BWR OWNERS' GROUP

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BWROG-00073
July 20, 2000

NRC Project 691

US Nuclear Regulatory Commission
Document Control Desk
Mail Stop 8 D1
Washington, DC 20555–0001
Attn: John N. Hannon,
Plant Systems Branch Chief

SUBJECT: ***BWR Owners' Group Appendix R Fire Protection Committee Use of Safety Relief Valves and Low Pressure Systems as Redundant Safe Shutdown Paths, GE Report No. GE-NE-T43-00002-00-03-R01, August 1999***

Reference: Robert M. Pulsifer to Stuart A. Richards, *Summary of April 25, 2000, Meeting with the Boiling Water Reactor Owners Group (BWROG) Regarding Appendix R Safe Shutdown*, May 24, 2000

Please find enclosed, the BWR Owners' Group (BWROG) Appendix R Fire Protection (FP) Committee's response to the actions requested in the meeting minutes from the April 25, 2000 Meeting with the Staff on our submittal related to the use of Safety Relief valves and Low Pressure Systems as Redundant Safe Shutdown Paths. This submittal contains three attachments. Each attachment addresses one of the actions requested of the BWROG in the referenced meeting minutes. The three attachments cover the topics described below:

1.) **Attachment 1** – Provides a step-by-step narrative discussion of how plant specific operating procedures (derived from BWR EGP, Rev. 4) can be used to achieve and maintain hot shutdown conditions using SRV/LPS.

2.) **Attachment 2** – Provides citations of plant specific licensing documents, which the BWROG believes supports its contention that after 1982, the staff explicitly approved SRV/LPS as a redundant means of achieving post-fire safe shutdown.

3.) **Attachment 3** – Provides the BWROG response regarding the applicability of the fire protection feature (wraps, detectors, sprinklers) removal assumptions in the Probabilistic Safety Assessment Branch risk analysis of the BWROG SRV/LPS position (Rubin to Weiss, April 18, 2000)

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The BWROG believes that the information provided with this letter resolves all of the remaining open issues between the BWROG and the Staff related to this subject. Based on this response, we expect that the NRC will be able to issue an SER on the subject BWROG Report endorsing the use of Safety Relief Valves and Low Pressure Systems as acceptable Safe Shutdown Paths. This acceptance would allow the use of Safety Relief Valves and Low Pressure Systems as Redundant Post-Fire Safe Shutdown paths meeting the requirements of Appendix R Section III.G.1 and 2 (and the equivalent sections of NUREG-0800, C.5.b.1 and C.5.b.2). It would also allow the use of Safety Relief Valves and Low Pressure Systems as Altemative Safe Shutdown Paths meeting the requirements of Appendix R Section III.G.3 (and the equivalent sections of NUREG-0800, C.5.b.3). Alternative shutdown is used in those areas where separation of redundant safe shutdown trains cannot be accomplished in accordance with the requirements of Appendix R Section III.G.2.

If you have any questions about the information provided here or if you would like a meeting to discuss this response, please contact Tom Gorman (PPL) at (610) 774-7762, or George Stramback (GE) at (408) 925-1913.

Sincerely,

J. M. Kenny

James M. Kenny, Chairman
BWR Owners' Group

Attachments

cc: JA Gray, BWROG Vice Chairman
BWROG Primary Representatives
BWROG Appendix R Committee
FA Emerson, NEI
TG Hurst, GE
GB Stramback, GE
KK Sedney, GE

Attachment 1

Achieving and Maintaining Hot Shutdown
using
Safety Relief Valves and Low Pressure Systems

Introduction:

In a memorandum from Robert M. Pulsifer, Project Manager, Project Directorate 1, Section 2 to Stuart A. Richards, Director, Project Directorate IV & Decommissioning, dated May 24, 2000, documenting the results of an April 25, 2000 meeting between the NRC staff and the BWROG, the following action was requested of the BWROG:

> *The BWROG will provide the staff with a step-by-step narrative discussion of how plant-specific operating procedures (derived from BWR EPG Rev. 4) can be used to achieve and maintain hot shutdown conditions using the SRV/LPS (rather than HPCI, RCIC, or condensate/feedwater or other possible shutdown systems) after a reactor scram which occurs with a 100 percent power history, to the extent that latent and decay heat would be of sufficient magnitude to permit continuation of this mode of plant operation.*
>
> *[Such a plant-specific operating procedure would be needed to meet the hot shutdown capability of Appendix R, Section III.G.1.a, and the intent of Appendix R as stated in the Statement of Considerations in Federal Register, Section Q, Associated Circuits, November 19, 1980 (45 FR 76609). As described in Appendix R, Section III.G.1.b, cold shutdown capability may not be available for up to 72 hours due to potential fire damage to shutdown cooling components. Therefore, the NRC staff and the BWROG agreed that hot shutdown capability is required in Appendix R, Section III.G.1.a.]*

BWROG Response to Requested Action:

Currently, most BWRs are using the BWR Owners' Group Emergency Procedures and Severe Accident Guidelines (EPG/SAG). The differences between EPG Revision 4 and EPG/SAG relative to this issue are not significant, therefore, the information provided below reflects the content of EPG Revision 4.

The entry conditions for the EPGs are symptomatic of both emergencies and events that may degrade into emergencies. The guidelines specify actions appropriate for both. As such, use of Emergency Operating Procedures developed from these EPGs is an appropriate response to a fire event should the plant symptoms dictate such a response.

The EPGs are organized to provide guidance for operator response to a full range of transients and accidents using all available systems. Since the EPGs provide guidance for the use of all systems capable of performing a function, some simplifying assumptions must be made in order to describe how these procedures could be used to maintain hot shutdown using SRV/LPS. For purposes of this response, it will be assumed that all other systems with the capability to perform the same functions as SRV/LPS are, at some

point in the fire scenario, damaged by the fire. Therefore, in the narrative that follows, the following assumptions are made relative to the extent of fire damage.

(1) The reactor is successfully scrammed. This occurs either because the fire causes an automatic scram or because the operator's ability to control the unit is degraded and the operator decides to manually scram the unit.

(2) The MSIVs are closed.

(3) Automatic functions are unavailable due to fire damage.

(4) One loop of RHR, with a heat exchanger, is available.

(5) A sufficient number of SRVs is available to control reactor pressure and to rapidly depressurize the reactor, if required.

(6) Necessary support systems, such as service water systems and electrical distribution systems, are available to assure the proper operation of the systems described above.

(7) All other systems capable of performing RPV inventory control (HPCI, RCIC, HPCS, Condensate/Feedwater, CRD, etc.) are, at some point, lost due to the fire damage.

For the fire event described above, the RPV Control Guideline of Revision 4 to the EPGs would apply. The purpose of the RPV Control Guideline is to restore and maintain RPV level within a satisfactory range, shut down the reactor, control reactor pressure and, ultimately, cool the RPV to cold shutdown conditions. The entry conditions are any of the following:

(1) Reactor pressure vessel (RPV) water level below the low level scram setpoint,

(2) Drywell pressure above the high drywell pressure scram setpoint,

(3) A condition which requires reactor scram and the reactor power is above the APRM downscale trip or cannot be determined, or

(4) RPV pressure above the high pressure scram setpoint.

The initial conditions of a reactor scram and MSIV closure described above would result in an increase in reactor pressure and a decrease in reactor level. These conditions would result in an entry condition into The RPV Control Guideline. Upon entry into the RPV

Attachment 1

Achieving and Maintaining Hot Shutdown
using
Safety Relief Valves and Low Pressure Systems

Control Guideline, the operator is instructed to enter and execute the three segments of the procedure (level control, pressure control and power control) concurrently.

The Power Control segment of the RPV Control Guideline verifies that the reactor is shutdown and the control rods are inserted. Through this step, hot shutdown is achieved. Hot shutdown is maintained as long as the reactor remains sub-critical with all control rods but one fully inserted. The requirements of Appendix R Section III.G.1.a to achieve and maintain hot shutdown are satisfied by this step. For the scenario being postulated, once a scram has been achieved, the remaining challenge to the reactor is limited to reactor vessel inventory loss due to boil-off.

