



## Recent Trends in Shutdown Events

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## Overview

- Background
- Examples of recent events and conditions
- Observations on trending
- NRC actions

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## Background

- NRC Generic Letter (GL) 88-17: "Loss of Decay Heat Removal"
- NUMARC 91-06: "Guidelines for Industry Actions to Assess Shutdown Management"
- EPRI: "Analysis of Loss of Decay Heat Removal and Initiating Event Frequencies (1998 – 2000)"
- Staff Requirements Memo: SECY 97-168 Proposed Rulemaking Package for Shutdown and Fuel Storage Pool Operation
  - Commission instructed staff to continue to monitor industry performance
- NRC Temporary Instruction 2515/167: Assurance of industry Implementation of Key Shutdown Voluntary Initiatives
  - Completed 2007

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### Examples of Recent Events and Conditions

#### Not maintaining containment capabilities

- Findings
  - Kewaunee - Unable to close containment equipment hatch within time to boil [IR05000305/2004009] White
  - McGuire (ice condenser) - Licensee did not maintain hydrogen igniters [IR05000369/2003003] Green
  - Point Beach - Unable to close containment equipment hatch within time to boil (TTB) [IR05000266/2005004] Green
- Observations
  - Procedurally permits containment breaches that take longer to close than TTB
  - Containment closure capability not linked to TTB
  - No requirement to close containment if reactor is intact regardless of TTB

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### Examples of Recent Events and Conditions (cont.)

#### Loss of Level Indication

- Findings
  - Calvert Cliffs - During reduced inventory operations lost all level indication for 5 hours [IR05000318/2007002] Green
  - Salem - Failure to identify and correct recurring issue with calibration of narrow range mid loop level transmitter [IR05000272/2008005] Green
  - Sequoyah - Failure to maintain continuous RCS level indication during all possible plant conditions while in reduced inventory/mid-loop configuration [IR05000328/2007006] Green

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### Examples of Recent Events and Conditions (cont.)

#### Loss of Decay Heat Removal

- Findings
  - Turkey Point - Maintenance permitted on AC distribution system just after reduced inventory causing loss of decay heat removal [IR05000250/2006015] White
  - Brunswick - Unauthorized Maintenance Results in Loss of Shutdown Cooling [IR05000324/2009002] Green
  - Pilgrim - Failure to implement procedures for testing analog trip system (ATS) resulting in isolation of reactor shutdown cooling for 25 minutes [IR05000293/2007003] Green
- Observations
  - Early in an outage, one utilities relied on small charging pumps when their capacity to mitigate loss of DHR (via feed and bleed) was questionable

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### Examples of Recent Events and Conditions (cont.)

#### Loss of Inventory

- Findings
  - Oconee – Failure to implement adequate maintenance procedure resulting in loss of power event that ultimately led to loss of RCS inventory [IR05000269/2008010] White
  - Palo Verde - Failure to adequately implement procedures resulting in approximately 930 gallons of water being inadvertently transferred from reactor coolant system to refueling storage water tank [IR05000529/2008003] Green
  - Hope Creek - Inadvertently drained water from reactor pressure vessel during safety relief valve solenoid testing [05000354/2007005] Green

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### Examples of Recent Events and Conditions (cont.)

#### Control Rod Drift

- Finding
  - Dresden - Failure to prevent inadvertent and uncontrolled control rod withdrawal [IR05000249/2009009] White
- Observation
  - Similar to an inadvertent criticality event reported in 2007 by Japanese regulator

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### Observations on Trending

- During early 1990s, number of shutdown events trended down significantly then leveled off in late 1990s (based on EPRI analysis)
- During early 2000s, number of events appeared to increase (based on INPO observations)
- In last eight years (2000 thru 4<sup>th</sup> quarter 2009\*), industry has had
  - 5 white findings
  - 201 green findings
- Increasing trend in number of findings in 2000s possibly due to:
  - Increasing number of problems
  - Increasing inspector awareness

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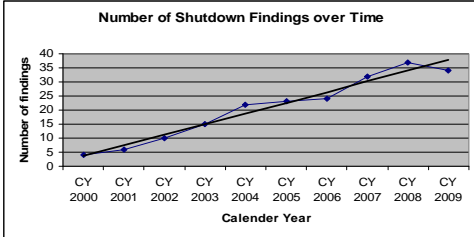
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### Number of Shutdown Findings by Calendar Year



\* Not all 4<sup>th</sup> quarter 2009 inspection reports were completed as of the finalizing of this presentation.

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### Conclusion from Observations

In not authorizing pursuit of a shutdown rule in 1997, the Commission charged the NRC staff with monitoring, evaluating, and, as appropriate, recommending NRC regulatory actions based on the maintenance of safety during shutdown operations.

In reviewing the data and observations, NRC Staff has noted:

- An apparent increase in the number of challenges to the risk-significant safety functions during shutdown operations
- An apparent increase in the breadth of challenges affecting more than one risk-significant safety function
- An increase in precursors to potentially more significant shutdown events

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### NRC Actions

- Participating in industry meetings
  - INPO Outage Managers meetings in 2008 and 2009
  - EPRI/Utility Configuration Risk Management meetings in 2008, 2009 and 2010
  - Public meeting including Nuclear Energy Institute in 2008
- Increased its capabilities to analyze low power and shutdown event (and condition) significance by developing shutdown probabilistic risk assessment (PRA) models and guidance and assessing development of additional models.
- Working with EPRI to revise shutdown initiating event frequency and trend analysis which is scheduled for completion in CY 2010
- Exploring ways to improve collection of data on number of shutdown events
- Initiated effort to develop integrated plan to enhance its ability to assess low power and shutdown operations

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