NEI 99-02 FAQ 20-05
RBS Unplanned Scram May 2019

Plant:	River Bend Station, Unit 1	
Date of Event:	5/31/2019	
Submittal Date:	October 09, 2020	
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Performance Indicator: IE04 - Unplanned Scrams with Complications (USwC)

Site-Specific FAQ (see Appendix D)? Yes or (No)

FAQ to become effective when approved or _____.

Question Section

NEI 99-02, Revision 7 Guidance needing interpretation (include page and line citation):

NEI 99-02, Revision 7, Page 11, Lines 11-14 *Unplanned Scram Definition*
NEI 99-02, Revision 7, Page 21, Lines 10-14 *USwC Indicator Definition*
NEI 99-02, Revision 7, Page 22, Lines 11-14 *Scram Response for a BWR*

Events or circumstances requiring guidance interpretation.

On May 31st RBS was being shutdown to repair an 'A' 5th Point Heater tube leak. The heater string had been isolated two days prior. Following the downshift of Recirculation Pumps 'A' and 'B', the feedwater (FW) system was aligned for low flow conditions utilizing the 'A' FW pump minimum flow valve. This alignment caused FW flow to raise by approximately 3,000 gpm which led to increased condensing action in the FW heaters, a high FW heater water level isolation, a loss of sufficient suction to the FW pumps and ultimately 'A' & 'C' FW pumps tripping on low suction pressure. A manual scram was inserted following the loss of suction to the 'A' & 'C' FW pumps. RBS classified this event as an Unplanned Scram per 7,000 Critical Hours.

Timeline Documented in CR-2019-3891 Causal Analysis:
(*** Notes provided to add clarity)

5/31/2019	Plant Shutdown is in progress. 'A' FW Heater String is isolated, and Heater Drain Pumps are secured. Reactor power was at 30%, Condensate Pumps 'B' and 'C' in service, Reactor FW Pumps 'A' and "C' in service, one FW Regulating Valve in service and Recirc Pumps in slow speed. Operations proceeded with shutdown of Reactor FW Pump 'A'.
23:38	Total Feedwater/Condensate flow is ~7,000 gpm and is all going through the 'B' FW Heater String.
23:39	FW Pump 'A' Min Flow Valve begins to Open, this increases total condensate flow through the 'B' FW heater string.

23:42 FW Pump Min Flow ‘A’ Valve is 100% Open, this increases total condensate flow through the ‘B’ FW heater string by 3,050 gpm. Total Feedwater/Condensate flow is now ~10,500 gpm.

*** The added condensate flow is condensing more Extraction steam in the 5th Point Heater. There is little DP (~8 psi) across the heater to force water out of the 5th Point Heater. This transient causes roughly 255 gal of water to be added to the 5th Point Heater in only 2.5 minutes. This equates to ~5.5 inches of level in the heater.

23:43 5th Point Heater Level reaches the High Level (8.125”) and ‘B’ FW heater isolation sequence begins.

*** This is the event that caused the conditions that ultimately led to the insertion of a Manual Scram. The system isolated as expected due to the high-water level in the 5th Point Heater.

23:44 5th Point Heater is isolated. ~10,000 gpm is now being pushed through the 5th Point Heater Bypass Line.

*** The Bypass line has an orifice (CNM-RO120). The rated maximum flow through the orifice is 3412 gpm. We were attempting to send ~10,000 gpm. Using 7247.431-145-052B (CNM-RO120 orifice calculation) it can be shown that it only takes 4170 gpm to yield a discharge pressure of 260 psi. This is the Feed Pump Suction Pressure trip setpoint.

23:45 FW pumps ‘A’ and ‘C’ trip on Low Suction.

23:45:10 Manual Scram inserted after Loss of FW pumps. Emergency Operating Procedure (EOP-0001) was entered.

23:45:30 RCIC was manually initiated for level control.

23:49:00 FW Pump ‘C’ was restarted for level control.

23:53:00 RCIC was manually tripped per CRS direction, level control transitioned to FW.

23:54:00 Reactor Scram reset.

23:55:00 Start-Up FW Regulating Valve placed in service.

23:56:00 85-degree F per hour cooldown rate established.

23:57:00 Reactor Core Isolation Cooling placed in a standby lineup.

6/1/2019

00:00:00 Emergency Operating Procedures (EOP-0001) was exited. Reactor Pressure Vessel water level and pressure are being controlled via normal operating procedures.

00:14:00 Secured CNM-P1B CONDENSATE PUMP B, per normal operating procedure.