The RPV Pressure Control segment of the RPV Control Guideline controls pressure such that safety relief valve cycling is minimized and suppression pool limits are not exceeded. SRVs are used to depressurize the RPV. Once the RPV pressure is reduced to below the pressure interlock of the RHR shutdown cooling system, the RHR system is put into service. Once RHR shutdown cooling is in service, (either normal shutdown cooling or the alternate shutdown cooling mode) normal reactor shutdown procedures are used.

The Level Control segment of this EPG will instruct the operator to maintain level above the low level scram setpoint. If level cannot be maintained above the low level scram setpoint, then the level control segment of this EPG will instruct the operator to maintain level above the top of active fuel (TAF).

To maintain level, the Level Control segment will instruct the operator to inject with Condensate/Feedwater, CRD, HPCI, RCIC, HPCS, RHR or Core Spray. Based on the assumptions described above, RHR would eventually be the only available source of injection not damaged by the fire. The RHR system, however, is a low pressure system and injection using RHR is not possible until reactor pressure reaches approximately 300 psia.

In a controlled depressurization of the reactor that reduces reactor pressure at a rate of less than 100° F/hr, the Technical Specification Limit[1], it will take approximately 1 hour and 20 minutes[2] to reach the reactor pressure at which RHR injection is possible. Depending on the timing of the fire damage to the other sources of injection, however, reactor level may reach TAF, due to boil off, prior to reactor pressure reaching the level where RHR can inject. The following examples provide information on the typical times to reach TAF in a BWR given fire damage to various systems:

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[1] For BWRs, this cooldown rate is an "operating limit", not a "safety limit". Cooldown in excess of 100° F/hr will not have adverse consequences on the integrity of the RPV or attached piping. The possibility of an ADS blowdown is included in the design basis of the Reactor Coolant System.

[2] **Basis**: Reactor $\text{Pressure}_{\text{init.}}$ = 1050 psia corresponding to 550° F; Reactor $\text{Pressure}_{\text{RHR inject.}}$ = 300psia corresponding to 417° F; {550° F – 417° F}/ 100° F/hr. = 1.33 hr.

Attachment 1

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(1) If the fire damage stops all high pressure injection at the same time that the reactor is scrammed and the MSIVs are closed, reactor level will reach TAF in approximately 25 minutes.

(2) If the fire damages all high pressure injection capability, except feedwater in a plant with a steam driven feedwater system, at the same time as (1) above, and feedwater operates (i.e. coasts down) until it is tripped by the high water level trip, then reactor level will reach TAF in approximately 35 minutes.

(3) If the fire damage is identical to that described in (2) above except that CRD is not damaged and is maximized by the operator after 10 minutes, then reactor level will reach TAF in approximately 1 hour.

It is evident from these cases, that the specific fire damage and the timing of this damage will have an effect on whether or not rapid depressurization of the reactor will be required. These cases also reflect analyses performed using decay heat values indicative of a full power operating history.

In each of the three cases described above, reactor level would reach TAF prior to reactor pressure reaching the level at which RHR could inject. Based on reactor level reaching TAF, the RPV Level Control section of the RPV Control Guideline would instruct the operator to rapidly depressurize the reactor at a rate greater than 100° F/hr. to allow injection using the available low pressure system.

In any case, during the time it takes for the reactor to depressurize to the reactor pressure at which low pressure systems can inject, the EPGs instruct the operator to line up and start any pumps with the ability to inject into the reactor at any pressure. During this time, the EPGs also expect that operators will take actions to attempt to re-establish injection and to reverse the RPV level trend. Since adequate core cooling is assured as long as RPV level remains above TAF, the EPGs instruct the operator to delay rapid depressurization until reactor level reaches TAF to provide the operator with the maximum amount of time for taking other corrective actions. [Note: At least one BWR does not inhibit ADS, but rather allows ADS to automatically depressurize the reactor when level reaches –129″. In this case, however, due to the timers installed in the ADS automatic logic, the actual depressurization does not occur until approximately the same level as when the operator performs this function manually.] If other systems could be restored or if the fire damage evolves over a longer period of time (i.e. 1.5 hours), rapid depressurization would not be required. For the scenario being postulated here, none of these other options are assumed to become available.

