Facility: Fermi 2 (50-341) Scenario No.: 2 Op-Test No.: 2010-301

Examiners: _____ Operators: _____

Initial Conditions: Approximately 90% RTP MOL; 5 control rods have slow scram times

Turnover: Approximately 90% RTP MOL during power reduction to perform rod sequence exchange. Power is being held to perform 24.109.02, Turbine Bypass Valve Operability Test.

Event No.	Malf. No.	Event Type*	Event Description
1		N (BOP)	Perform 24.109.02, Turbine Bypass Valve Operability Test
2		C (RO) TS (SRO)	Control Rod accumulator failure (unable to maintain pressure due to nitrogen leak); control rod is adjacent to one that has a slow scram time; TS 3.1.5, Condition A; TS 3.1.4, Condition A; TS 3.1.3, Condition C
3		C (RO) TS (SRO)	Reactor Recirc Pump High Temperature / Single Loop Operation
4		C (BOP)	Reactor Feed Pump Suction Strainer Clogging requiring shutdown of associated Reactor Feed Pump
5		C (CREW)	Modular Power Unit MPU 1 Normal Supply failure/transfer and restoration of loads (restore CRD Hydraulic Flow control, CCHVAC, RBHVAC, SBGT, NIAS, Drywell pneumatics).
~~6~~		~~C (BOP)~~	~~Small Torus Water Leak (3% or smaller such that sump pump able to keep up with leakage and normal makeup maintains level)~~
7		C (RO)	Main Steam Line ruptures in Reactor Building Steam Tunnel resulting in automatic MSIV closure with Automatic SCRAM failure.
8		M	Large Torus Water Leak (100% ramped over 600 seconds)

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

SUMMARY:

The scenario begins with the plant at approximately 90% rated thermal power with power being reduced to perform a rod sequence exchange. Five (5) control rods have slow scram times. Power is being held to perform 24.109.02, Turbine Bypass Valve Operability Test. When the Turbine Bypass Valve test is complete a control rod accumulator will fail (unable to maintain pressure due to nitrogen leak). The control rod will be adjacent to two other the control rods with a "slow" scram time. The SRO will address the Technical Specification impacts in accordance with TS 3.1.5, 3.1.4, and 3.1.3. Once the Tech Specs are addressed, one of the Reactor Recirculation pumps/motors will develop High temperatures requiring shutdown of the pump and operation in single loop. If the operators delay in shutting down the pump it will trip automatically after a time delay. The SRO will address the Technical Specification impacts per TS 3.4.1. Once the Tech Specs are addressed, the North Reactor Feed Pump Suction Strainer will foul requiring shutdown of associated Reactor Feed Pump. Once this malfunction is addressed, the normal power supply to Modular Power Unit (MPU) 1 will fail. ~~Once this malfunction is addressed, a small Torus leak (3% or smaller such that sump pump able to keep up with leakage) will develop and crew will take actions to mitigate.~~ A short time later a main steam line will rupture outside containment and will result in an automatic closure of the MSIVs. The reactor will fail to scram automatically and the RO will manually initiate a reactor scram. Following the scram the Torus leak will get larger requiring EOP response in accordance with 29.100.01 Sheets 2 and 5. The crew will need to control RPV level and pressure manually within the guidelines of EOP 1.

NOTES ON THE AS-ADMINISTERED SCENARIO

1. The small Torus Leak Event was eliminated as an Instrument/Component failure to shorten the length of the scenario. Malfunction was still entered as a precursor to the larger break, but the action to makeup to the Torus was eliminated since rate of Torus level decrease was insufficient to drive applicants to make up to the Torus.

I. SIMULATOR SETUP

A. Initial Conditions

1. Reset the simulator to an IC with the plant at the following conditions:

a) 90% rated thermal power, MOL

B. Malfunctions and Remotes

II.

