REACTIVITY MANAGEMENT ADMINISTRATION

1. PURPOSE

1.1. This guideline describes the controls and programmatic requirements necessary to administer the Exelon Reactivity Management Program.

2. TERMS AND DEFINITIONS

2.1. **Reactivity** - the fractional change in the neutron population from one neutron generation cycle to the next. It is a measure of how quickly the number of neutrons is changing and relates directly to the amount of heat being generated by the reactor core.

2.2. **Reactivity Management (RM)** - the systematic and philosophical direction given to controlling conditions that affect reactivity. This includes all activities that ensure core reactivity and stored nuclear fuel (where the potential for criticality can occur) are monitored and controlled consistent with fuel design and operating limits. It is a key factor in ensuring maintenance of barriers to fission product release. This systematic process ensures that:

- 2.1. All deliberate reactivity changes are planned and conducted in a controlled conservative manner.
- 2.2. Unexpected reactivity changes are minimized.
- 2.3. Conservative actions are taken in response to unexpected reactivity changes.
- 2.4. Reactivity control equipment is available and reliable.
- 2.5. Instrumentation and computer systems used to monitor plant performance are available and reliable.
- 2.6. Reactivity-related modifications, analysis, predictions, and procedures are correct and effectively implemented.

2.3. **Reactivity Management Program** - the program that defines the roles and responsibilities for the monitoring and control of reactivity to ensure safe and reliable operation. It provides the guidance to ensure that all plant evolutions that affect reactivity will be controlled, safe, and conservative. (INPO 06-006)

2.4. **Reactivity Management Event (RME)** – any Reactivity Management issue that results in a significant plant impact or indicates a high potential for future significant events. Normally indicative of the failure of two or more barriers which are in place to prevent a Reactivity Management Event from occurring

2.5. **Reactivity Management Precursor** - any Reactivity Management issue that indicates degradation of a barrier to proper Reactivity Management or creates an elevated potential for the occurrence of a Reactivity Management event.

2.6. **Reactivity Management Concern** - any Reactivity Management issue that indicates less than optimal Reactivity Management, but does not classify as a Reactivity Management Precursor or Event.

2.7. **Reactivity Management Performance Trending Issue** - These are issues that do not impact reactivity and do not meet the criteria defined for Reactivity Management Concern, Precursor, or Event, but the plant may desire to monitor and trend in order to prevent more significant issues from occurring at a later time.

2.8. **Exelon Reactivity Database –** An ACCESS database file used to track Reactivity Management Events, Precursors, Concerns, and Trending Issues. The database name and location is \\Cccntfs01\Fileshr\GenCo\NGG\Ops\Reactivity Management\Exelon Reactivity Management Event Database.mdb.

2.9. **Low Power Operation**

2.9.1. BWR stations this is defined as Operation with the reactor mode switch in Startup/Hot Standby and < 10% power.

2.9.2. PWR stations this is defined as;

1. Reactor is critical
2. Indicated neutron power on power range channels is <2% RP

2.10. **Reactivity Management Review Panel (RMRP) –** is a cross-disciplinary group that monitors Reactivity Management performance. In addition to the Fleet RMRP, each site has a RMRP (SRMRP).

3. RESPONSIBILITIES

3.1. Vice President Operations Support

3.1.1. Sponsors the Exelon Reactivity Management Program.

3.2. Vice President Nuclear Fuels

3.2.1. Overall responsibility for Nuclear Fuels products, processes and resources for sustaining error free operation at all Exelon sites.

3.3. Site Plant Managers

3.3.1. Sponsors the site Reactivity Management Program.

3.4. Operations Management

3.4.1. Ensures that plant operations, maintenance, and engineering activities follow established Reactivity Management controls.

3.5. Site Reactor Engineering and Nuclear Fuels (NF) personnel

3.5.1. Subject Matter Experts and technical support for Reactivity Management issues.

3.6. All Exelon Personnel and Contractors

3.6.1. Responsible to be aware of the importance of the Reactivity Management Program, and conduct their activities in accordance with established Reactivity Management fundamentals.

4. MAIN BODY

4.1. Procedures

4.1.1. **ASSESS** the impact on Reactivity Management whenever procedures or guidelines are written or revised. (Preparer)

4.1.2. **CONSIDER** (as a minimum) the following areas when assessing the impact of a procedure or guideline on Reactivity Management: (Preparer)

1. Parameters that directly impact reactivity (core, spent fuel and refueling-fuel handling), such as coolant temperature, boron / poison concentration, control rods, storage rack geometry.
2. Systems that have the potential to impact reactivity (core, spent fuel and refueling-fuel handling):
   - Systems which directly control or impact reactivity.
   - Core monitoring systems / plant process computer (including software).
   - Spent fuel handling and storage systems.
   - New fuel handling and storage systems.
3. Fuel Analysis Basis impact:
   - Heat balance (assumptions, calculations, modeling, etc.).
   - Shutdown margin analyses and assumptions.
   - Reactivity-related system operability analyses.
   - Fuel floor or spent fuel pool criticality analyses.
   - Fuel operating / thermal limit analyses (assumptions, calculations, modeling, restrictions, etc.).
   - UFSAR chapter 14/15 event analyses and bases.

4.2. <u>Plant Design Changes</u>

4.2.1. **REVIEW** all proposed plant changes to assess their impact on Reactivity Management. (Preparer)

4.2.2. **USE** the Design Input Document to prompt the initiator to assess whether the proposed design change impacts Reactivity Management. (Preparer)

4.2.3. **CONSIDER** the areas that are listed in Step 4.1.2. when assessing the impact of a design change on Reactivity Management. (Preparer)

4.2.4. **If** the installation, testing or operation of the design change potentially impacts Reactivity Management, **then INTERFACE** with an Operations Reactivity Management Champion. (Preparer)

4.3. Low Power Operation

4.3.1. Reactor operation at low-power levels for extended periods of time is discouraged.

- Operations Director approval is required for all low power operation.
- Station management shall carefully consider the risk of operating during off-normal plant conditions such as low-power operation or single-loop operation (BWR).
- Develop appropriate contingencies and provide training to operators before the evolution.
- Guidance should identify potential problems that could be encountered such as the possibility that the core may become subcritical and predefines conditions under which operators should shut down or manually scram the reactor.

4.4. Self Assessment

4.4.1. Each site and the fleet should **PERFORM** a self assessment of Reactivity Management Performance every 2 years utilizing the following in development of the FASA criteria and methodology:

1. OP-AA-3, and OP-AA-300 Series Policies, Procedures and T&RMs
2. INPO SOER 94-01, "Non-conservative Decisions and Equipment Performance Problems Result in Reactor Scram"
3. INPO 96-008, "Guidelines for the Conduct of Operations at Nuclear Power Stations"
4. INPO SOER 07-01, "Reactivity Management"
5. INPO 06-006, "Guideline for Effective Reactivity Management"
6. BWROG Reactivity Controls Review Committee "Guidelines for Excellence"

4.5. Reactivity Management Review Panel (RMRP)

4.5.1. The RMRP is a Fleet-wide group that **ENSURES** that Exelon has a strong, industry-best Reactivity Management Program consistent with the Exelon business plan.

4.5.2. The V.P. Operations Support is the sustaining Sponsor for the RMRP. The Reactivity Management Steering Committee, led by the V.P. Operations Support and consisting of the V.P. Nuclear Fuels, Corporate Operations Director, Corporate Engineering Director, Corporate Work Control Director and RMRP Chair, should meet annually to evaluate the effectiveness and direction of the RMRP.

4.5.3. The RMRP should:

1. **ADMINISTER** the Reactivity Management Program.
2. **MAINTAIN** a high level of Reactivity Management awareness at the sites and corporate offices.
3. **IMPLEMENT** initiatives to satisfy program goals and minimize the number of Reactivity Management Events (RME's), Precursors, and concerns.
4. **PROVIDE** a mechanism for implementing common Exelon best practices at the sites.
5. **REVIEW** site performance and corrective actions relative to Reactivity Management.
6. **PROMOTE** uniformity in identifying and rating RME's, Precursors, and Concerns.
7. **ASSESS** periodically the need for site Reactivity Management assessments, benchmarking and assist visits.
8. **MANAGE** the Reactivity Management Excellence Plan for Fleet-wide issues.
9. **PERFORM** other Reactivity Management activities as directed by the V.P. Operations Support.

4.5.4. The V.P. Operations Support should **ENSURE** the RMRP consists of an empowered, cross-disciplined team.

4.5.5. The RMRP Chair will be a member of the Corporate Operations Organization.

4.5.6. The RMRP Chair shall **ENSURE** a quorum consist of at least:

- RMRP Chair (or alternate).
- At least one Operations or Reactor Engineering member from each site.
- Operations members from at least half the sites.
- Reactor Engineering members from at least half the sites.
- At least one Nuclear Fuels member.
- At least one Corporate Operations member.
- At least one Corporate Engineering member.*
- At least one Corporate Work Control member.*

(*During the appropriate topics identified by the Chair)

4.5.7. The RMRP Chair should **AUGMENT ATTENDANCE** as necessary to effectively address the agenda. This may include Work Management, Outage Management, Chemistry, System Engineering, Design Engineering, Nuclear Fuels, Maintenance, Reactor Services, Radiation Protection, Information Technology, Vendors, Consultants, etc

4.5.8. **If** a quorum can not be met, **then** the RMRP Chairman shall determine if the meeting can proceed and **GENERATE** an Issue Report.

4.5.9. The RMRP Chair should **ENSURE** meetings are held at least quarterly. More frequent meetings allow for a more manageable agenda. Separate regional meetings may be held to optimize efficiencies, effectiveness and cost.

4.5.10. The RMRP should typically **INCLUDE** the following agenda items, but may be modified or augmented as directed by Management or as otherwise appropriate:

1. **REVIEW** of external industry events; with emphasis on lessons learned and potential impact on Exelon.
2. **REVIEW** internal events and trends, with emphasis on commonality within Exelon, consistency with industry best practices, corrective actions effectiveness and generic implications.
3. **ACHIEVE** consensus and provide recommended level classification of events.
4. **REVIEW** unit RM PIs and Fleet RM PI.
5. **REVIEW** Special Project and/or Site Concerns.
6. **REVIEW** future issues that could have an impact on Reactivity Management (i.e. Plant Changes, INPO initiatives, pending regulatory action, etc.).
7. **REVIEW** the Reactivity Management Excellence Plan.

8. **REPORT** out to Corporate Operations Management.

4.5.11. The RMRP Chair should **ENSURE** meeting minutes are prepared and distributed for Management review including the following:

1. Meeting attendance.
2. Recommendations relative to Reactivity Management.
3. Potential training issues.
4. Issues requiring sponsorship.
5. Conflicts with Exelon business plan.
6. Recommendations for site self-assessments or focus teams.
7. Reactivity Management Excellence Plan.

4.5.12. **ASSIGN** an action item for the site SRMRP to review RMRP recommended changes to classification level and provide documentation of the re-classification of level or justification for not accepting the RMRP recommendation. CFAM approval is required for not accepting and incorporating the RMRP's level classifications.

4.5.13. **DOCUMENT and TRACK** open items from the RMRP meetings on the Reactivity Management Excellence Plan.

