Appendix G

Shutdown Operations
Significance Determination Process

1. Guidance

When Appendix G Should be Used

Appendix G is applicable during refueling outages and forced outages, and maintenance outages starting when the licensee has met the entry conditions for RHR and RHR cooling has been initiated and ending when the licensee is heating up and RHR has been secured. NOTE: if the licensee is in a refueling outage or forced outage and the plant is above RHR entry conditions, then the full power SDP tools should be used acknowledging: (1) decay heat is less compared to full power, potentially allowing for more time for operator recovery, (2) some mitigating systems may require manual operation versus automatic operation, and (3) some containment systems may not be required to be operable potentially increasing the likelihood of containment failure.

Objective

This tool can be used to monitor shutdown capability (equipment, instrumentation, policies, procedures, and training) consistent with the staff's estimate of industry shutdown risk presented to the Commission in SECY 97-168 (the proposed Shutdown Rule). The objective is to assess the potential for an inspection finding to be risk significant. If plant conditions during the time period the finding occurred meet the threshold in this checklist, then more detailed risk analysis is needed to determine if the finding is risk significant. This is similar to the Phase 1 screening for findings at power operations.

The staff is also monitoring conditions that represent a loss of control which include losses of reactor coolant system (RCS) level and losses of thermal margin. These conditions are considered precursors to events that result in an actual loss of decay heat removal (DHR). The staff is monitoring losses of control because the staff's risk estimate of generic PWR and BWR shutdown performance indicates that, based on experience, losses of DHR are relatively infrequent.

Mitigation Capability

Attached are checklists for shutdown operation to ensure that the licensee's are maintaining an adequate mitigation capability. The checklist was developed for different plant operational states defined by: mode, time to boiling, reactor coolant system level, and reactor coolant system configuration. For each plant operational state defined in the checklist, there is a set of equipment, instrumentation, policies, and procedures that the staff expects the licensee to maintain during shutdown. This checklist is grouped by the five shutdown safety functions identified by NUMARC 91-06: decay heat removal, inventory control, power availability, reactivity control, and containment. As a plant enters into the different plant operational states, the inspector uses a different checklist. The inspector should check to ensure that each item on the checklist is being met. If an item is not being met, the inspector should review the section labeled, "Findings requiring phase 2 analysis" to see if the finding needs to be quantitatively assessed. These conditions vary with plant configuration and time to boiling. Findings not requiring quantitative assessment, may be screened "green" and forwarded to the licensee's corrective action program.

The risk estimates used to produce the following tables recognize that certain plant configurations have inherently higher risks than others. For higher risk evolutions, the tables have more

guidelines for each safety function. For example, based on past reviews of PWR shutdown PRAs, the staff has identified a step increase in risk that occurs when the RCS boundary is breached and the steam generators cannot be used for DHR. A second step increase in risk occurs when mid-loop conditions are reached. During midloop conditions, the likelihood that DHR can be lost due to poor RCS level control or poor DHR flow control increases. The staff has also identified the step increased in risk during cold shutdown in BWRs. This increase in risk occurs because technical specifications allow for more equipment to be inoperable in cold shutdown than in a hot shutdown. Also, the technical specifications allow the SRVs to be inoperable which are needed to provide an alternate decay heat removal path and pressure control if the DHR system is lost.

Losses of control During Shutdown

In addition to ensuring that the licensees maintain a mitigation capability during shutdown, as part of the Significance Determination Process, the staff is also monitoring conditions that represent a loss of control. These event are considered precursors to events that result in an actual loss DHR. The staff is monitoring losses of control because the voluntary action case for the proposed Shutdown Rule assumed that, based on experience, losses of DHR are relatively infrequent. In Table One, conditions that meet a loss of control are listed. If these conditions occur, then the finding needs to be quantitatively assessed.

Finding Requiring Quantitative Assessment

Findings that meet the threshold in these checklists and threrefore require quantitative assessment should be forwarded to the Region SRA. To start the assessment, the SRA needs the completed checklists for the outage and a complete description of the finding.

Definitions

Available: A piece of equipment is considered available if it can be put for use quickly enough to meet its functional need and all necessary supporting systems are functional (such as AC power, cooling water, DC control power, etc.).

Reduced Inventory operation: Reduced inventory operation exists whenever the reactor vessel water level is lower than three feet below the reactor vessel flange.
Midloop Operation: A midloop conditions exist whenever the RCS water level is below the top of the flow area of the hot legs at the junction with the reactor vessel.

Shutdown Operation: shutdown operation exists during hot shutdown, cold shutdown, and refueling when more than one fuel assembly is in the reactor vessel and the DHR system is in operation.

2. Basis

Background

In SECY 97-168, the staff requested the Commission to approve the publication of a proposed rule for comment that would cover shutdown and low power operation at nuclear power plants. The proposed rule was applicable during cold shutdown and refueling operation as defined in Technical Specifications. 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, inventory control, and pressure control are maintained and monitored. The proposed rule also required the licensees to provide a mitigation capability. The mitigation capability would

include the necessary equipment to maintain the reactor in a safe condition in the event of the loss of the operating decay heat removal system.