MF/RF/POLBL	DESCRIPTION	TARGET VALUE	STEP NO.	RAMP	DELAY
C71MF001	AUTO SCRAM FAILURE	ACTIVE	1	N/A	N/A
EOPRF0011	DIVISION 1 ARI LVL DEFEAT	DEFEAT	1	N/A	N/A
EOPRF0012	DIVISION 1 ARI PRESS DEFEAT	DEFEAT	1	N/A	N/A
EOPRF0013	DIVISION 2 ARI LVL DEFEAT	DEFEAT	1	N/A	N/A
EOPRF0014	DIVISION 2 ARI PRESS DEFEAT	DEFEAT	1	N/A	N/A
B31MF0059	RR A HIGH BEARING TEMP	ACTIVE	4	N/A	N/A
B31MF0056	A RR TRIP	ACTIVE	4	N/A	N/A
N21MF0015	N RFP SUCTION STRAINER CLOG	60	5	600 sec	N/A
R11RF0367	72B-2A-1E MPU1 NORMAL	OFF	6	N/A	N/A
E11MF0047	TORUS LEAK	0.15	7	10 sec	N/A
B21MF0103	STEAM LEAK IN TUNNEL	50	8	10 sec	N/A
E11MF0047	TORUS LEAK	100	9	600 sec	N/A
C7AEF9CCC	OVERRIDE TSV/TCV SCRAM BYPASS	1	2		
C7ACF9ACC	OVERRIDE TSV/TCV SCRAM BYPASS	1	2		
C7AGF9BCC	OVERRIDE TSV/TCV SCRAM BYPASS	1	2		
C7AIF9DCC	OVERRIDE TSV/TCV SCRAM BYPASS	1	2		
C11RF0249	HPU ACCUMULATOR 14-47 NITROGEN PRESSURE	600	3	240	N/A

C. Communications

EVENT	POSITION/TITLE	MESSAGE
2	Local Operator	Reports N2 press decreasing and sound of gas leak.
2	Local Operator	AFTER 10 MIN – No sound, No pressure, No obvious damage.
4	Local Operator	IF ASKED: Report DP ~14psid IF ASKED: S RFP Suction Strainer d/p = 0.5 psid before N RFP trip and 1.5 psid after N RFP trip
5	Local Operator	IF ASKED: Report MCC 72B-2A, Pos. 1E Tripped with no obvious indication of why. IF Dispatched: Report RWCU shut down, F/Ps in Hold
6	Local Operator	IF ASKED: Report TW Sump Pump A – RUN TOO SOON lit (initially); RUN TOO LONG lit (later)
6	RW Operator	IF ASKED: Report “No reports of manual draining to sump” Water on floor, Small leak on RHR A between Torus and Suction Isolation (Unisolable / ~40-50 GPM)

D. Required Materials

Shift Turnover Package

Marked up copy of 22.000.03, Power Operation 25% to 100% to 25% (marked up for power reduction)

Marked up copy of 24.109.02, Turbine Bypass Valve Operability Test

III. REQUIRED OPERATOR ACTIONS

TIME	POSITION	EXPECTED ACTIONS
	CRS	Focus/Turn Over Brief
		EVENT 1 – TURBINE BYPASS VALVE OPERABILITY TEST
	CRS/CRNSO	Briefs crew on surveillance test

	CRNSO	Performs 24.109.02, Turbine Bypass Valve Operability Test
		- Verifies completion of prerequisites
		- Removes/Directs removal of fuses (4) to override TSV/TCV Scram Bypass
		- Opens Bypass Valves
		  o Slowly decreases TURBINE SPEED/LOAD CONTROL until valve motion is observed
		  o Allows plant to stabilize
		  o Continues opening by slowly decreasing TURBINE SPEED/LOAD CONTROL in increments (not to exceed 4 MWe/minute) until Bypass Valves 5-10% open.
		- Closes Bypass Valves
		  o Slowly decreases reactor power until both Bypass Valves are shut; OR slowly increases turbine SPEED / LOAD CONTROL until Bypass Valves are shut.
		  o Increase the TURBINE SPEED/LOAD CONTROLS on COP H11-P804 at least 10% above actual turbine load so that the Bypass Valves remain closed.
		- Installs/directs installation of fuses (4) removed earlier to override TSV/TCV Scram Bypass
		- Requests independent verification of restoration
		- Completes documentation and reports completion to CRS.

