FAQ 18-03
Columbia Scram Exemption Request – Proposed NRC Response

Plant:	Columbia Generating Station	
Date of Event:	August 20, 2017	
Submittal Date:		
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Performance Indicator: Unplanned Scrams with Complications
Site-Specific FAQ (see Appendix D)? Yes
FAQ to become effective when approved.

Question Section

Nuclear Energy Institute (NEI) 99-02 Guidance needing interpretation (include page and line citation):

- NEI 99-02, Revision 7, Page 24, lines 45-46, and
- NEI 99-02, Revision 7, Page 25, lines 1-3

Event or circumstances requiring guidance interpretation:
This FAQ this is being submitted to request a plant-specific exemption from the guidance related to Unplanned Scrams with Complications (USwC) for Columbia due to the unique circumstances of the event which led to operators intentionally reducing pressure in the reactor pressure vessel (RPV) post scram resulting in a second +13 inch scram common to Boiling Water Reactor (BWR) designs.

On August 20, 2017, Columbia Generating Station (Columbia) operators manually scrammed the reactor in response to condenser vacuum degradation following an air removal valve closure. The scram was performed per procedure to prevent an automatic turbine trip (resulting in an automatic reactor scram), main steam isolation valve (MSIV) closure, and reactor feed turbine trip – all of which occur at various low condenser vacuum setpoints. Condenser vacuum was recovered before any of these actions could occur.

For BWRs, RPV water level responds to changes in RPV pressure following a reactor scram. Specifically, RPV water level reaches the Emergency Operating Procedure (EOP) entry criteria of Level 3, +13 inches, due to collapsing of voids when the turbine throttle and governor valves go closed to isolate steam flow to the turbine, reference NEI 99-02 FAQ 18-01, Definition of Initial Transient. During this pressure transient, there is no loss of water inventory in the vessel. In response to this, operators will enter the EOPs (Plant Procedures Manual (PPM) 5.1.1 for Columbia) and initial RPV level control will be with the feedwater level control system in automatic and RPV pressure control will be with the turbine bypass valve control system in automatic. Operators will then transition level control from reactor feed turbine automatic control to throttling with the start-up level control valves in automatic control. This transition is directed per procedures and allows for more precise level control in low feed flow conditions. During this transition, operators take manual control of the reactor feed turbine speed and the level control valve position per procedure. An initial level band is established using available injection systems in order of preference. For Columbia this band is from +13 inches to +54 inches. The feedwater level control valves control level in automatic. During a normal BWR

scram, pressure drops during the initial void collapse and will restore automatically once the turbine bypass valve control system responds.

For the event on August 20, 2017, following the reactor scram, condenser vacuum continued to slowly deteriorate. Continued degradation of condenser vacuum could result in closure of the MSIVs and a loss of reactor feed pumps. Prior to exiting the normal scram response procedure (PPM 3.3.1) and EOP (PPM 5.1.1) approximately 18 minutes after the initial scram, operators took action to lower RPV pressure to maintain the availability of the condensate system to control RPV level. This was an intentional operator action to reduce reactor pressure to maximize the time that the condenser could be used to reject energy from the RPV. It also rejected energy into the main condenser that would otherwise have been rejected to the suppression pool through the main steam safety/relief valves (SRVs) following MSIV closure. During the pressure reduction, the allowable cool down rates were not exceeded.

At the beginning of the pressure reduction, operators controlled RPV level in automatic midway between the established level band of +13 inches to +54 inches at the normal value of +36 inches. This value can allow for RPV level swell, which occurs at the beginning of the pressure reduction, similar to effects seen in a steam generator for a Pressurized Water Reactor (PWR). Control of initial RPV level is crucial to prevent the RPV level swell from reaching the Level 8 setpoint, which occurs at +54.5 inches. At Level 8, the reactor feed pumps trip and the high pressure core spray (HPCS) and reactor core isolation and cooling (RCIC) system injections automatically terminate, if running.

