NEI Reactor Oversight Process Task Force Whitepaper -
Clarifications to the Unplanned Scrams per 7000 Critical Hours Performance Indicator

Introduction

This Reactor Oversight Process (ROP) Whitepaper proposes to add clarification and additional examples that would be used to help identify conditions that would result in meeting the performance indicator (PI) for Unplanned Scrams per 7000 Critical Hours. The proposed change is driven by a recognition that manual scrams to shut down the reactor may be directed by procedures other than normal operating procedures (e.g., abnormal operating procedures, annunciator response manuals) following actions taken during an unplanned transient or power change where reactor scram/trip (automatic or manual) criteria was not reached but it is desired to shut down the reactor following the unplanned transient or power change.

Additionally, plant activities following major main turbine maintenance (e.g., overhaul, rotor replacement, modification) may require a series of reactor shutdowns and startups to support main turbine start up and rolls including breaking main condenser vacuum, to complete activities to address initial turbine rubs and vibrations that may be encountered and are expected prior to parallelling the main generator to the electrical grid. These manual scrams are planned in maintenance work orders and outage schedules that would be considered planned and intended when they occur.

Finally, clarification to the definition of an unplanned scram is also proposed.

If adopted, these changes would be included in NEI 99-02, "Regulatory Assessment Performance Indicator Guideline," revision 8 that is currently in draft[1] and in review by NRC staff.

NEI 99-02 Section Affected

The change proposed by this whitepaper affects NEI 99-02 section 2.1 entitled, "initiating Events Cornerstone" for the Definition of Terms section, "Unplanned scram," clarification added to the Unplanned Scrams per 7000 Critical Hours Performance Indicator under "Examples of scrams that **are included**" which are presented on page 10 of NEI 99-02, Revision 7[2] and examples under "Examples of the types of scrams that **are not** included" on page 11.

The guidance changes to this section are shown below, under "Proposed Changes to NEI 99-02" that if approved would be included in revision 8. No changes would be required to the NRC and INPO Performance Indicator databases.

[1] Refer to ADAMS Accession Numbers ML23290A125 & ML23290A147.

[2] Refer to ADAMS Accession Number ML23010A157.

Discussion

FAQ 17-02[3] was finalized as described in the June 2017 ROP public meeting summary[4] dated July 12, 2017. In the FAQ summary, a main turbine trip occurred at 100% power causing an automatic power runback and subsequent power reduction that was initiated by the operations staff. The affected plant staff elected to shut down the reactor via a manual scram at 34% power with the turbine offline to facilitate troubleshooting and repairs. The abnormal operating procedure being used provided the option of either a plant shutdown or holding power at 12% while conducting repairs following a load rejection event. The control room staff demonstrated conservative decision making to shut down the reactor to support troubleshooting in Mode 3 versus maintaining the reactor at 12% power while at the end of the current operating cycle. Had the reactor been kept at 12% power to facilitate the repairs, it would have counted as an unplanned power change. Since the decision was made to shut down the reactor instead, the response to the FAQ resulted in counting as an unplanned scram. While the purpose of the FAQ was to determine if this scenario should count as both an unplanned power change and unplanned scram, it was determined to only count as an unplanned scram due in part to the current NEI 99-02 definition of an unplanned scram. There were no recommended changes to NEI 99-02 as a result of this FAQ.

This example illustrates a situation where a manual scram to shut down the reactor may be directed by procedures other than normal operating procedures (e.g., abnormal operating procedure) following actions taken during an unplanned transient or power change where reactor scram/trip (automatic or manual) criteria was not reached but it is desired to shut down the reactor following the unplanned transient or power change.

