Temporary Instruction 2515/167

ASSURANCE OF INDUSTRY IMPLEMENTATION OF KEY SHUTDOWN VOLUNTARY INITIATIVES

CORNERSTONE: INITIATING EVENTS
MITIGATING SYSTEMS

APPLICABILITY: This Temporary Instruction (TI) applies to all holders of operating licenses for nuclear power reactors.

2515/167-01 OBJECTIVE

The objective of this TI is to confirm, through interviews and review of refueling outage documents, that licensees are continuing to implement the key voluntary shutdown initiatives as described in NUMARC 91-06 "Guidelines for Industry Actions to Assess Shutdown Management," and in Generic Letter (GL) 88-17 "Loss of Decay Heat Removal (Generic Letter No. 88-17) 10 CFR 50.54(f)." The information will be used to validate the probabilistic risk assessment (PRA) of shutdown operations, presented in SECY 97-168, "Issuance for Public Comment of Proposed Rulemaking Package for Shutdown and Fuel Storage Pool Operation."

2515/167-02 APPLICABILITY

This TI will be performed at approximately one facility per region. The following criteria should be considered when selecting the facility: reactor type, containment type, and method of outage assessment. The selection will be coordinated by NRR with input from the Regions.

2515/167-03 BACKGROUND

In SECY 97-168, the staff asked the Commission to approve the publication for comment of a proposed rule on shutdown operation at nuclear power plants. This rule would have required licensees to establish and implement procedures for training, quality assurance, and corrective actions to ensure that the safety functions of decay heat removal (DHR), inventory control, and pressure control were maintained and monitored. The proposed rule would have required licensees to provide a mitigation capability to ensure adequate core

cooling, DHR, and sufficient protection against the uncontrolled release of fission products in the event of loss or interruption of DHR during shutdown operations. The proposed rule would have also required licensees to provide an intact full-pressure containment or a risk comparable alternative mitigation capability.

A PRA was performed to support the proposed rulemaking (ADAMS Accession No.: ML052860318). The PRA addressed the period beginning with entry into cold shutdown conditions and ending with the flooding of the reactor cavity. The results are summarized in the Table 1.1.

Table 1.1 Results of Shutdown Operations PRA

Case	Description	Core Damage Frequency per Reactor-Year		Unmitigated Release Frequency per Reactor-Year	
		PWR	BWR	PWR	BWR
Base	Analysis limited to protection provided by legally enforceable requirements such as current regulations, TSs, licensee conditions, and orders. No credit allowed for any measure that was voluntary or could be unilaterally changed by the licensee such as commitments in response to generic letters and bulletins.	2E-2	1E-3	2E-2	1E-3
Voluntary Case 1	Minimal implementation of guidance from NUMARC 91-06 and GL 88-17.	8E-5	1E-5	2E-5	8E-6
Voluntary Case 2	In-depth implementation of guidance from NUMARC 91-06 and GL 88-17.	2E-6	6E-7	2E-7	6E-7
Rule	Protection provided by all licensees complying with the requirements of the proposed rule with no additional coverage of shutdown operation.	1E-5	4E-6	1E-6	4E-6

After reviewing the base case, voluntary action cases, and the rule case, the staff reported in SECY 97-168 that the existing level of safety at shutdown largely depends on measures that are not traceable to specific underlying regulations and that these measures could be withdrawn by licensees without prior staff approval. However, the risk results illustrated that the rule would have provided significant benefit if licensees provided minimal response to existing guidance, but would have been of little benefit for licensees that provided in-depth implementation.

The staff requirements memorandum (SRM) of December 11, 1997, in response to SECY 97-168, did not authorize the staff to issue the rule because, as documented in the *Federal Register* (FR) on February 4, 1999, the Commission determined that the proposed

rule was unnecessary given the staff's estimates. Nonetheless, as stated in the SRM and the FR, the Commission expected the staff to continue to monitor licensee performance to ensure that the existing level of safety was maintained and stated that "the Commission . . . may take further action if any adverse trends are identified."

2515/167-04 INSPECTION REQUIREMENTS

04.01 General

For the selected refueling outage, evaluate how the licensee's programs and procedures that ensure the five key safety functions defined in NUMARC 91-06 (decay heat removal, inventory control, power availability, reactivity control, and containment) have been implemented for cold shutdown, refueling, and fuel storage pool operations. This evaluation should include every operating condition and every configuration change between conditions.

04.02 PWR Draindown Operations

While developing the proposed shutdown rule, the staff identified a risk increase when the RCS is breached and the SGs cannot sustain DHR (PWRs only). A second risk increase occurs when midloop conditions are entered and the likelihood of losing DHR flow and level control increases. Determine the circumstances in which the licensee operates with the RCS partially filled following draindown.

