# FAQ 22-02: Diablo Canyon Scram – Proposed NRC Response

**Plant:** Diablo Canyon Power Plant Unit 2
**Date of Event:** 10/15/2021
**Submittal Date:** May 23, 2022


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**Performance Indicator:** IE 04, Unplanned Scrams with Complications

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

**FAQ to Become Effective** (X) when approved.

## Question Section

**NEI 99-02 Guidance needing interpretation:**

Page 24, lines 26-29

Page H-4, lines 26-32

Page H-5, lines 35 to 40

**Event or circumstances requiring guidance interpretation:**

On October 15, 2021, at 17:49 Pacific Daylight Time, DCPP Unit 2 was operating at 90 percent power. While diagnosing a potential tube leak in FWH 2-5B, the reactor was manually tripped in accordance with plant procedures due to increasing water level in the feedwater heater. The Operations crews responded to this event in accordance with plant operating procedures. There were no inoperable Technical Specification structures, systems, or components that contributed to the event.

Following the reactor trip, all safety-related equipment operated as designed. The auxiliary feedwater system (AFW) started as expected.

This FAQ focuses on the flowchart question pertaining Main Feedwater availability and recovery using approved plant procedures during the scram response.

Based on Figure 2, "IE04 Unplanned Scrams with Complications – Flowchart," on Page 29 of NEI 99-02, "Regulatory Assessment Performance Indicator Guideline," Revision 7, 5 of the 6 criteria for “no complications” are clear and not the subject of this FAQ:

- the control rods fully inserted
- the turbine tripped
- power was not lost to any Emergency Safeguards Features (ESF) bus
- a Safety Injection signal was not received
- the scram response procedure was completed without entering another Emergency Operating Procedure (EOP)

## Event Timeline, DCPP Unit 2, October 15, 2021 (All Times PDT):

17:12 Ramp completed at 1050 MW to support isolating and bypassing FWHs 2-5B & 2-

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| | 6B |
| 17:20 | Isolation activities commenced for FWH 2-5B & 2-6B |
| 17:40 | Isolation of condensate inlet to FWH 2-6B completed |
| 17:49:35 | Manual reactor trip Initiated due to level in FWH 2-5B being out-of-sight high per annunciator response procedure AR PK10-21 |
| 17:49:41 | Main steam isolation valves (MSIVs) manually closed per annunciator response procedure AR PK10-21 |
| 19:06 | Main condenser vacuum broken per annunciator response procedure AR PK10-21 |
| 20:36 | Secured condensate and booster pump sets per annunciator response procedure AR PK10-21 |

**NRC INSPECTOR POSITION:**

The resident inspectors and RIV maintain that the October 15th trip of Unit 2 at Diablo Canyon Power Plant should be considered an “Unplanned Scram with Complications” due to the inability of the operations crew to start a Main Feedwater pump and feed the Steam Generators with the Main Feedwater System. This inability to feed the Steam Generators with the Main Feedwater System was not due to a design feature or procedural prohibition. The damage to the Feedwater heater 2-5B required closing of the MSIVs, thus rendering the steam-driven Main Feedwater Pumps unavailable due to loss of motive force (main steam).

The operations staff would not have been able to start and operate main feedwater pumps using EOP FR-H.1, "Response to Loss of Secondary Heat Sink," Step 7, because the MSIVs were closed. The MSIVs were closed as a result of the severe tube leak in FWH 2-5B, which the station had been unable to isolate while the unit was online. Therefore, the unavailability of the Main Feedwater Pumps was a consequence of the failure of the main feedwater system (FWH 2-5B tube failure), not a design feature or a procedural prohibition.

If the conditions to feed with main feedwater pumps are not met, the condensate/condensate booster pumps are used to feed one steam generator, per EOP FR-H.1. This requires reduction of the pressure in one SG to below the condensate booster pump shutoff head (to approximately 480 psig), and is therefore a less desirable method than feeding the steam generators using the main feedwater pumps. The main feedwater pumps are a vital component of the main feedwater system. The discussion of reducing the secondary system below the injection capabilities of the condensate and condensate booster pump does not constitute equivalency of restoring the main feedwater system. The ability to use condensate/booster pumps to feed steam generators under extreme cases where main feedwater and auxiliary feedwater are no longer available is a common Westinghouse design. Despite the common nature of the method, this path is not discussed in the NEI 99-02, Revision 7, guidance as an acceptable means toward considering main feedwater available.

