

FAQ 23-01 (Rev. 1)
DC Cook Unit 1 Unplanned Scram Exemption Request

Plant: DC Cook
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Licensee Contact: M. Scarpello Tel/email: mkscarpello@aep.com
NRC Contact: Paul Zurawski Tel/email: paul.zurawski@nrc.gov

Performance Indicator:

IE01 – Unplanned Scrams Per 7,000 Critical Hours

Site-Specific FAQ (see Appendix D)? Yes. This FAQ is submitted to request an exemption from the current guidance due to unique conditions.

FAQ to become effective when approved.

Question Section

NEI 99-02, Rev. 7 Guidance to be referenced for the one-time exemption request (including page and line citation):

Page number and line citations are from the copy of NEI 99-02, Revision 7 posted on the ROP Program Document Page of the NRC website.

- Section 2.1 Initiating Events Cornerstone, page 11, lines 6 – 19; “Definition of Terms”
- Section 2.1 Initiating Events Cornerstone, page 12, line 1 - 2; “Clarifying Notes”
- Appendix C, Background Information and Cornerstone Development, page C-1, lines 10 – 33; “Initiating Events Cornerstone”

Event or circumstances requiring guidance interpretation:

This FAQ is submitted to request a one-time exemption from the guidance related to “Unplanned Scrams Per 7,000 Critical Hours” for DC Cook. The request made is due to the unique circumstances of the event, which led operators to shut down the reactor by performing a manual reactor trip following a manual trip of the main turbine due to high vibrations. The high vibrations were encountered while attempting to return the unit to service following substantial maintenance on the high-pressure turbine. The maintenance activities are not optional and are critical to maintain the turbine. The scope of maintenance involved the complete replacement of all interstage and shaft gland labyrinth seals. Significant “rubs” within the turbine are expected to occur during startup following this maintenance that may result in vibration issues. The reactor shut down was performed at approximately 12 percent power, prior to synchronizing the generator to the electrical grid to conclude the refueling outage.

Sequence of Events

Following conclusion of refueling outage maintenance activities, operators manually tripped the main turbine on three occasions during activities to return the unit to service while following procedures for normal turbine generator startup:

- On 5/23/22 at 0620 hours: During the first turbine roll, the main turbine experienced elevated vibrations at approximately 500 rpm and operators manually tripped the turbine. The turbine rotor experienced a rub, which caused the shaft to bow.
- On 5/23/22 at 1420 hours: During the second turbine run, thrust bearing metal temperatures increased above operating limits at 1800 rpm and operators manually tripped the turbine. The cause of the increased temperatures was due to inadequate thrust bearing clearance.
- On 5/24/22 at 0403 hours: During the third turbine run, the main turbine experienced elevated vibrations and operators manually tripped the turbine in accordance with annunciator response procedure. The turbine was tripped during speed escalation through the first critical speed band at approximately 1221 rpm. The turbine rotor experienced a rub, which caused the shaft to bow.
- On 5/24/22 at 0414 hours: Following the manual turbine trip, the turbine speed lowered down through the first critical speed band, which exacerbated the rub. Due to reaching procedure pre-established vibration limits to preclude damage to the turbine, operators shut down the reactor by performing a manual reactor trip from approximately 12% power in accordance with DC Cook normal practice to permit breaking condenser vacuum in the main condenser in order to achieve a turbine speed below the first critical band as quickly as possible. Manually tripping the reactor was an understood planned response when vibrations reached pre-established limits, to aid in slowing the turbine much faster than with the turbine condenser under vacuum conditions. The planned manual reactor trip went as expected with no abnormal equipment response. Initially, decay heat was removed by the condenser steam dump system. As part of the planned sequence of activities, decay heat removal from the condenser steam dump system was transferred to the atmospheric steam dumps (SG PORV) as expected. This is done by the operators taking the controllers that were in automatic operation mode and at the normal setpoint of approximately 1025 psig and lowering the SG PORV controller pressure setpoints to closely match steam generator pressure to accept load. The steam generator stop valves were closed in preparation to break condenser vacuum. Following closure of the stop valves, the decay heat flow path was to the steam generator SG PORVs. RCS temperature stabilized, as expected. There were no equipment challenges or other issues present until condenser vacuum was re-established, as the unit could be cooled down and depressurized to Mode 5 with Residual Heat Removal (RHR), if desired. Condensate Storage Tank levels were normal and make-up sources remained available with ample capacity to replenish the condensate consumed by remaining on the Steam Generator PORVs to remove decay heat.

- On 5/24/22 at 0425 hours: Operators broke main condenser vacuum in accordance with the normal operating procedure. The procedure provides direction for breaking main condenser vacuum under specific conditions, which include turbine vibration limits (high-high vibrations (14 mils)), to prevent damage. The steam dump system was functional and available for use at a time when condenser vacuum was re-established.
- On 5/30/22 at 0539 hours: Following inspections and repairs to the main turbine, Unit 1 synchronized to the electrical grid.