04.03 Maintenance Rule Acceptance Criterion

Determine the quantitative and/or qualitative acceptance criteria for the outage schedule and all emergent schedule changes. Determine how these types of changes are assessed with respect to risk assessments performed in accordance with 10CFR 50.65(a)(4). Determine the acceptance criteria, the basis for the criteria, and the use of contingency plans for maintaining defense-in-depth.

2515/167-05 GUIDANCE

05.01 General

This evaluation should include every operating condition and every configuration change between conditions for cold shutdown, refueling, and fuel storage pool operations. Review the licensee's controls and administrative procedures governing the following conditions:

(a) Decay Heat Removal
  (i) The availability of DHR system instrumentation and alarms.
  (ii) The capability to monitor RCS pressure, temperature, and level.
  (iii) The availability of structures systems and components (SSCs) needed to support alternate core cooling paths (including support systems) to maintain the plant in a safe stable state for 24 hours. The SSCs should include sources of water, available injection pumps (pumps not

performing the DHR function) and accumulators (or the equivalent) that can be used to inject into the RCS, and applicable RCS vent paths.

(iv) The availability of procedures that prioritize alternate cooling methods based on RCS configuration, decay heat rate, time to boiling, and time to core uncovery.

(v) The availability of procedures for a loss of spent fuel pool cooling and defense in depth commensurate with the risk associated with loss of spent fuel pool cooling.

(b) Inventory Control

(i) The availability of the automatic isolation function of the DHR system (BWRs only).

(ii) The availability of SSCs needed to maintain and control RCS inventory for 24 hours in the event that a drain path cannot be isolated. Identify sources of water, available standby injection pumps, RCS vent paths, and containment sump recirculation availability.

(iii) The capability to protect the spent fuel pool from loss of inventory, particularly as a result of reactor cavity seal failures, temporary RCS penetration failures (e.g., SG nozzle dams), and valve misalignments.

(iv) The availability of procedures and operator training that address loss-of-inventory events, and the level of diagnosis needed to identify the potential sources of the loss.

(v) The availability of procedures that address recovery from loss of reactor cavity seal failures and loss of cavity inventory (including alternate spent fuel pool cooling methods and temporary cooling for fuel in transit).

(c) Electrical Power

(i) The procedures that control work activities to minimize the potential to affect the DHR function or SSCs needed to support alternate DHR cooling paths.

(ii) The sources of offsite and onsite AC power that are maintained as a function of plant configurations.

(d) Reactivity Control

(i) Potential boron dilution paths (PWRs only).

(ii) Availability and monitoring of source range detectors.

(iii) Availability of boration paths.

(iv) Administrative control of unborated water additions to the RCS (PWRs only).

(v) Control of fuel movement in the reactor vessel concurrent with control rod drive mechanism maintenance (BWR only).

(vi) Loading of fuel after positive verification of control rod insertions.

(vii) Consideration of shutdown margin and source range monitor detector response for refueling sequences.

(e) Containment

(i) Procedures, training, and the pre-staging of equipment necessary to close the containment before core boiling, if the RCS is open.
(ii) Procedures, training, and pre-staging of equipment to close containment before core uncovery commensurate with plant conditions if the RCS is effectively closed.

The evaluation of items i and ii should include:

(A) Loss of offsite AC power and loss of onsite AC power.
(B) Adverse environmental conditions in containment (such as fog, noise, radioactivity, steam, or heat).
(C) A postulated loss of RCS inventory (which may shorten the time to RCS boiling).
(D) The differential pressure capability of the containment penetrations.
(E) The capability of the penetrations to remain intact after a severe accident considering steam pressures and containment pressure spikes due to hydrogen burns. For licensees operating PWRs with ice condenser containments and BWRs with Mark 3 containments evaluate the availability of hydrogen igniters.
(F) Availability of the ice condenser for containment pressure suppression and sump inventory supply post ice melt.

(f) Low Temperature Overpressure Protection (LTOP)/Cold Overpressure Mitigation System (COMS) (PWRs only)
(i) Availability of power operated relief valves (PORVs) with LTOP when required by TS.
(ii) Setpoints of PORVs with LTOP when required by TS.
(iii) Availability of relief valves in the DHR system that can meet LTOP TS. Determine whether single or double dropline exists from RCS hot leg to DHR pumps.
(iv) Setpoints and capacity of relief valves in the DHR system that can meet LTOP TS.
(v) Operational restrictions on work activities to prevent a LTOP/COMS challenge when in water solid conditions.

(g) Flood Prevention and Mitigation
(i) Removal of flood barriers and their location.
(ii) Impact of removal on DHR function, RCS inventory control function, electrical power, and containment closure.
(iii) Licensee risk management actions taken in response to barrier removal.
(iv) Operational guidance used to minimize the likelihood of human error during tagout and draining of flood sources (e.g. service water).