During the October 15th scram, immediate restarting of main feedwater pumps would not have been possible using the approved emergency operating procedure. Nor would main feedwater be able to be restored within 30 minutes, as required by NEI 99-02 guidance for feedwater availability credit. Note that there is no design feature or procedural prohibition that would prevent restarting Main Feedwater after a trip; in fact, EOP FR-H.1, “Response to Loss of Secondary Heat Sink,” Step 7 directs operators to place main feedwater pumps

back in service to feed the SGs via the feedwater regulating bypass valves. Thus, the question, “Was Main Feedwater unavailable or not recoverable using approved plant procedures during the scram response?” requires an answer of, “Yes,” per the guidance in NEI 99-02, Revision 7, and the October 15th trip should be designated as an “Unplanned Scram with Complications.”

**SITE POSITION:**

Main Feedwater System Description:

The main feedwater system consists of two steam-turbine-driven feed pumps, which take suction from the condensate system and provide feedwater to each of the four SGs via a common discharge header. Unlike some Westinghouse PWRs, the DCPP main feedwater system design does not include a motor-driven pump. During normal plant shutdown conditions, the AFW system provides feed flow when the SGs are being used for secondary heat removal.

In the event of a loss of AFW following a reactor trip, secondary cooling is established using one of two methods:

(1) Reestablish main feedwater flow via the feedwater regulating bypass valves (per EOP FR-H.1, "Response to Loss of Secondary Heat Sink," Step 7):

Main feedwater pumps are placed back in service to feed the SGs via the feedwater regulating bypass valves if certain plant criteria are met. This requires the main condenser to be available (vacuum established, at least one circulating water pump running, and MSIVs open) and the feedwater isolation signal to be reset. As noted above, the main feedwater pumps are steam-driven.

(2) Use the condensate/condensate booster pumps to establish flow at reduced secondary pressure (per EOP FR-H.1, "Response to Loss of Secondary Heat Sink," Step 9):

If the conditions to feed with main feedwater pumps are not met, the condensate/condensate booster pumps are used to feed one SG. This requires reduction of the pressure in one SG to below the condensate booster pump shutoff head (to approximately 480 psig).

**(NEI 99-02, Revision 7, Page 24, line numbers 26 to 29): "**For plants with design features or procedural prohibitions that prevent restarting Main Feedwater, this question should be answered as "No" if Main Feedwater is free from damage or failure that would prevent it from performing its intended function and is available for use."

Because approved plant procedures resulted in closure of the MSIVs which prevented restarting the main feedwater pumps, the answer to this question should be no. Closure of the MSIVs would have delayed the availability of main feedwater utilizing the main feedwater pumps, however, the main feedwater system was free of damage or failure that would have prevented it from performing its function.

**(Page H-4, line numbers 26 to 32): "**Since all PWR designs have an emergency Feedwater system that operates if necessary, the availability of the normal or main Feedwater systems as a backup in emergency situations can be important for managing risk following a reactor scram. This portion of the indicator is designed to assess that backup availability or ability to recover main feedwater as directed by approved plant procedures (e.g., the EOPs) on a loss of all emergency Feedwater."

The above uses "normal or Main Feedwater" but does not define what they are, nor does it specify the use of only main feedwater pumps. DCPP design includes an alternative option to providing cooling water to steam generator via electrically driven condensate booster pumps.

**(Page H-5, line numbers 31 to 40):** The estimated 30-minute timeframe for restart of main Feedwater was chosen based on restarting from a hot and filled condition. Since this timeframe will not be measured directly it should be an estimation developed based on the material condition of the plants

systems following the reactor trip. ..... The judgment of the on-shift licensed SRO during the reactor trip should be used in determining if this timeframe was met.

> **Simulator Scenario:** Operations estimated that the time it would take to establish flow to one depressurized SG to allow the condensate/booster pump set to inject feedwater in accordance with EOP is approximately 33 minutes, which is consistent with the time estimate of "about 30 minutes" in the NEI 99-02, Revision 7 for establishing main feed. During this simulator scenario, it was observed that the level in the other three SGs remained above the SG dry-out criteria.

