NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 04/30/98
ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Prairie Island Nuclear Generating Plant Unit 1	05000 282	1 OF 7

TITLE (4)
Containment to RHR MOV's Appendix R Safe Shutdown Analysis Issues

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
08	27	98	98	-- 15 --	01	10	26	98	Prairie Island Unit 2	05000 306
									FACILITY NAME	DOCKET NUMBER 05000

OPERATING	1
POWER	100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

20.2201(b)	20.2203(a)(2)(v)	50.73(a)(2)(i)	50.73(a)(2)(viii)
20.2203(a)(1)	20.2203(a)(3)(i)	√ 50.73(a)(2)(ii)	50.73(a)(2)(x)
20.2203(a)(2)(i)	20.2203(a)(3)(ii)	50.73(a)(2)(iii)	73.71
20.2203(a)(2)(ii)	20.2203(a)(4)	50.73(a)(2)(iv)	OTHER
20.2203(a)(2)(iii)	50.36(c)(1)	√ 50.73(a)(2)(v)	Specify in Abstract below or in NRC Form 366A
20.2203(a)(2)(iv)	50.36(c)(2)	50.73(a)(2)(vii)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Jeff Kivi	651-388-1121

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE).	√	NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On August 27, with both units operating at 100% power, site staff was prompted to review the susceptibility of the redundant containment sump to RHR pump suction MOVs to multiple failures due to a single fire. At the time it was unclear whether a postulated fire-induced spurious opening of the MOVs would drain the refueling water storage tank to containment, thereby causing a loss of the sole credited source of reactor coolant makeup for this postulated fire.

Appropriate compensatory measures will be maintained in the affected fire areas until the status of the subject MOV's is resolved with respect to 10CFR50, Appendix R.

EVENT DESCRIPTION

On August 27, 1998, while both units were operating at 100% power, a question from the Fire Protection Functional Inspection (FPFI) team (Question FP-I072) prompted Prairie Island Nuclear Generating Plant (PINGP) staff to review the susceptibility of the redundant containment sump B to Residual Heat Removal[1] (RHR) pump suction motor operated valves[2] (MOV's) to multiple failures due to a single fire. This review was completed via NCR 19982008. As discussed in FPFI question FP-I072, Unit 1 MOV's MV-32075, MV-32076, MV-32077, and MV-32078, and Unit 2 MOV's MV-32178, MV-32179, MV-32180, and MV-32181 were not on the Appendix R safe shutdown list.

These MOV's are the Containment Sump B suction valves to the RHR system and are arranged such that two Train A valves in series are in parallel with two Train B valves in series. The MOV's are located in the Containment Spray Pump rooms, with one of the MOV's in each series flowpath inside a "can" that forms an extended containment boundary. A postulated fire could cause both MOV's in a train to spuriously open, thereby providing a drain path from the refueling water storage tank[3] (RWST) to Containment Sump B via the RHR System. The MOV's inside the cans are not available for local manual repositioning following a spurious actuation.

CAUSE OF THE EVENT

This event was caused by an oversight during the completion of the current safe shutdown analysis (SSA, revised in 1997). Namely, the spurious operation assumption (at the time the current SSA was initiated) was that only one spurious operation would result from a fire in any one Fire Area. Using that assumption, the valves in question would not be required for safe shutdown. During the course of the completing the current SSA, subsequent interpretations of the requirements of GL 86-10 determined that spurious operations are not limited to one per fire, but that multiple spurious actuations must be considered. Thus, if one spurious operation were assumed to occur, a second spurious operation would have to be prevented from impeding the ability to achieve and maintain safe shutdown. The spurious operation assumptions of the SSA were subsequently changed and those portions of the analysis, where the original erroneous assumption was credited, were revised. However, this particular flow diversion path was overlooked during this process and was not included in the current SSA.