Throughout this entire process, the reactor remains in hot shutdown and adequate core cooling exists. If reactor level reaches TAF, the EPGs instruct the operator to rapidly

depressurize the reactor. After rapidly depressurizing the reactor, the reactor can remain in hot shutdown for an extended period of time unless decay heat is removed by using either RHR in the shutdown cooling or alternate shutdown cooling mode. Cold shutdown would be achieved and maintained by using RHR in the shutdown cooling or the alternate shutdown cooling mode. RHR is placed in the alternate shutdown cooling mode by directing injection flow through the open SRVs into the suppression pool where decay heat is removed by RHR suction being directed through the RHR heat exchanger. At this point the requirements of Appendix R Section III.G.1.b to achieve cold shutdown will be satisfied.

The actual amount of time that it will take to reach cold shutdown is a function of many variables such as, operating history, the extent of fire damage and the timing of the fire damage. In any case, including those cases where high pressure systems are available, the actual time will be dictated by reactor thermal hydraulics and physics. The amount of time that hot shutdown can be maintained, in the event that proceeding to cold shutdown is restricted for some reason, is similar for cases using high pressure systems and low pressure systems.

In the case of the scenario postulated above, however, the time to reach cold shutdown is not critical since the equipment required to maintain the plant in a safe and stable hot shutdown condition is also adequate for maintaining the plant in a safe and stable cold shutdown condition.

Attachment 2

Licensing Basis Citations
Demonstrating Acceptance of the Use of
Safety Relief Valves and Low Pressure Systems
As Redundant Safe Shutdown paths

Introduction:

In a memorandum from Robert M. Pulsifer, Project Manager, Project Directorate1, Section 2 to Stuart A. Richards, Director, Project Directorate IV & Decommissioning, dated May 24, 2000, documenting the results of an April 25, 2000 meeting between the NRC staff and the BWROG, the following action was requested of the BWROG:

> *The BWROG will provide citations (such as date of document, title of document, issuing organization, sender, addressee) for plant-specific licensing documents (e.g., licensee submittals and NRC staff SEs), which the BWROG believes support its contention that after 1982 the staff explicitly approved SRV/LPS as a redundant means of post-fire safe shutdown. The NRC staff will obtain these documents through its NUDOCS document retrieval system. The BWROG will identify at which points, and in what way, the documents provide approval (e.g., "at this point, if taken in context, the word 'safe' actually means "redundant", and therefore, the NRC staff was approving SRV/LPS as an Section III.G.2 "redundant train" means of post-fire safe shutdown capability").*

BWROG Response to Requested Action:

Provided below are specific references to supporting documentation from a number of BWRs which the BWROG believes supports the contention that after 1982 the NRC staff explicitly approved SRV/LPS as a redundant means of post-fire safe shutdown. Within the referenced documentation certain terms are consistently used. An understanding of the meaning of these terms is key to the BWROG positions provided for each licensee. The terms of interest are the following:

> **Safe Shutdown Systems:** This term is used to describe the redundant safe shutdown systems that are relied upon in a licensee's post-fire safe shutdown analysis to meet the requirements of Appendix R Sections III.G.1 and 2.
>
> **Alternative (or in some documents Alternate) Safe Shutdown Systems:** This term is used to described the systems relied upon in the licensee's post-fire safe shutdown analysis to meet the requirements of Appendix R Section III.G.3. [**Note**: Alternative Safe Shutdown is required when one redundant safe shutdown train cannot be protected in accordance with the separation requirements of Appendix R Sections III.G.1 and/or III.G.2.]

Attachment 2

Licensing Basis Citations
Demonstrating Acceptance of the Use of
Safety Relief Valves and Low Pressure Systems
As Redundant Safe Shutdown paths

Examples of Specific Licensing Citations from SERs:

(1) Perry Nuclear Power Plant, Units 1 and 2:
Refer to SSER 3 Section 9.5.1.4.2 (1), Safe Shutdown Capability, page 9-3.

Discussion: This section of this SSER describes the redundant systems used for hot and cold shutdown in the post-fire safe shutdown analysis. For hot shutdown, either reactor core isolation cooling (RCIC) or a combination of the pressure relief system (automatic depressurization system, ADS) and the residual heat removal (RHR) system are used. This same section of this SSER concludes that the systems used for safe shutdown during a fire are acceptable and in accordance with Appendix R. By virtue of these statements which approve ADS and RHR as safe shutdown systems, the BWROG believes that the use of SRV/LPS has been explicitly approved for Perry Nuclear Power Plant, Units 1 and 2.

