BWROG/NRC Meeting on BWR Technical Specification Requirements Related to "Operations with a Potential for Draining the Reactor Vessel" (OPDRVs)

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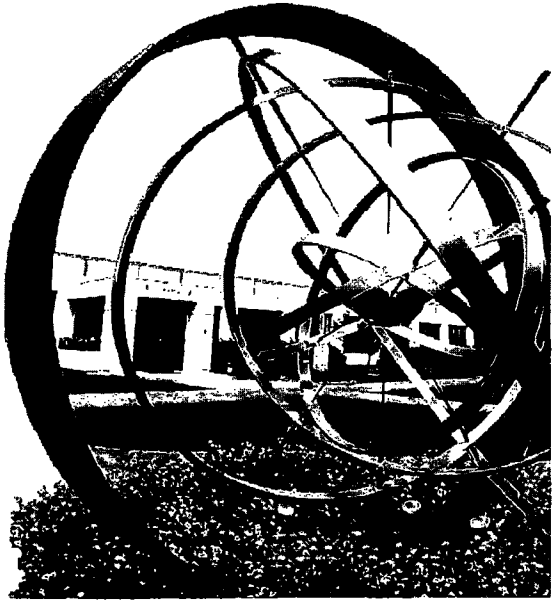
Chair



Agenda

- Introductions
- Historical Review of TS Requirements (NRC/Industry)
- Current Implementation (Industry/NRC)
- Safety Basis (NRC/Industry)
- Discussion of Proposed Definitions (Industry/NRC)
- Roundtable Discussion on Path Forward & Need for Future Meetings

Industry Research into OPDRV History

Origin

- The phrase "operations which have the potential for draining the reactor vessel" appeared in Technical Specifications issued circa 1971.
- The industry was unable to discover any NRC or industry historical documents that establish a safety basis for the term.
- The phrase appears in the initial BWR Standard Technical Specifications, NUREG-0123, beginning in Revision 0, issued October, 1976, through the last published revision, Revision 3, issued December, 1980.

Origin

- Revision 0 of the Improved STS was issued in September 1992.
- The term "operations with a potential for draining the reactor vessel (OPDRVs)" appears many times in the BWR ISTS.
- The term is not a defined term in Section 1.1 of the ISTS. The phrase and acronym appear many times in the ISTS Bases, but it is never defined nor its scope discussed.

NUREG-1433 (BWR/4)

- LCO 3.3.6.2, "Secondary Containment Isolation Instrumentation," Table 3.3.6.2-1, Note (a)
- LCO 3.3.7.1, "[MCREC] System Instrumentation," Table 3.3.7.1-1, Note (a)
- LCO 3.5.2, "ECCS - Shutdown," Required Action B.1, C.1, SR 3.5.2.2
- LCO 3.6.1.3, "PCIVs," Condition H, Required Action H.1
- LCO 3.6.4.1, "[Secondary] Containment," Applicability, Condition C, Required Action C.2
- LCO 3.6.4.2, "SCIVs," Applicability, Condition D, Required Action D.2
- LCO 3.6.4.3, "SGT System," Applicability, Condition C, Required Action C.2.2, Condition E, Required Action E.2
- LCO 3.7.4, "[MCREC] System," Applicability, Condition D, Required Action D.2.2, Condition F, Required Action F.2
- LCO 3.7.5, "[Control Room AC] System," Applicability, Condition C, Required Action C.2.2, Condition E, Required Action E.2
- LCO 3.8.2, "AC Sources - Shutdown," Required Action A.2.3, B.3
- LCO 3.8.5, "DC Sources - Shutdown," Required Action B.2.3
- LCO 3.8.8, "Inverters - Shutdown," Required Action A.2.3
- LCO 3.8.10, "Distribution Systems - Shutdown," Required Action A.2.3

NUREG-1434 (BWR/6)

- LCO 3.3.6.1, "Primary Containment Isolation Instrumentation," Required Action K.2.2, Table 3.3.6.1-1, Note (b)
- LCO 3.3.6.2, "Secondary Containment Isolation Instrumentation," Table 3.3.6.2-1, Note (a)
- LCO 3.3.7.1, "[CRFA] System Instrumentation," Table 3.3.7.1-1, Note (a)
- LCO 3.5.2, "ECCS - Shutdown," Required Action B.1, C.1
- LCO 3.6.1.3, "PCIVs," Condition H, Required Action H.1
- LCO 3.6.4.1, "[Secondary Containment]," Applicability, Condition C, Required Action C.2
- LCO 3.6.4.2, "SCIVs," Applicability, Condition D, Required Action D.2
- LCO 3.6.4.3, "SGT System," Applicability, Condition C, Required Action C.2.2, Condition E, Required Action E.2
- LCO 3.7.3, "[CRFA] System," Applicability, Condition D, Required Action D.2.2, Condition F, Required Action F.2
- LCO 3.7.4, "[Control Room AC] System," Applicability, Condition C, Required Action C.2.2, Condition E, Required Action E.2
- LCO 3.8.2, "AC Sources - Shutdown," Required Action A.2.3, B.3
- LCO 3.8.5, "DC Sources - Shutdown," Required Action B.2.3
- LCO 3.8.8, "Inverters - Shutdown," Required Action A.2.3
- LCO 3.8.10, "Distribution Systems - Shutdown," Required Action A.2.3

