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Subject: PWR Owners Group
Transmittal of the PWROG Comments on Regulatory Issue Summary (RIS) 2005-29, Rev. 1, "Anticipated Transients that Could Develop into More Serious Events" (PA-ASC-1197)

Please find enclosed the PWROG comments on the Draft Regulatory Issue Summary (RIS) 2005-29, Rev. 1, "Anticipated Transients that Could Develop into More Serious Events".

For technical questions regarding the enclosed PWROG comments, please contact Kurt Flaig, PWROG ASC Chairman (Dominion Virginia) at (804) 273-2271. If you have any additional questions or comments on the enclosed information, feel free to contact Jim Molkenthin in the PWROG office at (860) 731-6727.

Sincerely,

Norman J. Stringfellow

Jack Stringfellow
Chief Operating Officer & Chairman
Pressurized Water Reactor Owners Group

NJS:JPM:kpr

SUNSI Review Complete
Template = ADM – 013
E-RIDS= ADM -03
Add= H. Peppa (HXP16)

Attachments: (1) PWROG Comments on Regulatory Issue Summary (RIS) 2005-29, Rev. 1, "Anticipated Transients that Could Develop into More Serious Events"

cc: PWROG Management Committee
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On July 13, 2015, the Nuclear Regulatory Commission issued a draft Revision 1 to Regulatory Issue Summary RIS-2005-29, and is requesting comments. Consistent with Revision 0, the draft identifies an issue of inconsistency in the Final and Updated Final Safety Analysis Reports (U/FSARs) pertaining to precluding anticipated operational occurrences (AOOs, or Condition II events) from progressing to more severe events (Conditions III or IV). As stated in draft Revision 1, "By itself, a Condition II incident cannot generate a more serious incident of the Condition III or IV category without other incidents occurring independently or result in a consequential loss of function of the RCS or reactor containment barriers."

The specific events discussed in the RIS are the Chemical and Volume Control System (CVCS) or makeup system malfunction, and the Inadvertent Operation of Emergency Core Cooling System (IOECCS). Both events increase the reactor coolant system (RCS) inventory, and may continue to the point of filling the pressurizer and releasing liquid through the power-operated relief valves (PORVs), or even the pressurizer (ASME code) safety valves (PSVs).

The PWROG generally concurs with Revision 0, which principally stipulates that a Condition III event arises when either of the following occurs:

(1) a PORV not qualified for liquid discharge fails open, and its associated block valve is postulated as the single failure, or

(2) a PSV failing open because it is not qualified for liquid discharge.

Revision 0 also recognizes that crediting timely operator action is an acceptable way to prevent liquid discharge, and that a component's safety classification and qualification are factors for an acceptable licensing basis. Revision 1, however, appears to set forth new requirements that have unclear bases.

In particular, the Pressurized Water Reactors Owners Group (PWROG) takes exception to the implied generic applicability of the Revision 1 elements. It is the PWROG's position that the non-escalation criterion does not apply to a plant with a safety-related pressurizer PORV design that is qualified to pass liquid. Revision 1 also expands the original RIS scope by including the Inadvertent PORV or PSV opening, which has initiators different from a CVCS malfunction or IOECCS that result in pressurizer fill. Additionally, there are no clear limitations related to plants with intermediate-head ECCS, which would be exempt from IOECCS considerations. Herein are the consolidated comments of respondents from the PWROG. These comments are structured to promote understanding, and are grouped into general and section-specific feedback. Where helpful, cross-references between General and RIS Section-Specific portions are provided.

1. GENERAL COMMENTS

1. Applicability. The RIS needs to be explicit about whether it is only applicable to PORV models that are neither safety-related nor qualified for liquid relief. The PORVs are the principal focus of these comments because their safety classification may be limited to maintaining an intact RCS pressure boundary. Further, their operational function is to preclude or otherwise limit the cycling of the PSVs during overpressurization events, such as the CVCS malfunction or IOECCS. They may not necessarily have an actual safety-related function to open, unlike the PSVs.

2. Precedent. Revision 0 of the RIS identifies an acceptable plant configuration for water relief through the PORVs without escalation from a Condition II to Condition III event. Specifically, for a liquid relief event occurring at Millstone Unit 3 on April 17, 2005, the plant was determined to be acceptable for liquid relief. Under Revision 1, this would no longer be the case, since new requirements would be established. A RIS is not the appropriate vehicle for establishing new requirements.