*** Suction to the RFPs was still through the Low-pressure Heater String Bypass only. During the cooldown of the Reactor Vessel, Reactor Vessel level was cycling between 19 inches to 30 inches as Main Steam Bypass Valves cycled to maintain Reactor Pressure. The Startup FRV was cycling from full closed to 26 inches open to control Reactor Water Level. Whenever the Startup FRV was closed, the 'C' RFP minimum flow valve would open and start to close as the Startup FRV opened. When Condensate Pump 'B' was secured, the reduced pressure to the suction of the RFP resulting in the cycle times becoming larger—i.e. the Startup FRV would be open longer to raise level, etc. This combination of events eventually resulted in a low suction pressure to FW Pump 'C' which then tripped at 0028. The dynamics of the 0028 trip was different than that from the original trips at 2345 that led to the SCRAM. In the original trip, the low suction was caused solely by the heater string isolation. The 0028 trip was caused by combination of heater strings being isolated AND securing of the 'B' Condensate Pump.

00:28:00 Unexpected occurrence: Main Control Room alarm for FW Low Suction pressure was received for FW Pump 'C'.

*** On the restart of FW Pump 'C', the discharge MOV breaker tripped on thermal overload preventing the discharge valve from opening. With the 'C' RFP minimum FCV open, the 'C' RFP tripped on low suction pressure again. (Highlighted for emphasis)

00:32:00 Level 3/ Entered Emergency Operating Procedure EOP-0001.

*** At this point, Operations un-isolated the 'B' FW Heater String, in accordance with normal operating procedure SOP-0007 Condensate System, introducing another flow path to the RFP suctions and started the 'A' RFP with no issues. EOP's were entered and exited because Reactor Water Level and Pressure were under control and being managed by normal means. This was a separate event from the original scram due to low suction pressure caused by the FW heater isolation. In this event, the low suction was caused by the securing of the Condensate pump at 0014, which combined with the still isolated 'B' Low Pressure Heater String, caused larger oscillations in Reactor FW Level controls that ultimately led to a low suction trip. If the B Condensate pump had continued to run, the low suction pressure would have never occurred.

00:33:00 FW Pump 'A' was started.

00:36:00 Exited Emergency Operating Procedure EOP-0001. RPV water level and pressure are being controlled via normal operating procedures.

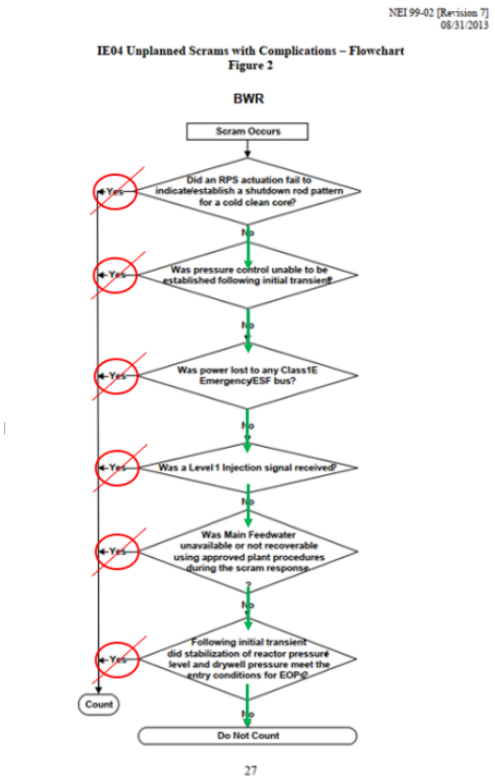
02:15:05 Completed NRC Form 361 Immediate (4-hour) Report (EN #54096) per 10 CFR 50.72 for manual reactor scram due to loss of FW.

Following the initial scram on 5/31/19 at 23:45, the plant was stabilized. EOP-001 RPV Control was exited and a normal shutdown was in process in accordance with GOP-0002 Plant Shutdown. A controlled, procedurally directed 85˚/hr cooldown was commenced and reactor water level was being controlled in accordance with procedural guidance with feedwater.

An USwC as defined by NEI 99-02 Rev. 7, in part states, *"…scrams…that require additional operator actions or involve the unavailability of or inability to recover main feedwater...during the scram response."* NEI 99-02 Rev. 7 defines the time period of scram response as, *"…the period of time that starts with the scram and concludes when operators have completed the scram response procedures and the plant has achieved a stabilized condition in accordance with approved plant procedures and as demonstrated by meeting the following criteria:*

- *No Emergency Operating Procedure (EOP) entry conditions exist related to either the primary containment or the reactor.*
- *Reactor cool-down rates are less than 100 degrees F/hr.*
- *Reactor water level is being maintained within the range specified by plant procedures."*

Based upon the above timeline and NEI 99-02 Rev. 7 definitions, RBS was outside the "Scram Response Time" by 30 minutes before the subsequent level three scram signal and therefore did not have an Unplanned Scram with Complications. Additionally, the below flowchart demonstrates this conclusion as seen in NEI 99-02 Rev.7, Figure 2.



