

Facility: ANO-2		Scenario No.: 2		Op-Test No.: 2000-1	
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Examiners:				Operators:	
<b>Objectives:</b> Evaluate AOP usage for pressurizer pressure transmitter failure and steam generator pressure transmitter failure. Evaluate AOP usage for RCP seal failures requiring plant shutdown and reactor trip. Evaluate EOP usage for Loss of Coolant Accident when vapor seal fails.					
<b>Initial Conditions:</b> 100%, MOL, All ESF systems in standby.					
<b>Turnover:</b> Maintain 100% power. Maintenance scheduled to clean service water pump strainers later in shift.					
Event No.	Malf. No.	Event Type*	Event Description		
1 T = 0	XRCCHAPLVL	I (CBOR)	Control Channel "A" pressurizer level fails low.		
2 T = 10	XSG2PT10411	I (CBOT)	Channel A SG pressure fails low.		
3 T = 20	RCP2P32BLOW RCP2P32BMID RCO2P32BUPP	C (CBOR) R (CBOR) N (ALL)	RCP seal failures requiring a plant shutdown and leading to manual reactor trip when third seal fails.		
4 T = 25	RCSLOCATCB	M (ALL)	Loss of coolant accident after reactor trip due to vapor seal leakage.		
5 T = 30	HPI2P89AFAL ESFK110A (New Malf)	C (CBOT)	A HPSI pump fails to auto start due to faulty ESF relay K110A. This relay failure also prevents CNTMT air sample valves 2SV-8273-1 and 8233-1 from auto closing.		
6 T = 30	416_2A406 (Remote)	C (CBOT)	B HPSI pump fails due to breaker fault.		

\* (N)ormal, (R)eactivity, (I)nstrument, (C)omponent, (M)ajor

**Simulator Instructions for Scenario 2**

PZR level control HS-4628 in Channel A.

Event No.	Malf. No.	Value/ Ramp Time	Event Description
1	XRCCHAPLVL Trigger = T1	0	Control Channel "A" pressurizer level fails low.
2	XSG2PT10411 Trigger = T3	0	Steam Generator pressure instrument fails low.
3	RCP2P32BLOW RCP2P32BMID RCO2P32BUPP Trigger = T4	True 3 min TD 12 min TD	RCP seal failures requiring a plant shutdown and leading to manual reactor trip when third seal fails.
4	RCSLOCATCB Trigger = T2	400 gpm	Loss of coolant accident after reactor trip due to vapor seal leakage.
5	HPI2P89AFAL ESFK110A Trigger = T2	True True	A HPSI pump fails to auto start due to faulty ESF relay K110A. This relay failure also prevents CNTMT air sample valves 2SV-8273-1 and 8233-1 from auto closing.
6	416_2A406 (Remote) Trigger = T2	True	B HPSI pump fails due to breaker fault.

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Event Description: Channel A pressurizer level control channel 2LT-4627-1 fails low.		
Time	Position	Applicant's Actions or Behavior
	CBOR	<p>Announce alarms 2K10-G6 CNTRL CH 1 LEVEL LO. 2K10-F6 CNTRL CH 1 LEVEL LO LO.</p> <p>Report 2LI-4627-2 and 2LR-4625 indicate normal.</p> <p>Report backup charging pumps started.</p>
	CRS	Refer to PZR Systems Malfunctions AOP 2203.028 and direct board operators actions.
	CBOR	<p>Determine PZR level Channel A failed.</p> <p>Place Letdown Flow controller (2HIC-4817) in MANUAL.</p> <p>Place PZR Level Channel Select switch (2HS-4628) to Channel B.</p> <p>Place PZR Low Low Level Cutoff select switch (2HS-4642) to Channel B.</p> <p>Verify PZR heaters and Normal Spray maintaining RCS pressure 2025 to 2275 psia.</p> <p>Adjust letdown to match automatic and manual signals and place letdown flow controller in AUTO.</p>
	CRS	Inform SS to refer to <b>TS 3.3.3.5</b> Remote Shutdown Instrumentation and <b>3.3.3.6</b> Post Accident Instrumentation.
Termination criteria: Unaffected PZR level channel selected and letdown in automatic or at examiners discretion.		

Event Description: Steam generator pressure transmitter 2PT-1041-1 fails low, faulty instrument must be identified and affected PPS channels placed in bypass.

Time	Position	Applicant's Actions or Behavior
	CBOR	Announce annunciators: 2K04-A4 CH A RPS/ESF/PRETRIP/TRIP 2K04-E4 MSIS pretrip
	CRS	Implement Annunciator Corrective Action AOP 2203.012D.
	CBOR	Report A SG pressure low pretrip and trip.
	CBOT	Compare all four channels and report 2PI-1041-1 indicates 0 psia.
	CRS	Refer to <b>Tech Spec 3.3.1.1, 3.3.2.1, and 3.3.3.5.</b>
	CBOT	Place the following channels in bypass on Channel A: A SG pressure low - RPS (Bistable 11) A SG $\Delta$ P - EFAS 1 (Bistable 19) B SG $\Delta$ P - EFAS 2 (Bistable 20)
	CBOR	Verify annunciator 2K04-C3 PPS CHANNEL BYPASSED Verify correct channels in bypass.
	CRS	Contact maintenance/PS liaison.
Termination Criteria: Affected channels bypassed or at examiners discretion.		