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[1] (EIIS System Identifier: BP)
[2] (EIIS Component Identifier: V)
[3] (EIIS Component Identifier: TK)

ANALYSIS OF THE EVENT

The preliminary circuit analyses for MOV's MV-32075, MV-32076, MV-32077, MV-32078, MV-32178, MV-32179, MV-32180, and MV-32181 indicates that these MOV's could be subject to spurious operation for fires in the Relay Room (Fire Area 18), Control Room (Fire Area 13), or Auxiliary Building 695' elevation (Fire Area 58/73). Each pair of series MOV's in a train are powered from the same motor control center[4] (MCC's 1K1, 1KA2, 2K1 and 2KA2) with their breakers in the same stack. Separate power and control cables are routed from the MCC's to the respective MOV's. However, a common control cable is routed from an MCC to the Relay Room for each trained pair of MOV's.

A preliminary walkdown determined that the subject Unit 2 MOV cables[5] are not protected. The Unit 1 MOV cables are partially protected with Kaowool from the MCC toward the riser to the Relay Room.

An estimate, based on RWST flow rate curves developed for severe accident management guidelines (SAMG), indicates that the RWST would drain to containment (reach equilibrium) in approximately one hour from the Technical Specification low level limit. An estimate based on calculation indicates that from the Technical Specification minimum of 70% (200,000 gallons), the RWST level will equalize with Containment water level at approximately 701' elevation.

For a fire requiring alternate shutdown (i.e., a Control Room or Relay Room fire), the 12 (22) Charging Pump[6] taking suction from the RWST is relied on for hot shutdown inventory control. A PINGP calculation determined that adequate net positive suction head (NPSH) for charging pump operation at 55 gpm is provided down to the 696.5 foot elevation. Thus, approximately 4.5 feet (or approximately 18,000 gallons) of inventory is available for charging pump inventory control. Assuming reactor coolant pump (RCP) seal failures, approximately 42 gpm leakage from the reactor coolant system[7] (RCS) would exist. Thus, approximately 9.8 hours of inventory is available. Due to system arrangements, there is no direct suction path from the containment sump to the charging pumps; thus, the water in containment is not available as RCS make-up for hot shutdown. There is no analyzed, credited equipment to either refill the RWST, or provide another water supply to the charging pumps for postulated fires in the Control Room or Relay Room.

For most fires in the Auxiliary Building (695 foot elevation), the 12 (22) safety injection (SI) pump (taking suction from the RWST) is relied on for inventory control. An estimate based on a PINGP calculation indicates that 27.1 feet of NPSH is available for SI pump operation with RWST level at the 701 foot elevation. The NPSH required is 17 feet for SI pump operation at 700 gpm. Since the top of the SI

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[4] (EIIS Component Identifier: MCC)
[5] (EIIS Component Identifier: CBL)
[6] (EIIS Component Identifier: P)
[7] (EIIS System Identifier: AB)

suction connection is at the 697.1 foot elevation, approximately 4 feet or 15,800 gallons of water would be available from the RWST. Assuming RCP seal[8] failure, approximately 42 gpm leakage from the primary would exist. Thus, approximately 8.5 hours of inventory is available. Due to system arrangements, there is no direct suction path from the containment sump to the SI pumps; thus, the water in containment initially will not be available as inventory for hot shutdown. As above, there is no analyzed, credited equipment to either refill the RWST, or provide another water supply to the SI pumps for postulated fires in the Auxiliary Building.

While there are no specifically analyzed makeup sources, other normally available sources may be unaffected by the fire. For the charging pumps, normal methods of refilling the VCT may be viable options for providing inventory. The Boric Acid Storage tank may be available for the SI pump operation. Normal means of refilling the RWST may be available to support either charging pump or SI Pump operation. A flowpath is available from Containment Sump B, through the RHR System, to the SI Pump to reclaim the water in containment.

Based on the above, sufficient inventory would be available in the RWST to allow time following the fire to establish another make-up source or to pump the water in containment back to the RWST.