Additional Information

The circumstances of attempting to return the unit to service following a refueling and maintenance outage that involved a manual reactor trip were not severe enough and unlikely to cause an initiating event, based on plant conditions at the time.

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

The NRC resident/region are in agreement with the licensee on the facts and circumstances surrounding or submitting this FAQ.

Additionally, the corresponding Licensee Event Report (LER) 315/2022-001-00 “Manual Reactor Trip Following Manual Turbine Trip Due to High Vibrations on Main Turbine” was reviewed in accordance with IP 71153. This review recommended the LER to be closed during the 4Q2022 Integrated Baseline Inspection exit meeting in January 2023, with no Findings or Violations.

Potentially relevant existing FAQ numbers:

There were no relevant FAQs that reflect similar requests or resolution for IE01 “Unplanned Scrams Per 7,000 hours.”

Response Section

Proposed resolution of FAQ:

This FAQ is proposed as a one-time exemption for not counting the subject event as an unplanned scram for DC Cook, due to the unique circumstances of the event that led operators to perform a manual reactor trip.

Unit 1 had recently completed a refueling and maintenance outage. There was substantial critical maintenance completed on the high-pressure turbine that could not have been eliminated. The scope of maintenance involved the replacement of all interstage and shaft gland labyrinth seals. This maintenance is certain to produce “rubs” which result in vibration issues during startup. Following completion of critical maintenance activities on the turbine, the first opportunity and only method to verify effectiveness is during low power levels necessary to operate the machine

at prescribed or rated speed. The manual reactor trip occurred prior to synchronizing to the electrical grid at a low power level of approximately 12 percent. Manually tripping the reactor was an expected response in the event that vibration levels reached pre-established limits in order to prevent damage to the turbine and is similar to the method that DC Cook normally uses to shut down the reactor from a low power level. The DC Cook normal shutdown procedure provides instruction to scram at approximately 17 percent power during normal shut down.

The manual turbine trip due to excessive vibrations and the shut down by manual reactor trip that followed was a known contingency to prepare to break condenser vacuum, as necessary, to protect large capital equipment. DC Cook plant relies on the Auxiliary Feedwater System (AFW) to provide dedicated feedwater flow that is not dependent upon main condenser vacuum to operate, unlike the turbine driven main feedwater pumps. The AFW system has a feedwater flow capacity limited to approximately 4 percent power. The SG PORVs have the capacity to remove decay heat up to approximately 10 percent power. Based on the design of the plant and reactor power level as described above, it is an expected response to pre-emptively, manually shut down the reactor to a power level that is within the capability of the AFW system to maintain steam generator levels, prior to breaking main condenser vacuum.

The SG PORVs are used as a normal mode of pressure and temperature control during conditions when condenser vacuum is unavailable. The SG PORV controllers are normally set in automatic operation at a pressure setpoint of 1025 psig. The condenser steam dump controllers are normally operated at a pressure setpoint of 1005 psig. The procedure steps taken prior to breaking condenser vacuum require closing the steam generator stop valves which transfers the decay heat flow path from the condenser steam dumps, allowing steam pressure to slightly rise, and open the SG PORVs at steam pressure setpoint. The SG PORV controllers produce a modulating output demand signal to gradually open and close the valves, as opposed to cycling full open or closed.

Under normal circumstances, main condenser vacuum is maintained until the main turbine generator decelerates to 10 percent of rated speed (180 rpm) to prevent damage to the low-pressure turbine last stage blades. When reaching procedure pre-established vibration limits, the main condenser vacuum breakers can be opened at any speed. High vibrations levels occurred as the turbine speed lowered down through the first critical speed band which is above 180 rpm.

Operator actions and power levels during normal power reduction to take the unit offline and during the event when the high turbine vibrations occurred are similar. During normal power reduction activities, operators plan to manually trip the reactor at approximately 17 percent power to bring the unit to hot standby conditions in a controlled manner. Similarly, the unit was at approximately 12 percent power during the manual reactor trip following a manual turbine trip due to high vibrations which did not upset plant stability.

The manual reactor trip was discussed by plant control room operators as a planned action if vibrations reached pre-established procedural vibration limits. The plant shut down was expected given the plant power level to support alignment of the plant to break condenser vacuum and quickly slow the main turbine.

There were no equipment failures or human performance events that led to the manual reactor trip.

Counting the scram where it was expected and pre-established contingency limits are met against the performance indicator as unplanned, is a disincentive to performing critical maintenance. Post maintenance testing of the main turbine can only be achieved at power levels necessary to operate the machine at prescribed or rated speed. This one-time exemption is appropriate due to these unique circumstances.

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

No. This FAQ is requesting a one-time, site-specific exemption from the current guidance due to unique conditions.

PRA update required to implement this FAQ? No.

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