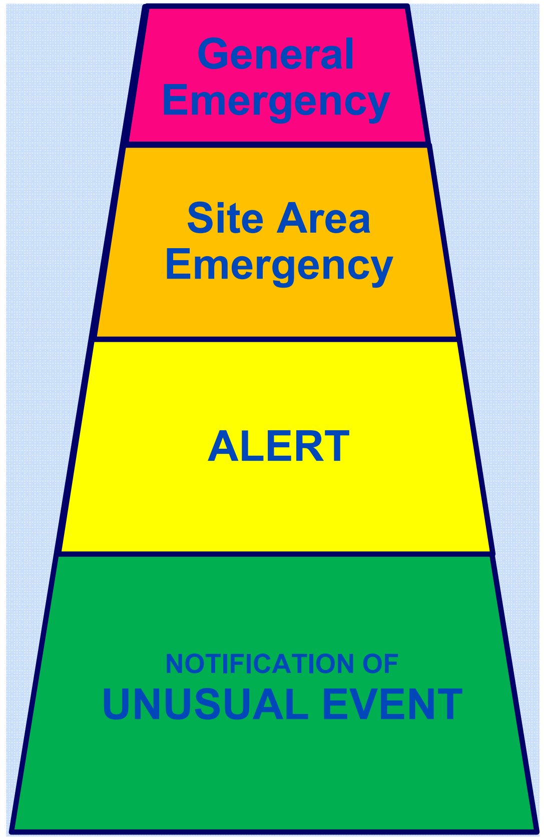
https://www.youtube.com/watch?v=wm-h7YR_410

Background

Who activates the Emergency Response Organization (ERO)?

Shift Manager (SM)

- Licensed senior reactor operator
- Maintains command & control of the plant
- Makes initial emergency classification
  - -- If ≥ Alert, SM must activate ERO
  - -- SM is the Emergency Director (ED) until relieved by on-call ED (after which SM advises ED on matters regarding control of the reactor



US System

Roles & Responsibilities for Accident Management After ERO Activation

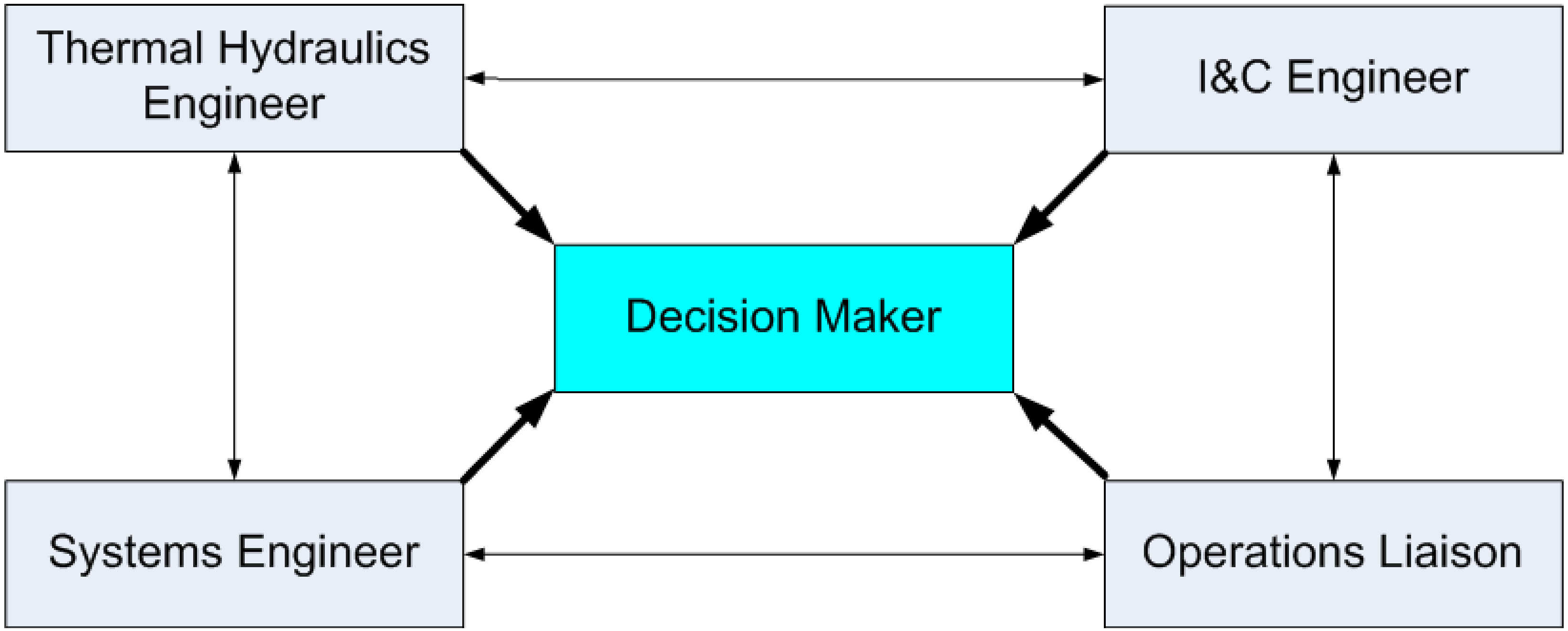
DECISION MAKERS	EVALUATORS	IMPLEMENTERS
The emergency response organization function responsible for assessing and selecting the accident mitigation strategy to be implemented	The emergency response organization function responsible for evaluating plant symptoms in order to determine the damage condition(s) and recommending any potential strategies that may be used to mitigate the event	Plant personnel responsible for performing those steps necessary to accomplish the objectives of the accident mitigation strategies (e.g., hands-on control of valves, breakers, controllers)
EOP Realm - Operations Shift Managers	EOP Realm – Shift Technical Advisor	EOP Realm – Operating Crew
Severe Accident Realm – ERO Emergency Director	Severe Accident Realm – ERO Staff: • STA • TSC • EOF	Severe Accident Realm – ERO • Operating Crew • Additional Site Resources • Additional Offsite Resources

Position Types are defined in:

1. ***BWR Owner's Group Accident Management Guidelines Overview Document. May 1996***
2. ***NEI 91-04, Rev 1, SEVERE ACCIDENT ISSUE CLOSURE GUIDELINES. December 1994***

TSC Evaluations

- TSC Accident Assessment Team (AAT) performs evaluation functions for EOP/SAG decision making at US BWR Plants
- Subset of the larger TSC Staff

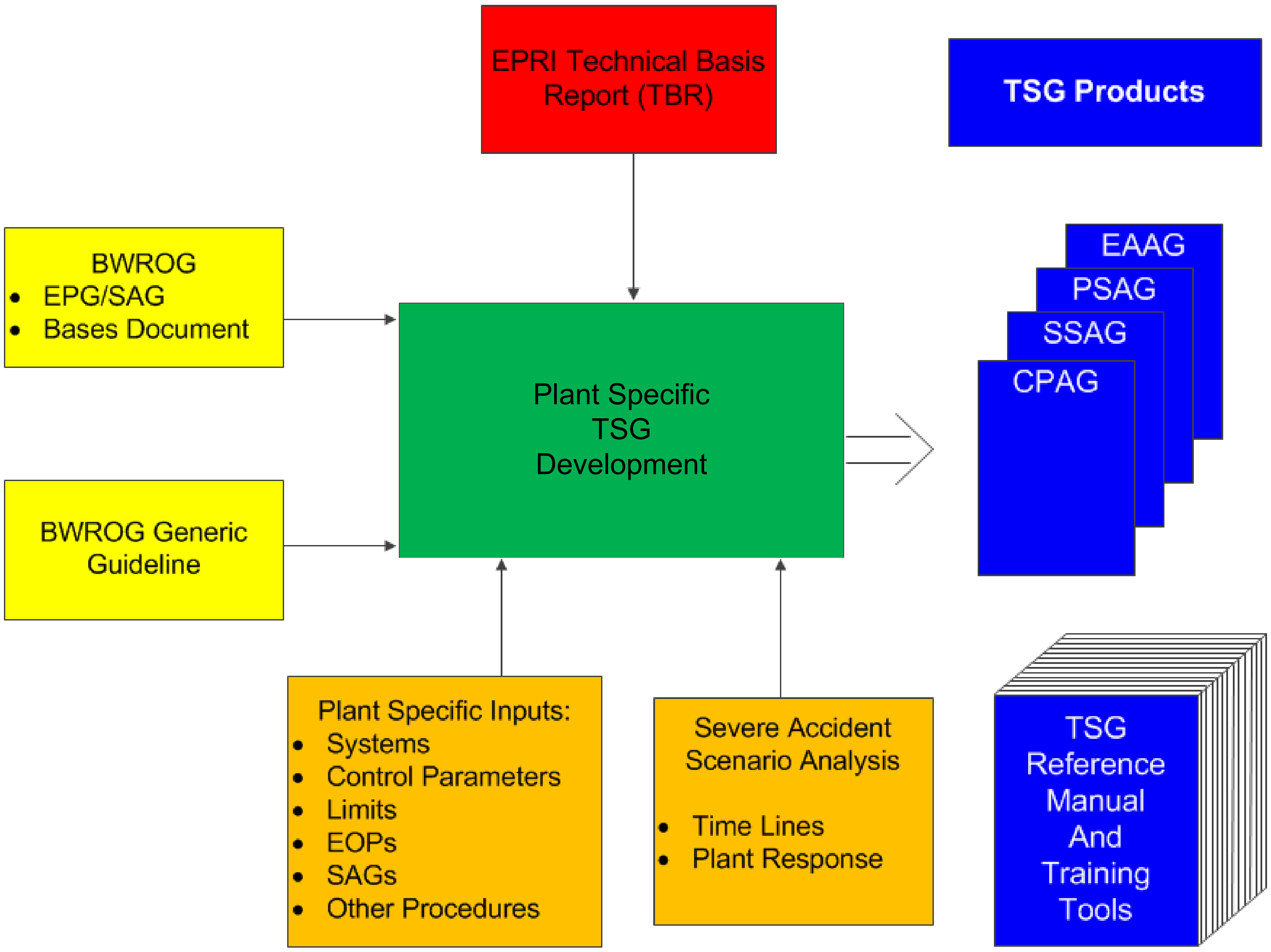


Impetus for Technical Support Guidelines (TSGs) from Fukushima Daiichi Accident

- **Data input is critical to support decision-making**
- **Trending assists in prioritization**
- **Understanding severe accident phenomena and timelines assist in recognizing critical events**
- **System operability assessment**
  - Allows projection of time to future needs
  - Identifies support systems necessary
- **Interpretation of EOP/SAG actions in light of current and projected plant conditions -- Examples:**
  - Functional situations (containment impaired)
  - Core debris may not be retained in RPV
  - RPV breached