Event Description: Reactor Coolant Pump 2P32B seal failures.

Time	Position	Applicant's Actions or Behavior
	CBOR	Announce alarm 2K11-G3 RCP BLEEDOFF FLOW HI/LO. Report lower seal failure.
	CRS	Refer to RCP Emergencies AOP 2203.025 and direct board operator actions.
	CBOR CBOT	Monitor RCP seals for further degradation. Report middle seal failure.
	CRS	Setup contingency to trip reactor and RCP if upper seal fails. Refer to OP 2102.004 Power Operations and commence a plant shutdown. Notify NLOs, Management, Dispatcher, Chemist, and Nuclear Eng.
	CBOR	Commence boration ~ 20 gpm. Maintain ASI -0.20 to +0.20 with Group 6 or P CEAs.
	CBOT	Reduce main turbine load to maintain Tave within 2° F of Tref.

Event Termination: When examiners satisfied with reactivity manipulation.

Event Description: Third RCP seal fails, manual reactor trip, vapor seal failure, and HPSI failures.

Time	Position	Applicant's Actions or Behavior
	CBOR	Announce third RCP seal failure. Manually trip reactor. Secure B RCP and place spray valve in MANUAL closed.
	CRS	Implement Standard Post Trip Actions, notify operators to monitor Exhibit 7 CBO Reactor Trip Checklist, track safety functions, and direct board operator actions.
	CBOR	<b>Check reactivity control:</b> Reactor power decreasing. All CEAs inserted.
	CBOT	<b>Check maintenance of vital auxiliaries:</b> Main turbine tripped. Generator output and exciter breakers open. Both 4160v and 6900 v non-vital buses energized. Both 4160v and 480v vital AC bus energized. Report both DGs started and not tied to bus. Both 125v vital DC bus energized.
	CBOR	<b>Check inventory control:</b> PZR level 16 to 80%. Trend from setpoint. Secure all PZR heaters when less than 29%.

Event Description: Third RCP seal fails, manual reactor trip, vapor seal failure, and HPSI failures.

Time	Position	Applicant's Actions or Behavior
	CBOR	<b>Check RCS pressure control:</b> RCS pressure 1800 to 2300 psia. Trend from setpoint Trip one RCP in each loop when pressure less than 1400 psia. Place spray valve for secured RCP in manual closed. Verify SIAS when pressure less than 1717.4 psia. Secure ALL RCPs if NPSH requirements violated.
	CBOR	<b>Check core heat removal by forced circulation:</b> RCP status Loop $\Delta T$ less than 10° F. RCS MTS 30° F or greater. Component cooling water aligned to RCPs. Service water aligned to CCW.
	CBOT	<b>Check RCS Heat Removal:</b> Report SG levels. 2P7A and 2P7B feeding both SGs. MFW in RTO. Report feedwater line intact. Report SG pressures.
	CBOR	Report RCS Tc 540 to 555°F.

Time	Position	Applicant's Actions or Behavior
	CBOR	<b>Check CNTMT parameters:</b> Temperature less than 140° F. Pressure less than 16 psia. Status of radiation alarms: CAMS (2K10-B6) In alarm Area radiation (2K11-B10) in alarm. Process liquid (2K11-C10) Report trends on radiation monitors increasing. Status of SEC SYS RADIATION HI (2K11-A10) Report trends on secondary system radiation monitors stable.
	CRS	Notify SS to perform the following: SE report to control room. Announce reactor trip on plant page. Refer to Tech Specs and EALs. Chemist sample SGs for activity. <b>Tech Specs 3.0.3, 3.6.3.1 and in Alert Emergency Class</b>
	CRS	Direct CBOs to acknowledge all control room annunciators and announce all significant alarms. Diagnose Loss of Coolant Accident EOP 2202.003.
	CRS	Implement Loss of Coolant, open place keeping page, and direct board operators actions.
	All	Perform crew brief and review floating steps.



Event Description: Third RCP seal fails, manual reactor trip, vapor seal failure, and HPSI failures.

Time	Position	Applicant's Actions or Behavior
	CBOR	Verify SIAS and CCAS actuated on PPS inserts.
	CBOT	Verify CCW aligned to RCPs <b>(Floating Step)</b>
	CBOR	Check RCS pressure greater than 1400 psia. <b>(Floating Step)</b> <ul style="list-style-type: none"><li>•Secure one RCP in loop 2.</li><li>•Secure ALL RCPs if MTS &lt;30°F.</li></ul>
	CBOT	Restore ESF/Non-ESF systems: <b>(Floating step)</b> <ul style="list-style-type: none"><li>•Verify at least one SW pump running in each loop.</li><li>•Verify DG SW outlet valves open.</li><li>•Verify SW suction aligned to Lake.</li><li>•Check 4160v Non-vital buses energized from offsite power.</li><li>•Start SW pumps as needed to maintain header pressure.</li><li>•Restore SW to CCW and ACW per Exhibit 5.</li><li>•Maintain SW header greater than 85 psig.</li></ul>

Event Description: Third RCP seal fails, manual reactor trip, vapor seal failure, and HPSI failures.

