

Facility: Byron Nuclear Station Scenario No.: 1 Op-Test No.: 2019-302

Examiners: \_\_\_\_\_ Operators: \_\_\_\_\_  
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**Initial Conditions:** 42% RTP, BOL, 1B CV Pump OOS for oil change; expected RTS in 6 hours.

**Turnover:** Crew is directed to start 3<sup>rd</sup> CD/CB per pump and raise power to 50% for calorimetric hold, IAW 1BGP 100-3, step F.52. 1B CV Pump is OOS for an oil change, expected RTS in 6 hours. LCO 5.2 Cond A and TLCO 3.1.d Cond A have both been entered.

**Critical Tasks:**

(CT-1) Insert negative reactivity to shutdown the reactor during an ATWS.

(CT-2) Trip RCPs when < 5% RTP.

(CT-3) Stop the uncontrolled RCS cooldown prior to entering orange path on Integrity safety function.

Event No.	Malf. No.	Event Type*	Event Description
1		N – BOP	Start 3 <sup>rd</sup> CD/CB Pump IAW BOP CD-CB-1
2		R – ATC R – CRS	Raise power to 50% per 1BGP 100-3
3		I – BOP I - CRS TS - CRS	S/G pressure transmitter 1PT-534 fails high
4		C – ATC C - CRS	1PK-455C PZR spray controller fails open in auto
5		C – BOP C - CRS TS - CRS	1CC685 spurious closure; valve can be successfully reopened, but will start to spuriously reclose and mechanically bind in an intermediate position.
6		C – ATC C - CRS TS - CRS	1A CV Pump trip (requires manual isolation of L/D, no seal injection or thermal barrier cooling, requires manual Rx trip) <b>(CT-2)</b>
7		M - ALL	ATWS (Rx fails to trip from either MCB C/S) <b>(CT-1)</b>
8		C – ATC C - CRS	Uncontrolled RCS cooldown. Steam dumps controller fails high in auto. <b>(CT-3)</b>

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

Scenario will start at approximately 42% RTP, BOL, steady state, with 1BGP 100-3 in progress at Step F.52. The 1B CV pump is OOS for an oil change and will be returned to service in approximately 6 hours. LCO 3.5.2 Cond A and TLCO 3.1.d Cond A. Online risk is green.

**Event 1**

The crew will place the 3<sup>rd</sup> CD/CB pump in service per BOP CD-CB-1.

**Event 2**

The crew will then raise power to 50% to perform a calorimetric hold. The crew may desire to continue placing a 2<sup>nd</sup> HD pump in service due to rising HD tank level, however, prior to the crew taking action to place the 2<sup>nd</sup> HD pump in service, insert Event 3.

**Event 3**

The crew will identify a failure of S/G pressure transmitter 1PT-534 (controlling channel, failing high) and take prompt operator action per BHC 1-SG. The crew should hold the ramp at this time, as the crew will take 1C S/G FRV to manual and stabilize 1C S/G level. The crew will take followup actions per 1BOA INST-2 and select an operable controlling channel. The crew should enter LCO 3.3.2 Cond A & D (functions 1e and 4d). 1PT-534 will remain unavailable for the rest of the scenario. At lead examiner discretion, insert Event 4.

**Event 4**

The crew will identify a failure of 1PK-455C PZR spray controller in auto (valve fails full open). The crew will take prompt action per BHC 1-RY-P to stabilize PZR pressure. The crew may elect to turn on an additional set of backup heaters. The crew may enter LCO 3.4.1 Cond A if RCS pressure drops below 2209 psig. 1PK-455C will remain non-functional in auto for the rest of the scenario. At lead examiner discretion, insert Event 5.

**Event 5**

The crew will identify 1CC685 spurious closure by the valve indicating lights or status light (sugar cube), as well as rising RCP temperatures due to a loss of thermal barrier cooling. The crew should reference BAR 1-7-A4 through D4 for RCP 1\_Therm Barr CC Wtr Flow Low due to 1CC685 failing closed. The crew should attempt to reopen 1CC685 IAW BAR 1-7-A4 through D4. The valve will reopen at this time and clear the thermal barrier low flow alarms. After flow is restored, the crew will identify that 1CC685 has failed to an intermediate condition (sufficient enough to again bring in all four RCP thermal barrier CC flow low alarms). If the crew attempts to close or open the valve, the valve will not move (mechanically bound). The crew should enter LCO 3.6.3 Cond A due to 1CC685 being not fully closed and not being able to fully close the valve. The crew will take action per required action A.1 and manually close and de-energize 1CC9438 to isolate the flowpath. The crew may opt to enter 1BOA PRI-6, Component Cooling Malfunction and/or 1BOA RCP-2, Loss of Seal Cooling. At lead examiner discretion, insert Event 6.