3. NUREG-0800 Applicability. The Standard Review Plan (SRP), published as NUREG-0800, is the document used by the Nuclear Regulatory Commission (NRC) staff in evaluating licenses and license amendments. It is not a regulatory requirement but rather provides NRC internal guidance on how to review licensing matters in order to ensure that regulatory requirements are met. Many of the operating plants' design, licensing, and operation preceded the issuance of NUREG-0800, and thus conform to their respective applicable standards. NUREG-0800 cannot therefore be the sole regulatory basis.

4. Loss of Coolant Accident (LOCA) Definition. Both 10 CFR 50 Appendix A and NUREG-0800 Revision 3 define LOCAs as follows:

   "Loss-of-coolant accidents (LOCAs) are postulated accidents that would result from the loss of reactor coolant, at a rate in excess of the capability of the normal reactor coolant makeup system, from piping breaks in the reactor coolant pressure boundary. The piping breaks are postulated to occur at various locations and include a spectrum of break sizes, up to a maximum pipe break equivalent in size to the double-ended rupture of the largest pipe in the reactor coolant pressure boundary."

   Accordingly, absent a break, the relief through a safety-related, liquid discharge-qualified PORV or PSV from either an Inadvertent Operation of Emergency Core Cooling System (IOECCS) or a charging system malfunction does not constitute a LOCA. Also, the volumetric addition of coolant will ensure that core cooling is assured, unlike in a LOCA (see also the Section A.2 comment). And it is critical to note that standard operating practice in both normal and emergency operating procedures is that securing any operating pump MUST be preceded by securing any unwanted flowpaths. In other words and in the context of this RIS, no plant will terminate ECCS until the PORV flowpath is secured. Thus, core cooling is always assured.

   Furthermore, a variety of PORV designs (e.g., pilot, pneumatic, etc.) are used in the industry. Each design will behave differently under liquid relief, and will not necessarily fail such that the LOCA definition is met. In particular, PORVs qualified for liquid relief are essentially additional letdown flowpaths.

   Finally, it follows that all LOCAs, being a breach in the RCS pressure boundary, cannot be isolated. The opening of a PORV, intact or otherwise, reduces RCS pressure sufficiently to preclude cycling of the PSVs. The post-Three Mile Island Action Plan (NUREG-0737) Item II.K.3.1 required all PWR licensees to provide a system that uses the PORV block valve to protect against a small-break loss-of-coolant accident. The closure of the PORV block valve thus ensures the isolation of any potentially damaged PORV.

5. The NRC should include references to "recent NRC review activities" at the bottom of page 3. This will provide better context and understanding of the concerns of the NRC Staff.

2. SECTION-SPECIFIC COMMENTS

Section A. CVCS Malfunction That Increases Reactor Coolant Inventory

A.1 Evaluation of the CVCS malfunction is not required, since it is already analyzed in the licensing basis (i.e., as a reactivity anomaly).

1. All PWRs consider the potential for CVCS malfunctions that result in a boron dilution. While this event adds mass to the pressurizer, an explicit analysis to solely examine the effects of mass addition is not included in the licensing basis of all plants. If a new requirement is being promulgated, which is inappropriate for a RIS, to include an explicit treatment in the licensing basis, then the PORV qualification should also be considered.

A.2 Evaluation of the CVCS malfunction is not required, since it is not as severe as the IOECCS.

1. For some plants, the evaluation of the CVCS malfunction and the IOECCS is covered in the same section of the FSAR. The FSAR usually describes the more limiting pressurizer fill rate event based on the design features of the CVCS and ECCS, as well as the plant-specific transient response.