TIME	POSITION	EXPECTED ACTIONS
		<u>EVENT 2 – ACCUMULATOR FAULT</u>
	P603	Responds to alarm 3D10, CRD ACCUMULATOR TROUBLE - Identifies and reports affected control rod - Dispatches NO to investigate

	CRS	Addresses the following Tech Spec Requirements
		- Section 3.1.5, Control Rod Scram Accumulators, Cond. A
		  - A.1 Declares rod slow within 8 hours; OR
		  - A.2, Declare rod inoperable within 8 hours
		- Section 3.1.4, Control Rod Scram Times
		[NOTE: Applicable only if associated control rod is NOT declared inoperable.]
		  - No more than 2 OPERABLE control rods that are "slow" shall occupy adjacent locations; Otherwise be in MODE 3 within 12 hours (Action A.1).
		- Section 3.1.3, Control Rod Operability
		  - Fully insert inoperable control rods within 3 hours; AND
		  - Disarm the associated CRD within 4 hours

TIME	POSITION	EXPECTED ACTIONS
		<u>EVENT 3 – RR PUMP HIGH TEMPERATURE/SINGLE LOOP OPERATION</u>
	P603	Responds to the following alarm: 3D100, RECIRC SYS COOLANTS TEMPERATURE HIGH 3D18, IPCS MONITORED INPUTS ABNORMAL **[NOTE: The following deleted due to insufficient time for response before pump trip.]** ~~Attempts to reduce temperature~~ ~~Increase GSW flow to RBCCW heat exchangers~~ ~~Reduce RR Pump A speed IAW 23.138.01~~ ~~Trips RR Pump A when it is determined that temperature cannot be lowered below 145°F~~ Upon RR Pump A Trips, Responds to the following alarms 3D96, MOTOR TRIP 3D135, RECIRC SYS A GEN LOCKOUT RELAY TRIPPED (only if not tripped by operator) 3D127, RECIRC SYS LOOP B ONLY OPERATING 3D150, RECIRC SYS B RECIRC FLOW LIMITING 3D119, OPRM ENABLE
	CRS	Announces entry into, and directs actions of, 20.138.01, “Recirculation Pump Trip” Verify operating RR MG Set speed ≤ 75%. Verify Reactor Power < 67.2%; Gives direction to insert CRAM Array. Verify 3D129 alarmed. Place Recirc A & B Flow Limiter 2/3 Defeat Switch in DEFEAT. Close B3105-F031A (B) for tripped RR Pump. After 5 minutes fully open B3105-F031A (B). Maintain RR MG Set speed as follows: o IF Limiter 1 is enforcing, verify speed < 30%. o IF staying in Single Loop operation maintain operating speed 50-75% (23.138.01). o IF in process of plant shutdown, maintain speed above lower speed oscillation region (22-26%) and continue with plant shutdown. IF in Exit or Scram region, o Increase core monitoring for instability. o Initiate action to insert control rods or increase core flow to restore operation outside the Exit region (23.138.01). Direct Chemistry to perform required samples. Contact Radiation Protection.