1993 Discussions with NRC

- At the June 28, 1993 meeting between the ITS conversion lead plants and the NRC, there was a discussion of an OPDRV issue related to an inspector question.
  - The issue focused on whether an activity was an OPDRV if there were automatic systems that would isolate an inadvertent drain down before the water level would reach the top of the reactor vessel (in this case, 13 feet above the top of fuel).
- The licensee's position was the activity was not an OPDRV and their position was consistent with other surveyed plants.

1993 Discussions with NRC

- At the September 27, 1993 meeting between the ITS conversion lead plants and the NRC, the BWRs provided a summary of the BWROG position:
- Based on a survey of BWR plants:
  - No plants had a written definition of OPDRVs.
  - There was general agreement on the concept of what constituted an OPDRV, related to the size and location of the potential pathway, and the types of barriers that existed to prevent the draining of the vessel.
  - To be an OPDRV, the potential pathway must exceed a certain size, be below an elevation, or exceed a flow rate, generally based on the ability to mitigate an event.

1993 Discussions with NRC

  - Freeze seals, inflatable bladders, etc. were not generally considered to be adequate to consider an activity as not constituting an OPDRV.
- At the meeting, the NRC Technical Specifications Branch disagreed with the industry position and stated they would pursue a generic NRC position, but no public record of such a generic position was found.

Bulletin 93-03

- Bulletin 93-03, "Resolution of Issues Related to Reactor Vessel Water Level Instrumentation in BWRs," addressed potential reactor coolant level instrumentation inaccuracies in Mode 3 that could prevent the automatic isolation of a reactor vessel drain-down event.
  - Note: the Bulletin addressed a long-standing issue and was unrelated to the 1993 ISTS lead plant meeting.

Bulletin 93-03

- Under short term compensatory actions, the NRC directed licensees within 15 days to take several actions, including development of enhanced procedures or additional restrictions and controls for valve alignments and maintenance that have a potential to drain the RPV during Mode 3.
- A consequence of this action was for licensees to develop procedural definitions of what constitutes an OPDRV.

Mid- to Late-1990's

- In the mid to late 1990's, BWRs established positions on OPDRVs.
- In August 1995, the NRC issued a response to TIA on Fermi 2 regarding performance of an operation with the potential to drain the reactor vessel with less than the minimum A.C. electrical power sources available.
- The TIA response acknowledged that there was not a consistent industry definition.
- The TIA response included a suggested NRR definition of OPDRV.
  - The industry recognizes that a TIA response is not considered to be a generic NRC position.

Mid- to Late-1990's

- "The plant is in an OPDRV condition if the following exists:
  - An open penetration > [1 inch] in diameter. (The size threshold is based upon that size which compensatory makeup measures are able to replace water inventory loss.)
  - The open penetration is below the normal water level.
  - The penetration is not protected by an automatic isolation valve, is not isolated by a closed valve, is unisolable, or is not isolable in a timely manner.
  - The open penetration has the potential to uncover irradiated fuel."

Recent Violation

- In an inspection report dated August 3, 2010, the NRC cited a licensee for a violation of 10 CFR 50.59 related to the definition of ODPRVs.
- The violation was based on the NRC's conclusion that the process by which the licensee chose to define OPDRVs is in contrast to the plain language contained in the licensee's licensing basis.
- The NRC's denial of the licensee's response to the violation states:

Recent Violation

- "The term 'OPDRV' was meant to be a plain language definition and nothing more, and 'OPDRV' is not otherwise defined in either the [licensee] Updated Final Safety Analysis Report or [licensee] Safety Evaluation documents. ... [T]he plain language wording of OPDRV ... is intended to address the threat of any reactor coolant inventory loss. The TS wording does not contain a threshold below which OPDRV does not apply."
- The NRC denial of the licensee's response to the violation did not provide references regarding "plain language definition and nothing more" and "intended to address the threat of any reactor coolant inventory loss."

Conclusion of Historical Research

- The term OPDRVs has existed in the BWR Technical Specifications for at least 40 years without a generic definition of the term.
- The NRC and industry discussed OPDRVs during initial ITS development without coming to a consensus position.
- Industry developed procedures and controls that described OPDRVs in response to Bulletin 93-03.
- The issue of what constitutes an OPDRV has been raised by the issuance of a violation to a licensee for making a procedure change affecting the implementation of the term.