4.6. <u>Operations Peer Group</u>

4.6.1. The Operations Peer Group should **ENSURE** that Exelon has a consistently strong, industry-best Reactivity Management Program that is consistent with the Exelon business plan.

4.6.2. The Operations Peer Group should:

1. **MAINTAIN** a visionary view of the Reactivity Management Program.
2. **ENSURE** program alignment with the Exelon business plan.
3. **REVIEW** the status of ongoing Reactivity Management initiatives.
4. **SPONSOR** new initiatives that further the goals of the Reactivity Management Program and promote best practice commonality across the Fleet.
5. **REVIEW** Reactivity Management Performance Indicators and approve new performance goals.

4.6.3. At least annually, the RMRP Chair should **PREPARE and PRESENT** an overview of the Reactivity Management Program at the Operations Peer Group. The scope of the presentation may include the following:

1. Significant internal and external events.
2. Significant issues from external audits, assessments and assists.
3. Lesson Learned.
4. Business plans for Reactivity Management initiatives.
5. Performance Indicator review (among the Exelon plants and vs. industry performance).
6. Industry issues and initiatives.
7. Self-assessments (target areas, scheduling).
8. Status of fleet performance with respect to the Reactivity Management Model.

4.7. <u>Site Reactivity Management Review Panels (SRMRP)</u>

4.7.1. The SRMRP should **ENSURE** that the Site effectively administers the Exelon Reactivity Management Program.

4.7.2. The Site Plant Manager is the sustaining sponsor for the SRMRP.

4.7.3. The SRMRP should:

1. **ADMINISTER** the Reactivity Management Program at the Site.
2. **MAINTAIN** a high level of Reactivity Management awareness.
3. **IMPLEMENT** initiatives to satisfy program goals and minimize the number of Reactivity Management Events (RME's) and Precursors.
4. **PROVIDE** a mechanism for implementing common Exelon best practices at the Site.
5. **REVIEW** Site performance and Corrective Actions relative to Reactivity Management.
6. **ENSURE** uniformity in identifying and rating RME's, Precursors, and Concerns.
7. **MAKE** recommendations to Site Management and the RMRP.
8. **ASSESS** the need for Site RM assessments and assist visits.
9. **MAINTAIN** the Site Reactivity Management Excellence Plan.

10. **PERFORM** other Reactivity Management activities as directed by the Ops Director.

4.7.4. The Site Plant Manager should **ENSURE** the SRMRP is an empowered, cross-disciplined team. Employee participation should be encouraged.

4.7.5. SRMRP Chairman shall **ENSURE** a quorum consists of a least:

1. SRMRP Chairman (Ops Director or designee)
2. Operations RM Champion.
3. Reactor Engineering Manager (REM) or designee
4. Qualified Nuclear Engineer / Reactor Engineer.
5. Reactor Operator.
6. Work Week Management Member.
7. Maintenance Member.
8. Engineering Member.
9. Training Member.

4.7.6. **If** a quorum can not be met, **then** the RMRP Chairman shall determine if the meeting can proceed and **GENERATE** an Issue Report.

4.7.7. SRMRP Chairman should **AUGMENT ATTENDANCE** as necessary to effectively address the agenda. This may include Outage Management, Chemistry, System Engineering, Design Engineering, Nuclear Fuels, Reactor Services, Radiation Protection, Information Technology, Vendors, Consultants, etc.

4.7.8. The SRMRP Chairman shall **ENSURE** meetings are held at least quarterly. More frequent meetings may allow for a more manageable agenda.

4.7.9. SRMRP meetings should typically **INCLUDE** the following agenda items, but may be modified or augmented as directed by the SRMRP Chairman or as otherwise appropriate:

1. **REVIEW** external industry RM events, with emphasis on lessons learned and potential impact to the Site and Exelon.

2. **REVIEW** internal events and trends, with emphasis on commonality within Exelon, consistency with industry best practices, corrective action effectiveness, and generic implications.

3. **REVIEW** FMS reactivity management performance focusing on weakness.

4. **COMPARE** performance to other sites by reviewing Reactivity Management Performance Indicators.

5. **EVALUATE** Reactivity-related equipment issues and corrective actions to ensure proper prioritization and compensatory measures.

6. **REVIEW** future issues that could have an impact on Reactivity Management. (i.e. Plant Changes, Initiatives, RMRP direction, etc.).

7. **EVALUATE** effectiveness of Site Reactivity Management communications.

8. **ASSESS** Reactivity Management Model performance.

9. **REVIEW** the Site Reactivity Management Excellence Plan.

4.7.10. The SRMRP Chair should **REPORT** out to Site Management:

1. Recommendations relative to Reactivity Management.
2. Potential training issues.
3. Conflicts with Site business plan.
4. Issues requiring sponsorship.
5. Recommendations for self-assessments.

4.7.11. Items affecting Reactivity Management should be **REVIEWED** in aggregate to assess the collective significance (Material condition, Performance, IRs, etc.).

4.7.12. **DOCUMENT and TRACK** open items from the SRMRP meetings on the Site Reactivity Management Excellence Plan. **ENSURE** action tracking items are used.

4.7.13. **DEVELOP** a Site Reactivity Management Excellence Plan.

- An example of a Site Reactivity Management Excellence Plan is in Attachment 5.
- The template in Attachment 5 is based on the 2009 Exelon Excellence Plan / PIIM template.

1. **OBTAIN** approval of the Site Reactivity Management Excellence Plan from the SRMRP.

2. **PRESENT** Site Reactivity Management Excellence Plan to the Plant Health Committee.

4.7.14. The SRMRP Chair should **ENSURE** meeting minutes are assembled and distributed.

4.8. <u>Reactivity Management Issue</u>

Any plant issue that does not meet expectations of the Reactivity Management Program. There are five different Significance Levels (L) for Reactivity Management Issues based on plant impact. Utilize a sixth level for issues that do not impact reactivity and do not meet the criteria defined for Level 1 through 5 issues, but the plant may desire to monitor and trend in order to prevent more significant issues from occurring at a later time.

"Reactor Operation" is used to denote plant conditions when a Reactivity Management Issue can have a significant plant impact. The below plant conditions are included in this term.

1. Reactor is Critical.
2. Actions are being taken to achieve Critical or Shutdown conditions.

NOTE: If an issue can be classified at more than one Level (L), then the highest L (Level) is used. Management discretion can be used to raise the L of an issue but not to lower it.

L	Plant Impact	Short Description
1	Highest	Fundamental Organizational Breakdown
2		Violation of Design or Licensing Basis
3		Violation of Process / Procedural Requirements
4		Precursor
5	Lowest	Concern
6	None	No impact; trending purposes only

L 1 through L 3 issues represent "lagging" performance while L 4 through L 5 issues represent "leading" performance.

4.8.1. Reactivity Management Event (L 1, 2, 3)

A Reactivity Management Issue that results in a significant plant impact or indicates a high potential for future significant events. There are three different classifications for Reactivity Management Events based on severity. Since almost all reactivity-related activities are protected by at least two barriers, a Reactivity Management Event normally involves the failure of at least two barriers.

1. Severe Reactivity Management Event (L 1)

   A Reactivity Management Event that results in a severe adverse effect on plant safety or indicates a high potential for future significant events. In either case, the event was caused by or aggravated by a fundamental organizational breakdown. In addition to the failure of multiple barriers, the event indicates a broader problem over multiple work groups and/or processes. These issues normally require a Root Cause to identify Corrective Actions and to resolve the organizational issues.

2. Major Reactivity Management Event (L 2)

   A Reactivity Management Event that places the plant outside of the Design or Licensing Basis or significant events that compromise fuel-related limits, or directly result in fuel failure.

3. Minor Reactivity Management Event (L 3)

   A Reactivity Management Event that represents a violation of process or procedures, more significant degradation in reactivity-related equipment performance, or unexpected reactivity changes not demanded by the reactor operator

4.8.2. Reactivity Management Issue (L 4, 5, 6)

1. Reactivity Management Precursor (L 4)

   A Reactivity Management Issue that indicates degradation of a barrier to proper Reactivity Management or creates an elevated potential for the occurrence of a Reactivity Management Event.

2. Reactivity Management Concern (L 5)

   A Reactivity Management Issue that indicates less than optimal Reactivity Management but does not classify as a LEVEL 1 through LEVEL 4 issue.

3. Performance Trending Issues (L 6)

Issues that the plant has decided to continue to monitor and trend in order to improve plant performance and potentially prevent more significant issues from occurring. These issues have no impact on reactivity management. There is no specific requirement to trend these issues.

4.8.3. Examples of Reactivity Management Events / Precursors / Concerns / Trending Issues are provided in Attachment 1 (BWR), Attachment 2 (BWR) and Attachment 3 (PWR).

4.9. Reactivity Management Event / Precursor / Concern Trending

4.9.1. Periodically **REVIEW** the Issue Reports (e.g., IRs, CAPs, etc.) generated at their site and screen them against the definitions in Section 4.8. Potential Reactivity Management issues may also be identified by reviewing the site's corrective action requests (e.g., Passport & PIMS action requests) and Operations logs. **(Reactivity Management Champions).**

NOTE: If multiple issues deal with the same component and same remedy but occur at different times, then the issues can be considered the same Reactivity Management issue. For example, multiple instances of movement problems of the same control rod count as a single Reactivity Management issue if the problems have the same remedy. Otherwise, grouping of issues is not allowed since it can lead to a non-conservative indication of the health of the Reactivity Management Program.

NOTE: If multiple issues occur during a single evolution, grouping of unrelated issues (i.e. different components or different remedies) is not allowed.

4.9.2. **OBTAIN** an independent review that all reactivity related issues have been identified by reviewing IRs and operator logs. This may be accomplished by daily/routine reviews performed by independent Reactivity Management Champions, Shift Managers, or the Reactor Engineering Manager. **(Reactivity Management Champions, SM, REM)**

4.9.3. **RESPOND** to the discovery of a Reactivity Management issue as follows:

1. Assign each Reactivity Management issue a classification code containing both the highest applicable Level and the example number (ex. “4-8” is Level 4, Example 8). If multiple examples are applicable at this Level, then choose the one that best fits the issue. When the issue does not fit an example, use “0” as the example number (ex. “4-0”).

2. Level 1, 2, 3, 4 or 5 RM Events / Precursors / Concerns

   A. **ENSURE** that an IR has been initiated in accordance with LS-AA-120.

   B. Immediately **NOTIFY** the Operations Director, Reactor Engineering Manager and the appropriate NF Manager.

   C. **DETERMINE** whether a root cause or an apparent cause investigation is required in accordance with LS-AA-125.

   D. **UPDATE** the Reactivity Management Event Database.

   E. **ENSURE** the Plant Health Committee (PHC) addressed equipment events are per ER-AA-2001.

   F. **TREND** the issue per 4.9.4.

3. Level 6 Reactivity Management Trending Issue

   A. **UPDATE** the Reactivity Management Event Database.

   B. **TREND** the issue per 4.9.4.

   C. Level 6 concerns should be **ANALYZED** at least yearly for adverse trends.

4. **RESET** the Site Reactivity Management Event Free clock for Level 1, 2, 3, or 4 RM Events / Precursors

   A. **UPDATE** Reactivity Management Event Clock locations (POD package, Websites, physical clocks, etc..)

   B. **ANNOUNCE** Reactivity Management Event Clock Reset at POD.

C. **DISTRIBUTE** a Reactivity Management Event update briefing to site personnel and to the fleet Reactivity Management Peer Group.