TIME	POSITION	EXPECTED ACTIONS
	P603	Performs 20.138.01 actions as directed: ☐ Verify operating RR MG Set speed ≤ 75%. ☐ Inserts Cram Array until Reactor Power < 67.2%. ☐ Verify 3D129 alarmed. ☐ Place Recirc A & B Flow Limiter 2/3 Defeat Switch in DEFEAT. ☐ Close B3105-F031A (B) for tripped RR Pump. ☐ After 5 minutes fully open B3105-F031A (B). ☐ Maintain RR MG Set speed as follows: o IF Limiter 1 is enforcing, verify speed < 30%. o IF staying in Single Loop operation maintain operating speed 50-75% (23.138.01). o IF in process of plant shutdown, maintain speed above lower speed oscillation region (22-26%) and continue with plant shutdown. ☐ IF in Exit or Scram region, o Increase core monitoring for instability. o Initiate action to insert control rods or increase core flow to restore operation outside the Exit region (23.138.01).
	CRS	Addresses Technical Specification Requirements ☐ Section 3.4.1, Recirculation Loops Operating – The following limits are applied within 4 hours: o LCO 3.2.1. "AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR)," single loop operation limits specified in the COLR: o LCO 3.2.2. "MINIMUM CRITICAL POWER RATIO (MCPR)," single loop operation limits specified in the COLR; o LCO 3.3.1.1, "Reactor Protection System (RPS) Instrumentation," Function 2.b (Average Power Range Monitors Simulated Thermal Power-Upscale) Allowable Value of Table 3.3.1.1-1 is reset for single loop operation, when in MODE 1: and o THERMAL POWER is < 67.2% RTP.
	CRNSO	Monitors balance of plant and assists as needed/directed.

TIME	POSITION	EXPECTED ACTIONS
		<u>EVENT 4 – REACTOR FEED PUMP SUCTION STRAINER CLOGGING</u>
	CRNSO	Responds to the following alarm - 5D25, N RFP STRAINER DIFF PRESSURE HIGH Direct an operator to H21-P404 (TB1-P11) to verify N21-N440A, N RFP Suction Strainer Diff Press Ind Switch, is greater than 12 psid.
	CRS	~~Announces entry into AOP 20.107.01, Loss of Feedwater~~ Orders reactor power reduction, IAW 22.000.03 to less than 60% RTP to support removal of RFP from service; **OR** Directs tripping of the N RFP (power will be low enough to support single RFP operation) **[OR evaluates current plant conditions and determines that pump can be removed from service without further power reduction.]**
	P603	Reduces reactor power as directed - Decrease Reactor Power by decreasing Reactor Recirculation Pump Speed and/or inserting Control Rods in reverse order of the approved Rod Pull Sheet

TIME	POSITION	EXPECTED ACTIONS
	CRNSO	Performs the following as required/directed to support power reduction. [May trip N RFP as directed, without a further power reduction.] ☐ Remove Condensate Filter Demins from service as required to maintain > 2000 gpm flow through each unit ☐ Stop Heater Drains pumping forward in accordance with 23.108, "Extraction Steam And Heater Drains." ☐ Shutdown Hydrogen Water Chemistry System in accordance with 23.143, "Hydrogen Water Chemistry System." ☐ Removes NRFP from service IAW 23.107, “Reactor Feedwater and Condensate Systems” o Verify C32-R618, Master Feedwater Level Controller, in AUTO. o Place off-going C32-R616A (B), N (S) Reactor Feed Pump Controller, in MANUAL. o Slowly lower the off-going C32-R616A (B), N (S) Reactor Feed Pump Controller output, until Reactor Feed Pump Turbine North (South) speed is at approximately 1600 to 1800 rpm. o open or verify open, the N RFP drains o Place Reactor Feed Pump Turbine North TRIP pushbutton collar in ARMED o Push Reactor Feed Pump Turbine North red TRIP pushbutton, and verify stop valves and min flow line valves closed o Verify turning gear engages o Place Reactor Feed Pump Turbine North TRIP pushbutton collar in DISARMED. o Push Reactor Feed Pump Turbine North green SPEED DECREASE pushbutton until backlight is ON and speed demand is 0%.