A quantitative regulatory analysis using PRA techniques was performed for SECY 97-168 to evaluate the benefit of the proposed rule. Core damage frequencies were developed for three cases of shutdown operation at PWRs and BWRs: the base case, the voluntary case, and the rule case. The base case represented the level of protection provided strictly by legally enforceable requirements, i.e., current regulations, technical specifications, licensee conditions and orders. It did not credit any measure that was voluntary or that could be unilaterally changed by the licensee, such as licensee commitments made in response to generic letters and bulletins. The base case was used to assess the benefit of the proposed new rule. The voluntary case represented the level of protection for plants operated with a reasonable implementation of voluntary measures, based on guidance from NUMARC 91-06 and GL 88-17. (NUMARC 91-06 provides guidance on improving outage management and GL 88-17 provides recommendations concerning the ability of a licensee to mitigate a potential loss of DHR during reduced inventory operations at PWRs). The voluntary action case also credited equipment assumed operable according to Technical Specifications. The rule case represents the level of protection provided by all plants complying with the requirements of the proposed rule.

For both PWRs and BWRs, two voluntary action cases were performed using different interpretation of NUMARC 91-06 and GL 88-17. The higher CDF voluntary case represents a minimal implementation of both guidance documents. The lower CDF voluntary case represents an in-depth implementation of both guidance documents.

The Regulatory analysis reported core damage frequencies (per reactor year) on the order of E-2 per year and E-3 per year for PWRs and BWRs respectively for the base case. The core damage frequencies (per reactor year) estimated for the voluntary action cases ranged from 8E-5 to 2E-6 per year for PWRs and from 1E-5 to 6E-7 for BWRS.

Based on staff review of the base case, voluntary action cases, and the rule case, the staff reported in SECY 97-168 that: (1) the existing level of safety at shutdown is largely dependent upon measures that are not traceable to specific underlying regulations, and that could, therefore, be withdrawn by licensees without prior staff approval (2) little reduction of risk is achieved by the rule for the licensee who has adopted effective voluntary practices that reduce risk for shutdown operation.

In response to SECY 97-168, the Staff Requirements Memorandum (SRM) did not authorize the staff to issue the rule. As documented in the Federal Register (dated February 4, 1999, vol. 64, no. 23), the Commission did not believe that the proposed shutdown rule was needed given the staff's estimate of current industry performance. However, as directed in the SRM, the Commission "expects the staff to continue to monitor licensee performance, through inspections and other means, in the area of shutdown operations to ensure that the current level of safety is maintained." In addition, in the Federal Register (dated February 4, 1999, vol. 64, no. 23), it states, "the Commission will continue to monitor industry performance and may take further action if any adverse trends are identified."

END

TABLE 1

Losses of Control

Loss of Thermal Margin (PWRs and BWRs)

(Inadvertent change in RCS temperature due to Loss of RHR)/(change in temperature that would cause boiling) > .2 (temperature margin to boil)

Loss of Level PWRs

Inadvertent loss of 2 feet of RCS inventory when not in midloop OR
Inadvertent entry into midloop conditions OR
Inadvertent loss of 2 inches of RCS inventory when in midloop conditions

Loss of Level BWRs

Inadvertent loss of 2 feet of RCS inventory OR
Inadvertent RCS pressurization

END

PWR Hot Shutdown operation

Time to core boiling < 2 hours

I Core Heat Removal Guidelines

A. Instrumentation

_____ (1) DHR heat exchanger inlet/outlet temperature and DHR flow indication in the control room with flow hi/low alarm.

_____ (2) 2 core exit thermocouples with readout and hi alarm in the control room.

B. Training/Procedures

____ (1) Training and Procedures for normal and abnormal DHR operation. Procedure for loss of normal DHR include: prioritized alternate core cooling paths (e.g steam generator cooling, low pressure pump feed and bleed, etc.) , initial magnitude of decay heat, versus time to boiling, time to core uncovery, (NUMARC 91-06 guideline 4.1.1 1)).

____ (2) Training and Procedures for DHR recovery.

C. Equipment

_____ (1) Two heat removal paths consisting of any combination of RCS loops and RHR systems and necessary support systems. (WOG STS 3.4-11)

_____ (2) Available equipment to support two alternate core cooling paths for at least 24 hours, steam generator cooling and feed and bleed. Minimum equipment needs include:

_____ Steam generator inventory, auxiliary feed water (if needed), secondary steam relief

_____ one available high pressure injection train (one operable ECCS train WOG STS 3.5-7)

_____ RWST operable (WOG STS 3.5.4),

_____ An RCS vent path of sufficient size to support feed and bleed (e.g. a PORV) (WOG LTOP TS 3.4.12)

____ Recirculation capability if needed

II Inventory Control Guidelines

A. Instrumentation

_____ 2 independent pressurizer level instruments with a Hi/Lo alarm or level deviation annunciator.

B. Training/Procedures

_____ (1) Loss of Inventory procedures which address: source and magnitude of loss, providing sufficient makeup capability, coping with high radiation levels in containment. (NUMARC 91-06 guidelines 4.2.2.1)

_____ (2) No plant configurations where a single active failure or personnel error can result in a rapid loss of RCS inventory (includes overlapping activities, e.g. Wolf Creek drain down in 1994) (NUMARC 91-06 guideline 4.2.2 2))

C. Equipment

_____ Available equipment sufficient to keep the core covered given a loss of RCS inventory. Minimum equipment needs include:

_____ one available high pressure injection train (one ECCS train operable by WOG STS 3.5-7)

_____ RWST operable (WOG STS 3.5.4).

III Power Availability Guidelines

A. Equipment

____ (1) Two qualified circuits between the offsite transmission network and the onsite class 1E AC Electrical Power Distribution Systems (WOG STS 3.8.1).
____ (2) Two sources of onsite AC power sources (WOG STS 3.8.1)
____ (3) Two trains of DC electrical power subsystems (WOG STS 3.8.4)

IV Containment Control Guidelines

A. Equipment
____ (1) Containment operable (WOG STS 3.6.1)
____ (2) Containment isolation valves operable (WOG STS 3.6.3)
____ (3) Containment Spray and Containment cooling operable (WOG STS 3.6.6)
____ (4) Containment ice beds, ice condenser doors, divider barrier integrity, containment Recirculation drains, and shield buildings operable if applicable (WOG STS 3.6.15 -19)

V Reactivity Guidelines
_____ assumes compliance with Technical Specifications

Findings requiring phase 2 analysis:

_____ Findings that result in non-compliance with LTOP Tech. Specs.
_____ Finding that increase the likelihood that a loss of DHR will occur due to failure of the system itself or support systems, includes findings on DHR and vessel temperature instrumentation such that degraded DHR system performance may not be detected. **Applicable Sections: I.A., I.C.(1)**
____ Findings that increase the likelihood of a loss of RCS inventory, includes: findings that could result in a loss of RCS level instrumentation. **Applicable Sections: II.A., II.B.(2)**
____ Findings that increase the likelihood of a loss of offsite power or findings that degrade the licensee's ability to cope with a loss of offsite power. **Applicable Sections: III.**
____ Findings that degrade the licensee's ability to terminate a leak path or add RCS inventory. **Applicable Sections: II.A, II.B.(1)**, **II.C,**
____ Findings that degrade the licensee's ability to recover DHR once it is lost. **Applicable sections: I.A, I.B.(2),**
____ Finding that degrade the licensee's ability to established an alternate core cooling path if DHR cannot be re-established. **Applicable Sections: I.B.(1), I.C.(2)**
____ Findings that degrade the ability of containment to remain intact following a severe accident. **Applicable Sections: IV.**

PWR Cold Shutdown operation
RCS closed AND SGs available for DHR removal
(LOOPS Filled and Inventory in Pressurizer)
Time to boiling less than 2 hours

I Core Heat Removal Guidelines

A. Instrumentation
_____ (1) DHR heat exchanger inlet/outlet temperature and DHR flow indication in the control room with flow hi/low alarm.
_____ (2) Two core exit thermocouples with control room readout and hi alarm.

B. Training/Procedures
._____ (1) Procedures for normal and abnormal DHR operation. Procedure for loss of normal DHR include: prioritized alternate core cooling paths (e.g steam generator cooling, low pressure pump feed and bleed, etc.) , initial magnitude of decay heat, versus time to boiling, time to core uncovery, (NUMARC 91-06 guideline 4.1.1 1))
_____ (2) Training and Procedures for DHR recovery.

C. Equipment
_____ (1) one RHR loop operable and one additional RHR loop operable or the secondary side water level of at least two steam generators sufficient for DHR (includes necessary support systems (WOG STS 3.4.7)
_____ (2) Available equipment to support two alternate core cooling paths for at least 24 hours, steam generator cooling and feed and bleed. Minimum equipment needs include:
- ____ steam generator inventory, secondary steam relief , and auxiliary feed water (if needed)
- ____ one available high pressure injection pump train AND one other pump train capable of keeping the core covered in addition to the pumps that are part of the normal DHR system.
- ____ An adequate vent path to support feed and bleed (e.g. a PORV) (WOG LTOP STS 3.4.12),
- ____ available RWST.
- ____ Recirculation from emergency sump (if needed).

II Inventory Control Guidelines

A. Instrumentation
_____ 2 pressurizer level instruments with hi/low alarm or level deviation in control room.

B. Training/Procedures
_____ (1) Loss of Inventory procedures address: source and magnitude of loss, providing sufficient makeup capability, coping with high radiation levels in containment. (NUMARC 91-06, guideline 4.2.2.1)
_____ (2) No plant configurations where a single active failure or personnel error can result in a rapid loss of RCS inventory, includes overlapping activities. (NUMARC 91-06, guideline 4.2.2. 2.)

C. Equipment

_____ Available equipment sufficient to keep the core covered given a loss of RCS inventory. Minimum equipment needs include:

_____ one available high pressure injection pump train AND one other pump train capable of keeping the core covered in addition to the pumps that are part of the normal DHR system.

III Power Availability Guidelines

A. Procedures/Training

____ (1) Control over switch yard and transformer yard activities. (NUMARC 91-06 guideline 4.3.2.1)

____ (2) Work activities do not have significant potential to affect existing operable power supplies (NUMARC 91-06 guidelines 4.3.1.2)

B. Equipment

____ (1) 3 sources of AC power including: 1 offsite and 1 onsite source.

____ (2) Necessary DC and AC vital bus electrical power distribution subsystems to support the equipment needed to meet the core heat removal and inventory control safety function guidelines.