4.9.4. It is expected that during the review of reactivity-related issues that **CONSIDERATION** be given to raising the Level and/or initiating an IR based upon:

- Repeat Issues.
- LTA Human Performance.
- Extent of Condition (Generic Implications).
- Aggregate Impact (e.g. number of IRs against a system, process etc.).
- Adverse Trending.
- Severity of the event.

4.9.5. A 12-month cumulative Reactivity Management Performance Indicator should be **CALCULATED** at least monthly for <u>each unit</u> using the following equation

EXECEPTION:
L 4 and 5 issues for degraded equipment only and Power Changes / Downpowers Related to the Equipment. This does not apply to all level 4 and 5 issues. If the degraded equipment is repaired, the issue can be removed four (4) months after identification. If the equipment is not repaired within four months, then the issue cannot be removed until repaired. This exception also applies to the downpower that is required to fix the degraded equipment. This exception rewards the prompt and effective repair of degraded equipment before it can cause a higher-level issue.

1. All issues have a minimum lifetime of 12 months.

   <u>Any</u> issue that has not been resolved during the 12 month period will be carried until resolution. For example, an issue could be open for more than 12 months if it required a refueling outage to resolve and the issue occurred more than 12 months before the outage.

NOTE: Level 6 concerns are trended only; they have no impact on the RM PI.

NOTE: Historical issues (i.e. greater than 12 months since occurrence) with no recent impact on reactor operations can be evaluated for possible exclusion from the PI.

2. If multiple issues deal with the same component and same remedy but occur at different times, then the issues can be considered the same Reactivity Management Issue. For example, multiple double-notching occurrences of the same control rod count as a single L 4-2 (same component, same remedy). Otherwise, grouping of issues is not allowed since it can lead to a non-conservative indication of the health of the Reactivity Management Program and it also increases the subjectivity of the PI. For example, grouping multiple, double-notching control rods due to the lack of full flow demineralizers into a single issue is not allowed (different components, same remedy).

3. If multiple issues occur during a single evolution, grouping of unrelated issues into a single issue is not allowed.

4. The following equation is used to calculate the PI:

$$PI = 100 - (20 * L1) - (10 * L2) - (2 * L3) - (0.5 * L4) - (0.1 * L5)$$

where L is the current number of L_X issues. A PI of 100 is the highest achievable and represents optimal performance.

4.9.6. All site Reactivity Management issues and PI's should be **REVIEWED** by the RMRP to ensure that the issue classifications are appropriate and that event classification is uniform across Exelon.

4.9.7. The Site Operations Management should **ENSURE** that an IR is initiated in accordance with LS-AA-120 for less than adequate performance in the identification or documentation of RMEs (e.g., IR not generated, RME trend coding errors, etc.).

4.9.8. Any site with a unit below its PI goal should **PERFORM** the following:

1. **GENERATE** IR to document PI Variance

2. **If** not previously completed, **ENSURE** a CAP investigation (CCA, RCA, ACE, or WGE) to document cause and drive corrective actions is performed.

3. **UPDATE** Reactivity Management Excellence Plan with actions from the CAP investigation.

4.9.9. <u>If</u> the Fleet PI is below goal, <u>Then</u> **PERFORM** the following:

1. **GENERATE** IR to document the PI Variance
2. **UPDATE** Reactivity Management Excellence Plan

5. **DOCUMENTATION** - None

6. **REFERENCES**

6.1. Exelon Nuclear Policy OP-AA-3, “Reactivity Management”

6.2. BWROG Reactivity Controls Review Committee “Guidelines for Excellence," Section 5.0 "Monitoring of Reactivity Management Issues"

6.3. INPO SOER 94-01, “Nonconservative Decisions and Equipment Performance Problems Result in Reactor Scram”

6.4. INPO 96-008, “Guidelines for the Conduct of Operations at Nuclear Power Stations”

6.5. INPO SOER 07-01, "Reactivity Management"

6.6. INPO 06-006, "Guideline for Effective Reactivity Management"

6.7. CAPR 1097528-13, RM ASSESSMENT & ROOT CAUSE CORRECTIVE ACTIONS (Revision 7)

7. **ATTACHMENTS**

7.1. Attachment 1 - Reactivity Management Event Examples (BWR)

7.2. Attachment 2 - Classification Examples for BWR (detailed examples)

7.3. Attachment 3 - Reactivity Management Event Examples (PWR)

7.4. Attachment 4 - Classification Examples for PWR (detailed examples)

7.5. Attachment 5 - Site Reactivity Management Excellence Plan

ATTACHMENT 1
Level 1 (Severe) Reactivity Management Event Examples (BWR)
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Level 1 (Severe) Reactivity Management Events: A Reactivity Management Event that results in a severe adverse effect on plant safety or indicates a high potential for future significant events. In either case, the event was caused by or aggravated by a fundamental organizational breakdown. In addition to the failure of multiple barriers, the event indicates a broader problem over multiple work groups and/or processes. These issues normally require a Root Cause to identify Corrective Actions and to resolve the organizational issues.

.Examples of Level 1 (Severe) Reactivity Management Events (BWR)

1-0 Lower Level Issue Raised to Level 1 Due to:
- Repeat Issue
- LTA Human Performance
- Extent of Condition (Generic Implications)
- Aggregate Impact (e.g. number of IRs against a system or process)
- Adverse Trending

OR a Level 1 Issue Not Matching an Example

1-1 Multiple Control Rods Fail to Fully Insert on a Scram

1-2 Inadvertent Criticality
- Inadequate Monitoring of Subcritical Conditions
- Recriticality During Shutdown/Startup
- Criticality During Refueling

1-3 Reactor Operation with a Fuel Placement or Orientation Error in the Reactor Core

1-4 Failure to Meet one of the following Reactivity-Related Technical Specification (TS) Action Statements

- Thermal Limit > 1.000
- Shutdown Margin < TS Requirement
- Reactivity Anomaly Not Within TS Requirement

1-5 L 2 or 3 Event Resulting from a Fundamental Organizational Breakdown

1-6 Violation of a Reactor Core Technical Specification (TS) Safety Limit

1-7 Improper Reactivity Control that Results in Fuel Failures Resulting in Radiological Releases Greater than Technical Specification (TS) Limits

ATTACHMENT 1
Level 2 (Major) Reactivity Management Event Examples (BWR)
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Level 2 (Major) Reactivity Management Events A Reactivity Management Event that places the plant outside of the Design or Licensing Basis or significant events that compromise fuel-related limits, or directly result in fuel failure. These issues are usually reportable to external organizations.

Examples of Level 2 (Major) Reactivity Management Events (BWR)

2-0 Lower Level Issue Raised to Level 2 Due to:
- Repeat Issue
- LTA Human Performance
- Extent of Condition (Generic Implications)
- Aggregate Impact (e.g. number of IRs against a system or process)
- Adverse Trending

OR a Level 2 Issue Not Matching an Example

2-1 Reactor Scram Caused by a Reactivity Event or Complicated by a Reactivity Management Issue
- OPRM Scram Due to Power Oscillation
- Scram Due to Recirculation Pump Runout
- Scram During Startup due to Short Period

2-2 Failure to Leave an Unanalyzed Area of the Power to Flow Map Within Time Requirements

2-3 Failure to Meet Acceptance Criteria of a Reactivity-Related Physics Test

2-4 Violation of a Core Thermal Power License Limit

2-5 Mispositioned Control Rod Due to a Personnel Error

2-6 Control Rod Fails to Fully Insert on a Scram

2-7 Entry into the following Reactivity-Related TS Action Statement Due to Degraded Conditions
- Thermal Limit > 1.000
- Shutdown Margin < TS Requirement
- Reactivity Anomaly Not Within TS Requirement

2-8 Fuel Location Error in the Reactor Core That is Found After Completion of the Fuel Movement Step (location only, not orientation)

2-9 Fuel Bundle in the Reactor Core, Spent Fuel Pool, New Fuel Vault or Dry Cask That Violates Reactivity Constraints

2-10 Implementation of a Reactivity-Related Product That Results in Violation of the Design or Licensing Basis or Exceeding Reactivity-Related Tech Specs

(Level 2 examples continued on next page)

ATTACHMENT 1
Level 2 (continued) (Major) Reactivity Management Event Examples (BWR)
Page 3 of 10

2-11 Failed Fuel Bundle Caused by Operational Practices resulting in fuel cladding breach
- Core Design Error
- Improper Fuel Handling
- Violation of Fuel Conditioning Requirements

2-12 Startup Terminated Due to Less than Tech Spec Required Nuclear Instrumentation

2-13 Bypass of a Reactivity Control System which Results in Improper Reactivity Control

ATTACHMENT 1
Level 3 (Minor) Reactivity Management Events Examples (BWR)
Page 4 of 10

Level 3 (Minor) Reactivity Management Events A Reactivity Management Event that represents a violation of process or procedures, more significant degradation in reactivity-related equipment performance, or unexpected reactivity changes not demanded by the reactor operator.

Examples of Level 3 (Minor) Reactivity Management Events (BWR)

3-0 Lower Level Issue Raised to Level 3 Due to:

- Repeat Issue
- LTA Human Performance
- Extent of Condition (Generic Implications)
- Aggregate Impact (e.g. number of IRs against a system or process)
- Adverse Trending

OR a Level 3 Issue Not Matching an Example

3-1 Failed Fuel Bundle not due to Operational Practices

3-2 Violation of Fuel Conditioning Requirements

3-3 Unanticipated Core Re-design or Re-analysis just prior to or during an outage

- Fuel Handling Damage
- Fuel Inspection Failure
- Excessive Crud / Corrosion on a Fuel Assembly
- Excessive Channel Distortion

3-4 Mispositioned Control Rod Due to degraded equipment or a control rod That moves more than two notches when given a single notch command within the bounds of the sequence

3-5 Use of a Reactivity Management -Related product with a Technical Error that does not result in violation of the design or licensing basis or exceeding Tech Specs

3-6 Reactor Scram with the Mode Switch in either Startup or Run (other than planned scram entering a Outage)

3-7 Unplanned Inoperable Control Rod

3-8 Change in Reactor Power of ≥ 0.5% RTP (other than reactor scrams) directly caused by Either Equipment Problems or Personnel Error

3-9 Unanticipated Change in Reactivity With the Mode Switch in STARTUP

(Level 3 examples continued on next page)

ATTACHMENT 1
Level 3 (Continued) (Minor) Reactivity Management Events Examples (BWR)
Page 5 of 10

3-10 Fuel Placement Error in the Reactor Core That is Found Prior to Completion of the Fuel Placement Step or Fuel Orientation Error in the Reactor Core Found Prior to Completion of Core Verification

3-11 Fuel Placement Error in the Spent Fuel Pool, New Fuel Vault or Dry Cask That Does Not Violate Reactivity Constraints

3-12 Entry into Unanalyzed Area of the Power to Flow Map

3-13 Failure to Leave Restricted Area of the Power to Flow Map within Time Requirements

3-14 Unplanned Entry into Restricted Area of the Power to Flow Map

3-15 Violation of Core Thermal Power Procedural Limit

3-16 Violation of Thermal Limit Procedural Limit

3-17 Reactor Operation with a Fuel Bundle or a Fuel Support Piece Improperly Seated

3-18 BOC Criticality Outside Predetermined Acceptance Criteria

ATTACHMENT 1
Level 4 Reactivity Management Precursor Examples (BWR)
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Level 4 Reactivity Management Precursors A Reactivity Management Issue that indicates degradation of a barrier to proper Reactivity Management or creates an elevated potential for the occurrence of a Reactivity Management Event.