2. The draft RIS states that it is impossible to make a direct comparison between a CVCS malfunction and an IOECCS. This statement does not consider plant specific aspects of the event. With a technically valid evaluation of plant design features and the expected transient response, a direct comparison can be made and should be allowed. The following wording is recommended for Section A.2:

   "A reactor trip signal is generated during a CVCS malfunction, and the event is terminated when the operator terminates charging flow. The CVCS malfunction could be less limiting (i.e., the pressurizer is predicted to fill at a slower rate) than the IOECCS. The time to fill the pressurizer could be longer, since the coolant shrinks after the reactor is tripped, and the charging flow rate is lower than when the charging pumps are operating as part of the ECCS flow path. However, the IOECCS is a mass addition event that begins with a reactor trip, whereas the CVCS malfunction involves the addition of both mass and heat *(as a result of reactivity addition)* to the RCS. A technically valid argument considers the effects of both mass and heat addition to the RCS as necessary for the IOECCS and CVCS malfunction."

Section B. IOECCS

1. The third sentence in the leading paragraph should be revised (as indentified ***in bold italic***):

"If one or more PORVs open while the pressurizer is water-solid, then the PORV(s) are generally assumed to fail open if they have not been qualified to pass ***liquid***, since valves that are not qualified to relieve ***liquid*** are conservatively assumed to remain the fully open position."

B.1 Closing a block valve to isolate a stuck-open PORV

1. The statement made in NSAL 93-013 was intended to convey the manageability and safety significance of a stuck-open PORV. Lessons learned from Three Mile Island Unit 2 have been incorporated into operating practices in particular and the nuclear industry's culture in general.

   The PORV Block valves are safety-related valves fully capable of isolating their respective PORV. Crediting Block valve closure as a result of IOECCS is similar to terminating a boron dilution at power in that an event (IOECCS, dilution) is diagnosed by operators monitoring their indication (ECCS alarms + flows, batch addition alarms), and take action to manage the event (close the Block valve, secure the addition). Given that flow through a qualified PORV does not constitute a LOCA (see 1.4 above), closure of the PORV Block valve does not constitute a Condition III-type action.

2. Credit for safety-related and qualified PORVs should be allowed. The recommended changes are as follows (as identified ***in bold italic***):

   "***A PORV that is neither safety-related nor qualified for liquid relief may be damaged during the course of liquid discharge, and its re-closure is not ensured.*** Licensing basis analyses that predict that the pressurizer fills and water is relieved through ***such*** PORVs often cite..."

B.2 Application of the PSVs as a Protection System

1. The title of this section is not clearly related to the issue discussed in the draft RIS. The ASME code safety valves or PSVs are required protection features for the RCS. The following is recommended (as identified ***in bold italic***):

   "PORV Status Assumptions in IOECCS Analyses"

2. The first two sentences of the first paragraph describe qualified PSVs, and then switch to discussing PORV status and assumptions used in IOECCS analyses. The text should be revised as follows (as identified ***in bold italic***):

   "In IOECCS analyses, PSVs qualified for liquid relief are credited to open, discharge liquid, and reseat fully. However, these analyses assume that none of the PORVs open, or if they open and are not liquid discharge-qualified, they will remain open. For these fail-open cases, acceptability is based upon the premise that the PORVs can be isolated. For those analyses that assume inoperable PORVs, no apparent consideration has been given to the effect of the PORVs controlling at their setpoint. With operable PORVs, the liquid mass addition is exacerbated in an IOECCS."

The second paragraph should be replaced with the following, which places the regulatory position in a clearer context, and more closely associates the IOECCS for those plants with liquid discharge-qualified PORVs with Condition II events (as identified ***in bold italic***):

"In essence, by not crediting PORV operation, the analysis has effectively substituted the PSVs, being liquid discharge-qualified, for the PORVs, which may not be similarly qualified. The analysis therefore does not reflect a mechanistic response to the IOECCS, which in this case is conservative with respect to mass addition."

3. The second paragraph describes the expected progression of any Condition II event, and characterizes the IOECCS as a Condition II event in a manner that is unclear. A Condition II event may cause any number of actuations during a transient, from a reactor trip to the lifting of a PSV or Main Steam Safety Valve (MSSV). The principal purpose of analyzing a Condition II event is to demonstrate that no fission product barrier fails. For overheating/overpressurization events, the mitigating effects of PORV operation are typically not credited, in order to maximize the pressure excursion such that the RCS is challenged, with the PSV(s) opening to provide pressure relief. The opening of a PSV or MSSV ensures that adequate relief capacity is available, thus ensuring overpressure protection. This is typically coupled with the assumption that the PSV with the lowest setpoint is gagged shut or otherwise unavailable. The lifting of a PSV does not therefore constitute a Condition III event. It is recommended that the following statements be deleted, since the preceding statements (as proposed above) are adequate to illustrate the substitution issue discussed in 2. above:

~~Condition II events are normally handled by the automatic pressure control system (e.g., during load rejections). If the plant conditions exceed the capabilities of the automatic pressure control system during a Condition II event, then the event should be ended with, at most, a reactor shutdown, as specified in the design requirements for Condition II events (AOOs). In contrast, PSVs will not open until after the reactor has been tripped, since the opening setpressure for the PSVs is higher than the high pressure reactor trip setpressure. In other words, PSVs are not expected to open during Condition II events.~~

4. The discussion of ECCS pump shutoff head and maximum RCS pressure as it relates to IOECCS does not serve any purpose. Referring to the initial discussions in this position, not all plants have high pressure injection that can lift a pressurizer PORV or PSV. Therefore, the applicability of this draft RIS should be clarified.

B.3 A stuck-open PORV or PSV resulting from an IOECCS is already addressed as an inadvertent opening of a PORV or PSV

1. 1. The first statement in this section could use an example to illustrate the reasoning behind the licensing basis used by certain plants. Such reasoning may stem from previous licensing agreements that may be invalidated by the intent of this draft RIS. Some provision should be allowed for such prior agreements, or acknowledgement that a potential backfit may be involved.

2. The second paragraph should be revised as follows (as identified in ***bold italic***):

"The inadvertent opening of a PORV or PSV is an event different from an IOECCS. The initiating malfunctions are different (valve or valve controller failure vs. spurious ECCS actuation signal), as are the event progressions (a depressurization leading to valid ECCS actuation versus a pressurization leading to PORV lift), and the actions to recover from the event (e.g., PORV isolation versus appropriate securing of ECCS). Therefore, additional justification should be provided for the common treatment of both events."

B.4 A stuck-open PORV or PSV is not as severe as a SBLOCA

1. The first sentence in this section states that a new "high frequency, severe–consequence" event classification is effectively created by acknowledging that a stuck-open PORV or PSV is less limiting than an SBLOCA. A stuck-open PORV or PSV event is very much bounded by a SBLOCA in many respects, foremost of which is the severity of the core cooling challenge associated with SBLOCA, particularly for a break on a cold leg. While it is correct that for the IOECCS and CVCS malfunction events the mass transfer at the discharge will be choked, the corresponding volumetric addition of coolant will ensure that core cooling is maintained. The location of a stuck-open PORV or PSV lends itself to effective core cooling throughput. The effectiveness of once-through cooling was demonstrated at Three Mile Island Unit 2 in 1979, up until the point of improper operator actions. The nature of the event is clear: the volume transfer from the RCS to the collection point or even to containment is limited by the available charging or ECCS flow. When the PORV, regardless of safety classification or qualification, is isolated and flow is secured as per operational practice, then the transfer is terminated and the core remains cooled and coolable. Therefore, a stuck-open PORV or PSV is not a severe-consequence event.

2. It is recommended that this section be modified to include a discussion of the safety classification and qualification of a valve to discharge liquid and reseat successfully.

B.5 RCS inventory that exits through the PORV(s) is made up by ECCS flow

1. The charging flow, as part of the ECCS flow path, does not control pressurizer level, however, it will operate at maximum capacity, and achieves the same function of supplying sufficient inventory to maintain (or exceed) the RCS volume loss. While operating at full capacity creates its own set of issues (assuring RCS inventory after ECCS isolation, volume of water being ejected out of the RCS potentially into containment, and overpressurization of the system), operating charging flow as part of the ECCS will, at a minimum, accomplish the stated goals of the normal makeup system (compensate for any leakage).

2. Comment 3 in Section A.2 above describes the end-state of an IOECCS or charging malfunction. In either event, core cooling is maintained, but the key variable which cannot be predicted pertains only to those valves that have not been qualified for liquid discharge. A failed valve may not fully reseat. Without knowing the valve's status, it cannot be said on first principles alone whether discharge flow will be matched by ECCS flow for the conditions of the plant. If it is assumed that the valve fails partially open, then ECCS flow will respond in a manner similar to that of a very small hot leg

SBLOCA. If the valve fails fully open, then ECCS will respond with even more flow. In either case, core cooling will be maintained.