05.02 Draindown Operations (PWR only)

Determine the following when the unit is operated with the RCS partially filled following draindown:

(a) Decay heat loads.
(b) Administrative requirements for minimum SG levels.
(c) Administrative requirements on RHR flow rate and its basis.
(d) Methods to prevent vortexing, air entrainment, and possible air binding of RHR pumps (midloop only).
(e) Changes in the status of equipment for maintenance and testing and coordination of such operations.
(f) Restrictions on testing, operations, and maintenance that could perturb the RCS.
(g) Ability of the RCS to withstand pressurization when temporary RCS pressure boundary closures such as nozzle dams are installed.
(h) Temporary connections, piping, and instrumentation used for this RCS condition and the quality control process to ensure proper operation of such connections, piping, and instrumentation.

05.03 Maintenance Rule Acceptance Criterion

No specific guidance is provided.

2515/167-06 REPORTING REQUIREMENTS

The detailed responses to the inspection requirements specified in Sections 05.01, 05.02, and 05.03 including applicable licensee procedure numbers and titles should be submitted electronically and forwarded to NRR/DRA, to the attention of Marie Pohida via e-mail to map@nrc.gov within 45 days after the completion of the TI.

Document inspection results in a resident inspectors' routine inspection report. At a minimum, the inspectors should document the completion of the TI, the dates of the inspection, and any findings in Section 4OA5, "Other," of the integrated inspection report.

Any findings identified during this inspection should be processed and documented in accordance with NRC IMC 0612. Significance of inspection findings should be evaluated in accordance with applicable appendices of NRC IMC 0609, "Significance Determination Process." Any noncompliance resulting from this inspection should be evaluated and documented in accordance with NRC Enforcement Policy (NUREG -1600) and Section 3.12 of the NRC Enforcement Manual.

2515/167-06 COMPLETION SCHEDULE

This TI will be completed by April 2007.

2515/167-07 EXPIRATION

This TI will expire one year from the date of issuance.

2515/167-08 CONTACT

Questions regarding the technical aspects of this TI should be addressed to Marie Pohida at 301-415-1846 or Nancy Salgado at 301-415-4039.

2515/167-09 STATISTICAL DATA REPORTING

All direct inspection effort expended on this TI is to be charged to 2515/167 for reporting by the STARFIRE/HRMS system with an IPE code of SI.

2515/167-10 ORIGINATING ORGANIZATION INFORMATION

10.01 Organizational Responsibility

This TI was initiated by the PRA Operational Support and Maintenance Branch (NRR/DRA/APOB).

10.02 Resource Estimate

The estimated direct inspection effort to perform this TI is estimated to be 100 hours per site. The TI should be performed by a regional SRA, a regional inspector, and two NRR PRA staff.

10.03 Training

No specialized training is needed to perform inspection requirements in this TI beyond the basic training for inspectors (specified in IMC 1245, "Inspector Qualifications").

2515/167-11 REFERENCES

Generic Letter 88-17, “Loss of Decay Heat Removal (Generic Letter No. 88-17)
10 CFR 50.54(f),” October 17, 1998.

NUMARC 91-06, “Guidelines for Industry Actions to Assess Shutdown Management.” http://nrr10.nrc.gov/adt/dssa/spsb/webpages/spsbpage/spsbhomepageindex.html

SECY 97-168, “Issuance for Public Comment of Proposed Rulemaking Package for Shutdown and Fuel Storage Pool Operation,” July 30, 1997.

Staff Requirements Memorandum, “Staff Requirements - SECY-97-168, Issuance for Public Comment of Proposed Rulemaking Package for Shutdown and Fuel Storage Pool Operation,” December 11, 1997.

Federal Register Notice (FR page 5623, Vol. 64 No. 23), February 4, 1999.

Probabilistic Risk Analysis (PRA) of Internal Events in Support of Proposed 10 CFR50.67, “Shutdown and Fuel Storage Pool Operations at Nuclear Power Plants,” August 27, 1997 (ADAMS Accession No.: ML052860318).

February 2000 Revision to Section 11, “Assessment of Risk Resulting from Performance of Maintenance Activities,” of NUMARC 93-01, *Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants.*

Regulatory Guide 1.182, May 2000, “Assessing and Managing Risk Before Maintenance Activities at Nuclear Power Plants.”

Inspection Procedure 71111, “ Reactor Safety - Initiating Events, Mitigating Systems, Barrier Integrity,” Attachment 71111.20, “Refueling and Other Outage Activities,” dated September 2, 2005.

Inspection Procedure 71111, “ Reactor Safety - Initiating Events, Mitigating Systems, Barrier Integrity,” Attachment 71111.13, “Maintenance Risk Assessment and Emergent Work Control,” dated January 17, 2002.

END

ATTACHMENT 1

Revision History for TI 2515/167

Commitment Tracking Number	Issue Date	Description of Change	Training Required	Training Completion Date	Comment Resolution Accession Number
N/A	04/21/06	Confirm licensees are continuing to implement the key voluntary shutdown initiatives as described in NUMARC 91-06 and Generic Letter 88-17 to validate the PRA of shutdown operations presented in SECY 97-168.	None	N/A	ML060960330