Examples of Level 4 Reactivity Management Precursors (BWR)

4-0 Lower Level Issue Raised to Level 4 Due to:
- Repeat Issue
- LTA Human Performance
- Extent of Condition (Generic Implications)
- Aggregate Impact (e.g. number of IRs against a system or process)
- Adverse Trending

OR a Level 4 Issue Not Matching an Example

4-1 Downpower ≥ 0.5% RTP In Accordance with Approved Operating Procedures Due to Emergent Issue (less than 72 hrs notice)

4-2 Problem with Reactivity Control System That Impacts Desired Reactivity Changes
- Double-Notching Control Rod During Reactor Operation (includes avoidance using emergency/continuous insert)
- RMCS, RPIS, ASD or MG Scoop Tube Lockup

4-3 Unplanned Inoperable SRM, IRM, or WRNM

4-4 Change in Target Control Rod Pattern or Core Design Due to Deviation Between Design and Actual Core Performance

4-5 Core Monitoring System or Instrumentation Problem That Significantly Impacts the Ability to Monitor the Core
- Core Monitoring System Reliability Problems
- Unplanned Loss of Heat Balance for Greater than 2 Hours

4-6 “Slow to Settle” Control Rod Due to Friction

4-7 Technical Error Found in Approved Reactivity-Related Product After Implementation of the Product But Prior to Use of the Information that is in Error (no impact on operation or calculations)

(Level 4 examples continued on next page)

ATTACHMENT 1
Level 4 (continued) Reactivity Management Precursor Examples (BWR)
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Examples of Level 4 Reactivity Management Precursors (BWR) - Continued

4-8 Observable Change in Reactor Power of < 0.5% RTP Caused by Either Equipment Problems or Personnel Error

4-9 Power Profile for a Planned Downpower Changed Significantly Within 72 hrs of Execution or During Execution

4-10 Control Rod Scram Time Requires Control Rod to be Declared "Slow"

4-11 Fuel Handling that results in impacts or damage to fuel assembly components

- Bumping/Dragging Fuel Bundle Into Obstruction
- Fuel Assembly damage due to fuel handling that requires component replacement

4-12 Non-BOC Criticality Outside Predetermined Acceptance Criteria

4-13 Improper Bypass of a Reactivity Control System

ATTACHMENT 1
Level 5 Reactivity Management Concerns Examples (BWR)
Page 8 of 10

Level 5 Reactivity Management Concerns A Reactivity Management Issue that indicates less than optimal Reactivity Management but does not classify as a L 1 through L 4 issue.

Examples of Level 5 Reactivity Management Concerns (BWR)

5-0 Level 5 Issue Not Matching an Example

5-1 Downpower ≥ 0.5% RTP in accordance with approved Operating procedures due to emergent issue (≥ 72 hours notice)

5-2 Core Monitoring System or Instrumentation Problem That Does Not Significantly Impact the Ability to Monitor the Core
- Intermittent Loss of CRD Flow Input to Heat Balance
- Intermittent Core Monitor Convergence Failure
- Loss of one or more channels in a single TIP machine

5-3 Bypassed LPRM

5-4 Degraded Reactivity-Related System Performance
- HCU Accumulator Alarm trend for CRD that meets standard for scheduling maintenance
- SRM Period Alarms Caused by Excessive SRM Noise
- RMCS, RPIS, ASD, or MG Scoop Tube Lockup that does not impact desired reactivity changes
- Unexpected Half-Scrams with the Mode Switch in either Startup or Run
- Unexpected Full-Scram with the Mode Switch NOT in Startup or Run with CRD HCU accumulators pressurized
- Sustained High Temperature CRD
- Rod with failed position 48 indication that is inserted to position 46

5-5 Control Rod That Can Not be Adjusted to Vendor Speed Requirements

5-6 Unexpected Behavior of Reactivity-Related System That Does Not Cause Observable Change in Reactor Power
- Short Spike in Recirculation Pump Speed
- Elevated Noise in Recirculation Pump Motor Power

5-7 Chemistry Readings Indicative of Possible Control Rod Degradation

5-8 Channel Distortion Monitoring Surveillance Required by Core Design

5-9 Technical Error Found in Reactivity-Related Product After Approval But Prior to Implementation of the Product

5-10 Deleted

5-11 Improperly seated Fuel Bundle Found Prior to Operating.

5-12 Unplanned Inoperable APRM / OPRM / RBM / RWM channel

ATTACHMENT 1
Level 5 Reactivity Management Concerns Examples (BWR)
Page 9 of 10

5-13 Less Than Adequate Fuel Handling Practice / Equipment Performance

- Refueling Bridge Lockup While Handling Fuel Bundle
- Hanging Fuel Bundle on Channel Clip During Insertion
- Damage to Fuel Handling Equipment or Non-Fuel Components
- Misplaced Non-Fuel Components (eg., control rods, channels)

ATTACHMENT 1
Level 6 Reactivity Management Concerns Examples (BWR)
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Level 6: No Impact on Reactivity Management These are issues that do not impact reactivity and do not meet the criteria defined for Level 1 through 5 issues, but the plant may desire to monitor and trend in order to prevent more significant issues from occurring at a later time. There is no specific requirement to trend these issues. These examples are provided to provide some clarity of examples of events that would not have to be considered in the Performance Indicator.

Examples of Level 6 Reactivity Management Concerns (BWR)

- Controlled Shutdowns or Downpowers that are a result of environmental conditions outside the control of the plant or requested by the grid operator
- Offsite electrical transients outside the control of the company that cause minor decreases in reactor power are not indicative of the plant Reactivity Management Program unless degraded equipment added to the magnitude of the event.
- Double notching control rods identified while testing following maintenance or speed adjustments
- Control rods that require speed adjustment following maintenance
- Issues concerning nuclear instrumentation that do not render the equipment inoperable and do not impact the ability to monitor the core
- Technical product errors identified by the reviewer during the normal review process.
- Phantom Nuclear Instrumentation alarms or erratic behavior
- APRM Upscale Light without alarm
- Nuclear instrumentation recorder issues
- Feedwater heater level alarms
- Work orders not flagged as reactivity-related
- Rod Block Monitor alarms
- Rod Block Monitor nulling issues
- TIP indicator lights operating erratically
- Reactivity Management Panel/Peer Group issues
- Technical Error Found in Reactivity-Related Product After Review is Complete but Prior to Approval
- Technical Error Found in Reactivity-Related Product from Vendor Prior to Owner's Acceptance
- Less Than Aadequate fuel handling practices or equipment while not handling fuel (with no component damage)
- A vendor manufacturing issue that does not require a change to a Reactivity Management related product

ATTACHMENT 2
Classification Examples for BWR (detailed examples)
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A Reactivity Management Issue must be understood prior to assigning the correct Level classification using the Level Definitions. Attachment 2 provides individual examples for each Level. The following examples illustrate how an issue can be classified at different Levels based on the details of the issue and the associated consequences.

- Heat Balance
- Thermal Limit
- APRM Transient
- Downpower
- Reactor Scram / Shutdown
- Change in Reactor Power
- Control Rod Movement Problem
- Channel Distortion
- Post-Scram Control Rod Position
- Control System or Instrumentation Problem
- Work Management
- Reactivity Management related Product Technical Error
- Operation Above the Analyzed Boundary Line (e.g., MELLLA)
- Fuel Placement Error
- Fuel Reliability
- Fuel Handling

Heat Balance

Heat Balance errors influence the following operational aspects. All aspects must be considered when determining the Level.

- APRM Calibrations
- Core Thermal Power License Limit
- Core Thermal Power Procedural Limit (if any)
- Thermal Limits
- Fuel Conditioning Requirements

ATTACHMENT 2
Classification Examples for BWR (detailed examples)
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L 5: The field input to the Plant Process Computer for CRD flow was periodically invalid for periods of less than 5 minutes. During these periods, the Heat Balance was invalid. [L 5-2]

L 4: The computer processor handling all field inputs to the Plant Process Computer failed, invalidating the Heat Balance. A valid Heat Balance was not available for 3 hours. [L 4-5]

L 3: A non-conservative error was found in the heat loss term used in the Heat Balance. Even with the error, APRM Calibrations, Core Thermal Power, Thermal Limits, and Fuel Conditioning met all requirements. [L 3-5]

L 3: With the ultrasonic feedwater flow measurement system out-of-service, Core Thermal Power was unintentionally at about 99 %RTP for over one hour, in excess of the procedural limit of 98% RTP. [L 3-15]

L 2: A non-conservative error was found in the calibration of the feedwater temperature instrumentation used in the Heat Balance. Average Core Thermal Power was unintentionally at 100.05 %RTP for one shift, in excess of the License Limit for the shift average. [L 2-4]

Thermal Limit

L 3: On a power ascension, a thermal limit increased from 0.992 to 0.998 during a control rod withdrawal, in excess of the Reactivity Plan Limit of 0.995. Core Thermal Power was reduced with a resulting decrease in the thermal limit to 0.992. [L 3-16]

L 2: On a power ascension, a thermal limit increased from 0.992 to 1.002 due to a recirculation control problem. Core Thermal Power was reduced with a resulting decrease in the thermal limit to 0.984 within TS time requirements. [L 2-7]

L 1: On a power ascension, a thermal limit reached 1.007 on a xenon transient. Due to lack of adequate monitoring, it was not reduced to ≤ 1.000 within TS time requirements. [L 1-4]

APRM Transient

It is possible to have a short APRM transient (neutronic power) that is not observed in the Heat Balance, steam flows, 1st stage pressure, or other indications of Reactor Power

ATTACHMENT 2
Classification Examples for BWR (detailed examples)
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L 5: While at 100% RTP, a spike in recirculation pump speed caused all APRM channels to momentarily increase. With a fuel thermal time constant of 6 seconds, Reactor Power was within the normal range of fluctuations for 100% RTP. [L 5-6]

L 4: While at 100% RTP, a power supply problem caused recirculation pump speed to increase slowly for about 10 seconds prior to returning to the pre-transient value. All APRM channels increased by about 0.8%. With a fuel thermal time constant of 6 seconds, Reactor Power was estimated to reach a maximum of 100.3% RTP. [L 4-8]

L 3: While at 100% RTP, a perturbation in feedwater temperature caused all APRM channels to increase by about 1.2% for about 15 seconds prior to returning to the pre-transient value. With a fuel thermal time constant of 6 seconds, Reactor Power was estimated to reach a maximum of 100.7% RTP. [L 3-8]

<u>Downpower</u>

None: Downpower to perform TS surveillances or cycle management activities (ex. Deep / Shallow Control Rod Exchange, Channel Distortion Testing).