When the desired pressure was attained the turbine bypass valves were throttled closed to terminate the pressure reduction thereby maintaining RPV pressure in the specified band. This resulted in an expected shrinkage of RPV water level due to collapsing of voids, similar to what occurs following a BWR scram. The RPV water level again momentarily dropped below the +13 inch (Level 3) setpoint while the feedwater level control system responded. Reactor water level was restored to normal levels automatically in less than a minute without operator action. The effects of swelling and shrinkage do not represent a loss of inventory in the reactor pressure vessel.

BWR operators need to account for swelling and shrinkage when depressurizing the RPV. However, while reaching the Level 8 setpoint upon water level swell will result in undesirable termination of inventory injection systems, reaching the Level 3 setpoint upon water level shrinkage does not result in any undesirable effects. That is, for BWRs, following a scram and initial RPV level excursion below +13 inches, there is no operational impact to a subsequent momentary level excursion below +13 inches during a controlled fast reduction in RPV pressure when the scram has not yet been reset since there are no additional actuations or complications. Inventory is not lost during shrinkage, all feedwater capability is still available and condensate is in service. Due to the condensate system in service and the feedwater system availability, reaching the Level 3 setpoint has no operational impact. In comparison, at Level 2, -50 inches, HPCS and RCIC, among other systems, will initiate automatically when accident conditions exist. The actuations at Level 2 create additional operator action to secure systems once started.

Per NEI 99-02 Rev 7 guidance, page 25, this scram was counted as an USwC due to the second reactor water level scram signal during the scram response. Energy Northwest requests an exemption from reporting as an USwC due to the unique circumstances of this event which led to operators intentionally reducing pressure in the RPV post scram per station procedures resulting in a second +13 inch scram common to BWR designs. For BWRs

post-scram responses in which a rapid RPV pressure reduction results in a subsequent reactor water level scram signal provides no additional operational challenges when the RPV level response was the result of intended operator actions, no accident conditions exist, available systems automatically recover level to above the Level 3 (scram) setpoint, and no additional actuations or complications occur.

NEI 99-02 Rev 7 page 19 states that the purpose for the USwC is to monitor "scrams that either require additional operator actions beyond that of the normal scram or involve the unavailability of or inability to recover main feedwater." Common to BWR plant designs, a controlled fast reduction in RPV pressure performed as part of approved procedures using forethought and operational knowledge which results in a momentary low level below the scram setpoint presents no additional operator action to restore RPV level. Feedwater flow remains available and able to automatically recover RPV level. Therefore, for a BWR, this event does not meet the intent of the complicated scram Performance Indicator (PI). As discussed in FAQ 18-01, Definition of Initial Transient, the expected collapsing of voids did not represent an inventory loss and feedwater from both main feedwater pumps was available during the transient, therefore no abnormal condition pertaining to water inventory existed.

NEI 99-02 Rev 7 page 24 lines 45-46 and page 25 line 1 states the following:

> *The requirement to remain in the EOPs because of reactor pressure/water level and drywell pressure following the initial transient indicates complications beyond the typical reactor scram.*

As described in the event for Columbia and typical of BWR plant response, the initial expected level excursion below +13 inches requires entry into the EOPs as discussed in FAQ 18-01, Definition of Initial Transient. However, no additional actions were taken in the EOPs to restore RPV level for the expected first or second level excursion as no emergency existed, and the feedwater level control system operated as designed; therefore, there was no requirement to "remain in the EOPs".

From page 25 lines 2-3, "Additionally, reactor water level scram signal(s) during the scram response indicate level could not be stabilized and require this question be answered — "Yes."" Although a BWR experiences a 'reactor water level scram signal' at the +13 inch setpoint during a controlled fast reduction in RPV pressure due to void collapse, this does not indicate that RPV level cannot be stabilized. As experienced by Columbia's event on August 20, 2017, and then subsequently demonstrated in Columbia's simulator, the subsequent +13 inch RPV water level excursion is an expected evolution that lasts for less than a minute and is automatically restored and stabilized by the feedwater level control system.