Current Industry Implementation

List Approach

- Most BWR plants maintain a list of activities that are or are not considered OPDRVs.
- The approaches have been a combination of prevention and mitigation actions and procedures.
- Examples :
  - Disabling certain valve interlocks that create potential flow paths.
  - A penetration > 1" unless isolated by at least one closed and deactivated valve.
  - A penetration capable of being isolated by an automatic isolation valve.

List Approach

- Examples (continued):
  - A table of potential flow path size vs. number of injection pumps for an evolution to not be an OPDRV.
  - Manual initiation capability of either 1 Core Spray loop or 1 RHR pump, capable of injecting water into the vessel is required & the associated EDG is required.
  - At least 20 minutes to respond to a drain down prior to level dropping to 16" above top of fuel.

List Approach

- Examples (continued):
  - An OPDRV will exist when all of following conditions exist:
    - There is irradiated fuel in RPV.
    - A planned activity will breach RPV pressure boundary or non-routine operation will be conducted on a system connected to RPV pressure boundary.
    - An RPV penetration(s) ≥ 0.8 in^2 cumulative cross-sectional area is involved (equivalent to penetration > 1" diameter).
    - The RPV penetration(s) is located below the feedwater nozzles.
    - An acceptable isolation barrier does not exist.

Evaluation

- Therefore, the typical industry approaches to implementing the phrase OPDRV assume the requirement is limited to:
  - Credible events
  - Events which could result in the RCS water level draining to below the top of the fuel
  - Events which cannot be prevented from uncovering the top of fuel by automatic systems or manual operator actions

Safety Basis

Standard Review Plan

- An unplanned draining of the reactor vessel is not an analyzed accident in Chapter 15 of NUREG-0800, "Standard Review Plan."
- It is not a Loss of Coolant Accident (LOCA), which is defined in NUREG-0800, Section 15.6.4 as 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.
- Given the low energy state of the RCS when the OPDRV term is used in TS, piping breaks are not considered to initiate the draining of the reactor vessel.

Bases

- The Bases treat inadvertent draining of the reactor vessel like an accident, but there is no referenced analytical or regulatory basis:
  - "The Function is also required to be OPERABLE during operations with a potential for draining the reactor vessel (OPDRVs) because the capability of isolating potential sources of leakage must be provided to ensure that offsite dose limits are not exceeded if core damage occurs."
  - "Maintaining the [system] OPERABLE is not required in MODE 4 or 5, except for the following situations under which significant radioactive releases can be postulated:
    a. During operations with a potential for draining the reactor vessel (OPDRVs) and
    b. During movement of [recently] irradiated fuel assemblies in the [secondary] containment."

Technical Specifications

- Based on the Technical Specifications which utilize the phrase, the following safety basis is inferred:
  - The apparent event to be averted is a loss of reactor coolant to below the top of irradiated fuel with the plant in cold shutdown or refueling.
  - The concern is damage to the irradiated fuel in the reactor vessel due to loss of cooling requiring the public and control room operators to be protected from radioactive releases.
  - In order to mitigate the above, at least one subsystem of safety injection is required and certain containment and control room isolation and treatment systems must be available, with required electrical power.

Industry Working Draft Definition

Approach

- The industry discussions have focused on the differences between initiation and mitigation
  - "potential for", vs.
  - "draining the reactor vessel"
- There are number of approaches to capture the concepts:
  - Technical Specifications defined term
  - Administrative Control program
  - Technical Requirements Manual (TRM)
  - Updated Final Safety Analysis Report

Approach

- We have discussed the advantages and disadvantages of an entirely new approach:
  - Create a new Chapter 3 specification with an LCO and Applicability based on defining an OPDRV and Required Actions based on mitigation of an OPDRV.
  - Consistent with other performance based Required Actions, examine the actions that are needed when the LCO is not met.
  - Examine the existing TS references to OPDRVs to determine which would still be required.

Approach

- The advantages are:
  - More concise
  - Expanded Bases
  - Actions appropriate to the safety basis
- HOWEVER,
  - We still need to define "what's an OPDRV?"

Industry Working Draft Definition

Operations With A Potential For Draining The Reactor Vessel (OPDRVs)

OPDRVs shall be any configuration or evolution in which the failure of a single structure, system, or component (SSC) or a single human error could result in draining the water from the reactor pressure vessel to below the top of active fuel when there is irradiated fuel seated in the reactor vessel. A configuration or evolution shall not be an OPDRV if capable of being mitigated prior to the water level reaching the top of active fuel by OPERABLE automatic SSCs or preplanned manual actions, assuming no additional failure(s) or additional human errors. SSCs capable of withstanding an Operating Basis Earthquake may be credited.

Roundtable Discussion on Path Forward