Technical Support Guideline (TSG) Overview

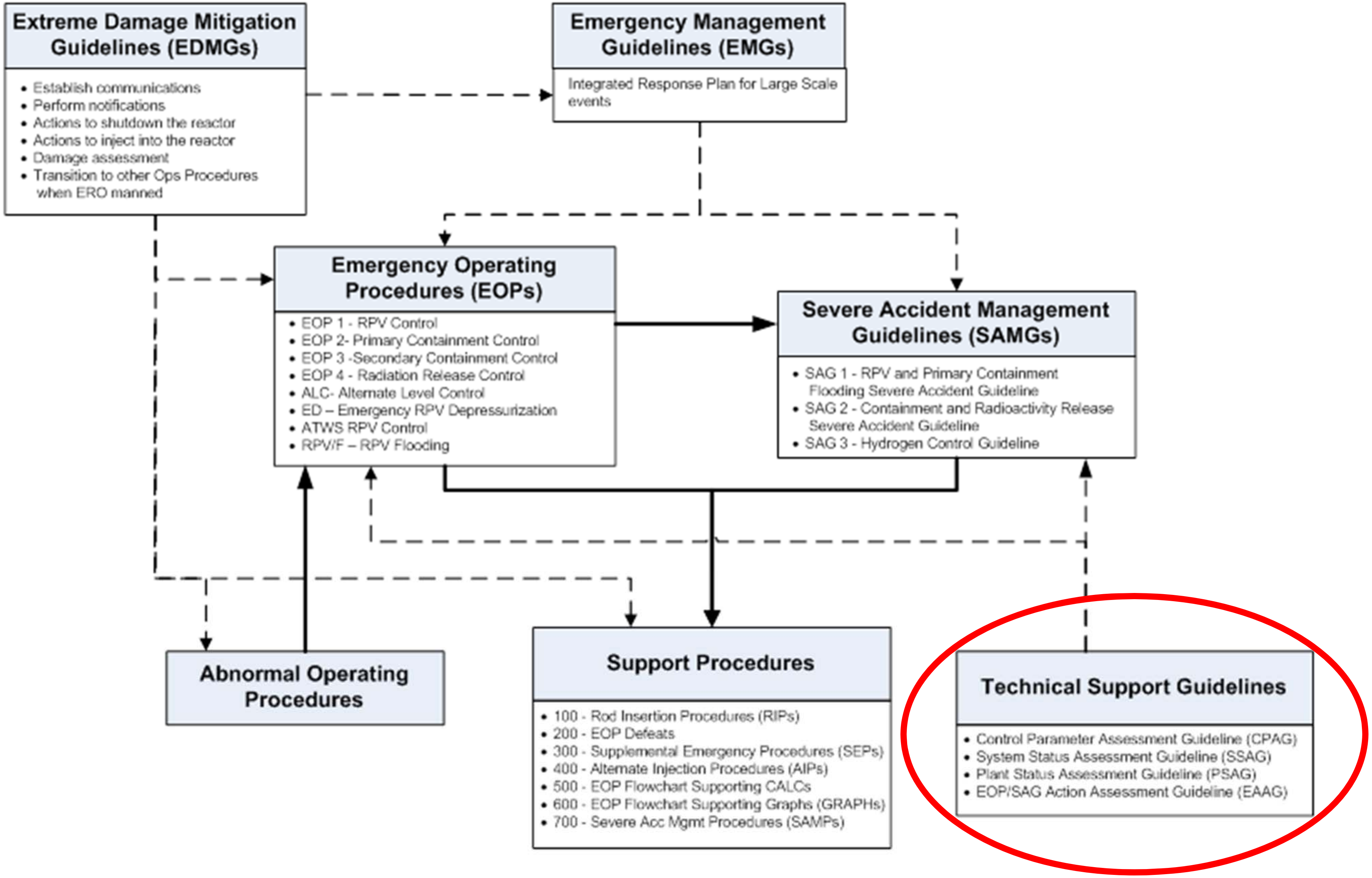
Technical Support Guideline (TSG) Development



Technical Support Guidelines (TSG) Purpose

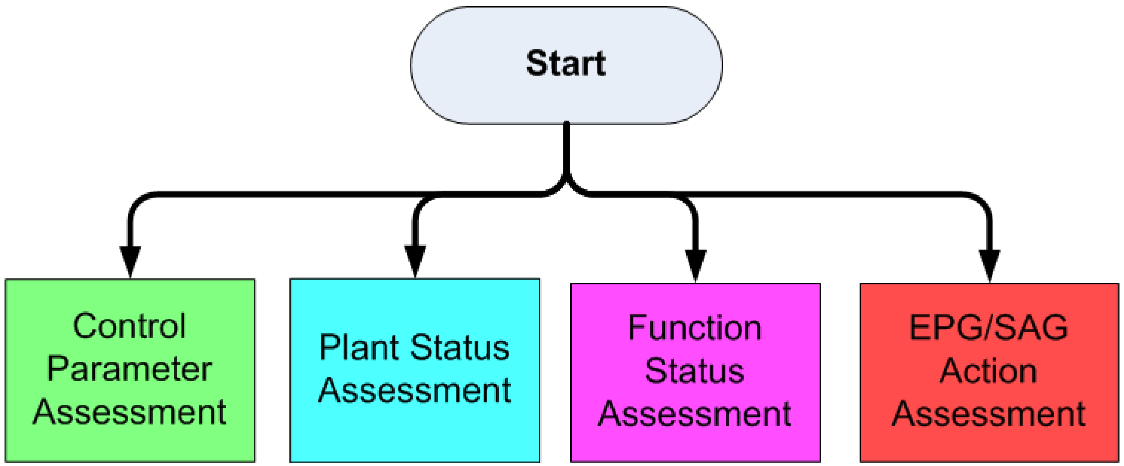
- **Developed by the US BWR Owner's Group and BWR Plants**
- **Used by the Accident Assessment Team in the ERO Technical Support Center (TSC)**
- **Support execution of Emergency Operating Procedures (EOPs) and the Severe Accident Guidelines (SAGs)**
- **Specify engineering support activities**
- **Identify constraints and limitations of tools and capabilities used in assessment and prognosis, and uncertainties in the results**
  - **Instrument uncertainties**
  - **Core damage assessment**
  - **Assessment of resource limitations (can ERO effectively perform the expected actions – on-shift and after callout)**

Relationship: Accident Management Guidelines and Plant Procedures

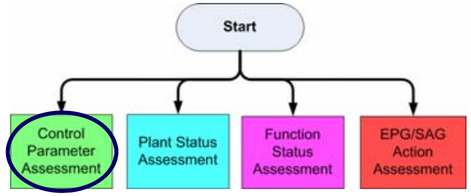


Structure of Technical Support Guidelines (TSGs)

Guideline	Purpose
Control Parameter Assessment Guideline (CPAG)	Identify best estimate value for each EOP and SAG control parameter
Plant Status Assessment Guideline (PSAG)	Forecast the future values of control parameters
Function (System) Status Assessment Guideline (SSAG)	Establish operability and reliability of plant systems
EOP/SAG Action Assessment Guideline (EAAG)	Priority and timing for actions directed by the EOPs/SAGs



Control Parameter Assessment



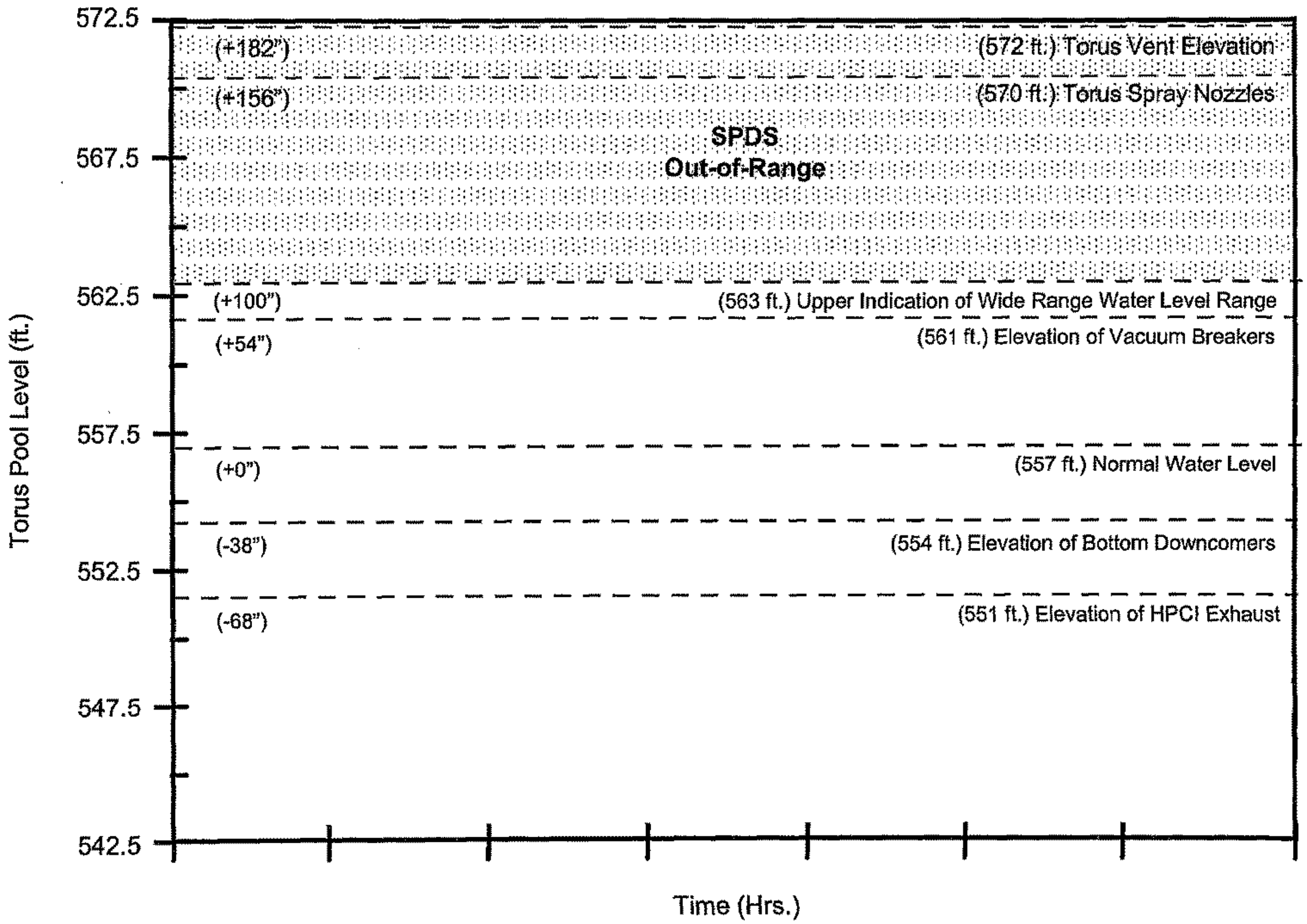
- **Purpose of Control Parameter Assessment (CPA) is to evaluate the availability of instrumentation used to determine the values of EOP/SAG control parameters**
- **Under some conditions, indirect methods or calculation aids may be required**
- **Control Parameter Assessment helps determine:**
  - Condition of the plant based on the parameter indications
  - Whether or not indications are telling 'truth'
  - Whether or not any are indicating 'error'