IV Containment Control Guidelines

A. Procedures/Training

____ Procedures and training to close containment before core uncovery commensurate with plant conditions (should consider unavailability of AC power and environmental conditions in containment) following a loss of RHR AND a loss of RCS inventory. (NUMARC 91-06 guideline 4.5.1))

B. Equipment

____ Containment penetrations (including temporary) have a differential pressure equal to the ultimate pressure capability of containment or would be expected to remain intact following a severe accident .

V Reactivity Guidelines

____ assumes compliance with Technical Specifications

Findings requiring phase 2 analysis:

_____ Findings that result in non-compliance with LTOP Tech. Specs.

_____ Findings that increase the likelihood that a loss of DHR will occur due to failure of the system itself or support systems, includes findings on DHR instrumentation and vessel temperature instrumentation such that degraded DHR system performance may not be detected. **Applicable Sections: I.A., I.C.(1)**

____ Findings that increase the likelihood of a loss of RCS inventory, includes: findings that could result in a loss of RCS level instrumentation. **Applicable Sections: II.A, II.B.(2)**

____ Findings that degrade the licensee's ability to terminate a leak path or add RCS inventory when needed. **Applicable Sections: II.A, II.B.(1)**, **II.C**

____ Findings that increase the likelihood of a loss of offsite power or findings that degrade the licensee's ability to cope with a loss of offsite power. **Applicable Sections: III.**

____ Findings that degrade the licensee's ability to recover DHR once it is lost. **Applicable Sections: I.A, I.B.(2)**

_____ Finding that degrade the licensee's ability to established an alternate core cooling path if DHR cannot be re-established. **Applicable sections: I.B.(1), I.C.(2)**

____ Findings that degrade the ability of containment to remain intact following a severe accident. **Applicable Sections: IV**.

PWR Cold Shutdown and Refueling operation
RCS open and Refueling Cavity level < 23'
OR
RCS Closed and No inventory in Pressurizer
Time to boiling less than 2 hours

I Core Heat Removal Guidelines

A. Instrumentation

_____ (1) DHR heat exchanger inlet/outlet temperature, DHR flow indication with hi/low flow alarm, and DHR pump motor current with alarm. (GL 88-17)

_____ (2) At least two core exit thermocouples with control room readout and hi alarm until must be removed for preparations for vessel head removal (GL 88-17).

B. Training/Procedures

._____ (1) Procedures for normal and abnormal DHR operation. Procedure for loss of normal DHR include: alternate core cooling paths (e.g feed and bleed), initial magnitude of decay heat, versus time to boiling, time to core uncovery, initial RCS condition (e.g. filled, mid-loop, etc.), RCS configuration (open/closed, nozzle dams installed or loop isolation valves closed, etc.) (NUMARC 91-06 guideline 4.1.1.1)

_____ (2) Training and Procedures for DHR recovery.

C. Equipment

_____ (1) Both trains of DHR operable with necessary support systems. (TS)

_____ (2) Available equipment to support feed and bleed for at least 24 hours. Minimum equipment needs include:

_____ One high pressure injection pump train AND one other pump train capable of keeping the core covered in addition to the pumps that are part of the normal DHR system (GL 88-17)

_____ An adequate vent path that can (1) support feed and bleed and (2) prevent loss of a nozzle dam during RCS re-pressurization following a postulated loss of DHR (e.g. pressurizer manway). (GL 88-17),

_____ Available RWST (GL 88-17)

_____ Recirculation capability from sump (if needed).

II Inventory Control Guidelines

A. Instrumentation

_____ (1) 2 sources of pressurizer level instrumentation with hi/low alarm or level deviation in control room when inventory in pressurizer.

_____ (2) Two sources of level continuous level instrumentation with pressurizer empty. Monitoring performed by an operator in the control room or from a location other than the control room with a provision for providing immediate water level values to an operator in the control room if significant changes occur. (GL 88-17)

B. Procedures/Training

_____ (1) Outage schedule minimizes the overall time that the plant is in a reduced inventory condition (NUMARC 91-06 guideline 4.2.1.3)

_____ (2) Outage schedule delays to the extent practical going to reduced inventory conditions when decay heat load is high. (NUMARC 91-06 guideline 4.2.1.2)

_____ (3) Training, procedures and administrative controls implemented to avoid operations that could lead to perturbations in RCS level control or DHR flow (GL 88-17, NUMARC 91-06 guideline 4.2.1.4)

_____ (4) Loss of Inventory procedures address: source and magnitude of loss, providing sufficient makeup capability, coping with high radiation levels in containment. (NUMARC 91-06 guideline 4.2.2.1)

_____ (5) Drain down is controlled; inventory balances performed and appropriate action taken on level deviation.

C. Equipment

_____ (1) At least, one large hot leg vent established and maintained prior to opening an RCS cold leg penetration. (GL 88-17)

_____ (2) Equipment sufficient to keep the core covered given a loss of RCS inventory. Minimum equipment needs include: one high pressure injection pump train (after breaker racked -in) AND one other pump capable of keeping the core covered in addition to the pumps that are part of the normal DHR system. (GL 88-17).

III Power Availability Guidelines

A. Procedures/Training/Administrative Controls

____ (1) Work activities do not have significant potential to affect existing operable power supplies (NUMARC 91-06 guidelines 4.3.1.2)

___ (2) Control over switch yard and transformer yard activities. (NUMARC 91-06 guideline 4.3.2.1)

B. Equipment

____ (1) 3 sources of AC power including: 1 offsite and 1 onsite source.

____ (2) Necessary DC and AC vital bus electrical power distribution subsystems to support the equipment needed to meet the core heat removal and inventory control safety function guidelines.