TIME	POSITION	EXPECTED ACTIONS
		<u>EVENT 5 – MPU 1 FAILURE</u>
	ALL	Respond to the following alarms: 10D55, MPU ON ALTERNATE POWER 10D59, MPU POWER FAILURE Determine from IPCS the affected MPU\ Dispatch NO to investigate MPU failure
	CRS	Announces entry into and directs actions of 20.300.MPU, “Loss of an MPU” and 20.707.01, “Loss of RWCU.” Directs restorative actions Review 23.308 Enclosure C for specific load impact.
	CRNSO	Performs the following as directed: Depress Inboard MSIV Isolation RESET pushbutton (H11-P601). Depress Outboard MSIV Isolation RESET pushbutton (H11-P602). Start Div 1 (2) CCHVAC (23.413). Place Div 1 NIAS in Standby as follows: o Start Div 1 Control Air Compressor if necessary. o Verify Div 1 Control Air Compressor is loaded. o If not loaded, throttle open P5000-F228A to cause Div 1 Control Air Compressor to load, otherwise N/A. o Close P5000-F228A, if opened. o Open P5000-F402. o Open P5000-F440. o Stop Div 1 Control Air Compressor. o Place Div 1 Control Air Compressor in AUTO. Start RBHVAC (23.426). Place Div 1 SGTS in standby (23.404). Restore Div 1 Drywell Pneumatics (23.406). Restore Div 1 PCMS and PCRMS (23.408). Close T2300-F409. IF installed, remove SDC Logic defeats (Attachment 1). Restore TWMS to Standby (23.144).

TIME	POSITION	EXPECTED ACTIONS
	P603	Performs the following as directed ☐ Start RWCU (20.707.01). ☐ Place CRD Flow Control Valve in AUTO.

TIME	POSITION	EXPECTED ACTIONS
		<u>EVENT 6 – SMALL TORUS LEAK</u>
	CRNSO	Responds to the following alarm: ☐ 2D83, REAC BLDG LEAKAGE TO TORUS SUMP HIGH o Verify the following (back of COP H11-P601), Reactor Building Torus Sump G1101-D065 Pumps G1102-C036A(B) running. o Direct an operator to Leak Detection Panel RR H11-P614 to determine cause of alarm o Determine source of in-leakage and attempt control in accordance with 23.702.01, "Plant System Leak Check Procedure."
	CREW	Observes decreasing trend in Torus Water Level
	~~CRS~~	~~Directs CRNSO to makeup to the Torus with TWMS~~
	~~CRNSO~~	~~Starts makeup to the Torus using TWMS~~ ~~☐ Using a Torus Return Line which is not currently in use, perform one of the following:~~ ~~o RHR Test Line, open G5100-F604, TWMS Rtrn to RHR Inbd Iso Vlv.~~ ~~o CS Test Line, open G5100-F606, TWMS Rtrn to CS Inbd Iso Vlv.~~ ~~☐ To prevent the CRD pump from tripping on low suction pressure, slowly open G5100-F611, TWMS Cond to Torus Makeup Vlv, until desired influent flow is achieved.~~ ~~☐ When desired Torus level is achieved:~~ ~~o Close G5100-F611, TWMS Cond to Torus Makeup Vlv.~~ ~~o Close or verify closed G5100-F606, TWMS Rtrn to CS Inbd Iso Vlv.~~ ~~o Close or verify closed G5100-F604, TWMS Rtrn to RHR Inbd Iso Vlv.~~