CPAG: Monitor Key Control Parameters Using Available Instrumentation

Example: Torus Water Temperature

ERIS	PIS Number	Readout	Range	Power Supply Isometric	Other Limitations and Adjustments	Sensor Location	Transmitter Location	Environmental Limitations [1] Temp. Limit (°F)	Reading °F	Adjusted °F
PRIMARY										
PT#259	T50N404A	T50-R800A PT#11 H11-P601	0-400°F	(SD-2861-2B)		TORUS Temp. DIV I AZ 270^0	RB/Bsmnt Grid 270^0 El. 551'04"	365		
	T50N405A	T50-R800A PT#12 H11-P601	0-400°F	(SD-2861-2B)		TORUS Temp. DIV I AZ 0^0	RB/Bsmnt Grid 0^0 El. 551'04"	365		
	T50N405B	T50-R800B PT#12 H11-P602	0-400°F	(SD-2861-2A)		TORUS Temp. DIV II AZ 90^0	RB/Bsmnt Grid 90^0 El. 551'04"	365		
PT#111	T23N001	T23-R800 CH 1 H11-P601	0-100°F	(I-2860-9)		TORUS Wtr. Temp. AZ 22^0	DW Grid 22^0 El. 551'01"	365		
PT#112	T23N002	T23-R800 CH 2 H11-P601	0-100°F	(I-2860-9)		TORUS Wtr. Temp. AZ 67^0	DW Grid 67^0 El. 556'01"	365		
PT#112	T23N003	T23-R800 CH 3 H11-P601	0-100°F	(I-2860-9)		TORUS Wtr. Temp. AZ 112^0	DW Grid 112^0 El. 556'01"	365		
PT#4	T23N004	T23-R800 CH 4 H11-P601	0-100°F	(I-2860-9)		TORUS Wtr. Temp. AZ 157^0	DW Grid 157^0 El. 556'01"	365		
PT#115	T23N005	T23-R800 CH 5 H11-P601	0-100°F	(I-2860-9)		TORUS Wtr. Temp. AZ 202^0	DW Grid 202^0 El. 556'01"	365		
PT#116	T23N006	T23-R800 CH 6 H11-P601	0-100°F	(I-2860-9)		TORUS Wtr. Temp. AZ 247^0	DW Grid 247^0 El. 556'01"	365		
PT#117	T23N007	T23-R800 CH 7 H11-P601	0-100°F	(I-2860-9)		TORUS Wtr. Temp. AZ 292^0	DW Grid 292^0 El. 556'01"	365		
PT#118	T23N008	T23-R800 CH 8 H11-P601	0-100°F	(I-2860-9)		TORUS Wtr. Temp. AZ 337^0	DW Grid 337^0 El. 556'01"	365		
ALTERNATE										
	E11N004A	E11-R601A Red Pen H11-P601	0-400°F			RHR Ht. XGHR "A" Inlet Temp. DIV I		365		
	E11N004B	E11-R601B Red Pen H11-P602	0-400°F			RHR Ht. XGHR "B" Inlet Temp. DIV II		365		

Example: Torus Level Forecasting (Wide Range)



Example: Restrictions on RPV Water Level Indication

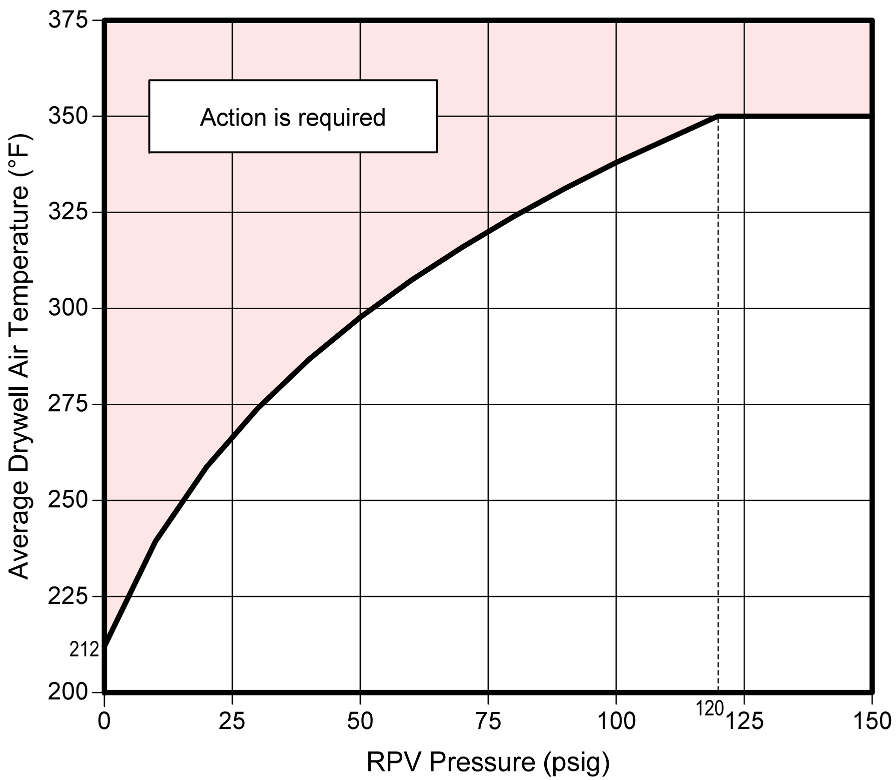
1

The following restrictions apply to RPV water level instruments:

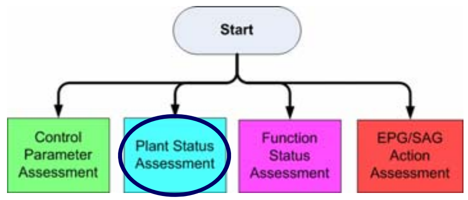
1. If drywell air temperature is above the RPV Saturation Temperature (Graph 1), water in the instrument legs may boil. If boiling is suspected:
   a. Subtract 23 inches from Fuel Zone and Narrow Range GEMAC indications.
   b. Do not use Floodup and Wide Range Yarway instruments.
2. Floodup and Wide Range instruments may not be used below the Minimum Indicated Level for the indicated drywell temperature.

Level Instrument	Temperature Instrument	Drywell Temp (°F)	MIL (in.)
Wide Range Yarway LI-4539 (+8 to +218 in.)	TR-4383A Channel 1 (red)	100-150 151-200 201-250 251-300 301-350 Upscale	+8 +12 +16 +20 +25 +48
Wide Range Yarway LI-4540 (+8 to +218 in.)	TR-4383B Channel 2 (green)		
Floodup Range LI-4541 (+158 to +458 in.)	TR-4383A Channel 1 (red)	100-150 151-200 201-250 251-300 301-350 Upscale	+168 +174 +181 +189 +199 +257

Graph 1: RPV Saturation Temperature



Plant Status Assessment

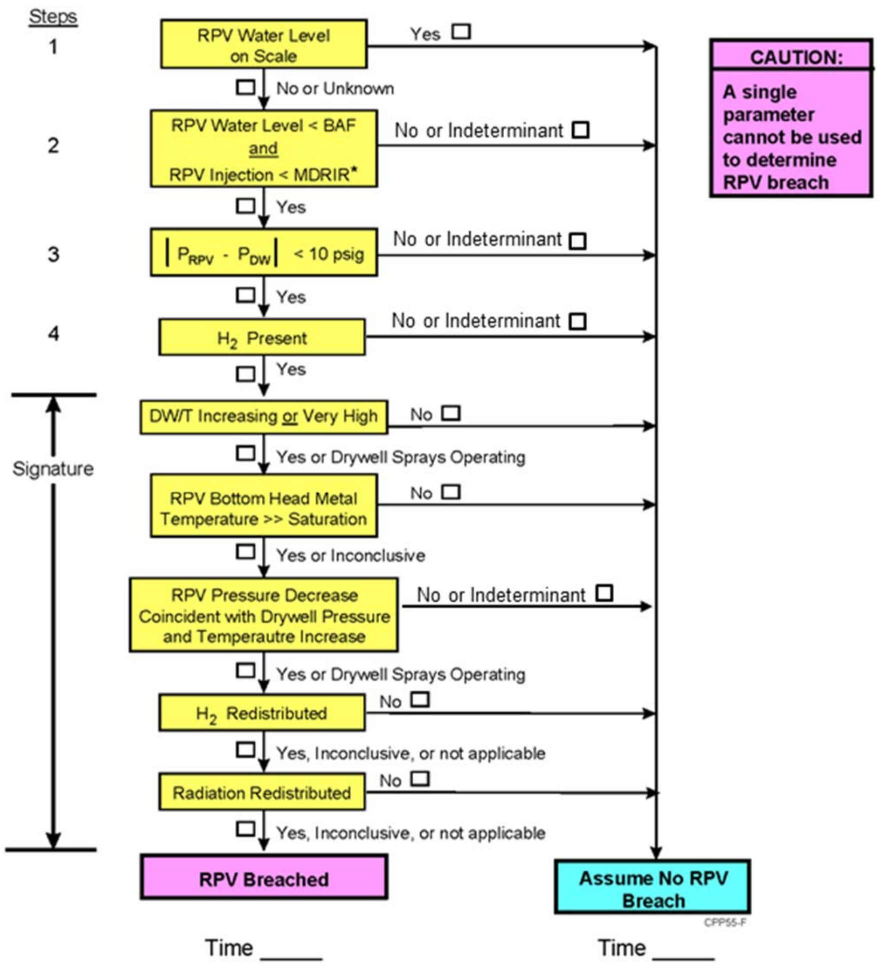


Purpose of Plant Status Assessment (PSA) is to:

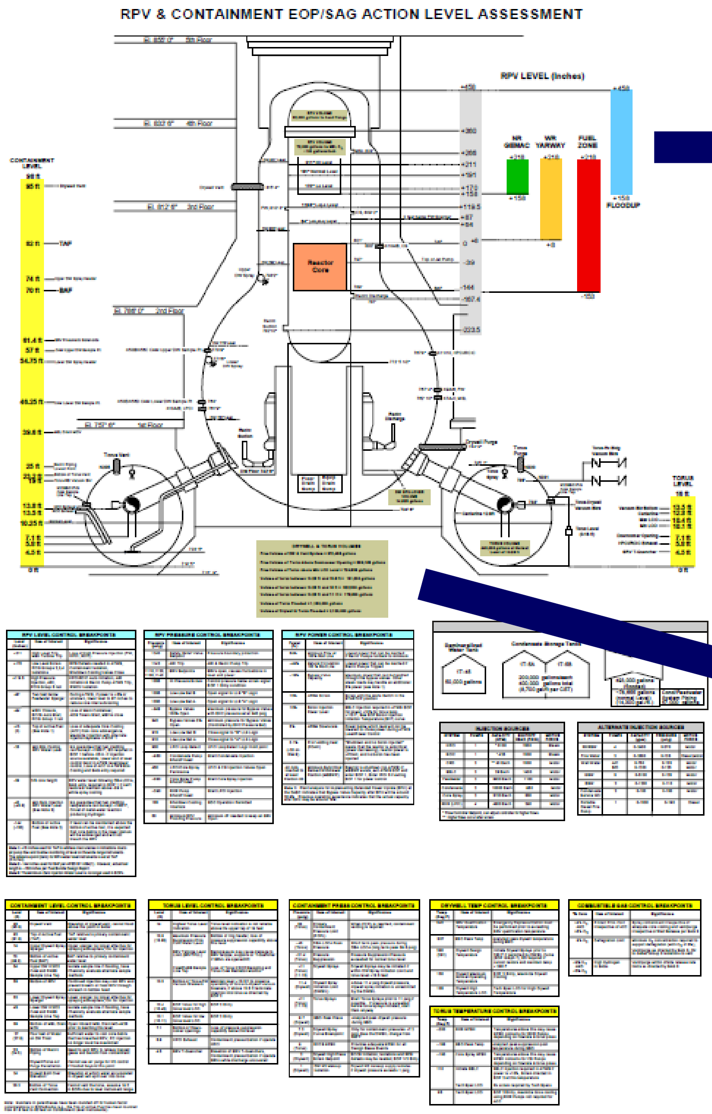
- Forecast future values of EOP/SAG control parameters
  - Linear extrapolation of past values of the parameter
  - Calculation based on past values of the parameter or related parameters
- Specify the current state of the plant with respect to certain conditions = Identifying plant conditions
  - Status of plant parameters used to determine the condition of the core, RPV and containment
  - Some plant conditions are difficult to determine and require simultaneous comparison of several parameters and coincident parameter changes
    - ➢ RPV breach by core debris
    - ➢ Primary Containment Integrity Impairment