IV Containment Control Guidelines

A. Procedures/Training

____ (1) Procedures and training to close containment prior to core boiling if the RCS is open. (NUMARC 91-06 guideline 4.2.5 and GL 88-17

____ (2) Procedures and training to close containment before core uncovery commensurate with plant conditions if the RCS is closed (should consider unavailability of AC power and environmental conditions in containment) following a loss of RHR AND a loss of RCS inventory. (NUMARC 91-06 guideline 4.5.1))

B. Equipment

____ Containment penetrations (including temporary) have a differential pressure equal to the ultimate pressure or would be expected to remain intact following a severe accident. (GL 88-17)

V Reactivity Guidelines

_____ (assumes compliance with Technical Specifications)

Findings requiring phase 2 analysis:

____ Finding that increase the likelihood that a loss of DHR will occur due to failure of the system itself or support systems, includes findings on DHR instrumentation and vessel temperature instrumentation such that degraded DHR system performance may not be detected. **Applicable Sections: IA., IC.(1)**

____ Findings that increase the likelihood of a loss of RCS inventory, especially during reduced inventory conditions, includes: findings that could result in a loss of RCS level instrumentation. **Applicable Sections: IA(1), II.A, II.B (1), II.B(2)., II.B(3), II.B.(5)**

____ Findings that increase the likelihood of a loss of offsite power or findings that degrade the licensee's ability to cope with a loss of offsite power. **Applicable Sections: III.**

____ Findings that degrade the licensee's ability to terminate a leak path or add RCS inventory. **Applicable Sections: II.A, II.B(4), II.C**

____ Findings that degrade the licensee's ability to recover DHR once it is lost. **Applicable Sections: I.A**, **I.B(2)**

____ Finding that degrade the licensee's ability to established an alternate core cooling path if DHR cannot be re-established. **Applicable Sections: I.B.(1), I.C.(2)**

____ Findings that degrade the ability of containment to remain intact following a severe accident. **Applicable Sections: IV.**

PWR Refueling Operation RCS level > 23' OR
PWR Shutdown Operation with Time to Boil > 2 hours AND Inventory in the Pressurizer.

I Core Heat Removal Guidelines

A. Instrumentation

_____ (1) DHR heat exchanger inlet/outlet temperature and DHR flow indication in the control room with flow hi/low alarm.

_____ (2) Two sources of vessel temperature instrumentation (as soon as practical during vessel head re-installation).

B. Procedures/Training

____ (1) Procedures for normal and abnormal DHR operation. Procedure for loss of normal DHR include: alternate core cooling paths (e.g feed and bleed, use of fuel storage pool cooling), initial magnitude of decay heat, versus time to boiling, time to core uncovery, initial RCS condition (NUMARC 91-06 guideline 4.1.1.1))

____ (2) Procedures for RHR recovery.

C. Equipment

_____ At least one RHR loop shall be operable and in operation with support systems (WOG STS 3.9.8.1 or applicable RHR TS)

II Inventory Control Guidelines

A. Instrumentation

_____ Two sources of level instrumentation system with low level setpoint alarm with level < 23 ‘ above reactor vessel flange. One source of level instrumentation with refueling cavity flooded.

B. Procedures/Training/Administrative Controls

_____ (1) Preventive maintenance/inspection or post-installation testing performed on reactor cavity seals prior to filling the reactor cavity to preclude potential seal failure. (NUMARC 91-06 guideline 4.2.5.1)

_____ (2) Verify procedures for reactor cavity seal failure or loss of cavity inventory (NUMARC 91-06 guideline 4.2.5.2)

____ (3) Loss of Inventory procedures address: source and magnitude of loss, providing sufficient makeup capability, coping with high radiation levels in containment. (NUMARC 91-06 4.2.2.1).

____ (4) Freeze seals used in locations that can impact RCS inventory are continuously monitored. Procedures and contingency plans are established in the event of freeze seal failure. (NUMARC 4.2.2.6)

C. Equipment

____ Equipment necessary for makeup to the refueling cavity

III Power Availability Guidelines

__ TS for AC and DC power are being met.

IV Containment Control Guidelines

____ TS for core alterations are being met, if applicable. Containment closure should be addressed in contingency plans and/or in procedures.

V Reactivity Guidelines

____ TS are being met.

Findings requiring phase 2 analysis:

____ Findings that increase the likelihood of a loss of RCS inventory, includes: findings that could result in a loss of RCS level instrumentation. **Applicable Sections: II.A, II.B.(1),**

____ Findings that degrade the licensee's ability to terminate a leak path or add RCS inventory when needed. **Applicable Sections: II.A., II.B (2), II.B.(3), II.B(4) II.C**

____ Findings that degrade the licensee's ability to recover DHR once it is lost. **Applicable: Sections: I.A, I.B.2**

BWR Hot Shutdown
Time to boil < 2 hours
RHR in operation (RCS pressure < RHR cut-in permissive)

I Core Heat Removal Guidelines

A. Instrumentation

_____ (1) DHR heat exchanger inlet/outlet temperature and DHR flow indication in the control room with hi/low flow alarm.