Section C. Inadvertent Opening of a PORV or PSV

1. The section describes that the typical licensing basis analyses involving the inadvertent opening of a PORV or PSV typically terminate the accident simulation on reactor trip, foregoing the potential escalation into a Condition III event (SBLOCA) as a result of a stuck-open PORV. The importance of a qualified PORV in this matter cannot be overstated, since its closure would be assured. Following the reactor trip, securing the source of inventory loss is a key concern of the operators (see C.1 comments below), and ensures core cooling and coolability.

2. The statement below does not consider the function of a PORV qualified for liquid relief:

   "An actuation of the ECCS could lead to a water-solid pressurizer, followed by water relief through the PORVs, and ultimately to a Condition III SBLOCA event."

   The above statement implies that any liquid relief through the PORVs would result in a Condition III SBLOCA event. This is not consistent with the case where the pressurizer PORVs are qualified for liquid relief. Further, closing the PORV block valve isolates the RCS inventory loss and is therefore not a Condition III SBLOCA event (see General Comment #4 above regarding the definition of a Condition III SBLOCA). This statement requires additional clarification. Specifically, please reconcile how plants with pressurizer PORVs qualified for liquid relief would have to conclude that the non-escalation criterion is not met.

3. The applicability of this draft RIS is not clear, based on the following statement:

   "Manual action must be taken to close the inadvertently opened PSV, PORV or its block valve before actuation of ECCS could begin."

   This statement implies that only one acceptable method to demonstrate compliance with regulations. However, there does not appear to be a basis for this position. Valve closure before or after pressurizer overfill is acceptable if the valve is qualified for liquid relief. Additionally, The phrase "if it is not water qualified" is embedded in C.1, but that does not adequately convey, as an endorsement, that PORVs or PSVs that are qualified for liquid relief provide an effective means of meeting the non-escalation criterion. The draft RIS needs a stronger position statement on the credit for qualified PORVs and PSVs (also refer to General Comment #2). Also, there are no creditable manual actions to close a PSV in the time frame of interest (i.e., before ECCS actuation). The draft RIS needs to provide clarification on how manual actions could be credited.

4. Please provide the basis for the following statement:

   "Most licensing basis analyses choose to show closure of the PSV, PORV, or its block valve prior to ECCS actuation, in order to avoid the pressurizer filling shortly after ECCS delivery begins."

An informal PWROG survey was not able to substantiate the claim that "most" licensing basis analyses show closure prior to ECCS actuation. In fact, the majority of plant FSARs neither discuss pressurizer overfill in response to a stuck open Pressurizer PORV or PSV, nor present the results of an analysis. The long-term recovery from this event is governed by commitments to the post-Three Mile Island action plan (NUREG-0737) and not by FSAR Chapter 14/15 safety analysis requirements.

This statement appears to imply the need for a new FSAR-grade licensing basis analysis to characterize the long-term response of pressurizer level after an inadvertent opening of PORV or PSV. Additionally, the time frame for closure is vague, with no specific criterion for acceptability. The draft RIS should be clarified.

5. The last sentence in Section C states "...an approach within NSAL 93-013 that failed to meet the non-escalation criterion." However, Section C.1 does not cite the specific approach in NSAL 93-013 that is being referred to. Section C.1 should include more detail on the specific issues with the NSAL.

C.1 Closure of the PSV, PORV, or block valve after ECCS actuation

1. The phrase "if it is not water qualified" is embedded in C.1, but that does not adequately convey, as an endorsement, that PORVs or PSVs that are qualified for liquid relief provide an effective means of meeting the non-escalation criterion. The RIS should include a conclusive statement regarding the crediting of PORVs and PSVs that are qualified for liquid relief to preclude the events from escalating into Condition III or IV events (please also refer to General Comment #2).

2. The quoted statement below is fundamentally incorrect:

   "After the ECCS flow is terminated, operators could begin closing the PSV, PORV, or its block valve."

   As identified in Comment 4 in the General Section, the operators are trained and use the EOPs to ensure proper flow alignments, including isolating reactor coolant losses, before securing ECCS. This minimizes inventory loss, as well as ensuring that core cooling maintained.