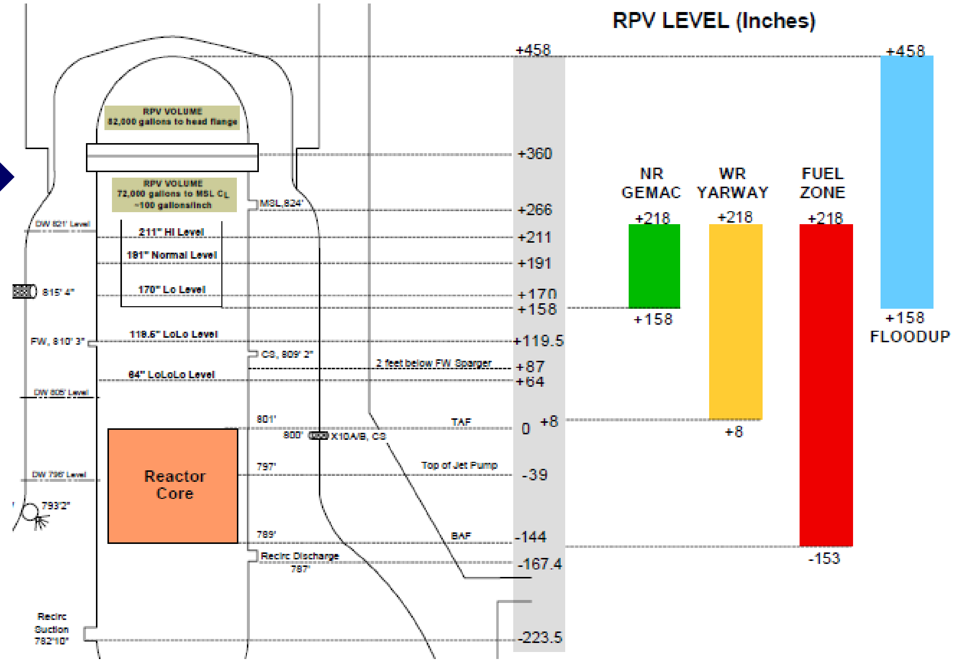
Critical Decision-Making In Plant Status Assessment

RPV Breach Signature



Plant Status Assessment Tools





DRYWELL & TORUS VOLUMES

Free Volume of DW & Vent System = 972,465 gallons

Free Volume of Torus Above Downcomer Opening = 899,156 gallons

Free Volume of Torus above Min LCO Level = 724,636 gallons

Volume of torus between 10.25 ft and 13.5 ft = 191,200 gallons

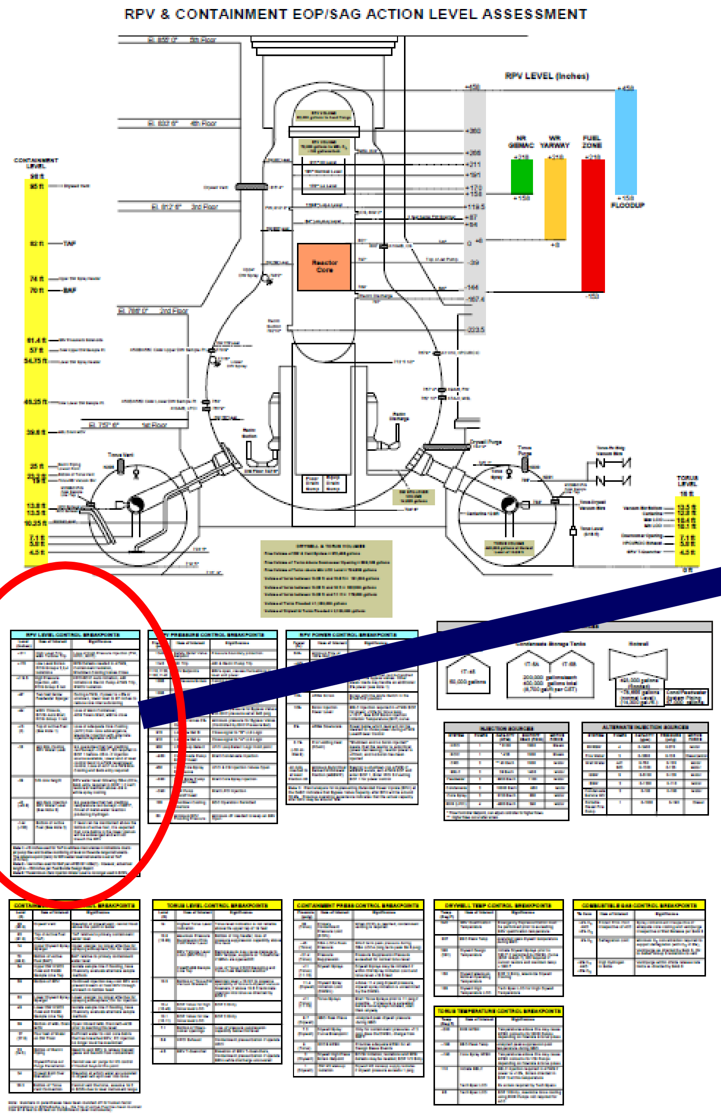
Volume of torus between 10.25 ft and 16 ft = 322,300 gallons

Volume of torus between 10.25 ft and 7.1 ft = 175,500 gallons

Volume of Torus Flooded = 1,150,000 gallons

Volume of Drywell & Torus Flooded = 2,120,000 gallons

Plant Status Assessment Tools



RPV LEVEL CONTROL BREAKPOINTS		
Level (Inches)	**Item of Interest**	**Significance**
+211	High Level Trip, Main Turbine Trip	Loss of High Pressure Injection (FW, HPCI, RCIC)
+170	Low Level Scram PCIS Groups 2,3,4 Isolations	RPS Defeats needed in ATWS, Containment Isolation, Shutdown Cooling Valves Close
+119.5	High Pressure Injection, ARI, PCIS Group 5 Isol	HPCI/RCIC Auto Initiation, ARI Initiation & Recirc Pump ATWS Trip, RWCU Isolation
+87	Two feet below Feedwater Sparger	During ATWS, if power is >5% or unknown, lower level to 87 inches to reduce core inlet subcooling
+64	MSIV Closure, ECCS Auto Start, PCIS Group 1 Isol	Loss of Main Condenser, ADS Timers Start, MSIVs close
+15 (0)	Top of Active Fuel (See Note 1)	Loss of Adequate Core Cooling (ACC) from core submergence, Maximize Injection with Alternate Injection Systems in EOP 1
-25	Min Stm Cooling RPV Water Level	No guarantee that fuel cladding can be kept <1500 F, ED required in EOP 1 before -25 in. if injection source available, Lower end of level control band in ATWS level/power control, Loss of ACC in ATWS Stm Cooling and SAG entry required
-39	2/3 core height	RPV water level following DBA LOCA, SAG entry required in EOP 1 if can't restore & maintain above -39 in. while spray cooling
-40 (-43.8)	Min Zero Injection RPV Water Level (See Note 3)	No guarantee that fuel cladding temperature can be kept <1800 F, Onset of metal-water reaction producing Hydrogen
-144 (-150)	Bottom of Active Fuel (See Note 2)	If level can be maintained above the bottom of active fuel, it is expected that core debris in the lower plenum will be submerged and will not breach the RPV

Plant Status Assessment Tools

CUMULATIVE TIME TO FLOOD CONTAINMENT TO VARIOUS HEIGHTS

Item	Height		Cumulative Time to Flood from Normal Level (minutes)			
Physical Feature	Elevation	Distance Above Torus Bottom	1000 gpm	2000 gpm	4000 gpm	6000 gpm
Normal Water Level	729'8"	10'3"	0	0	0	0
Vacuum Breakers	733'	13'5"	195.7	97.9	48.9	32.6
Vent Lines Full	744'1"	24'8"	259.8	129.9	64.9	43.3
Drywell Sphere Equator	766'	46'7"	612.7	306.4	153.1	102.1
Bottom of RPV	772'5"	53'	721.5	360.8	180.3	120.2
Upper Drywell Spray	793'	74'	1048.5	524.3	262.0	174.7
TAF	801'	82'	1084.9	542.5	271.1	180.8
Drywell Vent	815'4"	95'	1151.5	575.8	287.8	191.9

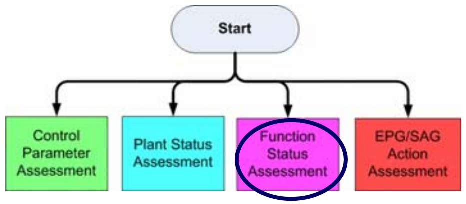
Plant Status Assessment Tools

MINIMUM TIMES TO RPV BREACH

Accident Type	Approximate Time (Min.)	
	TAF to Breach	1/3 Core Height to Breach
Large LOCA with loss of make-up (LII-3C1)	40	40
Low pressure transient with loss of make-up (LII-1D1) (with ADS at TAF)	78	75
High Pressure Transient with loss of make-up (LII-1A1)(1) (No Depressurization)	160(1)	138(1)
High Pressure transient with loss of makeup (LII-1A2C)(2)	93(2)	72(2)
Loss of Makeup event initiated from High Pressure with SORV occurring when RPV level is below TAF (LII-1A4SRV)	102	84

NOTE: No injection to the RPV and no drywell sprays are operating in the above evaluations. Operation of either would result in increasing the observed time to RPV breach. In addition, other core melt progression models predict longer times to RPV breach by hours.

Function (System) Status Assessment



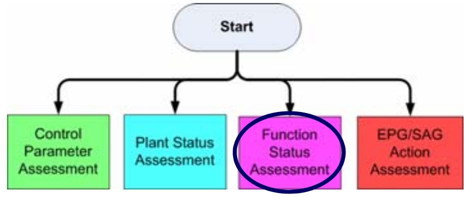
Purpose:

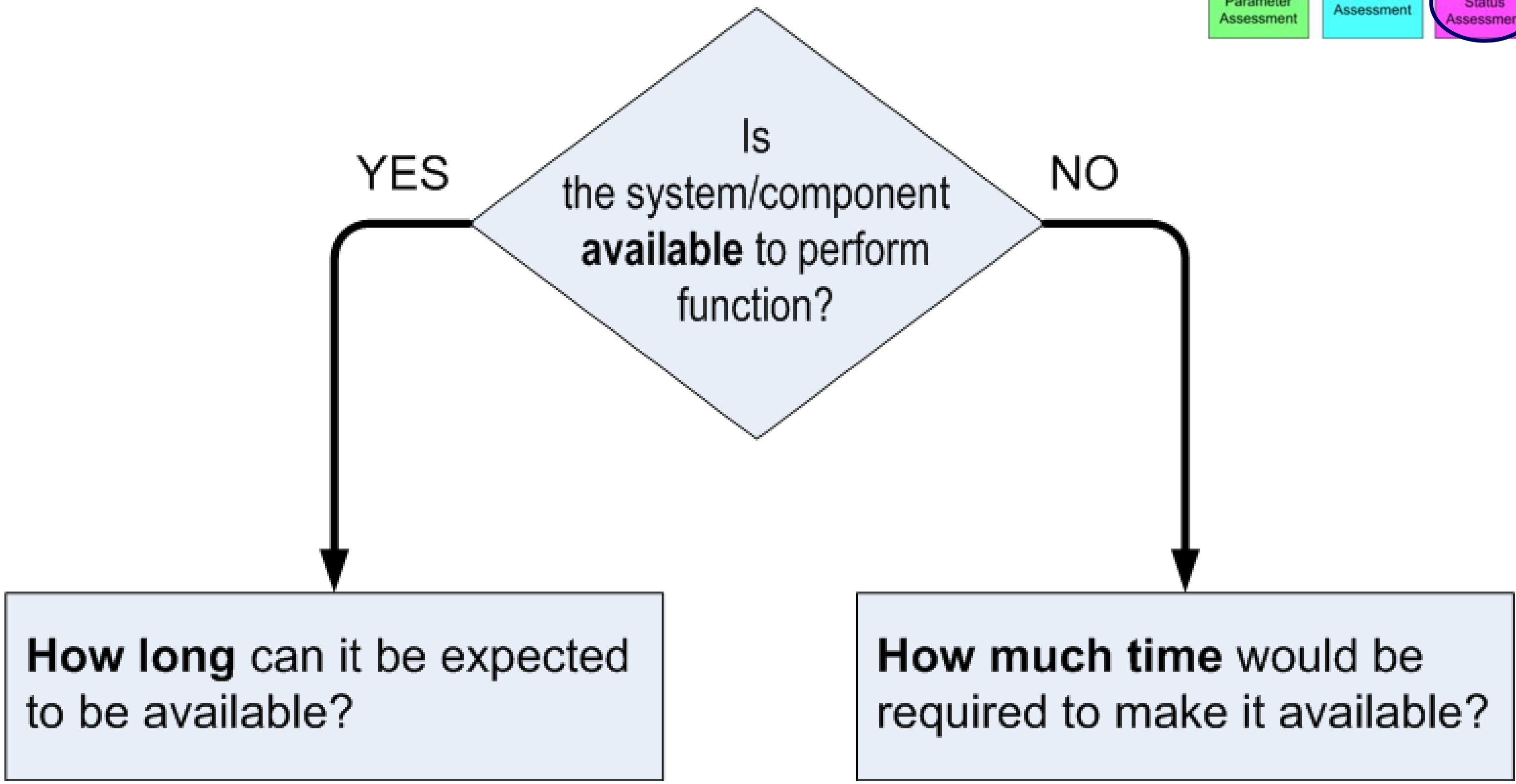
- Evaluate the availability of systems/ components needed to implement EOPs/SAGs

Applies to:

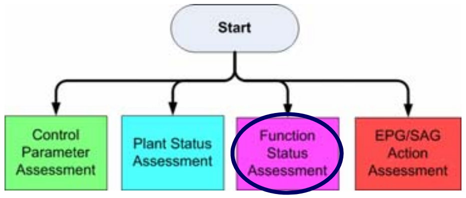
- Systems/components identified in EOPs/SAGs
- Any support systems required by the identified systems/components

Function (System) Status Assessment





Function (System) Status Assessment



FSA involves knowing the following:

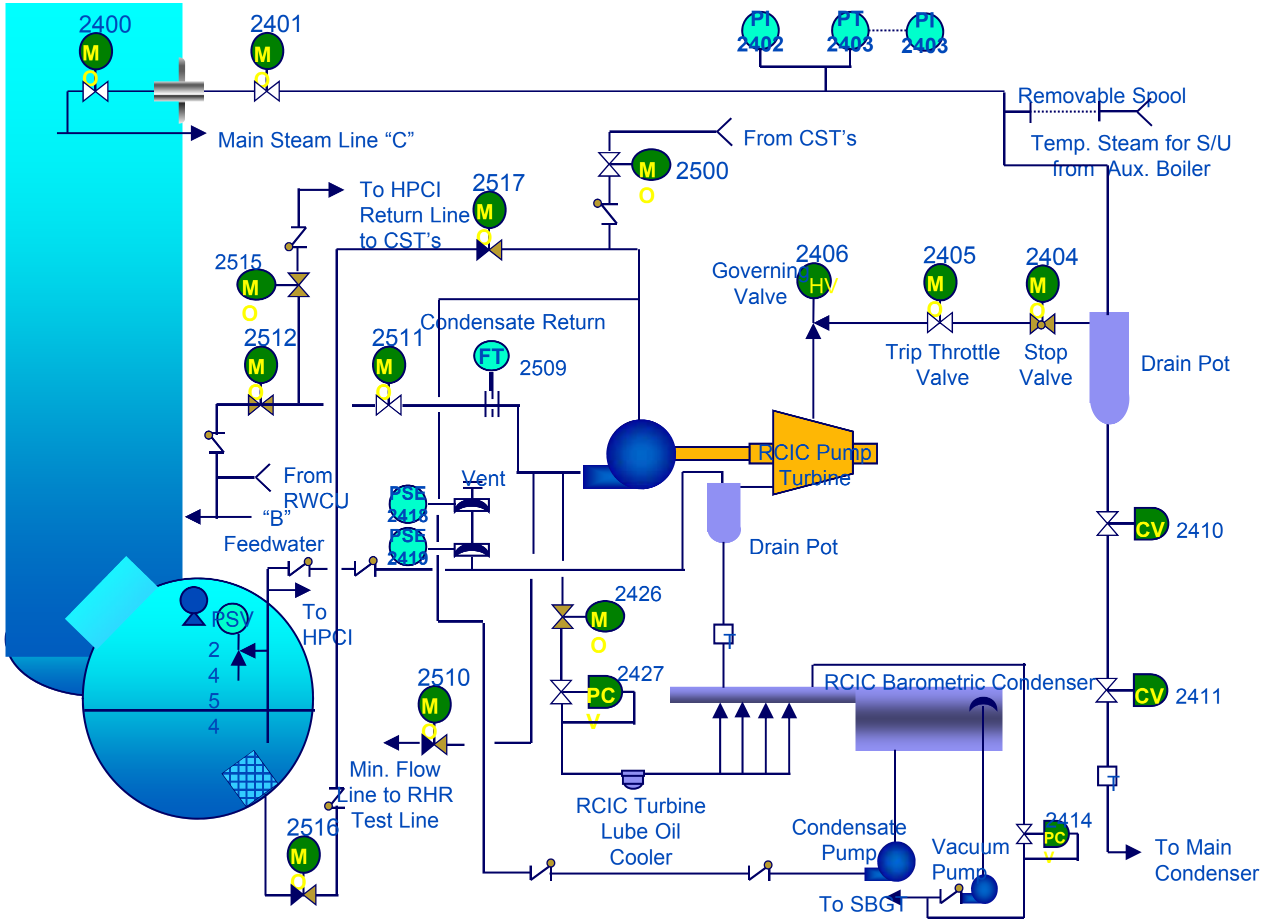
- Component location
- Power availability
- System lineup
- Support systems (cooling water, pneumatics, etc.)
- Motive force (steam, air, etc.)
- Environmental qualifications
- Interlocks
- Possible damage

Function (System) Status Assessment

SYSTEM DEPENDENCY MATRIX

Support System	Reactivity Control			High Pressure Coolant Makeup				RPV Depressurization		Low Pressure Coolant Makeup						Containment Pressure/ Temperature Control			
	RPS	RPT	SLC	Feed-water	HPCI	RCIC	CRD	ADS/SRV Logic	SRVs	Cond.	LPCI	CS	RHRSW	ESW	GSW	MSIV Remain Open	Main Condenser	Torus Cooling	Torus Venting
	A B	A B	A B	A B			A B	A B	A B	A B	A B	A B	A B	A B	A B C			A B	
125 VDC Panel 1D13		X(20)				X(31)	P(21)	P	P B		P(12)	P(12)	P(12)	P(12)		P(28)	P(28)	P(12)	
125 VDC Panel 1D14						X													
125 VDC Panel 1D21				P(18)	P(30)					P(18)		P(12)					P(8)		X(7)
125 VDC Panel 1D23		X(20)			X		P(21)	B P	B P		P(12)	P(12)	P(12)	P(12)	P(12)	P(28)	P(28)	P(12)	
250 VDC MCC 1D41					X														
GSW				X(17)			X(22)			X(17)					X X X	D(26)	P(37)		
RBCCW							X(22)												
ESW (A)					P(3)(6)	P(3)(6)					(14)(16)	X(13)(14)	X(13)					(16)	
ESW (B)					P(3)(6)	P(3)(6)					(14)(16)	(13)(14)X	X(13)					(16)	
RHRSW (A)													X					X(24)	
RHRSW (B)													X					X(24)	
Stilling Basin													X(15)	X(15)					
River Water				(36)						(36)			X(15)	X(15)	P(35)		P(34)		
Well Water				(36)						(36)					P(35)		P(34)		
Keep Full Pump					(25)	(25)					(25)	(25)						(25)	

RCIC Response to Loss of Control Power



***INPO IER 13-10 Rec. 4 (WANO SOER 2013-02 Rec. 4)** - Verify that training programs prepare licensed operators and selected emergency response personnel to anticipate, recognize, and respond to core cooling system isolations that may occur during an event.*

RCIC Response to Loss of Control Power

Table X.1.3-1

RCIC SYSTEM RESPONSE TO CONTROL LOGIC FAILURES

System	Initial Configuration	Control Logic Power Supply	Resulting Condition	Guidance for Restoration / Operation
RCIC	Standby Readiness	Control Logic 'A' 1D13, Circuit 17	• No auto-initiation at lo-lo RPV water level • No high RPV water level trip • No remote trip capability with pushbutton at 1C04 • No auto-isolation of MO-2401 [1]	OI150 for manual operation
		Control Logic 'B' 1D23, Circuit 07	• No high level trip • No auto-isolation of MO-2400	OI150 for manual operation (if required)
		Control Logic 'A' & 'B' 1D13, Circuit 17 1D23, Circuit 07	• No auto-initiation at lo-lo RPV water level • No high RPV water level trip • No remote trip capability with pushbutton at 1C04 • No auto-isolation capability • No auto-isolation for RCIC steam line (MO-2400 and MO-2401) [1]	OI150 for manual operation
	Injecting	Control Logic 'A' 1D13, Circuit 17	• No auto-initiation at lo-lo RPV water level • No high RPV water level trip • No remote trip capability with pushbutton at 1C04 • No auto-isolation of MO-2401 [1]	OI150 for manual operation
		Control Logic 'B' 1D23, Circuit 07	• No auto-initiation at lo-lo RPV water level • No auto-isolation of MO-2400	OI150 for manual operation (if required)
		Control Logic 'A' & 'B' 1D13, Circuit 17 1D23, Circuit 07	• No auto-initiation at lo-lo RPV water level • No high RPV water level trip • No remote trip capability with pushbutton at 1C04 • No auto-isolation capability • No auto-isolation for RCIC steam line (MO-2400 and MO-2401) [1]	OI150 for manual operation

NOTES TO TABLE 3.4-1:

(1) With DC supplied motive power available to MO-2401, Outboard Steam Line Isolation, RCIC steam line can be manually isolated from the Control Room.