None: Due to elevated river/Ultimate Heat Sink (UHS) temperature, Reactor Power was reduced to maintain compliance with environmental requirements.

None: Due to high grid voltage, the grid operator requested a reduction in Reactor Power.

None: Due to a solar magnetic disturbance, Reactor Power was reduced to maintain transformer parameters within operating requirements.

L 5: “A” Primary Condensate Pump vibrations had been trending upward for one month. A downpower was planned and executed to resolve the issue before vibration limits were reached. [L 5-1]

L 4: “A” Primary Condensate Pump vibrations had been trending upward for 2 hours. A vibration limit requiring pump removal from service was reached and a downpower was promptly performed to remove the pump from service. [L 4-1]

L 3: “A” Primary Condensate Pump vibrations had been trending upward for 2 hours. The pump tripped and caused an automatic recirculation runback with an associated reduction in Core Thermal Power of 30% RTP. [L 3-8]

ATTACHMENT 2
Classification Examples for BWR (detailed examples)
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Reactor Scram / Shutdown

None: Reactor is scrammed / shutdown to enter Refueling Outage.

L 5: Drywell floor drainage had been trending up for 2 months. A Forced Outage was planned and executed before TS limits were exceeded. [L 5-1]

L 4: TS Shutdown due to inoperable diesel generators. [L 4-1]

L 3: I&C was working on a surveillance that included the insertion of a half-scram at 100% RTP. A full scram occurred due to a spurious signal on the other half of the Reactor Protection System. [L 3-6]

L 2: An OPRM scram occurred during a recirculation runback. There were indications of a power oscillation. [L 2-1]

Change in Reactor Power

None: The plant experiences bi-stable flow within a specific range of behavior. Periodically, Reactor Power changes consistent with this expected flow behavior. In other words, the plant is operating in the normal range of fluctuations around an average Reactor Power.

None: Instantaneous Reactor Power as indicated by the Heat Balance normally fluctuates in the band 99.8% to 100.2% RTP while at 100% RTP based on the one-hour average. While monitoring the one hour average, Operations reduced Reactor Power slightly to maintain the one hour average at or below 100% RTP. All equipment was operating as expected. This behavior was not due to an equipment or human performance issue.

L 5: A Feedwater Heater normal drain valve closed due to equipment failure and level increased until controlled by the dump valve. There was no observable change in Reactor Power. [L 5-6]

L 4: A Feedwater Heater normal drain valve closed due to equipment failure and level increased until controlled by the dump valve. Reactor Power increased by 0.3% RTP prior to Operator action to reduce power. [L 4-8]

L 4: RWCU isolated due to an equipment failure and Reactor Power decreased by 0.2% RTP. [L 4-8]

ATTACHMENT 2
Classification Examples for BWR (detailed examples)
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L 3: A Feedwater Heater trip caused Reactor Power to increase by 0.6% RTP prior to Operator action to reduce Reactor Power. [L 3-8]

<u>Control Rod Movement Problem</u>

None: While performing shutdown control rod exercising, control rod 30-31 multi-notched from 00-06 when being broken loose from 00. Once loose, it moved normally.

None: While performing shutdown control rod exercising, control rod 30-31 multi-notched. The control rod was adjusted to the procedural speed requirements and moved normally.

None: At 75% RTP, control rod 30-31 was timed due to reports of being slightly fast on withdrawal. The withdrawal speed was too fast and speed adjustment was attempted. The control rod multi-notched after the first adjustment. The Reactivity Plan allowed for the multi-notch. On the second adjustment, the control rod was adjusted to the vendor speed requirements and Moved normally

None: Following HCU maintenance at 50% RTP, control rod 22-31 multi-notched. The maintenance had the potential to impact the control rod speed. The Reactivity Plan allowed for the multi-notch. The control rod was adjusted to the vendor speed requirements and moved normally.

L 5: While performing shutdown control rod exercising, control rod 30-31 double-notched from 00-04 at normal pressure. The withdrawal speed was too fast and speed adjustment was attempted. The control rod could not be adjusted to the vendor speed requirements although it was no longer double-notching. [L 5-5]

L 4: While performing control rod exercising, control rod 30-31 double-notched at normal pressure. The withdrawal speed was too fast and speed adjustment was attempted. The control rod could not be adjusted to the vendor speed requirements and it continued to double-notch. [L 4-2]

L 4: At 50% RTP, control rod 30-31 did not move off 00 at normal pressure. At elevated pressure, it double-notched from 00 to 04. [L 4-2]

L 4: At 50% RTP, control rod 30-31 was being single-notched from 08 to 10. The operator noted a fast withdrawal speed and used emergency/continuous insert to avoid the double-notch and stop the control rod at 10. [L 4-2]

ATTACHMENT 2
Classification Examples for BWR (detailed examples)
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L3: A control rod is being moved in sequence from 12 to 48 via single notch movement. On the initial notch movement, the control rod triple notches to 18 vice 14. This type of behavior, although not considered a mispositioned control rod, could have had more significant consequences than a double notching control rod [L 3-4]

Channel Distortion

Each control rod with a "Slow to Settle" condition and each inoperable control rod is treated as a separate Reactivity Management Issue.

L 5: For the current cycle, channel distortion surveillance is required by the core design (i.e., not designed out of the core). There is potential for channel distortion to impact the operation of control rods. [L 5-8]

L 4: A "Slow to Settle" condition due to excessive friction has been detected for control rod 30-31. Significant channel distortion has occurred but control rod operability has not yet been impacted. [L 4-6]

L 4: A "Slow to Settle" condition due to excessive friction has been detected for control rods 30-31 and 22-31. Significant channel distortion has occurred but control rod operability has not yet been impacted. [two L 4-6s]

L 3: Control rod 30-31 is declared inoperable due to excessive channel distortion. [L 3-7]

L 3: A number of fuel bundles scheduled for reload were inspected for channel distortion during a Refueling Outage. One of the fuel bundles showed a higher degree of distortion than allowed by the fuel vendor. The fuel bundle was not rechanneled due to its high exposure and was permanently discharged. The Core Loading Plan had to be unexpectedly altered. [L 3-3]

Post-Scram Control Rod Position

L 5: Control rod 54-27 fully inserted on a scram but bounced out and latched at notch 02. This behavior was consistent with the scram function since it fully inserted on the scram. It was consistent with the design assumption of a post-scram position of at least notch 02. [L 5-4]

L 2: Control rod 54-27 did not fully insert on a scram but latched at notch 02. This behavior was inconsistent with the scram function since it did not fully insert on the scram. [L 2-6]

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Classification Examples for BWR (detailed examples)
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L 2: Control rod 54-27 did not fully insert on a scram and latched at notch 16. Based on APRM Power, the reactor core was shutdown. This behavior was inconsistent with the scram function since it did not fully insert on the scram. [L 2-6]

L 1: Control rods 54-27 and 22-31 did not fully insert on a scram and latched at notches 16 and 02, respectively. Based on APRM Power, the reactor core was shutdown. This behavior was inconsistent with the scram function since they did not fully insert on the scram. [L 1-1]

L 1: Fifteen control rods failed to fully insert on an automatic scram. Based on APRM Power, the reactor core was not shutdown following this automatic scram. [L 1-1]

<u>Control System or Instrumentation Problem</u>

None: A Control Room recorder displaying Recirculation suction temperatures failed. There were alternate sources for these temperatures.

None: A Control Room alarm is received due to a Control Rod HCU Accumulator issue. Operations personnel are able to correct the problem with no maintenance support. This is the first occurrence for that accumulator in the last 30 days.

L 5: A Control Room alarm is received due to a Control Rod HCU Accumulator issue. Although Operations personnel are able to correct the problem, the trend for this accumulator meets the standard for scheduling preventative/corrective maintenance. [L 5-4]

L 5: While at 100% RTP, a Reactor Manual Control System lockup occurred. No control rod movements were in progress or necessary. A transponder card was replaced and the lockup cleared. [L 5-4]

L 4: While performing Scram Time Testing, a Reactor Manual Control System lockup occurred. Scram timing was suspended since control rods could not be moved. A transponder card was replaced and the lockup cleared. Scram timing was resumed once the Reactivity Plan had been evaluated for impact. [L 4-2]

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Classification Examples for BWR (detailed examples)
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<u>Work Management</u>

L 4: Two (2) days before the planned Deep / Shallow Control Rod Exchange, Corrective Maintenance involving feedwater heaters was added to the schedule. These maintenance activities required a longer duration at a lower power level than originally planned. The Reactivity Plan required rework/revision (not simply a pen-and-ink change). [L 4-9]

L 4: During execution of a planned maintenance downpower, the time at the minimum power plateau was lengthened in order to complete the planned work activities. The Reactivity Plan required revision (not simply a pen-and-ink change). [L 4-9]

<u>Reactivity-Related Product Technical Error</u>

Reactor Engineering, Nuclear Fuels, Site Engineering, Design Engineering, Operations, Fuel Vendors, and other organizations produce products that may be Reactivity Management -related. Such products include procedures, COLR's, Cycle Management Reports, Reactivity Plans, fuel move sheets, rod move sheets, calculations, databanks, and design modifications. These products are documents that are actually utilized in the plant for performing calculations, monitoring fuel-related parameters, or manipulating or modifying plant equipment (including fuel handling). Any technical errors that could result in changes to Reactivity Management related products should be considered under the Performance Indicator, even if the errors are not directly related to reactivity. Errors in products that do not affect these types of documents are not tracked by this Performance Indicator.Only technical errors impact the Performance Indicator. The LEVEL of an issue is based on time of discovery and the impact of the technical error if it is implemented. Implementation of the product refers to it being utilized by the plant, for example to perform a reactivity change or in performing calculations, even if the parameter was not specifically utilized in a calculation. If fuel move sheets have been authorized for use and a Fuel Handling Supervisor identifies an error in the move sheets during the course of the fuel moves, this is considered implemented but prior to use. If an error is identified in the core monitoring system input deck prior to the use of that information (eg., Equipment Out Of Service Option limit), this is still considered implemented but prior to use.

None: A technical error was found in the core shuffle move sheets prior to approval by the Reactor Engineering Manager.

None: A vendor fuel manufacturing issue is not typically considered an error in a technical product unless the issue requires a change to a Reactivity Management related product, e.g. a MCPR penalty.