A. Deterministic Evaluation of the Safety Significance of the Non-compliance

An evaluation of the sequence that could have occurred if a fire had affected these MOV's concluded:

"1. Procedures and guidance would be available to operators to recognize the potential loss of RWST water.

2. Other sources of water and procedures would be available to supply RCS inventory beyond that remaining in the RWST.

3. Equipment would be available to allow operators to recover the water in Containment.

4. Sufficient time would be available to operators to take action to supply water from other sources such that RCS inventory control would always be maintained and fuel damage would not occur."

"Based on the above, there is ample time and RCS makeup inventory available to ensure that safe shutdown can be achieved with out uncovering the core. Therefore, draining the

[8] (EIIS Component Identifier: SEAL)

RWST to Containment due to fire induced spurious operation of the Sump B Suction Valves is considered an event of low safety significance."

B. Risk Significance Evaluation

An investigation was performed during the fire IPEEE analysis of the risk significance of spurious actuation of MOV's. As part of this analysis, valve pairs MV-32075, MV-32077 (Train A) and MV-32076, MV-32078 (Train B) were addressed. Although not explicitly modeled, the analysis also applies to Unit 2 valve pairs MV-32178, MV-32180 (Train A) and MV-32179, MV-32181 (Train B).

- The frequency of fires that may result in spurious actuation of either of these two valve pairs is low.
- For the valve pairs in question, two spurious actuations are required (since the valves are in series) to open the flowpath to the containment sump.
- Even in this unlikely event, which would potentially fail normal RHR capability, the auxiliary feedwater (AFW) system[9] would remain free of fire damage. Operation of AFW would allow the plant to remain at hot shutdown indefinitely while any repair activities needed to progress to cold shutdown are made. If the fire is in the main control board RHR panel[10], and is large enough to require evacuation of the control room, all controls necessary for operation of the AFW system and control of steam generator level are available at the Hot Shutdown Panel.

Due to the above considerations, the frequency of core damage from this event was found to be less than 1E-8/rx-yr. This is well below the risk contribution of other scenarios in the affected fire areas and substantially less than the IPEEE reporting criteria. Also, this does not credit further actions such as the potential for manual and automatic fire suppression availability and attempted local operation of the outside-containment MOV (or other valves in the flowpath that could be used) to stop the RWST drainage.

C. Compensatory Measures Established

Continuous Fire Watch: Considering the issues identified in this NCR, coupled with other compliance concerns in the Auxiliary Building 695' elevation and the investigation required to determine other appropriate compensatory measures, a continuous fire watch was established in addition to the existing hourly roving fire watch as a compensatory measure. Upon implementing

[9] (EIIS System Identifier: BA)
[10] (EIIS Component Identifier: PL)

procedural compensatory measures (discussed below), the continuous fire watch was discontinued and the hourly roving fire watch was maintained.

Roving Fire Watch: As part of the resolution program for Thermo-Lag issues, Special Order SO-236, was put in effect and remains in effect. This special order maintains the roving hourly fire watches and will remain in effect until resolution of the exemption request associated with the use of Rockbestos Firezone R cable, as well as other related Appendix R/Fire Protection related issues. In addition, NCR 19981794 (IN 92-18 MOV Hot Shorts -- submitted to NRC as LER 1-98-10) also has compensatory measures in place for this area which consists of the roving fire watch under SO-236. The adequacy of the hourly fire watch was evaluated and justified as part of the assessment of NCR 19981794.

Procedural Guidance: Temporary Change Notices (TCN's) were issued against the guidance in PINGP Plant Safety Procedures F5, Appendix B and F5, Appendix D to address the potential for spurious operation of these MOV's. Current manual actions are proceduralized in F5, Appendix B and F5, Appendix D to provide guidance to operators that the MOV's are vulnerable to spurious operation for fires in the Relay Room, Control Room and the Auxiliary Building 695' elevation. These TCN's were reviewed by the Operations Committee on September 10, 1998 and implemented September 11, 1998.