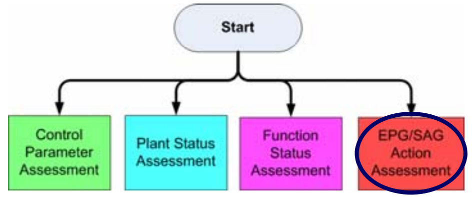
Actions to Prolong RCIC Operation Under ELAP Conditions: Example of Pinch Points

RCIC Critical "Pinch Point"	Accident Management Actions
Maintain DC Power	• Perform DC load shed • Install portable generator • Recover AC power (offsite/EDG) • Cross tie TSC EDG
Maintain Adequate Lube Oil Cooling via the Working Fluid	• Prefer CST as the suction source (see Attachment YA) • Replenish CST if necessary • Cool torus • Anticipatory vent to minimize the maximum torus temperature
Maintain Adequate RPV Pressure	• Maintain adequate steam pressure band when depending on RCIC for adequate core cooling
Maintain High Turbine Speed	• Maintain high RPMs on turbine to ensure adequate lubrication if high temperature water source is being used. (>3500 RPM at suction temperatures >200°F)
Maintain Adequate NPSH	• Control torus water level • Make up for vented non-condensables with non-combustibles • Minimize torus temperature increase

Accident Mgmt Actions to Prolong RCIC Operation Under ELAP Conditions: Example of Pinch Points

RCIC Critical "Pinch Point"	Accident Management Actions
Ensure Adequate Room Cooling and Prevent High Room Temperature Trips	• Open door on the RCIC room • Provide portable gas powered fan • Bypass high room temperature trips
Prevent High Steam Line Temperature Trip	• Insert temperature isolation interlock override
Prevent RCIC Room Flooding	• ARP 1C14A<A-4> and, <B-4> (above max safe, above max normal, respectively) direct monitoring and refer operators to EOP-3. • EOP-3 to verify that all available sump pumps are operating to lower water level. • There is no installed equipment that could be used to limit flooding or arrest the rate of water level rise besides the sump pump.
Prevent High Turbine Exhaust Pressure Trip	• Provide a set point change that permanently increases the high pressure trip to ~100 psig as recommended by GEH
Implement Authorized Bypasses of RCIC Protective Isolations and Trips	• Bypass the high RPV water level trip (Defeat 8)(1) • Bypass the low RPV pressure isolation (Defeat 1) • Bypass the high room temperature isolation

EOP/SAG Action Assessment



Purpose:

- **Determine priority for returning systems to service**
  - What systems are needed to perform EOP/SAG functions?
  - How can resources be applied to ensure needed systems are available? (…and thus be successful in performing EOP/SAG functions)
- **Identify timing for actions directed by the EOPs/SAGs**
  - When to start performing actions?
  - How long to perform them?

Key Areas of EOP/SAG Action Assessment Guidelines

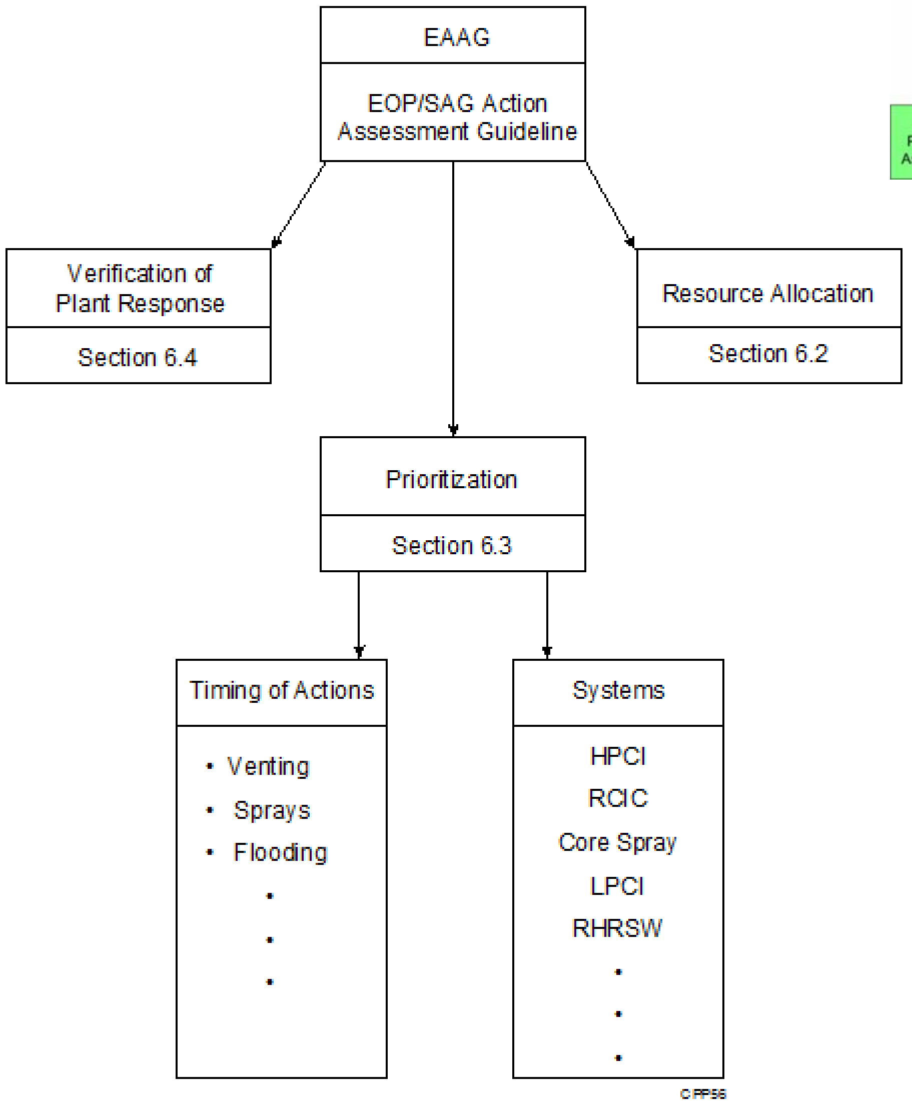
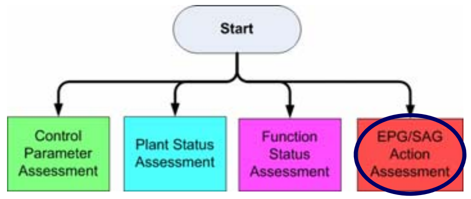
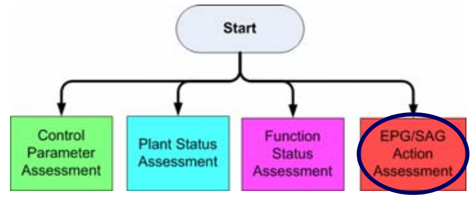
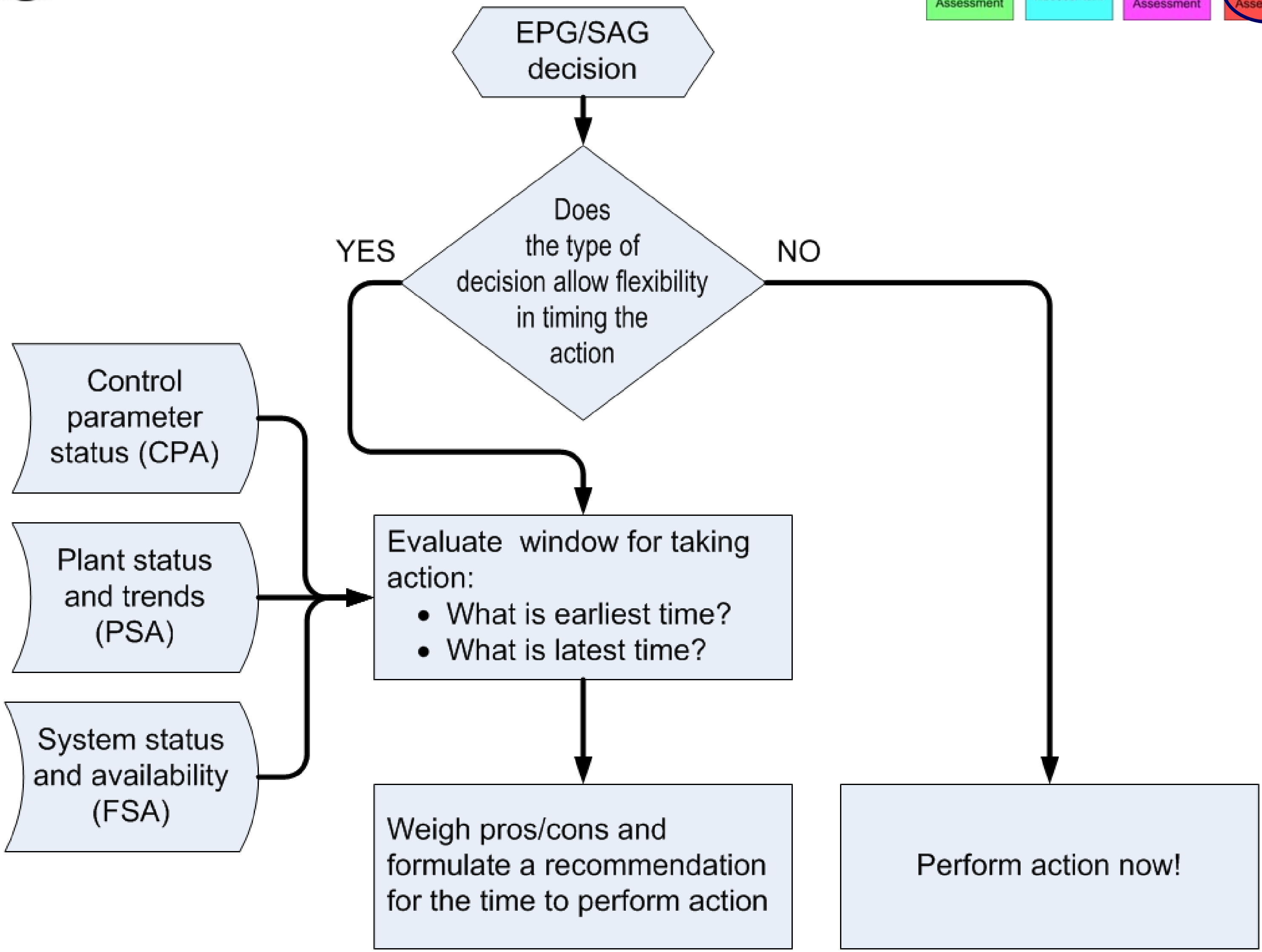


Figure 6.0-1 Key Areas of Expertise Available from the EOP Action Assessment Guideline