FAQ 18-05[5] was finalized as described in the January 2019 ROP public meeting summary[6] dated February 13, 2019. In the FAQ summary, while at 100% power, a reduction in reactor coolant pump (RCP) seal flow was observed and the plant staff performed a fast power reduction to shut down the reactor IAW their general operating procedures. The intent was to protect the equipment and shut down the reactor so that repairs could be made. It should be noted that plant procedures direct immediate trip (scram) of the reactor if RCP temperatures exceed acceptable limits. However, since RCP temperatures remained within those limits, plant operators commenced a shutdown using a general operating procedure. Once at 18% power, a manual scram was initiated to shut down the reactor to facilitate equipment repairs. Automatic or manual reactor scram/trip criteria were never reached. A conservative decision was made to shut down the reactor IAW operating procedures and support equipment protection. The plant is normally shut down in this manner when the reactor is less than 35% power. The ROP task force

[3] Refer to ADAMS Accession Number ML17207A100.
[4] Refer to ADAMS Accession Number ML17193A305.
[5] Refer to ADAMS Accession Number ML19024A500.
[6] Refer to ADAMS Accession Number ML19044A692.

supported the industry position in the FAQ that this situation should count as an unplanned power change and not an unplanned scram. Following initial discussion with the NRC staff, the FAQ was revised to include more history and insights from the development of the ROP performance indicators for initiating events. Ultimately, the NRC staff concluded that they did not view a rapid load reduction from full power to shut down within an hour, when there was no intention to do so just shortly prior, as the normal method of shutdown, nor a planned evolution. This was determined to be an unplanned scram versus an unplanned power change based on wording in NEI 99-02. It is also noted in the NRC staff response to this FAQ, *"The staff acknowledges that consideration of additional clarification to the guidance on performance indicator reporting may be beneficial."* There is no record of any additional follow-up, thus leading to this white paper and the proposed changes.

This is another example that illustrates a situation where a manual scram to shut down the reactor may be warranted and acceptable as a method to safely shut down the reactor whereas reactor scram/trip (automatic or manual) criteria was not reached but it is desired to shut down the reactor following an unplanned transient or power change.

More recently, FAQ 23-01[7] was submitted to allow for an exemption to the unplanned scram PI based on expected conditions encountered following major turbine related maintenance. History has shown that when major turbine maintenance is performed (e.g., monoblock rotor upgrade, replacement of interstage and gland labyrinth seals, other turbine work to support plant uprates) "rubs" and vibrations are expected and are addressed through maintenance work order planning and post maintenance activities during turbine roll. This may require the reactor to be shutdown in a timely manner and to lower condenser vacuum. These shutdowns and subsequent startups are planned into the outage schedules and may occur multiple times during main turbine start up activities prior to connecting the generator to the electrical grid. The use of a manual scram is a normal and acceptable method for conducting a reactor shutdown. In the NRC response to this FAQ, they considered the definition of an unplanned scram to be applicable and the description in the clarifying notes of NEI 99-02, rev. 7, "A scram that occurs during the execution of a procedure or evolution in which there is a high likelihood of a scram occurring, but the scram was neither planned nor intended."

This example illustrates that the current language in NEI 99-02 should be improved to better reflect conditions that are expected to occur requiring a reactor shutdown to support the activity versus equipment failure or conditions that are not expected to occur but have a high likelihood of a scram (manual or automatic) occurring during execution of a procedure or evolution most likely as a result of equipment failure or performance errors.

[7] Refer to ADAMS Accession Number ML23104A432.

SECY-99-007[8], **Introduction** (p.4) contained the following:
Initiating Events - The objective of this cornerstone is to limit the frequency of those events that upset plant stability and challenge critical safety functions, during shutdown as well as power operations. If not properly mitigated and multiple barriers are breached, a reactor accident could result which would compromise the public health and safety. Licensees can reduce the likelihood of a reactor accident by maintaining a low frequency of these initiating events. Such events include reactor trips due to turbine trips, loss of feedwater, loss of off-site power, and other reactor transients. (p. 4)

Appendix A of SECY 99-007, **Performance Indicators for Power Operations** (p. A-4) contains in part the following:

1. **Scrams - unplanned automatic and manual scrams while critical per 7,000 Critical Hours and risk-important scrams.**
   "This measure is a count of events that upset plant stability and challenge safety functions. The indicator includes all scrams while the reactor is critical that are not directed by a normal operating or test procedure. It also includes scrams that occur during the execution of procedures in which there is a high probability of a scram but the scram was not planned. Examples of the types of scrams included are those that result from unplanned transients, equipment failures, spurious signals, human error, or those directed by abnormal, emergency, or annunciator response procedures. This is the same as the WANO indicator that is used by all U.S. plants, except that it also counts manual scrams because, from a risk perspective, they are just as important as automatic scrams…."