L 5: A technical error was found in a Reactivity Plan by the Control Room Supervisor prior to authorization. The error had not been found during the review and approval process. [L 5-9]

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Classification Examples for BWR (detailed examples)

L 4: A technical error was found in an approved vendor calculation involving reduced feedwater temperature operation. The limits associated with this operational flexibility had been incorporated into the input deck and COLR, but the operational flexibility was not used prior to discovery of the error. [L 4-7]

L 4: During execution of the Reactivity Plan but prior to control rod movement, the Reactor Operator found an error in the final position of BPWS Group 9C on the approved movement sheet. The position did not match the intended position in the Reactivity Plan. [L 4-7]

L 3: A non-conservative error was found in the Core Monitoring System databank for the exposure-dependency of the LHGR limit for a specific fuel type. Even with the error, MFLPD was ≤ 1.000. [L 3-5]

L 3: A Reactor Operator moved a control rod to the position on the approved form. This position was later determined to be different from the position used in the supporting predictions. [L 3-5] If this actually resulted in moving a control rod that should not have been moved, this would be considered a Level 2 event. [L 2-5]

L 2: A non-conservative error was found in the Core Monitoring System databank for the exposure-dependency of the LHGR limit for a specific fuel type. With this error, MFLPD was > 1.000 earlier in the cycle. [L 2-10]

L 1: During a maneuver, BPWS Group 9B was withdrawn from 00 to 08 IAW the Reactivity Plan. Due to an error in the associated predictions, the withdrawals placed the plant above the MELLLA Boundary Line. When the error in the predictions is coupled with the failure to adequately monitor plant parameters during the withdrawals, this event represents a fundamental organizational breakdown and was elevated from L 3-12 to L 1. [L 1-5]

L 1: During execution of the Reactivity Plan, xenon burnout unexpectedly placed the plant above the MELLLA Boundary Line. At the time of occurrence, neither Operations nor Reactor Engineering detected the problem. The Reactivity Plan did not provide sufficient margin to the MELLLA Boundary Line and personnel did not adequately monitor the plant position on the Power to Flow Map. The operating procedure incorrectly used Rod Line to indirectly monitor the MELLLA Boundary Line. Due to the extent of the failures, this event represents a fundamental organizational breakdown and was elevated from L 2-2 to L 1. [L 1-5]

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Classification Examples for BWR (detailed examples)
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L 1: An electrical transient caused a recirculation runback. The plant was stabilized and subsequently returned to 100% RTP IAW the Reactivity Plan. At 100% RTP, it was noted that feedwater temperature was below the minimum temperature required by the license. The same electrical transient that caused the runback had also tripped off all three #6 feedwater heaters. No one had noticed the change in the feedwater heater status prior to the start of the power ascension. During the preparation and execution of the Reactivity Plan, no one noticed the low feedwater temperature. Due to inadequate monitoring of plant status, this event represents a fundamental organizational breakdown and was elevated from L 2-10 to L 1. [L 1-5]

Operation Above the MELLLA Boundary Line

Operation above the MELLLA Boundary Line is considered within the analysis when entry was caused by an unplanned event initiated on or below the MELLLA Boundary Line. In these cases, L 3-12 does not apply. Examples include automatic or manual recirculation runbacks. (GE SIL 653)

L 3: Following an automatic runback from 100% RTP due to a condensate pump trip, the plant stabilized above the MELLLA Boundary Line. Operators inserted control rods to move below the MELLLA Boundary Line within the time requirements. [L 3-8 for downpower]

L 2: Following a manual runback from 100% RTP due to degraded vacuum, the plant stabilized above the MELLLA Boundary Line. Operators did not insert control rods to move below the MELLLA Boundary Line within the time requirements. [L 2-2, separate issue from L 3-8 for downpower]

Operation above the MELLLA Boundary Line is considered outside the analysis when entry was caused by actions unrelated to an unplanned event. In these cases, L 3-12 applies. Examples include control rod withdrawals, Total Core Flow increases, xenon burnout, and feedwater system configuration changes unrelated to plant events (ex. taking a feedwater heater out of service for planned maintenance).

L 3: During power ascension, the Reactor Operator withdrew control rods such that operation was above the MELLLA Boundary Line. The Reactivity Plan included sufficient margin to the MELLLA Boundary Line if the reactivity change had been implemented as specified. Control rods were inserted to move below the MELLLA Boundary Line within the time requirements. [L 3-12]

L 2: At reduced power, removal of 6A Feedwater Heater from service to perform planned maintenance resulted in operation above the MELLLA Boundary Line. Operators did not insert control rods to move below the MELLLA Boundary Line within the time requirements. [L 2-2]

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Classification Examples for BWR (detailed examples)
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Fuel Placement Error

A fuel placement error occurs when the fuel bundle enters or exits the active fuel region of the core the Spent Fuel Pool, the Dry Cask, Fuel Vault, or any other location and the fuel bundle is not in the proper location (if specified).

The fuel placement step has been completed when the Verifier confirms that the fuel bundle has been placed in the correct location (if specified) and the fuel bundle is released from the tooling.

L 3: Prior to fuel grapple release, the Verifier discovered that the fuel bundle was in the wrong core location. The error did not violate reactivity constraints. [L 3-10]

L 3: As the fuel bundle was entering the Dry Cask, the Equipment Operator observed that the fuel bundle was in the wrong cask location. The error did not violate reactivity constraints. [L 3-11]

L 3: A misoriented fuel bundle was found during core verification. [L 3-10]

L 2: During placement of a fuel bundle in the core, it was discovered that there was already a fuel bundle in the core location. The location should have been empty. A fuel placement error had occurred earlier in the fuel movements. [L 2-8]

L 2: As the fuel bundle was entering the SFP racks, the Reactor Operator discovered that the fuel bundle was in the wrong rack location. The error violated rack reactivity constraints. [L 2-9]

L 1: A misoriented fuel assembly was found in the core while being off-loaded during a Refueling Outage. It had been in this position during the previous cycle. [L 1-3]

Fuel Reliability

If there are multiple fuel bundles with the same problem, each fuel bundle is counted separately with respect to the PI. If there are multiple fuel defects in the same fuel bundle, it is counted as a single event with respect to the PI.

None: The plant had been operating at 100% RTP with one suppressed fuel failure (L 3-1 already taken). The off-gas pretreatment RMS alarmed and subsequent grab samples indicated that a second fuel defect has occurred. Based on the radiochemistry, the burnup was consistent with the emergence of a secondary defect in the suppressed fuel bundle (i.e., expected behavior).

ATTACHMENT 2
Classification Examples for BWR (detailed examples)

L 3: During power ascension, the ramp rate on a fuel bundle exceeded the fuel conditioning requirements. [L 3-2]

L 3: The plant had been operating at 100% RTP without a fuel failure. The off-gas pretreatment RMS alarmed and subsequent grab samples indicated that a fuel defect had occurred. [L 3-1]

L 3: The plant entered the Refueling Outage expecting one failed fuel bundle (L 3-1 already taken). During in-mast sipping, two additional fuel bundles were found to contain fuel defects. The PI data was backfitted for the two additional fuel bundles based on the most likely dates of occurrence from a review of the chemistry data. [two new L 3-1s]

L 3: The plant had been operating at 100% RTP with one suppressed fuel failure (L 3-1 already taken). The off-gas pretreatment RMS alarmed and subsequent grab samples indicated that a second fuel defect had occurred. Based on the radiochemistry, the burnup was not consistent with a second defect on the suppressed fuel bundle. A defect had opened in a second fuel bundle. [a new L 3-1]

L 2: During a deep / shallow control rod exchange, fuel conditioning requirements were violated during control rod withdrawals. Fuel failure occurred during power ascension. Power Suppression Testing confirmed that the fuel failure occurred in a cell associated with the violation. [L 2-11]

<u>Fuel Handling</u>

None: During failed fuel inspection, a fuel rod separated during eddy-current testing. This possibility was known and mechanisms were in place to capture all pieces and respond to any fission gas release.

None: During preparations for fuel movement, the dummy fuel bundle was being moved in the SFP when the refueling bridge locked up.

L 5: During insertion of a fuel bundle into its core location, it caught on the channel clip. The fuel bundle was raised and checked with a camera. The channel clip was not bent. The fuel bundle was inserted into its core location without a repeat of the problem. [L 5-13]

ATTACHMENT 2
Classification Examples for BWR (detailed examples)

L 4: During insertion of a fuel bundle into its core location, it caught on the channel clip. The fuel bundle was raised and checked with a camera. The channel clip was bent and required replacement. [L 4-11]

L 4: During movement of a fuel bundle from the reactor core to the SFP, it was dragged for a short distance on the bottom of the cattle chute. The fuel bundle was raised and checked with a camera. There was no damage. [L 4-11]

L 3: Following insertion of a fuel bundle into its core location, the fuel grapple was not released from the bail handle prior to lateral movement of the bridge and the bail handle was bent. The fuel assembly was inspected and determined to be unusable and was consequently discharged prematurely. The Core Loading Plan had to be altered. [L 3-3]

L 2: Fuel Handling incident that results in a breach of fuel cladding. [L 2-11]

ATTACHMENT 3
Level 1 Reactivity Management Event Level Examples (PWR)
Page 1 of 6

Level 1 (Severe) Reactivity Management Events A Reactivity Management Event that results in a severe adverse effect on plant safety, a substantial hazard to the safety and welfare of the public or plant personnel, a major deficiency in the implementation of the quality program, or indicates a high potential for future significant events. In any case, the event was caused by or aggravated by a fundamental organizational breakdown. In addition to the failure of multiple barriers, the event indicates a broader problem over multiple work groups and/or processes. These issues normally require a Root Cause to identify Corrective Actions and to resolve the organizational issues.

Examples of Level 1 (Severe) Reactivity Management Events (PWR)

1.1. Control Rod Ejection

1.2. Anticipated Transient Without Trip

1.3. Violation of a Reactor Core Safety Limit

1.4. Improper Reactivity Control that Results in Fuel Failures Greater Than Technical Specification (TS) Limits

1.5. Reactor Criticality with Misloaded Fuel Bundle in the Core

1.6. Inadvertent Criticality:

- Due to Inadequate Monitoring of Subcritical Conditions
- Critical During Cooldown / Heatup
- Critical During Cold Shutdown or Refueling

1.7. Level 2 or 3 Event Resulting From a Fundamental Organizational Breakdown

1.8. Lower Level Issue Raised to Level 1 due to:

- Repeat Issue
- LTA Human Performance
- Extent of Condition (Generic Implications)
- Aggregate Impact (e.g. number of IRs against a system or process)
- Adverse Trending

OR Other Reactivity Management Issues Meeting Level 1 Criteria

ATTACHMENT 3
Level 2 Reactivity Management Event Level Examples (PWR)
Page 2 of 6

Level 2 (Major) Reactivity Management Events A Reactivity Management Event that places the plant outside of the Design, Analysis, or Licensing Basis or significant events that compromise fuel-related limits, or directly result in fuel failure.

Examples of Level 2 (Major) Reactivity Management Events (PWR)

2.7. Uncontrolled Rod Withdrawal

2.8. Boron Dilution in the RCS, Spent Fuel Pool, or Refueling Canal That Violates Shutdown Margin Limits

2.9. Failure to Meet Physics Testing Acceptance Criteria

2.10. Multiple Control Rod Drop Event While Critical

2.11. Bypass of Reactivity Control System which Results in Improper Reactivity Control

2.12. Criticality Occurs Outside the Predetermined Acceptance Criteria

2.13. Fuel Misload in the Reactor that is Corrected or Reanalyzed Prior to Criticality

2.14. Mislocated Fuel Assembly in Spent Fuel Pool or Dry Cask That Violates Reactivity Constraints

2.15. Reactor Trip With Complications Due to Reactivity Management Issues (NEI 99-02)

2.16. Violation of a Core Thermal Power License Limit (NEI Position Statement on the Licensed Power Limit)

2.17. Violation of Fuel Conditioning Rules That Leads to Fuel Failure

2.18. Implementation of a Reactivity-Related Product That Results in Violation of the Design or Licensing Basis or Exceeding Reactivity-Related TS[1] limit.