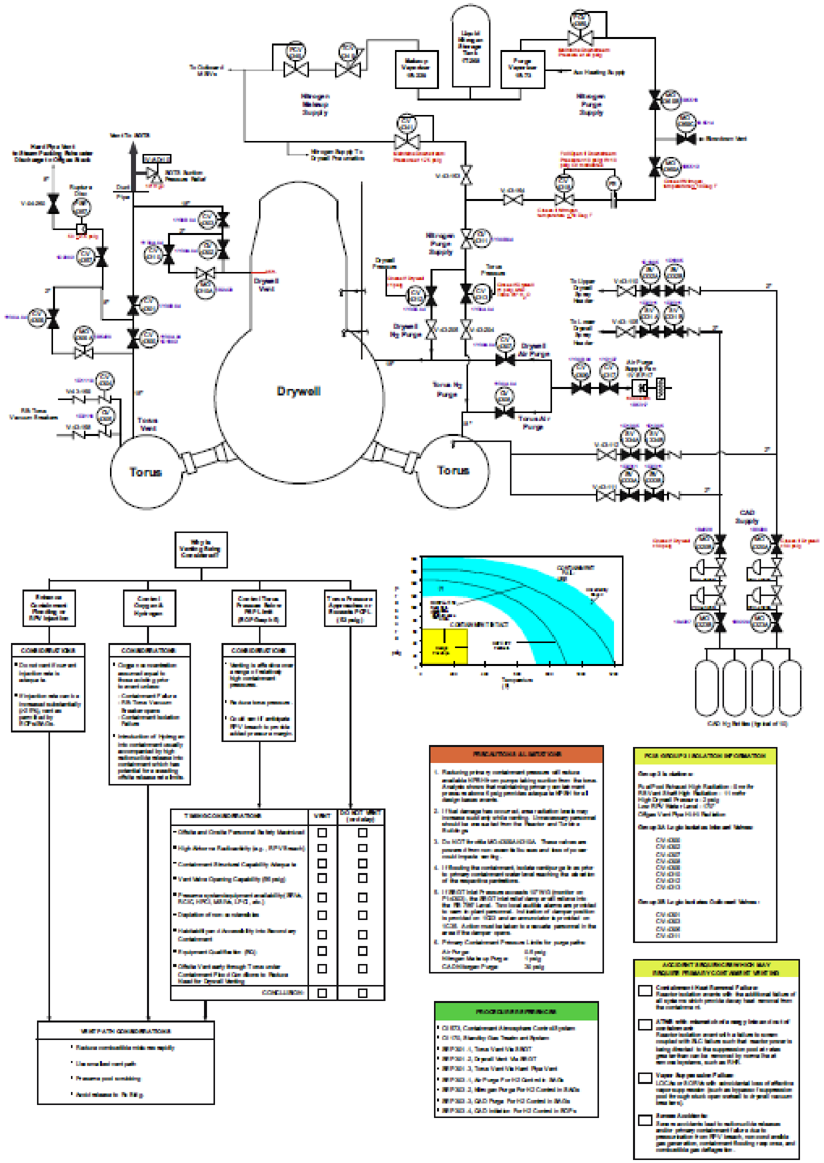
Timing of Actions





EOP/SAG Action Assessment

PRIMARY CONTAINMENT VENT/PURGE ASSESSMENT



Why is Venting Being Considered?

Enhance Containment Flooding or RPV Injection

CONSIDERATIONS

- If current injection is adequate **DO NOT VENT** only to enhance injection.
- If either RPV or containment injection is not adequate and will be increased by more than 25% **VENT**

Control of Oxygen/ Hydrogen

CONSIDERATIONS

- O_2 concentrations assumed equal to those existing prior to event unless:
  - Containment Failure
  - Rx Bldg. to Torus Vacuum Breaker open
  - Containment isolation failure
  - Break in instrument air line
- Introduction of Hydrogen into containment usually accompanied by high radionuclide release into containment under severe accident conditions and potential for exceeding release limits.

Control Torus Pressure below PSP

CONSIDERATIONS

- Venting is effective over a range of relatively high containment pressures
- Reduce Torus Pressure
- Could be used to anticipate RPV breach and provide added margin

Torus Pressure Approaches or Exceeds PCPL

TIMING CONSIDERATIONS	VENT	NO VENT (or delay)
Off-site and On-site Personnel Safety Maximized	☐	☐
High Airborne Radioactivity (e.g., RPV Breach)	☐	☐
Containment Structural Capability Adequate	☐	☐
Containment Vent Valve Capability Adequate	☐	☐
Preserve System Operability	☐	☐
Depletion of Non-condensibles	☐	☐
Habitability and Accessibility, and Equipment Operability Adverse Impact	☐	☐
Vent early through Torus Under Containment Flood Conditions to Reduce Need for Drywell Vent	☐	☐
CONCLUSION*	☐	☐

***Additional considerations included in pro/con table if time permits**

DESIRABLE FEATURES OF PATHWAY

• Use Smallest Path • Preserve Pool Scrubbing • Avoid Release to Reactor Bldg.	• Reduce Combustible Mixture Rapidly • Use Smallest Path • Preserve Pool Scrubbing • Avoid Release to Reactor Building	• Use Smallest Path • Preserve Pool Scrubbing • Avoid Release to Reactor Bldg.

TIME = ____________

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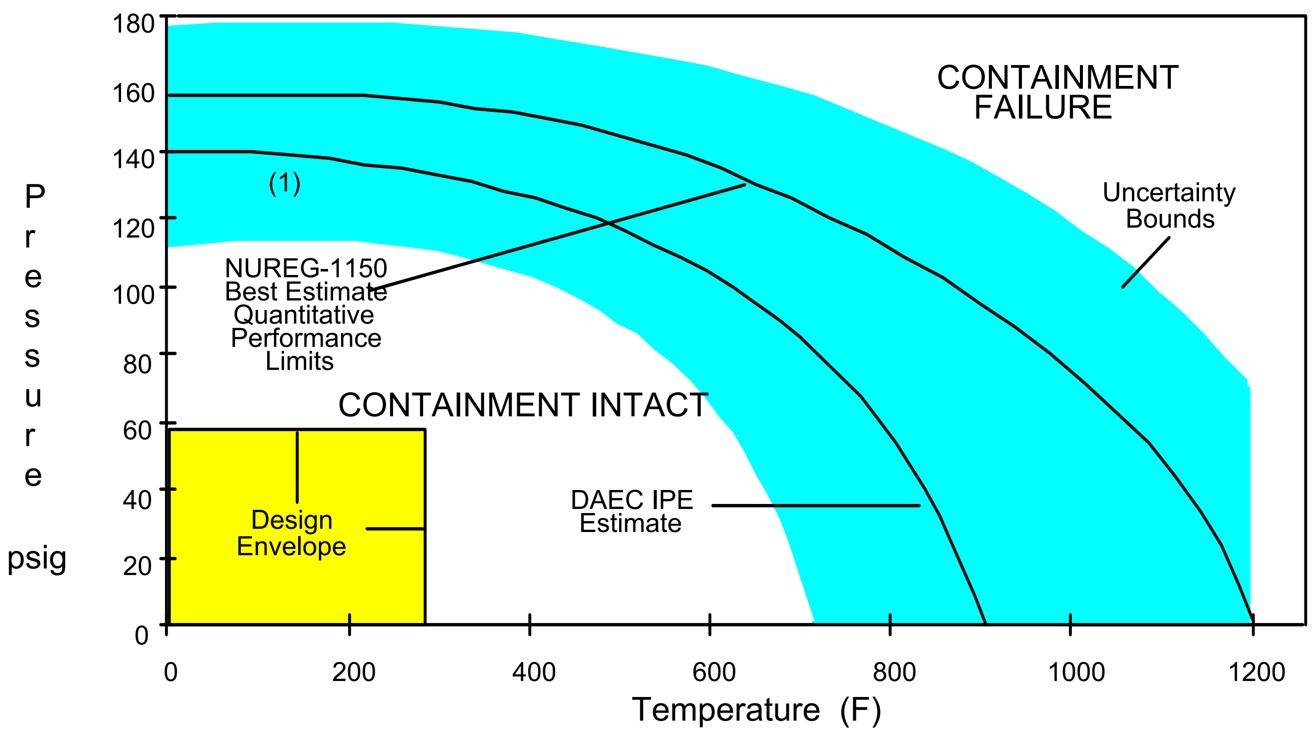
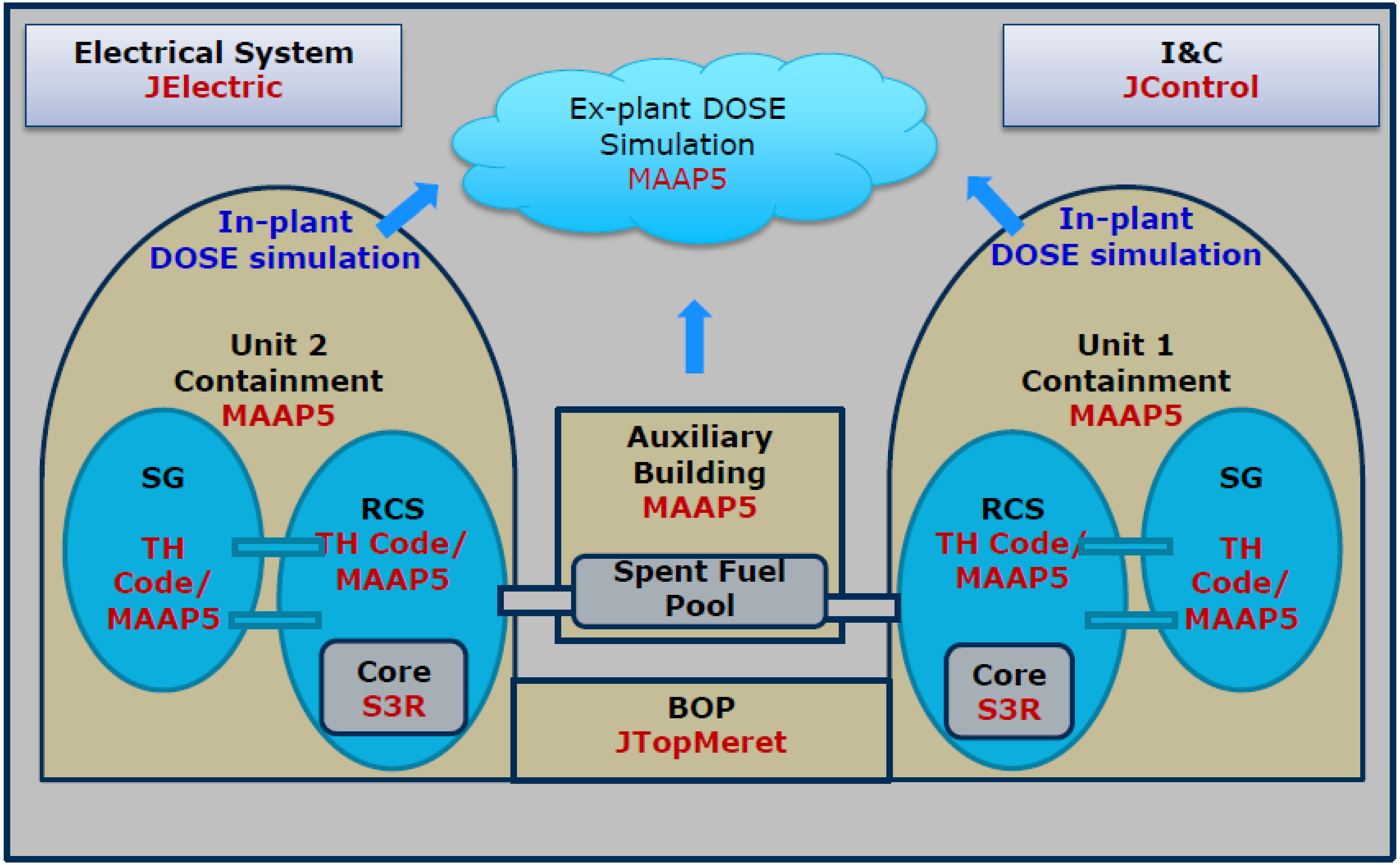
EOP/SAG Action Assessment