While IMC-0308, Att.1, Technical Basis for Performance Indicators[9], documents the bases why manual scrams are included in the scram PI, better reflecting the differences between a manual scram directed by stations procedures for the conditions described above from those that are a result of the decision to shut down the reactor following situations where a manual or automatic scram was not required would improve the accuracy of the initiating events PIs (unplanned scrams and unplanned power changes) and overall reflection of industry performance.

[8] SECY-99-007, Recommendations for Reactor Oversight Process Improvements
[9] IMC-0305, Att. 1. Technical Basis for Performance Indicators.

Proposed Change to NEI 99-02

The proposed changes to NEI 99-02 are presented below.

NEI 99-02, revision 7, page 10

Definition of Terms

Current:

Unplanned scram means that the scram was not an intentional part of a planned evolution or test as directed by a normal operating or test procedure. This includes scrams that occurred during the execution of procedures or evolutions in which there was a high chance of a scram occurring but the scram was neither planned nor intended.

Proposed:

Unplanned scram means that the scram was not an intentional part of a planned evolution or test as directed by a normal operating or test procedure. This includes scrams that occurred during the execution of procedures or evolutions in which there was a high chance of a scram occurring but the scram was neither planned nor intended. Manual scrams that are intentionally used to shut down the reactor when the turbine is offline following a down power or transient response whereas automatic or manual scram criteria was not reached would not be considered an unplanned scram.

Current:

Examples of the types of scrams that **are included:**

- Scrams that resulted from unplanned transients, equipment failures, spurious signals, human error, or those directed by abnormal, emergency, or annunciator response procedures.

New:

Examples of the types of scrams that **are included:**

- Scrams that resulted from unplanned transients, equipment failures, spurious signals, human error, or those directed by abnormal, emergency, or annunciator response procedures unless a manual scram is used to shut down the reactor after the main generator has been removed from the electrical grid following transient response in which manual or automatic scram criteria was not reached but a reactor shutdown following the transient is desired and in accordance with either normal, abnormal operating or annunciator response procedures.

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NEI 99-02, revision 7, page 11

Current:

Examples of scrams that **<u>are not</u>** included:

- Scrams that are planned to occur as part of a test (e.g., a reactor protection system actuation test), or scrams that are part of a normal planned operation or evolution.

New:

Examples of scrams that **<u>are not</u>** included:

- Scrams that are planned to occur as part of a test (e.g., a reactor protection system actuation test), or scrams that are part of a normal planned operation or evolution (e.g., main turbine post maintenance testing or initial startup activities to address expected rubs and vibration (not equipment failures) encountered prior to parallelling the main generator to the electrical grid).

Current:

Examples of scrams that **<u>are not</u>** included:
Scrams that are initiated at less than or equal to 35% reactor power in accordance with normal operating procedures (i.e., not an abnormal or emergency operating procedure) to complete a planned shutdown and scram signals that occur while the reactor is shut down.

New:

Examples of scrams that **<u>are not</u>** included:
Scrams that are initiated at less than or equal to 35% reactor power in accordance with normal operating procedures (i.e., not an abnormal or emergency operating procedure) to complete a planned shutdown and scram signals that occur while the reactor is shut down.

Manual scrams when used to shut down the reactor (e.g., when less than 15% reactor power after the main generator has been removed from the electrical grid) following transient response in which manual or automatic scram criteria was not reached but a reactor shutdown following the transient is desired and in accordance with either normal, abnormal operating or annunciator response procedures.
Note: May require reporting as an unplanned power change.