_____ (2) Two Sources of vessel level instrumentation

B. Procedures/Training

____ (1) Procedures for normal and abnormal DHR operation. Procedure for loss of normal DHR include: alternate core cooling paths (e.g feed and bleed), initial magnitude of decay heat, time to boiling, time to core uncovery, initial RCS condition (NUMARC 91-06 guideline 4.1.1.1))

_____ (2) Procedures for DHR recovery if lost.

C. Equipment

_____ (1) Two RHR shutdown cooling subsystems shall be operable with one RHR system in operation (BWR/4 STS 3.4.8)

_____ (2) Available equipment to support an alternate core cooling path (Recirculation using SRVs and suppression pool) for at least 24 hours, includes:

_____ operable SRVs (BWR/4 STS 3.4.3)

_____ Each ECCS injection/spray subsystem shall be operable except HPCI and ADS (BWR/4 STS 3.5-1)

____ Two operable RHR suppression pool cooling subsystems. (BWR/4 STS 3.6.2.3)

II Inventory Control Guidelines

A. Instrumentation

_____ (1) The automatic isolation function of the DHR system (on low vessel level) is operable (BWR/4 STS 3.3.6.1 Primary Containment Isolation Instrumentation) (NUMARC 91-06 guideline 4.2.3.1)

_____ (2) Two sources of vessel level instrumentation.

B. Procedures/Administrative Controls/Training

_____ (1) Special administrative controls are used for valves which can cause rapid inventory loss (e.g. inventory losses to suppression pool) (NUMARC 91-06 guideline 4.2.3.2)

____ (2) Loss of Inventory procedures address: source and magnitude of loss, providing sufficient makeup capability, coping with high radiation levels in containment. (NUMARC 91-06 4.2.2.1).

C. Equipment

_____ Equipment sufficient to keep the core covered given a loss of RCS inventory, includes:

_____ operable SRVs (BWR/4 STS 3.4.3)

_____ Each ECCS injection/spray subsystem shall be operable except HPCI and ADS (BWR/4 STS 3.5-1)

_____ Two operable RHR suppression pool cooling subsystems (BWR/4 STS 3.6.2.3)

III Power Availability Guidelines

A. Procedures/Training

____ (1) Control over switch yard and transformer yard activities (NUMARC 91-06 guidelines 4.3.2.1)

____ (2) Work activities do not have significant potential to affect existing operable power supplies (NUMARC 91-06 guidelines 4.3.1.2)

B. Equipment (same as full power)

____ (1) Two qualified circuit between the offsite transmission network and the onsite 1E AC electrical power distribution subsystems shall be operable(BWR/4 STS 3.8.1)

____ (2) Necessary diesel generators and automatic sequencers to support Technical Specification (TS) compliance. (BWR/4 STS 3.8.1)

____ (3) The necessary portions of the AC, DC, and vital AC bus electrical power distribution subsystems shall be operable to support equipment required to be operable.

IV Containment Guidelines

A. Equipment

____ Primary Containment and Secondary Containment are required to be operable. Most containment systems are required to be operable, exceptions include: primary oxygen concentration and hydrogen re-combiners (if permanently installed)

Findings requiring phase 2 analysis:

_____ Finding that increase the likelihood that a loss of DHR will occur due to failure of the system itself or support systems, includes findings on DHR instrumentation or vessel level instrumentation such that degraded core cooling via DHR not be detected. **Applicable Sections: I.A, I.C.(1)**

____ Findings that increase the likelihood of a loss of RCS inventory, includes: findings that could result in a loss of RCS level instrumentation. **Applicable Sections: II.A.(2), II.B.(1)**

____ Findings that increase the likelihood of a loss of offsite power or findings that degrade the licensee's ability to cope with a loss of offsite power. **Applicable Sections: III.**

____ Findings that degrade the licensee's ability to terminate a leak path or add RCS inventory when needed. **Applicable Sections: II.A. , II.B(2), II.C.**

____ Findings that degrade the licensee's ability to recover DHR once it is lost. **Applicable Sections: I.A, I.B.(2)**

_____ Findings that degrade the licensee's ability to establish an alternate core cooling path if DHR cannot be re-established for 24 hours. **Applicable Sections: I.B(1), I.C(2)**

BWR Cold Shutdown or Refueling Operation
Time to boil < 2 hours
RCS level < 23 above the top of the flange

I Core Heat Removal Guidelines

A. Instrumentation

_____ (1) DHR heat exchanger inlet/outlet temperature and DHR flow indication in the control room with hi/low flow alarm.

_____ (2) Two sources of vessel level instrumentation

B. Procedures/Training

____ (1) Procedures for normal and abnormal DHR operation. Procedure for loss of normal DHR include: alternate core cooling paths (e.g feed and bleed), initial magnitude of decay heat, time to boiling, time to core uncovery, initial RCS condition (NUMARC 91-06 guideline 4.1.1.1))

____ (2) Procedures for DHR recovery if lost.

C. Equipment

_____ (1) Two RHR shutdown cooling subsystems shall be operable with one RHR system in operation (BWR/4 STS 3.4.9, BWR/4 STS 3.9.9)

_____ (2) Available equipment to support an alternate core cooling path (Recirculation using SRVs and suppression pool) for at least 24 hours, includes:

_____ (1) two available SRVs, if vessel head is on

_____ (2) two operable low pressure ECCS injection/spray subsystems (BWR/4 STS 3.5-7)

II Inventory Control Guidelines

A. Instrumentation

_____ (1) The automatic isolation function of the DHR system (on low vessel level) is operable (BWR/4 STS 3.3.6.1 Primary Containment Isolation Instrumentation) (NUMARC 91-06 guideline 4.2.3.1)

____ (2) Two sources of level instrumentation with low level set point alarm.

B. Procedures/Administrative Controls/Training

_____ (1) Special administrative controls used for valves which can cause rapid inventory loss (e.g. inventory losses to suppression pool) (NUMARC 91-06 guideline 4.2.3.2)

____ (2) Loss of Inventory procedures address: source and magnitude of loss, providing sufficient makeup capability, coping with high radiation levels in containment. (NUMARC 91-06 4.2.2.1).

____ (3) Freeze seals used in locations than can impact RCS inventory are continuously monitored. Procedures and contingency plans are established if freeze seal fails. (NUMARC guideline 4.2.2.6).

C. Equipment

_____ Equipment sufficient to keep the core covered given a loss of RCS inventory, includes two operable low pressure ECCS injection/spray subsystems (BWR/4 STS 3.5-7).

III Power Availability Guidelines

A. Procedures/Training

____ (1) Control over switch yard and transformer yard activities (NUMARC 91-06 guidelines 4.3.2.1)

____ (2) Work activities do not have significant potential to affect existing operable power supplies (NUMARC 91-06 guidelines 4.3.1.2)

B. Equipment

____ (1) One qualified circuit between the offsite transmission network and the onsite 1E AC electrical power distribution subsystems shall be operable(BWR/4 STS 3.8.2)

____ (2) One diesel generator capable of supplying one division of the onsite class 1E electrical power distribution subsystems shall be operable (BWR/4 STS 3.8.2)

____ (3) The necessary portions of the AC, DC, and vital AC bus electrical power distribution subsystems shall be operable to support equipment required to be operable. (BWR/ STS 3.8.10)

IV Containment Guidelines

A. Procedures/Training

____ Secondary containment closure can be accomplished in sufficient time before the release of fission products. Procedure includes the unavailability of AC power and expected environmental condition in containment. (NUMARC Guideline 4.5-1)

Findings requiring phase 2 analysis:

_____ Findings that increase the likelihood that a loss of DHR will occur due to failure of the system itself or support systems, includes findings on DHR instrumentation or vessel level instrumentation such that degraded core cooling via DHR could not be detected. **Applicable Sections: I.A., I.C(1)**

____ Findings that increase the likelihood of a loss of RCS inventory, includes findings that could result in a loss of RCS level instrumentation. **Applicable Sections: II.A(2), II.B.(1), II.B.(2), II.B.(3)**

____ Findings that increase the likelihood of a loss of offsite power or findings that degrade the licensee's ability to cope with a loss of offsite power. **Applicable Sections: III.**

____ Findings that degrade the licensee's ability to terminate a leak path or add RCS inventory when needed. **Applicable Sections: II.A, II.B(3), II.C**.

____ Findings that degrade the licensee's ability to recover DHR once it is lost. **Applicable Sections: I.A, I.B.(2)**

_____ Findings that degrade the licensee's ability to establish an alternate core cooling path if DHR cannot be re-established for 24 hours. **Applicable Sections: I.B(1)., I.C(2).**

BWR Refueling operation with RCS level > 23'

I Core Heat Removal Guidelines

A. Instrumentation

_____ (1) DHR heat exchanger inlet/outlet temperature and DHR flow indication in the control room with hi/low flow alarm.

_____ (2) Two sources of vessel level instrumentation

B. Procedures/Training

____ (1) Procedures for normal and abnormal DHR operation. Procedure for loss of normal DHR include: alternate core cooling paths (e.g feed and bleed), initial magnitude of decay heat, time to boiling, time to core uncovery, initial RCS condition (NUMARC 91-06 guideline 4.1.1.1)

_____ (2) Procedures for RHR recovery if lost.

C. Equipment

_____ At least one RHR loop shall be operable and in operation with necessary support systems (BWR/4 STS 3.9.8)

II Inventory Control Guidelines

A. Instrumentation

_____ (1) Two sources of level instrumentation system with low level setpoint alarm.

_____ (2) The automatic isolation function of the DHR system (on low vessel level) is operable (BWR/STS 3.3.6.1 Primary Containment Isolation Instrumentation) (NUMARC 91-06 guideline 4.2.3.1)

B. Procedures

_____ (1) Preventive maintenance/inspection or post-installation testing is performed on reactor cavity seals prior to filling the reactor cavity to preclude potential seal failure. (NUMARC 91-06 guideline 4.2.5.1)

____ (2) Freeze seals used in locations than can impact RCS inventory are continuously monitored. Procedures and contingency's are established in the event of freeze seal failure. (NUMARC guideline 4.2.2.6).

_____ (3) Verify procedures for reactor cavity seal failure or loss of cavity inventory (NUMARC 91-06 guideline 4.2.5.2)

_____ (4) Loss of Inventory procedures address: source and magnitude of loss, providing sufficient makeup capability, coping with high radiation levels in containment. (NUMARC 91-06 4.2.2.1).