Containment Venting Considerations

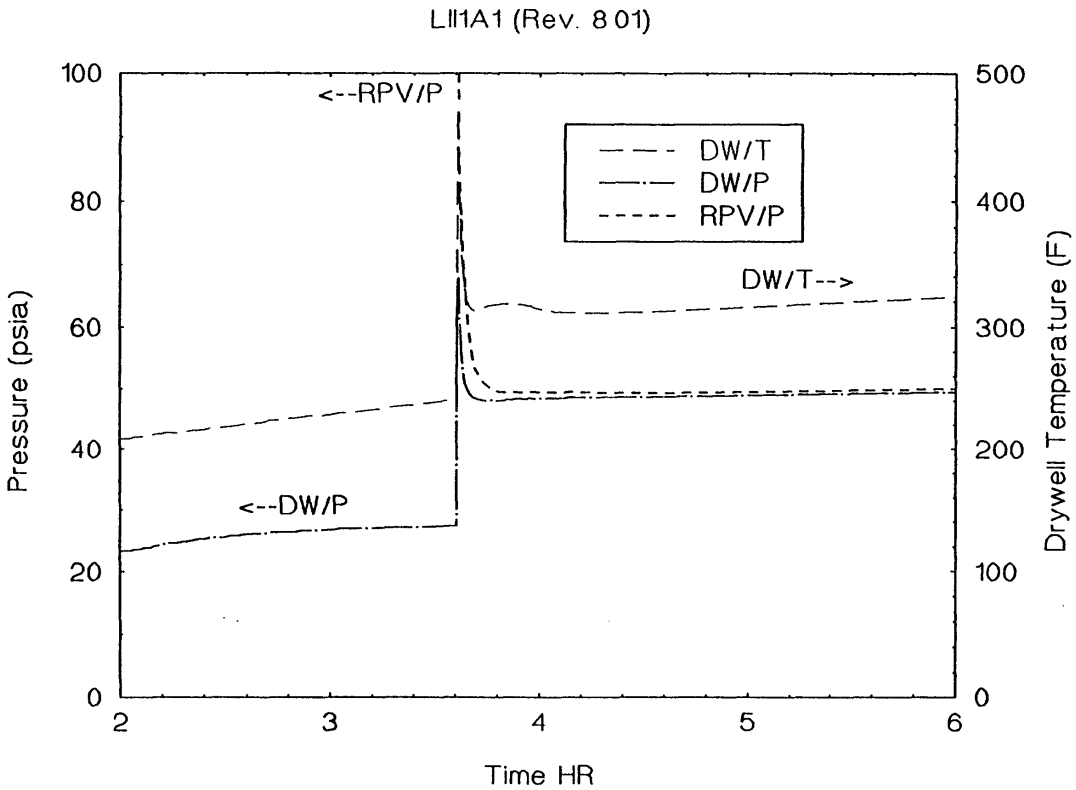


EOP/SAG Action Assessment Using MAAP Models



EOP/SAG Action Assessment Using MAAP Models

High Pressure Transient with loss of make-up (LII-1A1)
(No Depressurization)

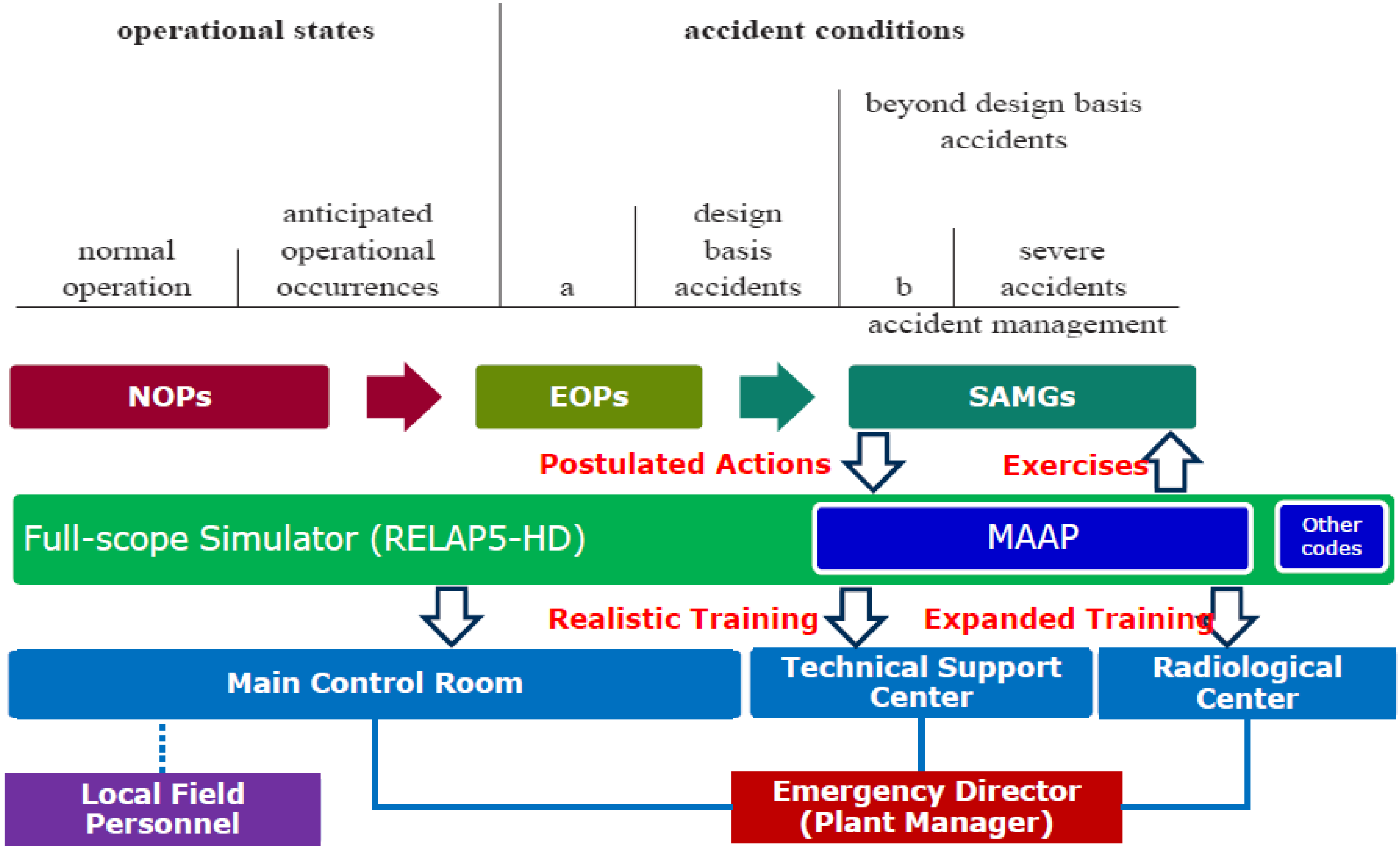


These deterministic calculations are for accidents with:

- 100% Initial Power
- Scram Success
- No Injection after Scram
- NO DW Sprays
- No Containment Flooding

MAAP my be used to identify the accident sequence and provide insights on timing of actions.

EOP/SAG Action Assessment Using MAAP Models



Using MAAP with desk-top and full-scope simulators is very useful for training and can provide insights on the timing of actions

Conclusion

- Lessons-learned from the event at Fukushima illustrate the need for tools for Accident Assessment Team Members that are:
  - Fully developed to the extent practical
  - Attune to current understanding of accidents
  - In line with and support sound decision making
  - Will working conditions during an accident be amenable to accurate and timely decision making?
- Severe accident conditions do not lend to simple, easy to understand instrument readings
- While operators have much training, they do little training on SAM
- Engineers who support operations do not have same degree of training and have little training on SAM

Voices from the Field – a Reminder of our Call to Action

"At that time, I was conjuring up faces of fellow colleagues who would die with me." (Masao Yoshida, Site Superintendent)

"I was determined to stay behind to my death; however I was resolved to send my men back home alive." (Ikuo Izawa, Shift Manager)

"Let me go and vent the containment. I know where the valve is and I can run fast. Let me protect the unit that I love." (Kazuhiro Yoshida, Deputy Shift Manager)

"On the Brink: The Inside Story of Fukushima Daiichi"

"Book reveals human drama in Fukushima No. 1 crisis" The Japan Times 12/11/2012

http://amzn.com/4902075547

http://www.japantimes.co.jp/news/2012/12/11/national/book-

BWR Owners Group (BWROG)

TSG Workshops

Contact for participation in Training:

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What Will the Workshop Be?

Workshop will consist of the following:

- Introduction to Severe Accident Management (SAM)
- Phenomenology of Severe Accidents
- Review of Technical Support Guidelines from EPG/SAG R3 Workshop
- Case studies of 1F1, 1F2, and 1F3 using simple flowcharts and spreadsheets
- TEPCO discussion of findings since the accidents
- Key plant features which influence event progression

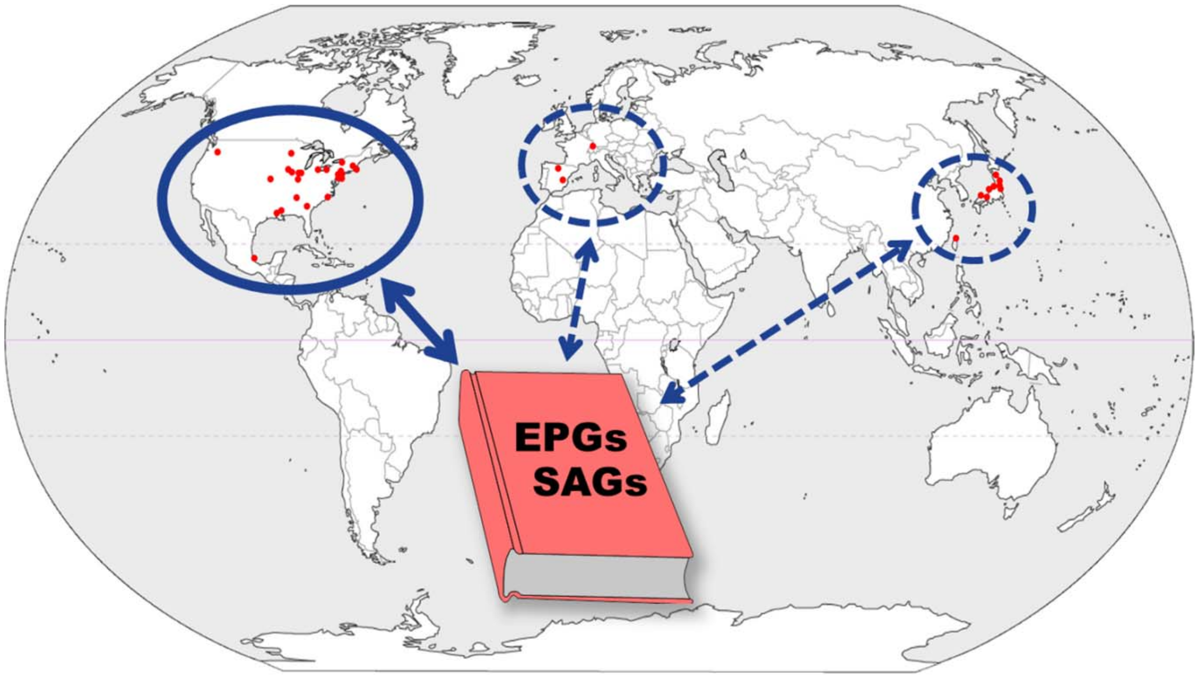
TSG Skill Set Workshop is planned to be held at the request of International members:

- Tokyo, Japan
- Taipei, Taiwan
- Vera Cruz, Mexico
- Europe (Madrid or Bad Zurzach)
- Multiple locations in the United States

Where Will the Workshop Be? (cont.)

Initial TSG Skill Set Workshop 2015 schedule:

- **September 22-25: Taipei, Taiwan**
- **September 28 – October 1: Tokyo, Japan**



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