If licensee and NRC resident/region do not agree on the facts and circumstance, explain:

NOTE: The following verbiage (*in Times New Roman font and italics*) was provided by the NRC residents and is their perspective on the events.

The resident inspectors believe the May 31, 2019 scram is an unplanned scram with complications based on answering "Yes" to NEI 99-01 Revision 7, "IE04 Unplanned Scrams with Complications – Flowchart" questions #5 and #6.

Question #5

On Question #5, "Was main feedwater unavailable or not recoverable using approved plant procedures during the scram response", the resident believes the answer is "Yes." The resident takes the word "recoverable" in the sentence to mean recoverable in a sustainable manner. Main feedwater was not recoverable in a sustainable manner using approved plant procedures because approved plant procedures did not instruct operators to un-isolate the heater string when bringing the feed pump back online. In using approved plant procedures, operators failed to un-isolate the heater string during their initial start of the feed pump. Consequently, when they secured the condensate pump per procedure, they caused the feed pump to trip, resulting in a low-level scram signal and an EOP re-entry.

NEI 99-02 provides clarifying guidance that "situations that require maintenance or repair activities or non-proceduralized operating alignments will not satisfy this question." The situation in question required a "non-proceduralized" operating alignment in the sense that it required operators to take actions and observe restrictions that were not specified in any procedures. Specifically, to allow for sustained recovery of feed flow, operators needed to either un-isolate a heater string, or refrain from securing condensate pumps per the condensate system operating procedure. Neither of these actions or restrictions were specified in any of the procedures in use at the time, and therefore operators did not know that they applied. After the feed pump tripped, operators continued to attempt to restart it in the non-proceduralized lineup. Only after the additional restart attempts failed did operators recognize that the system needed to be realigned.

Question #6

On Question #6, "Following initial transient, did stabilization of reactor pressure/level and drywell pressure meet the entry conditions for EOPs?", NEI 99-02 offers the following clarifying guidance:

> ***"****When a scram occurs plant operators will enter the EOPs to respond to the condition. In the case of a routine scram the procedure entered will be exited fairly rapidly after verifying that the reactor is shutdown, excessive cooling is not in progress, electric power is available, and reactor coolant pressures and temperatures are at expected values and controlled. Once these verifications are done and the plant conditions considered "stable" (see guidance in the Definition of Terms section under scram response) operators will exit the initial procedure to another procedure that will stabilize and prepare the remainder of the plant for transition for the use of normal operating procedures. The plant would then be ready be maintained in Hot Standby, to perform a controlled normal cool down, or to begin the restart process. The criteria in this question is used to verify that there were no other conditions that developed during the stabilization of the plant in the scram response related vessel parameters that required continued operation in the EOPs or re-entry into the EOPs or transition to a follow-on EOP."*

The guidance clearly indicates that the scope of the question includes the period after the plant has been initially stabilized and EOP's have been exited, where operators are stabilizing the remainder of the plant to allow for the use of normal operating procedures. The station was in that period when the second EOP entry occurred. Due to the abnormal feed system lineup that the station implemented during the initial response and stabilization, an abnormal condition developed in a scram response related vessel parameter—specifically, reactor vessel level—that required re-entry into EOPs.

If the USwC performance indicator only applied during the brief window between the scram and the initial stabilization that allows for EOP exit, then the above guidance--in particular, the specification of EOP re-entry as a basis for triggering the USwC PI--would not make sense. As soon as the EOP was exited, the window of applicability for the PI would close, preventing EOP re-entry from triggering the PI. The clarifying language explicitly calls out EOP re-entry as a basis for triggering the PI, so an interpretation that closes out the window of applicability as soon as the EOP is exited cannot be consistent with the intent.

Potentially relevant FAQs:

FAQ 10-02 significantly revised Section 2.1 of NEI 99-02 on August 31, 2013.
FAQ 18-03 Unplanned Scrams with Complications (USwC) PI

Response Section

Proposed Resolution of FAQ:

Based on the definition of Scram Response Time, the response to the guidance questions below are:

1. Was main feedwater unavailable or not recoverable using approved plant procedures during the scram response?"

   Should be "NO" provided that the main FW system was available for use within an estimated 30 minutes of the event.

2. Following initial transient did stabilization of reactor pressure level and drywell pressure meet the entry conditions for EOPs?

   Should be "NO" since all Scram Response criteria were met within 11 minutes of the initial scram and was being maintained in a stable condition for the duration of the event. Therefore, the reactor was never considered to be in an unstable condition.

If appropriate, provide proposed rewording of guidance for inclusion in next revision:

Because it is believed this FAQ is answered with existing NEI 99-02 Rev. 7 guidance no wording changes are proposed.