If licensee and NRC resident/region do not agree on the facts and circumstances, explain:
This event was counted as an Unplanned Scram with Complications due to the second reactor water level scram signal during the scram response. The licensee asks that the NRC reconsider this event as an uncomplicated scram for Columbia due to the unique circumstances of the event which led to operators intentionally reducing pressure in the RPV post scram per station procedures resulting in a second +13 inch scram common to BWR designs. The language in NEI 99-02 for this PI is overly restrictive and does not allow for events such as this where there are no operational impacts of momentarily reaching additional reactor water level scram signals where no emergency exists. As described above no emergency existed pertaining to reactor pressure or level, and operators were not required to "remain in the EOPs".

This level excursion below +13 inches was an expected evolution and did not "present additional challenges to the plant operators" NEI 99-02 page 19 line 6.

Potentially relevant FAQs:
FAQ 18-01, Definition of Initial Transient

Response Section

Proposed Resolution of FAQ:
This FAQ is proposed as a plant-specific exemption for this event as an uncomplicated scram for Columbia due to the unique circumstances of the event which led to operators intentionally reducing pressure in the RPV post scram per station procedures resulting in a second +13 inch scram common to BWR designs. This event was the result of intended operator actions, no accident conditions existed, available systems automatically recovered reactor water level above the scram setpoint, and no additional actuations or complications occurred.

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

PRA update required to implement this FAQ? No

MSPI Basis Document update required to implement this FAQ? No

Attachment: August Scram Timeline

Proposed NRC Response:

The purpose of the IE04, "Unplanned Scrams with Complications," performance indicator, as stated in NEI 99-02, Revision 7, 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 BWR scrams – if any of the questions are answered 'yes' then the scram counts as a complicated scram.

- Did an RPS actuation fail to indicate / establish a shutdown rod pattern for a cold clean core?
- Was pressure control unable to be established following the initial transient?
- Was power lost to any Class 1E Emergency / ESF bus?
- Was a Level 1 Injection signal received?
- Was Main Feedwater not available or not recoverable using approved plant procedures during the scram response?
- Following initial transient, did stabilization of reactor pressure/level and drywell pressure meet the entry conditions for EOPs?

In the case of the scram that is the subject of this FAQ, a controlled pressure reduction carried out in accordance with procedures roughly 18 minutes following the reactor scram resulted in a momentary (less than one minute) drop in RPV level slightly below Level 3. The feedwater

control system promptly automatically responded to the level decrease without any operator action needed. Because RPV Level 3 is an EOP entry point, the answer to the sixth question would be 'yes,' meaning this event meets the criteria for being counted in the IE04 PI as a complicated scram.

However, the feedwater system remained available and the feedwater level control system remained in automatic and appropriately responded to RPV level changes throughout the event. The pressure reduction that caused the momentary RPV level drop below Level 3 was conducted in accordance with plant procedures and RCS cooldown rates remained within the 100 degree F/hr limit. No other BWR scram questions in NEI 99-02 could be answered 'yes' before, during, or following the brief RPV level drop below Level 3.

In summary, the Level 3 deviation was both very brief and very minor, the feedwater level control system was already functioning normally and quickly restored level to an appropriate level band without operator intervention, the evolution that caused the brief and minor Level 3 excursion was deliberately conducted via appropriate plant procedure, and there were no other complications before, during, or after the Level 3 deviation that would result in answering one of the NEI 99-02 BWR scram questions as 'yes.' The staff views this as a rare and unique instance in which the complicated scram criteria in NEI 99-02 were met for a scram that the staff could not reasonably conclude had the potential to present additional challenges to the plant operations staff beyond that of a normal scram.

The staff approves the request for a plant-specific exemption from counting the August 20, 2017 Columbia scram as a complicated scram per the IE03 PI. The scram continues to count as an unplanned scram per the IE01 PI.