TIME	POSITION	EXPECTED ACTIONS
		<u>EVENT 7 – MAIN STEAM LINE RUPTURE OUTSIDE CONTAINMENT / AUTO SCRAM FAILURE</u> **AND** **<u>EVENT 8 – LARGE TORUS LEAK</u>**
	P603	Observes and reports failure to scram on MSIV isolation. **Manually scrams the reactor. (CRITICAL TASK)** Post-Scram Report: ☐ Reactor Mode Switch in SHUTDOWN ☐ Control Rod Status (All Inserted) ☐ Reactor Power and Trend (Downscale and decreasing on -80 sec period) ☐ RPS Status (Manually Actuated) ☐ Turbine Status (Tripped or On-Line)
	CRNSO	Post-Scram Report ☐ RPV Water Level Status ☐ RPV Pressure Status ☐ MSIV Status (Shut)
	CRS	Announces Entry into and direct actions of 29.100.01, Sht. 1, “RPV Control” ☐ Confirm reactor shutdown with all rods inserted ☐ RPV LEVEL o Confirm isolations and actuations o Restore and maintain RPV water level 173” to 214” ☐ RPV PRESSURE o Manually open SRV’s and reduce RPV press to 960 psig o Stabilize RPV press < 1093 psig o Depressurize RPV at < 90°F/hr
	CREW	Observes rapidly decreasing Torus water level

TIME	POSITION	EXPECTED ACTIONS
	CRS	Announces entry into and directs actions of 29.100.01, Sht. 2, “Primary Containment Control” TORUS TEMP o When torus water temp > 95°F Operate ALL available torus water cooling TORUS WATER LEVEL o Attempt to raise torus water level with TWMS (23.144), defeating interlocks if necessary (29.ESP.21) o When Torus water level cannot be kept > -38”, Emergency RPV Depressurization
	CRS	Announces entry into and directs actions of 29.100.01, Sht. 5, “Secondary Containment and Rad Release” Operate available sump pumps to restore and keep water level < Max Normal Operate available area coolers If any RB area water level, rad level, or area temp exceeds Max Normal value, Isolate all systems (except those required of EOPS or damage control) discharging into the area When any one parameter exceeds Max Safe in two or more areas, Emergency Depressurize RPV
	P603	Performs the following as directed: Maintains RPV water level 173” to 214” with SBFW, CRD, RCIC and/or HPCI
	CRNSO	Performs the following as directed: Opens SRVs as needed to lower RPV pressure to 960 psig Stabilizes RPV pressure < 1093 psig. Places one or both divisions of RHR in Torus Cooling o If High Drywell Pressure or RPV Level 1 actuation exists, place the Containment Spray Mode Select switch in MANUAL. o Unlock and open E1150-F028A (B), Div 1 (2) RHR Torus Iso Vlv. o Start one RHR Pump. o Throttle E1150-F024A (B), Div 1 (2) RHR Torus Clg Iso, to desired flow. o When flow is > 3000 gpm, verify E1150-F007A (B), Div 1 (2) RHR Pmps Min Flow Vlv, closes. o Start RHR Service Water System. (RHRSW Flow may be delayed until after Torus Spray is established.) o To increase cooldown rate, throttle closed E1150-F048A (B), Div 1 (2) RHR Hx Bypass Vlv. Attempts to raise Torus water level with TWMS

TIME	POSITION	EXPECTED ACTIONS
	CRS	When “required” announces transition to 29.100.01 Sht. 3 for EMERG DEPRESS - If Drywell Pressure > 1.68 psig, directs prevention of injection from CS and LPCI not needed for core cooling - **Directs that 5 SRVs be Opened (ADS Preferred) (CRITICAL TASK)**
	CRNSO	**Opens the 5 ADS SRVs when required (CRITICAL TASK)**
	P603	Restores and maintains RPV water level 173” to 214” with SBFW, CRD, RCIC and/or HPCI

TERMINATION CRITERIA		
		The scenario may be terminated when: - 4 or more SRVs are open - RPV water level is under the control of the crew OR - When directed by the Chief Examiner

IV. CRITICAL TASKS

A. Manually SCRAM the reactor when automatic scram fails.

B. Emergency Depressurize the RPV when one of the following occurs:

- When RB Water Level exceeds Max Safe in two or more areas; OR
- When Torus water level cannot be kept > -38”