2.19. Two or More Control Rods Fail to Insert Following Reactor Trip

2.20. Entry Into Reactivity-Related TS Action Statement and not Corrected Within TS Time Requirements

2.21. Reactivity Anomaly Greater Than TS Limit

2.22. Lower Level Issue Raised to level 2 due to:

- Repeat Issue
- LTA Human Performance
- Extent of Condition (Generic Implications)
- Aggregate Impact (e.g. number of IRs against a system or process)
- Adverse Trending

OR Other Reactivity Management Issues Meeting Level 2 Criteria

ATTACHMENT 3
Level 3 (Minor) Reactivity Management Events Examples (PWR)
Page 3 of 6

Level 3 (Minor) Reactivity Management Events A Reactivity Management Event that represents a violation of process or procedures.

Examples of Level 3 (Minor) Reactivity Management Events (PWR)

3.1. Violation of Fuel Conditioning Rules

3.2. Violation of Core Thermal Power Procedural (Administrative) Limit

3.3. Performance of Inaccurate Procedure That Causes Non-Conservative Reactivity Control and Could Potentially Damage Fuel

3.4. Single Control Rod Drop Event

3.5. Mislocated Fuel Assembly in Spent Fuel Pool or Dry Cask (does not Violate Reactivity Constraints)

3.6. Unplanned and Uncomplicated Manual or Automatic Trip

3.7. Fuel Cladding Breach Requiring Power or Ramp Rate Restrictions

3.8. Untrippable Control Rod When Critical

3.9. Unplanned Reactivity Change Caused by Equipment Problem or Personnel Error

- Reactor Power Change $\geq$ 0.5% RTP When > 5% RTP
- Reactivity Change $\geq$ x pcm When $\leq$ 5% RTP

3.10. Use of a Reactivity-Related Product Containing a Technical Error That Impacts Operation But Does Not Result in Violation of the Design or Licensing Basis or Exceeding Reactivity-Related Tech Specs

3.11. Unplanned Entry into Reactivity-Related TS Action Statement, corrected within TS Time Requirements

3.12. One Control Rod Fails to Insert Following Reactor Trip

3.13. Lower level Issue Raised to level 3 due to:

- Repeat Issue
- LTA Human Performance
- Extent of Condition (Generic Implications)
- Aggregate Impact (e.g. number of IRs against a system or process)
- Adverse Trending

OR Other Reactivity Management Issues Meeting Level 3 Criteria

ATTACHMENT 3
Level 4 Reactivity Management Precursor Examples (PWR)
Page 4 of 6

Level 4 Reactivity Management Precursors A Reactivity Management Issue that indicates degradation of a barrier to proper Reactivity Management or creates an elevated potential for the occurrence of a Reactivity Management Event.

Examples of Level 4 Reactivity Management Precursors (PWR)

4.1. Issue Requiring a Power Reduction > 0.5% RTP (with less than 72 hours notice)

4.2. Unexplained (after evaluation) Discrepancy Between Alternate Indications of Reactor Power (not meant to include instrument failures)

4.3. Core Monitoring System or Instrumentation Problem That Adversely Impacts Core Monitoring

4.4. Improper Bypass of Reactivity Control Systems

4.5. Error in the Heat Balance Calculation (not an instrumentation problem)

4.6. Unplanned Reactivity Change Caused by Equipment Problem or Personnel Error
- Reactor Power Change < 0.5% RTP When >5% RTP
- Reactivity Change < x[1] pcm When ≤ 5% RTP

4.7. Fuel Handling That Results in Damage to Fuel Assembly or Control Components

4.8. Technical Error Found in Approved Reactivity-Related Product After Implementation of the Product But Prior to Use of the Information that is in Error (no impact on operation)

4.9. Crud Induced Power Shift (CIPS) (actual Axial Offset > 5% from predicted)

4.10. Lower Level Issue Raised to level 4 Due to:
- Repeat Issue
- LTA Human Performance
- Extent of Condition (Generic Implications)
- Aggregate Impact (e.g. number of IRs against a system or process)
- Adverse Trending

OR Other Reactivity Management Issues Meeting Level 4 Criteria

[1] Value determined on plant-specific basis

ATTACHMENT 3
Level 5 Reactivity Management Concerns Examples (PWR)
Page 5 of 6

Level 5 Reactivity Management Concerns A Reactivity Management Issue that indicates less than optimal Reactivity Management but does not classify as a L 1 through L 4 issue.

Examples of Level 5 Reactivity Management Concerns (PWR)

5.1. Procedure Deficiency Affecting Reactivity Management

5.2. Degraded Reactivity-Related Equipment Function

5.3. Downpower for Maintenance (≥ 72 hour notice)

5.4. Unanticipated Change in the Ability to Monitor Reactivity (for example, instrument channel failure)

5.5. Less Than Adequate Fuel Handling Practices or Equipment Performance While Handling Fuel or Control Component (with no fuel or control component damage).

5.6. Unexpected Behavior of Reactivity-Related Equipment That Does Not Cause Observable Change in Reactor Power

5.7. Technical Error Found in Reactivity-Related Product After Approval But Prior to Implementation of the Product

5.8. Other Reactivity Management Issues Meeting Level 5 Criteria

ATTACHMENT 3
Level 6 Reactivity Management Concerns Examples (PWR)
Page 6 of 6

Level 6: No Impact on Reactivity Management These are issues that do not impact reactivity and do not meet the criteria defined for Level 1 through 5 issues, but the plant may desire to monitor and trend in order to prevent more significant issues from occurring at a later time. There is no specific requirement to trend these issues. These examples are provided to provide some clarity of examples of events that would not have to be considered in the Performance Indicator.

Examples of Level 6 Reactivity Management Concerns (PWR)

6.1. Procedure Enhancement Affecting Reactivity Management

6.2. Recommendation for Reactivity Management Training Improvement

6.3. Shutdowns or Downpowers That are a Result of Environmental Conditions Outside the Control of the Plant or Requested by the Grid Operator

6.4. Issues concerning nuclear instrumentation that do not impact the ability to monitor the core

6.5. Human Performance Tool enhancements related to reactivity management

6.6. Reactivity-Related Work orders not flagged as reactivity-related

6.7. Reactivity Management Panel/Peer Group issues (e.g., failure to achieve a quorum)

6.8. Less Than Adequate Fuel Handling Practices or Equipment Performance While Not Handling Fuel or Control Components (with no component damage).

6.9. Technical product errors identified by the reviewer during the normal review process

6.10. Technical Error Found in Reactivity-Related Product After Review is Complete but Prior to Approval

6.11. Technical Error Found in Reactivity-Related Product from Vendor Prior to Owner's Acceptance

6.12. Grid Disturbances

ATTACHMENT 4
Classification Examples for PWR (detailed examples)
Page 1 of 9

A Reactivity Management Issue must be understood prior to assigning the correct significance level classification using the Level Definitions. The following examples illustrate how an issue can be classified at different Levels based on the details of the issue and the associated consequences.

- Heat Balance
- Downpower
- Reactor Scram / Shutdown
- Change in Reactor Power
- Control Rod Movement Problem
- Post-Scram Control Rod Position
- Control System or Instrumentation Problem
- Work Management
- Reactivity-Related Product Technical Error
- Operation Outside of the Analyzed Limit
- Fuel Placement Error
- Fuel Reliability
- Fuel Handling

ATTACHMENT 4
Classification Examples for PWR (detailed examples)
Page 2 of 9

<u>Heat Balance</u>

Heat Balance errors influence the following operational aspects. All aspects must be considered when determining the LEVEL.

- Power Range NI Calibrations
- Core Thermal Power License Limit
- Core Thermal Power Procedural Limit (if any)
- Fuel Conditioning Requirements

L 5: The field input to the Plant Process Computer for Blowdown flow was periodically invalid for periods of less than 5 minutes. During these periods, the Heat Balance was invalid. [L 5-2]

L 4: The computer processor handling all field inputs to the Plant Process Computer failed, invalidating the Heat Balance. A valid Heat Balance was not available for 12 hours. [L 4-5]

L 3: A non-conservative error was found in the heat loss term used in the Heat Balance. Even with the error, NI Calibrations, Core Thermal Power, Thermal Limits, and Fuel Conditioning met all requirements. [L 3-4]

L 3: With the ultrasonic feedwater flow measurement system out-of-service, Core Thermal Power was unintentionally at about 99 %RTP for over one hour, in excess of the procedural limit of 98% RTP. [L 3-12]

L 2: A non-conservative error was found in the calibration of the feedwater temperature instrumentation used in the Heat Balance. Average Core Thermal Power was unintentionally at 100.05 %RTP for one shift, in excess of the License Limit for the shift average. [L 2-3]

ATTACHMENT 4
Classification Examples for PWR (detailed examples)
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<u>NI Transient</u>

It is possible to have a short NI transient (neutronic power) that is not observed in the Heat Balance, steam flows, 1st stage pressure, or other indications of Reactor Power (see Section III.K).

L 5: While at 100% RTP, all NI channels momentarily increased. The 1 minute heat balance was within the normal range of fluctuations for 100% RTP. [L 5-5]

L 4: While at 100% RTP, a power supply problem caused Tave to decrease slowly for about 10 seconds prior to returning to the pre-transient value. All NI channels increased by about 0.8%. Reactor Power was estimated to reach a maximum of 100.3% RTP. [L 4-8]

L 3: While at 100% RTP, a perturbation in temperature caused all NI channels to increase by about 1.2% for about 15 seconds prior to returning to the pre-transient value. Reactor Power was estimated to reach a maximum of 100.7% RTP. [L 3-7]

<u>Downpower</u>

None: Downpower to perform TS surveillances or cycle management activities.

None: Due to elevated river temperature, Reactor Power was reduced to maintain compliance with environmental requirements.

None: Due to a solar magnetic disturbance, Reactor Power was reduced to maintain transformer parameters within operating requirements.

L 5: "A" Condensate Pump vibrations had been trending upward for one month. A downpower was planned and executed to resolve the issue before vibration limits were reached. [L 5-1]

L 4: "A" Condensate Pump vibrations had been trending upward for 2 hours. A vibration limit requiring pump removal from service was reached and a downpower was promptly performed to remove the pump from service. [L 4-1]

L 3: "A" Heater Drain Pump vibrations had been trending upward for 2 hours. The pump tripped and caused an automatic runback with an associated reduction in Core Thermal Power of 30% RTP. [L 3-7]

ATTACHMENT 4
Classification Examples for PWR (detailed examples)
Page 4 of 9

Reactor Scram / Shutdown

None: Reactor is scrammed / shutdown to enter Refueling Outage.

L 5: RCS leakage had been trending up for 2 months. A Forced Outage was planned and executed before TS limits were exceeded. [L 5-1]

L 4: TS Shutdown due to inoperable diesel generators. [L 4-1]

L 3: I&C was working on a surveillance that included the insertion of a half-scram at 100% RTP. A full scram occurred due to a spurious signal on the other half of the Reactor Protection System. [L 3-5]

L 2: An OPRM scram occurred due to a multiple CR drop event. [L 2-9]

Change in Reactor Power

None: The plant experiences bi-stable flow within a specific range of behavior. Periodically, Reactor Power changes consistent with this expected flow behavior. In other words, the plant is operating in the normal range of fluctuations around an average Reactor Power.