Operator Awareness: A PINGP 1224 Crew Meeting Review was issued September 10, 1998 to explain the concerns to the operating crews.

The RHR Sump B valves, which isolate the Refueling Water Storage Tank from Sump B, are not protected from spurious operation during a fire. This condition could lead to the RWST (the sole credited source of reactor coolant makeup) being drained into containment thereby impacting the ability to maintain RCS inventory. Therefore, this condition is reportable per 10CFR50.73(a)(2)(v) as a condition that could affect the ability to safely shutdown the reactor and per 10CFR50.73(a)(2)(ii)(B) as being outside the PINGP Appendix R design basis.

CORRECTIVE ACTION

1. Compensatory actions that have been established in each affected fire area shall remain in effect until all corrective actions for this event have been implemented or have been determined to be unnecessary. The following specific corrective actions for this event are 2 and 3 below:

2. Include MOV's MV-32075, MV-32076, MV-32077, MV-32078, MV-32178, MV-32179, MV-32180, and MV-32181 in the Appendix R safe shutdown equipment list. Complete the circuit analysis

packages for the valves with recommendations to provide assurance of maintaining the flow diversion path closed.

3. Evaluate the valves for IN 92-18 damage concerns. If the valves could be mechanically damaged during spurious operation, circuit modifications will be performed as required under the IN 92-18 program. Results of this evaluation will be provided in a Supplement to LER 1-98-10.

4. Review the Appendix R safe shutdown list against the appropriate flow diagrams to ensure that all other flow paths vulnerable to diversion were included in the SSA.

5. Implement modifications and/or administrative controls to resolve this issue (and any other flow diversion issues identified in 4, above).

FAILED COMPONENT IDENTIFICATION

None.

PREVIOUS SIMILAR EVENTS

Cases of missing Appendix R Fire Barriers have been identified previously. Refer to Unit 2 Licensee Event Report (LER) 98-03 and Unit 1 LER's 98-12 and 98-14. Unit 1 LER 98-10 addresses the related issue of MOV hot shorts and spurious operation.

Attachment 2

Deterministic Evaluation of
Safety Significance of Draining the RWST to Containment Due to Fire induced Spurious Operation of Sump B Suction Valves

An event has been postulated in which a fire in the Control Room/Relay Room complex (FA 13/18) or 695' elevation of the Auxiliary Building (FA 58/73) could cause sequential spurious opening of the residual heat removal system (RHR) suction valves from Containment Sump B. In that event, the contents of the refueling water storage tank (RWST) would drain through the RHR suction piping to Containment. This assessment discusses equipment and measures available to operators in order to assess the safety significance of the postulated event.

Due to separation across the fire areas, only one unit would be affected by this event at a time. The event and measures taken apply to both units; therefore, a generic discussion follows. Any differences between units is noted.

The discussion below centers on the inventory remaining in the RWST, the systems used for inventory control and other sources of inventory available.

Effect of the Fire on Systems of Interest

Off-site Power

For both FA 13/18 and FA 58/73, power would be made available to operate the equipment required for safe shutdown.

For other sources of makeup discussed below, safeguards MCCs power the boric acid transfer pumps. Other equipment powered by normal sources would be made available by powering the 4 kV normal buses from D3 and D4 emergency diesel generators (EDGs). It should be noted that the cable routes and specific power sources have not been strictly analyzed as part of this assessment.

RCS Makeup

FA 13/18 - Local operation of Train A Charging Pump is the credited and available equipment for this fire area.

FA 58/73 – Train B Safety Injection (SI) is the normally credited inventory control system for this fire area. The appropriate power and control cables for the SI Pump and valves are protected in the area. For fires in this area for which the SI system is not available, the safe shutdown analysis relies on a charging pump and its attendant equipment.

RCS Letdown

FA 13/18 – Letdown and the pressurizer PORVs are secured by de-energizing DC panels in the battery rooms. A repair kit is in place in order to reduce primary pressure through the head vent system in the event that the pressurizer PORVs are not available.