## **Facts**:

1. Due to a FWH tube leak, the reactor was manually tripped in accordance with an annunciator response procedure.
2. The MSIVs were manually closed in accordance with annunciator response procedure.
3. Following the reactor trip, all safety-related equipment operated as designed. The AFW system started as expected. No complications were experienced during or after the reactor trip. There were no inoperable Technical Specification structures, systems, or components that contributed to the event.
4. There was no abnormal equipment condition that would have precluded the use of the main feedwater flow path. The only degradation in the feedwater system was the tube leakage experienced in Feedwater Heater equipment. This condition would not preclude the use of the main feedwater flowpath to supply feedwater to the SGs in order to maintain a heat sink.
5. The main feedwater pumps are steam-driven.
6. There are no electric-driven main feedwater pumps at DCPP.
7. At DCPP, the AFW and main feedwater pumps are the only pumps that supply the SGs with water when the SGs are at normal operating pressure.
8. The condensate booster pumps are in the main feedwater system flow path. The same water is provided to the steam generators using the same flow path as the main feedwater pumps.

**Conclusion:** Based on the guidance of NEI 99-02, Revision 7, and the simulator study, the licensee concluded that the question "Was Main Feedwater unavailable or not recoverable using approved plant procedures during the scram response?" should be answered "No," either (1) because of the design features (steam driven main feedwater pumps) and procedural instructions at DCPP which directed closure of MSIVs, or (2) because of the ability to provide feedwater to one depressurized SG (to approximately 480 psig) via a condensate/condensate booster pump set within about 30 minutes utilizing plant procedures. The plant conditions did not cause an actual complication for the operations staff during the reactor trip response. Therefore, in accordance with either of the exceptions stated on page 24, page H-4, and page H-5 of NEI 99-02, Revision 7, this event should be classified as a "Normal Scram."

**If licensee and NRC resident/region do not agree on the facts and circumstances, explain:**
N/A

**Potentially relevant FAQs:**

FAQ 14-03

FAQ 14-03 discussed two ways that backup to EFW (AFW at DCPP) could have been provided, including an alternate (referred to as AFW for ANO) means to provide feedwater to SGs. A similar

position is being made regarding using condensate booster pumps, as directed by DCPP procedures, to establish backup cooling via the main feedwater piping to a steam generator. The FAQ was silent on the argument for alternate means, instead agreeing that MFW could have been recovered within 30 minutes, and the trip was uncomplicated.

## Response Section

**Proposed Resolution of FAQ:**
Based on the guidance of NEI 99-02, Revision 7 the NRC Staff concluded that the question "Was Main Feedwater unavailable or not recoverable using approved plant procedures during the scram response?" should be answered "Yes," because the steam driven main feedwater pumps were not able to be started due to the closure of MSIVs. The MSIVs which were required to be closed specifically in response to a feedwater system issue rather than another shutdown reason (e.g., low decay heat, normal plant shutdown sequence, etc.). In this case, the MSIVs were closed due to a latent failure of a feedwater heater. Additionally, the use of condensate booster pumps is not recognized by NEI 99-02 as an equivalent method to feed a steam generator as a Main Feedwater pump. Therefore, this event should be classified as an Unplanned Scram with Complications.

**If appropriate, provide proposed rewording of guidance for inclusion in next revision:**
N/A

**PRA update required to implement this FAQ?**
No

**MSPI Basis Document update required to implement this FAQ?**
No

**Proposed NRC Response:**

The NRC staff completed the evaluation of this FAQ by reviewing the details of the event provided in this FAQ and the guidance provided in NEI 99-02, Revision 7. The evaluation took into consideration the review by resident inspectors, operator licensing staff, and other headquarters staff.

The purpose of the IE04, “Unplanned Scrams with Complications,” performance indicator, as stated in NEI 99-02, Revision 7 and IMC 308 Attachment 1, is to monitor “that subset of unplanned automatic and manual scrams that either require additional operator actions beyond that of the “normal” scram or involve the unavailability of or inability to recover main feedwater. Such events or conditions have the potential to present additional challenges to the plant operations staff and therefore, may be more risk-significant than uncomplicated scrams.” Further clarifying guidance on what is considered an unplanned scram with complications is included in NEI 99-02, Revision 7. Specifically, NEI 99-02 includes six questions applicable to PWR scrams – if any of the questions are answered ‘yes’ then the scram counts as a complicated scram.

1. Did two or more control rods fail to fully insert?
2. Did the turbine fail to trip?
3. Was power lost to any ESF bus?
4. Was a Safety Injection signal received?
5. Was Main Feedwater unavailable or not recoverable using approved plant procedures during the scram response?
6. Was the scram response procedure unable to be completed without entering another EOP?

The review of this FAQ will focus on clarifying question 5 for this event.