**Event 6**

The crew will identify a trip of the 1A CV pump. The crew will take prompt action to isolate normal letdown IAW BHC 1-9-A3. The crew may enter LCO 3.5.2 Cond C and TLCO 3.1.d Cond B and shut the plant down to Mode 3 within 6 hours. However, prior to shutting down the RCPs, the crew should exercise 1BOA RCP-2, Step 1 RNO to manually trip the reactor, verify the reactor tripped, and then trip all RCPs, as no seal injection is available and RCP thermal barrier low flow alarms are lit.

**Event 7**

The crew will attempt to manually trip the Rx, which will fail from both MCB switches. The crew will enter 1BFR S.1. RCPs should not be tripped until the reactor power is < 5%, per 1BFR S.1. The crew will be unable to emergency borate per 1BFR S.1 step 4. When the reactor is tripped locally or power is < 5%, the crew should transition to 1BEP-0 and trip all RCPs.

**Event 8**

The crew will identify an uncontrolled RCS cooldown in progress by Step 10 of 1BEP-0. The steam dump controller will fail high, causing excessive steam dumps to be open. The crew should take the steam dump controller to manual and close the steam dumps to mitigate the uncontrolled cooldown. The scenario will be terminated after the crew has mitigated the uncontrolled cooldown in 1BEP-0 and transitioned out of 1BEP-0.

Facility: Byron Nuclear Station Scenario No.: 2 Op-Test No.: 2019-302

Examiners: \_\_\_\_\_ Operators: \_\_\_\_\_  
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**Initial Conditions:** 100% RTP, MOL, steady state conditions.

**Turnover:** 100% RTP, MOL, steady state. Crew is directed to maintain power operations and perform 1BOSR FW-M4. 1B SI Pump OOS. Expected RTS in 26 hours. LCO 3.5.2 Cond A has been entered. 0B WS Pump is OOS. Expected RTS in 72 hours. Severe weather is forecasted for the shift.

**Critical Tasks:**

**(CT-1)** Trip RCPs within 10 minutes of meeting RCP trip criteria.

**(CT-2)** Start Train A SI loads before transition to 1BEP-1.

Event No.	Malf. No.	Event Type*	Event Description
1		N – BOP N – CRS	Perform 1BOSR FW-M4, 1A FW Pump AOP Test
2		I – ATC I – CRS TS - CRS	1LI-459 PZR level instrument fails low (controlling channel)
3		C – ATC C – BOP C – CRS TS - CRS	Spurious Phase A Isolation, with a failure of 1SD005C to close
4		C – BOP C – CRS	6A FW heater string leak (requires removing intermediate pressure string from service per BOP HD-10)
5		R – ATC R – CRS	Ramp down < 1156 MW due to removing intermediate pressure FW heater string from service
6		I – ATC I – BOP I – CRS TS - CRS	1PT-505, turbine impulse pressure channel fails low
7		M – ALL	SBLOCA inside containment <b>(CT-1)</b>
8		C – ATC C – CRS	A-Train SI fails to automatically or manually actuate (must manually start all loads) <b>(CT-2)</b>

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

Scenario will start at 100% RTP, MOL, steady state. Crew is directed to maintain power operations and perform 1BOSR FW-M4. 1B SI Pump OOS; expected RTS in 26 hours. LCO 3.5.2 Cond A has been entered. 0B WS Pump is OOS; expected RTS in 72 hours. Severe weather is forecasted for the shift. Online risk is green.

**Event 1**

The crew will perform 1BOSR FW-M4, 1A FW Pump Aux Oil Pump Pressurization Test.

**Event 2**

The crew will identify a 1LI-459, controlling pressurizer level channel failing low. The crew will respond to rising pressurizer level and take manual control of the Master Pressurizer Level controller to stabilize pressurizer level at program. The crew would most likely take this action IAW BAR 1-12-C3. Additionally, the crew will identify automatic letdown isolation and followup with BHC LD-1. The crew will enter 1BOA INST-2 to further address the failure, including selecting an operable controlling channel. The crew should enter LCO 3.3.1 Cond A & K (functions 9). At the lead examiner discretion, continue to Event 3.