FA 58/73 – Letdown, pressurizer PORVs, etc. would be unaffected and could be secured immediately to minimize inventory loss.

Decay Heat Removal

FA 13/18 – Local operation of the auxiliary feedwater system and steam generator PORVs is available for decay heat removal to cool down the plant.

FA 58/73 – Local operation of the auxiliary feedwater system and steam generator PORVs is available for decay heat removal to cool down the plant.

Available Inventory:

Calculation ENG-ME-388 was performed to determine the effects of draining the RWST. The calculation considered two cases:

- Reactor Coolant Pump (RCP) seal failed resulting in 21 gpm/pump leakage (per the USAR)
- RCP seals intact resulting in 3 gpm/pump leakage

The results of ENG-ME-388 showed that:

In the unlikely event that fire induced damage causes two valves in series to spuriously open and drain the RWST to Containment through the Sump B RHR suction valves, level would equalize at the 701.1' elevation in approximately 50 minutes. Approximately 15,800 gallons of inventory would be available (between 701.1' elevation and the RWST connection to the SI pump suction piping) for SI pump operation, or 18,200 gallons would be available for charging pump operation, without refilling the RWST. The following table shows the time available for operators to take alternate action, depending on the state of the RCP seals:

	Time Available (hours)	
Pump	Seals Failed	Seals Intact
SI	8.5	59.5
Charging	9.8	58.5

Alternate Water Sources and Operator Response

Operators, with support from the site Emergency Response Organization (ERO), must be able to diagnose the situation and identify alternate sources of makeup to the RWST, the charging or SI pump, or to the RCS within the time available.

Operator Diagnosis of Event

If, during the postulated fire in Fire Area 58/73, two sump B valves in series had spuriously opened draining the RWST to Containment, several indications in the Control Room are available to alert the operators to the occurrence.

1. Containment Sump C High Level Alarm
2. Containment Sump A High Level Alarm
3. Containment Sump B Level Indicators
4. Open or no indication on the Sump B MV indicating lights
5. Erratic or low RWST level indication (may be subject to fire damage)
6. Lo and Lo-Lo RWST level alarms (may be subject to fire damage)

For fires in Fire Area 13/18, flooding of containment can be detected by various means. These include: ERO personnel (e.g., Shift Manager) monitoring ERCS alarms, by roving watchstanders after the fire is extinguished, or

ultimately by operators observing flooding in the lower level of containment when attempting to align RHR cooling manually. Access to the valves requiring manual operation would be prohibited by the water level. Local inspection of the position of the Sump B isolation valves in the Containment Spray Pump room would determine actual valve position.

Given the number of diverse indicators available, operators can reasonably be expected to recognize a loss of RWST inventory to containment if a postulated fire in Fire Area 58/73 or Fire Are 13/18 were to cause spurious opening of the RHR suction valves from Containment Sump B well within the 8.5 hours (minimum) available before losing inventory for RCS makeup.

Operator Options for Maintaining RCS Inventory

Once operators determined that the RWST did drain to containment, several options exist for obtaining water for inventory makeup to the RCS.

Boric Acid Storage Tanks

There are three Boric Acid Storage Tanks (BASTs) -- one dedicated to each unit (11 and 21 BASTs) and one shared between the units (121 BAST). Each tank has a 5,000 gallon capacity and is normally kept above 75% full. This provides an additional 11,250 gallons of available makeup. For either the SI or Charging Pump, the Boric Acid Storage Tanks (BASTs) can be aligned to provide additional makeup using the Boric Acid Transfer Pumps (BATPs), or directly to the SI Pump.

The outlet motor operated valves from the BASTs to the SI Pumps are located in and are powered by MCCs in fire area 58/73; portions of the control circuitry are routed through the Control Room/Relay Room complex. Thus, there is some potential that they would be affected by a fire in the area; however, it is not considered credible that the circuit damage would prevent local manual operation of the valves due to the spurious operations (beyond the sump suction valves) which would be required.