> Was Main Feedwater unavailable or not recoverable using approved plant procedures during the scram response?

Specifically, NEI 99-02, Rev. 7 guidance:

- Page 24, lines 26-29
- Page H-4, lines 26-32
- Page H-5, lines 35 to 40

**NEI 99-02, Revision 7, Page 24, line numbers 26 to 29**

> *For plants with design features or procedural prohibitions that prevent restarting Main Feedwater, this question should be answered as "No" if Main Feedwater is free from damage or failure that would prevent it from performing its intended function and is available for use.*

It is the NRC staff's position that for the Diablo Canyon Unit 2 scram on October 15, 2021, Main Feedwater was not free from damage that would prevent it from performing its intended function and was unavailable for use. The latent tube leak of Feedwater heater 2-5B when the scram occurred caused the operators to close MSIVs in accordance with plant procedures, this action rendered the steam-driven Main Feedwater Pumps unavailable due to loss of motive force i.e., main steam.

**Page H-4, line numbers 26 to 32**

> *Since all PWR designs have an emergency Feedwater system that operates if necessary, the availability of the normal or main Feedwater systems as a backup in emergency situations can be important for managing risk following a reactor scram. This portion of the indicator is designed to assess that backup availability or ability to recover main feedwater as directed by approved plant procedures (e.g., the EOPs) on a loss of all emergency Feedwater.*

**And**

**Page H-5, line numbers 31 to 40**

> *The estimated 30-minute timeframe for restart of main Feedwater was chosen based on restarting from a hot and filled condition. Since this timeframe will not be measured directly it should be an estimation developed based on the material condition of the plants systems following the reactor trip… The*
>
> *judgment of the on-shift licensed SRO during the reactor trip should be used in determining if this timeframe was met.*

While it is true that "normal and Main Feedwater" is not explicitly defined in NEI 99-02, Rev. 7, starting a Main Feed Pump and feeding the Steam Generators is mentioned on multiple occasions throughout NEI 99-02, Rev 7 (see below), strongly suggesting that "normal and Main Feedwater" would include starting a Main Feedwater pump and not relying on condensate booster pumps, which cannot be used unless and until the steam generators are depressurized to 480 psig.

> *(Page 24, line numbers 21-24)*
> *Additionally, the restoration of Feedwater must be capable of feeding the Steam Generators in a reasonable period of time. Operations should be able to start a Main Feedwater pump and start feeding Steam Generators with the Main Feedwater System within about 30 minutes from the time it was recognized that Main Feedwater was needed.*

*(Page H-5, line numbers 13-16)*
*Loss of one feed pump does not cause a loss of main feedwater. Only one is needed to remove residual heat after a trip. As long as at least one pump can still operate and provide Feedwater to the minimum number of steam generators required by the EOPs to satisfy the heat sink criteria, main feedwater should be considered available.*

**Reference to FAQ 14-03**

The licensee pointed to this ANO FAQ as potentially applicable. This FAQ considered two ways to provide a backup to EFW ─ using the site specific AFW pump or restarting MFW without condenser vacuum. The staff at the time focused on the licensee's ability to recover MFW since NEI 99-02 highlights the importance of having normal or Main Feedwater available (excerpt below).

*(FAQ 14-03 "ANO Scram March 31, 2013," NRC Response)*
*For this event, ANO proposes that backup to EFW could have been provided in two ways: (1) using AFW, or (2) restarting MFW without condenser vacuum. The staff's review was focused on the licensee's ability to recover MFW, since NEI 99-02 highlights the importance of having normal or main feedwater available as a backup to EFW in emergency situations. NEI 99-02 does not discuss the applicability of AFW as a backup to EFW under the Unplanned Scrams with Complications PI.*

*The staff reviewed the licensee's procedures for restarting MFW without condenser vacuum and agrees that MFW could likely have been recovered within 30 minutes. The staff also recognizes that the Reactor Coolant System parameters were stabilized in less than 30 minutes, and that the MFW pump could operate without condenser vacuum for several hours, according to the information provided in this FAQ. The staff concludes that this event does not count in the Unplanned Scram with Complications PI.*

In conclusion, upon reviewing the event details, prior applicable FAQs, and discussing the circumstances surrounding the October 15, 2021, reactor scram, the staff determined that the answer to Question 5 regarding main feedwater is 'Yes' and this event should be classified as an Unplanned Scram with Complications (IE04). No changes to NEI 99-02 are needed because of this FAQ.