**Event 3**

The crew will identify a spurious phase A actuation of Train B and respond using 1BOA PRI-13. The crew will take make control of charging to minimize pressurizer level rise and will start available RCFCs in high speed. The crew will identify that 1SD005C failed to close on the actuation signal and enter LCO 3.6.3 Cond C. The crew will close 1SD005C to satisfy the TS requirement. At the lead examiner discretion, continue to Event 4.

**Event 4**

The crew will identify that a leak has occurred in the 6A intermediate pressure FW heating string, as evidence by BAR 1-17-B2, HTR 15 LEVEL HIGH LOW, and, subsequently cascading to, BAR 1-17-A2, HTR 16 LEVEL HI-2. The crew should take action to promptly initiate the 'HTR ISOL RUNBACK' via DEHC to reduce turbine load (Event 5). The crew should take action per BOP HD-10 to remove the 6A intermediate pressure FW heating string. Per BOP HD-6T1, turbine load is limited to 1159 MW with one intermediate pressure string isolated and bypassed. At the lead examiner discretion, continue to Event 6.

**Event 5**

The crew will take action to reduce turbine load using the heater isolation runback via DEHC (see Event 4).

**Event 6**

The crew will identify a failure of 1PT-505, turbine impulse pressure channel failing low. The crew will take action per BHC 1-RD to stop the uncontrolled rod insertion (due to a false low Terror signal). The crew will implement 1BOA INST-2 and take followup actions to select an operable impulse pressure channel, restore steam dumps, and restore rods back to the pre-transient position. The crew will enter LCO 3.3.1 Cond A & P (functions 17e). At lead examiner discretion, continue to Event 7.

**Event 7**

The crew will experience a SBLOCA. Degrading RCS pressure and level will exceed the capacity of a single charging pump. The crew may opt to enter 1BOA PRI-1, maximize charging and isolate letdown, however, this will prove incapable of mitigating the leak. The crew will trip the reactor, verify the reactor is tripped and actuate SI. The crew will enter 1BEP-0 and actuate

SI. The crew will determine that A-train SI fails to actuate (either manually or automatically, if the crew were to get to the auto SI setpoint prior to manual actuation) (**Event 8**). All A-train SI loads must be manually started. It is critical that the 1A SI pump is started as the 1B SI pump is OOS. The crew will transition to 1BEP-1 and then to 1BEP ES-1.1. Terminate the scenario when the crew has reduced SI flow during SI termination.

Facility: Byron Nuclear Station Scenario No.: 3 Op-Test No.: 2019-302

Examiners: \_\_\_\_\_ Operators: \_\_\_\_\_  
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**Initial Conditions:** ~1% RTP, BOL, raising power to the POAH per 1BGP 100-2, Step 17.

**Turnover:** Continue raising power IAW 1BGP 100-2 Step 17. BOP MS-9a is in progress at Step 14. Continue opening all MSIVs. 2B SX pump is OOS, expected RTS in 14 hours. LCO 3.7.8 Cond A has been entered. Severe weather is forecasted for the shift.

**Critical Tasks:**

**(CT-1)** Start 1B SX pump to restore limited SX flow.

**(CT-2)** Restore power to Bus 142 within 10 minutes of the onset of loss of all AC.

Event No.	Malf. No.	Event Type*	Event Description
1		N – BOP N – CRS	Continue I/P BOP MS-9a and open all MSIVs
2		R – ATC R - CRS	Raise Rx power past the POAH to 5% (Mode change)
3		I – ATC I – CRS	VCT level channel 1LI-112 fails high
4		I – ATC I – CRS TS – CRS	RCS Thot RTD fails high (requires manual control of PZR level)
5		C – BOP C – CRS TS – CRS	Flooding in the AB from SX return header (1SX07HA-20"). Induces a loss of both A-train SX pumps (both 1A and 2A SX pumps trip). 1B SX pump fails to auto-start on low pressure, requiring manual start. <b>(CT-1)</b>
6		M – ALL	Lightning strike causes U1 and U2 LOOP, with Bus 242 fault. 1A DG experiences a lockout.
7		C – BOP C - CRS	1B DG output breaker fails to close on the DG U/V start. A loss of all AC power on Unit 1 occurs until the output breaker is closed. During this time, the site will experience a loss of all SX (loss of UHS). <b>(CT-2)</b>

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

The scenario will start at ~1% RTP, BOL, with the crew being directed to continue raising power to the POAH per 1BGP 100-2, step 17. The crew is directed to continue the in progress BOP MS-9a at Step 14, to open all MSIVs. The 2B SX pump is OOS, expected RTS in 14 hours. LCO 3.7.8 Cond A has been entered. Severe weather is forecasted for the shift.