	CBOT	Verify SIAS flow to RCS: Report A HPSI pump failure to auto start and manually start. Report B HPSI breaker trip.
	CRS	Contact NLOs to align C HPSI pump to green bus.
	CBOT	Start C HPSI when aligned to green bus. Verify ALL CNTMT Cooling Fans running in Emergency Mode.
	CBOT	Verify SG levels greater than 23%. <b>(Floating Step)</b>
		Align Feedwater: <ul style="list-style-type: none"><li>•Check EFW pump 2P7B running.</li><li>•Secure EFW pump 2P7A.</li><li>•Verify AFW pump 2P75 secured.</li><li>•Secure running MFW pump and close ALL FW blocks.</li></ul>
		Check LOCA not isolated per Attachment 17.

Time	Position	Applicant's Actions or Behavior
	CBOR	Check LOCA limited to CNTMT.
	CBOR	<p>Check CNTMT Isolation parameters. <b>(Floating Step)</b></p> <p>CNTMT pressure exceed 18.3 psia.</p> <p>CNTMT RADIATION HI alarm 2K10-A6 in alarm. Actuate CIAS and commence Attachment 5.</p> <p>Verify ONE Penetration Room Ventilation Fan Running.</p>
	CBOR	<p>Check CNTMT pressure trend not exceeded 23.3 psia. <b>(Floating Step)</b></p> <ul style="list-style-type: none"> <li>•Verify CSAS actuated on PPS inserts.</li> <li>•Stop ALL RCPs, place spray valves in manual closed.</li> <li>•Verify spray pumps running with greater than 2300 gpm each.</li> </ul>
	CBOT	Terminate CNTMT Spray if conditions met.
	CBOT	<p>Start both Hydrogen Analyzers per 2104.044.</p> <p>Report CNTMT Air Sample valves 2SV-8273-1 and 2SV-8233-1 failed to auto close.</p>
	CBOT	<p>Verify All available miscellaneous CNTMT ventilation running:</p> <ul style="list-style-type: none"> <li>•CNTMT Bldg. Recirc fans (2VSF-31A-D)</li> <li>•Reactor Cavity fans (2VSF-34A&amp;B)</li> </ul> <p>Three CEDM Shroud Cooling fans (2VSF-35s)</p>

Event Description: Third RCP seal fails, manual reactor trip, vapor seal failure, and HPSI failures.

Time	Position	Applicant's Actions or Behavior
	CBOT	Check ALL AC and vital DC buses energized. <b>(Floating Step)</b>
	CBOR	Check IA pressure greater than 65 psig. <b>(Floating Step)</b>
	CRS	Check LOCA not isolated and proceed to Section 3
	CBOR	Perform controlled cooldown to 275°F. <b>(Float Step)</b> <ul style="list-style-type: none"><li>•Reset low PZR pressure and low SG pressure setpoints.</li><li>•Record and plot cooldown on Attachments 1 and 8.</li></ul> Initiate cooldown using SDBCS bypass valves.
	CBOT	Check Condensate pump in service.
	CBOT	Maintain SG levels 45 to 90%. Check CST level greater than 80%
	CBOR	Restore PZR level. <b>(Floating Step)</b> Maintain 29% to 80%
	CBOR	Verify Natural Circulation if RCPs secured: <ul style="list-style-type: none"><li>•Loop <math>\Delta T</math> less than 50° F.</li><li>•Thot and Tcold constant or lowering.</li><li>•RCS MTS 30° F or greater.</li><li>•<math>\Delta T</math> between Thot and average CETs less than 10° F.</li></ul>

Event Description: Third RCP seal fails, manual reactor trip, vapor seal failure, and HPSI failures.

Time	Position	Applicant's Actions or Behavior
	CBOR	<p>Check RCS void free:</p> <ul style="list-style-type: none"> <li>•PZR level stable using aux spray.</li> <li>•RVLMS LVL 01 indicates WET.</li> <li>•Upper head thermocouples indicate subcooled.</li> </ul>
	CBOR	<p>Maintain RCS P-T limits and RCP NPSH per Attachment 1.</p> <p>Check uncontrolled RCS cooldown below 500° F Tcold has not occurred.</p>
	CBOT CBOR	<p>Override HPSI when termination criteria met: <b>(Floating Step)</b></p> <ul style="list-style-type: none"> <li>•RCS MTS 30° F or greater.</li> <li>•PZR level greater than 29% and controlled.</li> <li>•RVLMS LVL 03 or higher indicates WET.</li> <li>•At least one SG available – Level 10 to 90% with FW available OR level being restored with FW flow greater than 485 gpm.</li> </ul> <p>Throttle HPSI flow OR place HPSI pump in PTL as needed to control RCS pressure, inventory, and heat removal.</p>
Termination criteria: Cooldown in progress with HPSI throttled or at examiners discretion.		