C. Equipment

____ Two low pressure ECCS injection/spray subsystems shall be operable (BWR STS 3.5-7 except when the spent fuel storage pool gates are removed).

III AC Power Guidelines

____ (1) One qualified circuit between the offsite transmission network and the onsite 1E AC electrical power distribution subsystems shall be operable(BWR/4 STS 3.8.2)

____ (2) One diesel generator capable of supplying one division of the onsite class 1E electrical power distribution subsystems shall be operable (BWR/4 STS 3.8.2)

____ (3) The necessary portions of the AC, DC, and vital AC bus electrical power distribution subsystems shall be operable to support equipment required to be operable. (BWR/ STS 3.8.10)

Containment Control Guidelines

____ Secondary Containment shall be operable during fuel movement, core alterations, and during operations with a potential for draining the reactor vessel. (BWR STS 3.6.4.1)

Reactivity Guidelines

____ assumes existing core alteration TS are being met.

Findings requiring phase 2 analysis:

____ Findings that increase the likelihood of a loss of RCS inventory, includes findings that could result in a loss of RCS level instrumentation. **Applicable Sections: II.A, II.B(1), II.B(2)**

____ Findings that degrade the licensee's ability to terminate a leak path or add RCS inventory when needed. **Applicable Sections: II.A, II.B(2), II.B(3), II.B(4), II.C**

____ Findings that degrade the licensee's ability to recover DHR once it is lost. **Applicable Sections: I.A, I.B(2)**

BWR Cold Shutdown or Refueling Operation
Time to boil > 2 hours
RCS level < 23 above the top of the flange

I Core Heat Removal Guidelines

A. Instrumentation

_____ (1) DHR heat exchanger inlet/outlet temperature and DHR flow indication in the control room with hi/low flow alarm.

_____ (2) Two sources of vessel level instrumentation.

B. Procedures/Training

____ (1) Procedures for normal and abnormal DHR operation. Procedure for loss of normal DHR include: alternate core cooling paths, initial magnitude of decay heat, time to boiling, time to core uncovery, initial RCS condition (NUMARC 91-06 guideline 4.1.1.1))

____ (2) Procedures for RHR recovery if lost

C. Equipment

_____ (1) Two RHR shutdown cooling subsystems shall be operable with one RHR system in operation (BWR/4 STS 3.4.9, BWR/4 STS 3.9.9)

_____ (2) Available equipment to support an alternate core cooling path for at least 24 hours, includes:

_____ Two available SRVs, if vessel head is on

_____ Two low pressure ECCS injection/spray subsystems shall be operable (BWR/4 STS 3.5-7)

II Inventory Control Guidelines

A. Instrumentation

_____ (1) The automatic isolation function of the DHR system (on low vessel level) is operable (BWR/4 STS 3.3.6.1) (NUMARC 91-06 guideline 4.2.3.1)

____ (2) Two sources of level instrumentation with low level set point alarm.

B. Procedures/Administrative Controls/Training

_____ (1) Special administrative controls used for valves which can cause rapid inventory loss (e.g. inventory losses to suppression pool) (NUMARC 91-06 guideline 4.2.3.2)

____ (2) Freeze seals used in locations that can impact RCS inventory are continuously monitored. Procedures and contingency's are established in the event of freeze seal failure. (NUMARC guideline 4.2.2.6).

___ (3) Loss of Inventory procedures address: source and magnitude of loss, providing sufficient makeup capability, coping with high radiation levels in containment. (NUMARC 91-06 4.2.2.1).

C. Equipment

_____ Equipment sufficient to keep the core covered given a loss of RCS inventory, includes: two operable low pressure ECCS injection/spray subsystems (BWR/4 STS 3.5-7).

III Power Availability Guidelines

Procedures/Training

____ (1) Control over switch yard and transformer yard activities (NUMARC 91-06 guidelines 4.3.2.1)

____ (2) Work activities do not have significant potential to affect existing operable power supplies (NUMARC 91-06 guidelines 4.3.1.2)

Equipment

____ (1) One qualified circuit between the offsite transmission network and the onsite 1E AC electrical power distribution subsystems shall be operable(BWR/4 STS 3.8.2)

____ (2) One diesel generator capable of supplying one division of the onsite class 1E electrical power distribution subsystems shall be operable (BWR/4 STS 3.8.2)

____ (3) The necessary portions of the AC, DC, and vital AC bus electrical power distribution subsystems shall be operable to support equipment required to be operable. (BWR/ STS 3.8.10)

Containment Guidelines

Procedures/Training

____ secondary containment closure can be accomplished in sufficient time before the release of fission products. This procedure includes unavailability of AC power and expected environmental condition in containment. (NUMARC Guideline 4.5-1)

Findings requiring phase 2 analysis:

____ Findings that increase the likelihood of a loss of RCS inventory, includes findings that could result in a loss of RCS level instrumentation. **Applicable Sections: II.A., II.B(1), II.B(2)**

____ Findings that degrade the licensee's ability to terminate a leak path or add RCS inventory when needed. **Applicable Sections: II.A, II.B(2), II.B(3), II.C**

____ Findings that significantly degrade the licensee's ability to recover DHR once it is lost. **Applicable Sections: I.A., I.B(2)**

_____ Findings identifying that one or less SRVs are available to establish a heat removal path to the suppression pool if the vessel head is on. **Applicable Sections: I.C(2)**

END