**Event 1**

The crew is directed to continue the in progress BOP MS-9a procedure to open all MSIVs. Step 14 to warm the steam lines 30 minutes has been completed.

**Event 2**

The crew will simultaneously raise power to the POAH, per 1BGP 100-2, step 17. The crew will be directed to proceed to raise power to 5% to enter Mode 1. At the lead examiner discretion, continue to Event 3.

**Event 3**

The crew will identify a failure of VCT level channel 1LI-112 (failing high) and respond to BAR 1-9-A2. The crew should place 1CV112A to VCT, per the BAR. At lead examiner discretion, continue to Event 4.

**Event 4**

The crew will identify a failure of RCS Thot RTD 1TE404 failing high. The crew will respond by taking manual control of pressurizer level to stabilize at program value. A false high program value will be observed due to the Auctioneered high Tave input to PZR level control. Rod control should remain in manual and no uncontrolled rod motion should occur during the transient. The crew should enter 1BOA INST-2 and take followup actions to select an operable controlling channel. The crew should LCO 3.3.1 Cond A & E (function 6, 7). The crew may enter LCO 3.4.1 Cond A if PZR pressure drops below 2209 psig during the transient. At lead examiner discretion, continue to Event 5.

**Event 5**

The crew will experience flooding in the Aux Bldg, due to a leak in the SX return header, 1SX07HA-20". The crew should enter 0BOA PRI-8, Aux Bldg Flooding, to attempt to find the source of water (the crew may reference BOP SX-22 to determine the source of the leak and the impact of the leak). The leak will eventually induce a loss of both A train SX Pumps, as the A-train SX pump room will flood. The running 1A and 2A SX pps will trip and the 1B SX pp will fail to auto start. The crew will start 1B SXZZ pump per BHC 1-2-A1. The crew should enter 1BOA PRI-7, SX malfunction. The crew should identify that LCO 3.0.3 is applicable, as no Unit 2 SX pumps are available and enter LCO 3.7.8 Cond A for Unit 1 (due to a loss of 1A). At lead examiner discretion, continue to Event 6.

**Event 6**

Severe weather in the area will impact the site via lightning strikes and high winds that induce a U1 and U2 LOOP, with a subsequent Bus 242 fault and a lockout of the 1A DG, ultimately a Loss of all AC power on Unit 1. On the 142 bus undervoltage, the 1B DG will start, but the output breaker will fail to close (Event 7). The source of power at this point is the 2A DG. The crew will enter 1BCA-0.0 and take action to reenergize Bus 142.

**Event 7**

The crew will be alerted to the 1B DG output breaker failing to close when the DG starts on the undervoltage signal (BAR 1-22-D9), resulting in a complete loss of SX flow, loss of UHS (0BOA PRI-7) until 1B DG output breaker is closed and bus re-energized. Actions per 0BOA PRI-7 will



be ineffective, as the highest priority at this point is restoring Bus 142 so the 1B SX pump can be restarted. The scenario can be terminated after the crew has restored Bus 142, started the 1B SX pump, and transitioned out of 1BEP-0.

Facility: Byron Nuclear Station Scenario No.: 4 Op-Test No.: 2019-302

Examiners: \_\_\_\_\_ Operators: \_\_\_\_\_  
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**Initial Conditions:** 90% RTP, MOL, steady state conditions