There are four BATPs. Portions of the pump control circuitry are routed through the Control Room/Relay Room complex; however, it is not considered credible that all of the BATPs would be rendered inoperable by the fire. Thus, at least one BATP would remain available to transfer borated water, with operation from the hot shutdown panel.

Aligning a BAST to the SI pump suction would require manual operation of one valve; aligning to the charging pump suction would require manual operation of a maximum of five valves. Thus, there is ample time to align a BAST to either the SI pump or charging pump as required.

Boric Acid Batch Tank

The BASTs can be refilled from the 800 gallon Boric Acid Batch Tank (BABT), which is normally kept at 90% full. Transferring from the BABT entails adding boric acid to the demineralized water in the tank, mixing, sampling, and pumping to the BAST. The operation of transferring from the BABT to another tank would take less than 2 hours. The BABT can be refilled from the demineralized water supply to provide additional makeup as desired. The equipment required for this operation does not reside in FA 58/73 and would not likely be affected by a fire in this area, since the equipment is not powered by sources in the fire area and does not receive control signals from equipment from equipment in the area.

Recovery of Water in Containment

For SI pump operation, the RHR System can be aligned for piggy-back operation by taking suction from the Containment B Sump and supplying the suction of the SI pump. This would allow recovery of the water in Containment for direct makeup to the RCS and could be used for the FA 58/73 case after installation of the repair kit for the RHR pump. A pressurizer PORV could be used to provide a recirculation flow path.

For use of the charging pump for the FA 13/18 case, the water in Containment cannot be directly recovered. However, the ability exists to refill the RWST from Containment by taking suction from the Containment Sump B with the RHR pump, aligning RHR pump discharge to the suction of the SI pump and pumping to the RWST through the SI suction piping. For use of the RHR Pump, a repair kit is in place in the event that the fire damages the cabling. The head vent system or a pressurizer PORV (if not damaged by the fire) could be used for a letdown path if required.

Given the number of available alternate sources of RCS inventory make-up, the means for recovering reactor coolant from containment, and the fact that the operators would have support from the site ERO, operators can reasonably be expected to diagnose and mitigate the situation within the time available.

Operator Options for Long Term Cooling

Pumping water back through the SI system to the RWST could also be used as a method of dewatering Containment in order to enter Containment and make manual alignment (if necessary) for recirculation to put the RHR System in service for long term cooling.

Once the RCS is depressurized per ES-1.1, the RHR pump can take suction directly from sump B and discharge to the RCS.

Conclusion

1. Procedures and guidance would be available to operators to recognize the potential loss of RWST water.
2. Other sources of water and procedures would be available to supply RCS inventory beyond that remaining in the RWST.
3. Equipment would be available to allow operators to recover the water in Containment.
4. Sufficient time, at least 8.5 hours, would be available to operators to take action to supply water from other sources such that RCS inventory control would always be maintained and fuel damage would not occur.

Based on the above, there is ample time and RCS makeup inventory available to ensure that safe shutdown can be achieved without uncovering the core. Therefore, draining the RWST to Containment due to fire induced spurious operation of the Sump B Suction Valves is considered an event of low safety significance.

References

1. PINGP Calculation ENG-ME-388, RWST Draining Due to Spurious Sump B Suction Valve Operation," Revision 0.
2. PINGP Procedure F5, Appendix D, "Impact of Fire Outside the Relay Room," Revision 2.
3. PINGP Procedure F5, Appendix B, "Control Room Evacuation (Fire)", Revision 19.
4. PINGP Calculation GEN-PI-026, "Safe Shutdown Analysis for Compliance With 10CFR50 Appendix R, Section III.G," Addendum C13/18, Revision 2.
5. PINGP Calculation GEN-PI-026, "Safe Shutdown Analysis for Compliance With 10CFR50 Appendix R, Section III.G," Addendum C58/7332, Revision 1.