None: Instantaneous Reactor Power as indicated by the Heat Balance normally fluctuates in the band 99.8% to 100.2% RTP while at 100% RTP based on the one-hour average. While monitoring the one hour average, Operations reduced Reactor Power slightly to maintain the one hour average at or below 100% RTP. All equipment was operating as expected. This behavior was not due to an equipment or human performance issue.

L 5: A Feedwater Heater normal drain valve closed due to equipment failure and level increased until controlled by the dump valve. There was no observable change in Reactor Power. [L 5-5]

L 4: A Feedwater Heater normal drain valve closed due to equipment failure and level increased until controlled by the dump valve. Reactor Power increased by 0.3% RTP prior to Operator action to reduce power. [L 4-8]

L 4: SG Blowdown isolated due to an equipment failure and Reactor Power decreased by 0.2% RTP. [L 4-8]

L 3: A Feedwater Heater trip caused Reactor Power to change by 0.6% RTP prior to Operator action to stabilize Reactor Power. [L 3-7]

ATTACHMENT 4
Classification Examples for PWR (detailed examples)
Page 5 of 9

Control Rod Movement Problem

None: While performing control rod exercise surveillance, control rod 7-3 was adjusted closer to the group average.

L 5: While performing monthly power distribution surveillance, control rod 7-3 was outside the alignment prerequisite of +/-3% of the group average. Alignment was required to perform the surveillance. [L 5-4]

L 4: While performing TVGV quarterly surveillance, control rod M-12 received a DRPI alarm. The actual control rod position was confirmed to be within alignment; bad indication on one train. Response to the alarm affected the maneuver plan (longer stay at lower power). [L 4-2]

L 3: During rod exercise surveillance, rod M-12 was determined to be stuck, and declared inoperable. [L 3-6]

Post-Scram Control Rod Position

L 5: Control rod M-12 fully inserted on a scram but DRPI indication on PPC of a post-scram position of 10% withdrawn. [L 5-2]

L 3: Control rod M-12 did not fully insert on a scram but stopped at 10% withdrawn. (Met TS requirement of 2/3 inserted). [L 3-6]

L 2: Control rod M-12 did not fully insert on a scram but stopped at 50% withdrawn. This behavior was inconsistent with the scram function since it did meet TS. [L 2-5]

L 1: Control rods M-12 and M-4 did not fully insert on a scram but stopped at 50% withdrawn. Based on NI Power, the reactor core was shutdown. [L 1-1]

ATTACHMENT 4
Classification Examples for PWR (detailed examples)
Page 6 of 9

Control System or Instrumentation Problem

None: A Control Room recorder displaying Reactor coolant hot leg temperatures failed. There were alternate sources for these temperatures.

L 5: While at 100% RTP, an Integrated Control System lockup occurred. No control rod movements were in progress or necessary. A tristable card was replaced and the lockup cleared. [L 5-3]

L 3: While at 100% RTP, an Integrated Control System card failure occurred, and power reduced 1%RP before Operators took manual control to stabilize. A tristable card was replaced and the system restored. [L 3-7]

Work Management

L 5: Five (5) days before the planned Load drop to support an offsite transmission line repair, Corrective Maintenance involving feedwater heaters was added to the schedule. These maintenance activities required a longer duration at a lower power level than originally planned. The Reactivity Plan required rework/revision (not simply a pen-and-ink change). [L 5-7]

Reactivity-Related Product Technical Error

Reactor Engineering, Nuclear Fuels, Site Engineering, Design Engineering, Operations, Fuel Vendors, and other organizations produce products that may be reactivity-related. Such products include reactivity related procedures, COLR's, Cycle Management Reports, Reactivity Plans, fuel move sheets, rod move sheets, calculations, databanks, and design modifications. Only technical errors impact the Performance Indicator. The Level of an issue is based on time of discovery and the impact of the technical error if it is implemented. Implementation of the product refers to it being utilized by the plant, for example to perform a reactivity change or in performing calculations, even if the parameter was not specifically utilized in a calculation. If fuel move sheets have been authorized for use and a Fuel Handling Supervisor identifies an error in the move sheets during the course of the fuel moves, this is considered implemented but prior to use. If an error is identified in the core monitoring system input deck prior to the use of that information (eg., Equipment Out Of Service Option limit), this is still considered implemented but prior to use. The error also has to have the potential to cause a problem. For example, an error in a COLR that did not translate to an error in the input deck and would not have resulted in errors in calculations or operation outside of the analysis, is not considered an implemented error. An error in an analysis that does not impact operation would also not be included if it does not impact the overall outcome of the end result (i.e., COLR limits).

ATTACHMENT 4
Classification Examples for PWR (detailed examples)
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None: A technical error was found in the core shuffle move sheets prior to approval by the Reactor Engineering Manager.

L 5: A technical error was found in a Reactivity Plan by the Control Room Supervisor prior to authorization. The error had not been found during the review and approval process. [L 5-6]

L 4: A technical error was found in an approved vendor calculation involving reduced feedwater temperature operation. The limits associated with this operational flexibility had been incorporated into plant procedures and COLR, but the operational flexibility was not used prior to discovery of the error. [L 4-7]

L 4: During execution of the Reactivity Plan but prior to power increase, the Reactor Operator found an error in the allowed ramp rate on the approved ReMA. [L 4-7]

L 3: A non-conservative error was found in the Core Monitoring System databank for the exposure-dependency of the LHGR limit for a specific fuel type. Even with the error, power distribution limits were acceptable. [L 3-4]

L 3: A Reactor Operator reduced Tave <550 degF per the approved ReMA. This temperature was later determined to be outside of the approved analysis and procedure for low temperature operation. [L 2-8]

L 2: A non-conservative error was found in the Core Monitoring System databank for the exposure-dependency of the LHGR limit for a specific fuel type. With this error, a power peaking limit was exceeded for this fuel type earlier in the cycle. [L 2-8]

L 1: During a maneuver, Control Rod Group 7 was withdrawn 50% IAW the Reactivity Plan. Due to an error in the associated predictions, the withdrawals placed the plant above the NOT ALLOWED Line. When the error in the predictions is coupled with the failure to adequately monitor plant parameters during the withdrawals, this event represents a fundamental organizational breakdown and was elevated from L 3-10 to L 1. [L 1-5]

ATTACHMENT 4
Classification Examples for PWR (detailed examples)
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Fuel Placement Error

A fuel placement error occurs when the fuel bundle enters the active fuel region of the core, the level of the stored fuel assemblies in the Spent Fuel Pool, or the Dry Cask and the fuel bundle is not in the proper location or orientation (if specified).

The fuel placement step has been completed when the Verifier confirms that the fuel bundle has been placed in the correct location and orientation (if specified) and the fuel bundle is released from the tooling.

L 3: Prior to fuel grapple release, the Verifier discovered that the fuel bundle was in the wrong core location. The error did not violate reactivity constraints. [L 4-3]

L 3: A fuel bundle was placed into the Dry Cask and ungrappled. The Equipment Operator observed that the fuel bundle was in the wrong cask location. The error did not violate reactivity constraints. [L 3-9]

L 2: A mislocated fuel bundle was found during core verification. [L 2-11]

L 3: During placement of a fuel bundle in the core, it was discovered that there was already a fuel bundle in the core location. The location should have been empty. A fuel placement error had occurred earlier in the fuel movements. [L 3-9]

L 2: As the fuel bundle was placed in the SFP racks, the Reactor Operator discovered that the fuel bundle was in the wrong rack location. The error violated rack reactivity constraints. [L 2-7]

L 1: A mislocated fuel assembly was found in the core while being off-loaded during a Refueling Outage. It had been in this position during the previous cycle. [L 1-3]

Fuel Reliability

If there are multiple fuel defects in the same fuel bundle, it is counted as a single event with respect to the PI.

None: The plant had been operating at 100% RTP with one identified fuel failure (L 3-1 already taken). The RMS indicated and subsequent grab samples indicated that a second fuel defect has occurred.

L 3: During power ascension, the ramp rate on a fuel bundle exceeded the fuel conditioning requirements. [L 3-2]

ATTACHMENT 4
Classification Examples for PWR (detailed examples)
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L 3: The plant had been operating at 100% RTP without a fuel failure. The off-gas RMS and subsequent grab samples indicated that a fuel defect had occurred. [L 3-1]

L 5: The plant entered the Refueling Outage expecting one failed fuel bundle (L 3-1 already taken). During in-mast sipping, two additional fuel bundles were found to contain fuel defects. The PI data was backfitted for the two additional fuel bundles based on the most likely dates of occurrence from a review of the chemistry data. [5-3; no new L 3-1s]

Fuel Handling

None: During failed fuel inspection, a fuel rod separated during eddy-current testing. This possibility was known and mechanisms were in place to capture all pieces and respond to any fission gas release.

None: During preparations for fuel movement, the dummy fuel bundle was being moved in the SFP when the refueling bridge locked up.

L 5: During insertion of a fuel bundle into its core location, it caught on the shoehorn device. The fuel bundle was raised and checked with a camera. The fuel bundle was not damaged. The fuel bundle was inserted into its core location without a repeat of the problem. [L 5-9]

L 4: During movement of a fuel bundle from the reactor core to the SFP, it was dragged for a short distance on the bottom of the cattle chute. The fuel bundle was raised and checked with a camera. There was no damage. [L 4-11]

L 3: Following insertion of a fuel bundle into its core location, the fuel grapple was not released from the top nozzle prior to lateral movement of the bridge and the upper grid was torn. The fuel assembly was inspected and determined to be unusable and was consequently discharged prematurely. The Core Loading Plan had to be altered. [L 3-3]

ATTACHMENT 5
Site Reactivity Management Excellence Plan
Page 1 of 2

Site Reactivity Management Excellence Plan

Area Owner: (*Site Reactivity Management Champion)*

Affected Functional / Cross-Functional Areas: Nuclear Safety

Performance Gap Title: Nuclear Safety - Reactivity Management performance lags industry

Performance Gap Description (Clearly define the gaps/problems that are being addressed by this Excellence action plan):

PI Impact: The following table represents a summary of all the Reactivity Management issues in the analysis timeframe from MONTH/YEAR to MONTH/YEAR. The number of hits includes Level 6 Reactivity Management Concerns that do not impact the RM PI.

Reactivity Management Trend Code	Number of Hits	Points
Sum Equipment Issues:		
Human Performance *(excludes equipment issues)*		

How Identified:

Potential/Actual Consequences: Reactivity Management performance lags industry.

ATTACHMENT 5
Site Reactivity Management Excellence Plan
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Analysis Products:

AR Number	Description	Status

Key Actions (Completed/Planned)

AR Number	Action Description	Owner	Status

Performance Monitoring Tools:

Tool	Description		Status
PI	O.2 Reactivity Management PI		Ongoing
Trending PI	Reactivity Control Systems EM Degraded Work down Curve		Ongoing

Success Criteria (Identify criteria that must be satisfied to declare success):
1. ..

Results Achieved:
1. ..

Metrics Used to Demonstrate Sustainability (Attach as applicable):