**Turnover:** Power reduced to 90% for partial TV/GV surveillance on GV1. 1A FW Pump OOS for oil change.

**Critical Tasks:**

**(CT-1)** Secure 1A DG due to a lack of SX cooling water prior to equipment damage.

**(CT-2)** Establish RCS bleed and feed before either PZR PORV opens automatically as a result of a loss of heat sink.

Event No.	Malf. No.	Event Type*	Event Description
1		N – BOP N – CRS	Perform partial TV/GV 1BOSR 3.G.4-1 for GV1
2		C – ATC C – CRS TS – CRS	PZR PORV 455A leak, requires isolating block valve 1RY8000A
3		C – BOP C – CRS	1C HD Pump trip (requires starting standby HD pump)
4		R – ATC R – CRS	1A HD pump trips (requires HD runback to 780 MW)
5		C – ATC C – CRS	U1 BAT pump trips during runback (requires swapping to U0 BAT pump)
6		C – BOP C – CRS TS - CRS	1A DG inadvertent auto-start with a failure of 1SX169A to open <b>(CT-1)</b>
7		M - ALL	DC Bus 112 fault (manual Rx trip due to inability to maintain SG level, loss of all main FW)
8		C – BOP C – CRS	1A AF pump fails to auto start. Pump experiences a shaft shear after initial developing of flow (run indication, no flow). 1B AF pump will not start due to a low lube oil pressure lockout. Crew will have to implement bleed and feed. <b>(CT-2)</b>

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

The scenario will start at approximately 90% RTP, MOL, steady state conditions, for an impending partial performance of 1BOSR 3.G.4-1, TV/GV surveillance on the GV1. The 1A FW pump is OOS for an oil change.

**Event 1**

The crew will be directed to perform a partial surveillance of 1BOSR 3.G.4-1, TV/GV for only the GV1. When the crew has completed the surveillance, continue to Event 2.

**Event 2**

The crew will receive annunciator 1-12-C6 for PZR PORV 455A discharge temperature high. The crew will respond using BAR 1-12-C6 and determine leakoff line temperature is high and mitigate the leak by closing the block valve 1RY8000A. The crew should enter LCO 3.4.11 Cond A. The crew may enter LCO 3.4.14 Cond A for RCS leakage, depending on the RCS leak rate through the PORV. At lead examiner's discretion, continue to Event 3.

**Event 3**

The crew will identify the 1C HD Pump tripped. The crew will take action per 1BOA SEC-1 and start the standby 1A HD pump. The crew may opt to place the tripped 1C HD pump in PTL. After the crew has stabilized the secondary and at lead examiner's discretion, continue to Event 4.

**Event 4**

The crew will identify a trip of the recently started 1A HD pump. With only 1 running HD pump and no standby pump, the crew will initiate a HD runback via DEHC to 780 MW, IAW 1BOA SEC-1. The crew should leave rod control in auto, while adding pre-determined batches of boron for the HD runback REMA.

**Event 5**

During the HD runback, the crew will experience a trip of the U1 BAT pump. Auto rod control will allow control rods to insert negative reactivity and maintain RCS temperature deviation. Rods should remain above the Lo-2 insertion limit during the transient, however, the crew should respond to annunciator 1-9-A4 and swap to the U0 BAT pump such that they can borate to restore AFD (withdrawing control rods). The crew will use BOP AB-17 to swap to the U0 BAT pump. At lead examiner discretion, continue to Event 6.

**Event 6**

The crew will identify the 1A DG inadvertently started and the 1SX169A valve failed to open. When the crew attempts to open 1SX169A, the valve will not open and the DG will be running without SX cooling water. The crew will be required to secure the 1A DG prior to overheating. The crew will enter LCO 3.8.1 Cond B. At lead examiner's discretion, continue to Event 7.

**Event 7**

The crew will experience a DC Bus 112 fault. A fault of DC Bus 112 will result in FRVs failing closed and the crew will be required to insert a manual Rx trip prior to a loss of SG level and Lo-2 trip. The crew will implement 1BOA ELEC-1 and take followup actions, including tripping the running FW pumps. The crew will go to 1BEP-0.

**Event 8**

During the immediate actions of 1BEP-0, the crew will identify that the turbine failed to automatically trip and will take action to trip the turbine, per 1BEP-0 Step 3. The turbine will fail

to trip from either the pushbutton or DEHC turbine trip soft key, and will need to be run back by closing the governor valves.

**Event 9**

The crew will identify that 1A AF pump fails to auto start, if a Lo-2 SG level is reached. After manually starting the pump, the pump experiences a shaft shear after initial developing of flow (run indication, no flow). The crew will be in a loss of all FW scenario and must enter 1BFR H.1. The crew will be required to dispatch an EO to locally start 1B AF pump due to DC 112 failure. The pump will not start due to a low lube oil pressure lockout after manual start is attempted. The crew will proceed to feed and bleed. Terminate the scenario after the crew has initiated feed and bleed and is depressurizing the RCS.