(2) Grand Gulf Nuclear Station, Units 1 and 2:
Refer to SSER for Amendment No. 82, dated 8/23/91, page 29, 30 and 31.

Discussion: This section of this SSER states that the safe shutdown method relied on by the licensee would be the ADS valves for depressurization and the RHR system for makeup operating in the LPCI mode. These systems would be protected in lieu of showing the availability of either RCIC or HPCS. This same section of this SSER concludes that the systems used for safe shutdown during a fire are acceptable and in accordance with Appendix R. By virtue of these statements which approve ADS and LPCI as safe shutdown systems, the BWROG believes that the use of SRV/LPS has been explicitly approved for Grand Gulf Nuclear Station, Units 1 and 2.

(3) Clinton Power Station, Unit 1:
Refer to SSER 6, page 9-33, 9-34 and 9-35, Safe-Shutdown Capability.

Discussion: This section of this SSER states that the pressure relief system (automatic depressurization system and safety/relief valves) and the RHR system, including the LPCI mode, are among the systems used to maintain the reactor in the hot shutdown condition. This section goes on to discuss that the reactor core could become uncovered for a short period of time from the effects of the fire, but that the staff concluded that the time that the core would be uncovered would be too short to result in damage to the fuel. This same section of this SSER concludes that the systems used for safe shutdown during a fire are acceptable. By virtue of these statements which approve ADS and LPCI as safe shutdown

systems, the BWROG believes that the use of SRV/LPS has been explicitly approved for Clinton Power Station, Unit 1.

(4) Washington Nuclear Project Number 2, WNP-2:
Refer to SER for WNP-2 FSAR Amendment 37 (TAC 63528) dated November 11, 1987, Docket No. 50-397.

Discussion: In Section 3.2 of this SER entitled 'Areas Where Alternate Safe Shutdown is Required', the following statement is made: "The licensee examined the need for alternate safe shutdown of the facility in any of the 61 fire areas. Based on the examination, the licensee has concluded that a fire in any fire area will not require an alternate safe shutdown capability, except for the main control room." In Section 3.1 of this same SER entitled 'Systems Required For Safe Shutdown', the following statement is made: "In the event of a fire, other than in the control room, seven Automatic Depressurization System (ADS) valves are opened to reduce reactor pressure. Once the reactor pressure is sufficiently reduced, one train of Residual Heat Removal (RHR) system is initiated in the Low Pressure Coolant Injection (LPCI) mode of operation in order to maintain an adequate reactor coolant inventory." Finally, in the cover letter transmitting this SER, the following statement is made: "...the proposed method of providing fire protection and safe shutdown capability for WNP-2 will satisfy the criteria of Appendix A to BTP APCSB 9.5-1 and the requirements of 10 CFR 50 Appendix R, Items III.G and III.L." By virtue of these statements which approve ADS and LPCI as safe shutdown systems, the BWROG believes that the use of SRV/LPS has been explicitly approved for WNP-2.

(5) Peach Bottom Atomic Power Station, Units 2 and 3:
Refer to SERs for Peach Bottom Atomic Power Station, Units 2 and 3, dated May 04, 1984 and September 16, 1993.

Discussion: In SER dated May 4, 1984, section 2.1 entitled 'Systems Required for Safe Shutdown', the following statement is made: "Reactor coolant inventory can be maintained by either the reactor core isolation cooling (RCIC) system, the high pressure coolant injection (HPCI) system during high pressure conditions or the low pressure coolant injection (LPCI) system or the core spray (CS) system in conjunction with the automatic depressurization system during low pressure conditions." In Section 4.0 entitled 'Conclusion', the following statement is made: "Based on our review, we conclude that the licensee has adequately identified the systems needed for post-fire safe shutdown...".

Similarly, in an SER dated September 16, 1993, the NRC concluded that the safe shutdown capability at Peach Bottom, satisfies the requirements of Section III.G

and III.L of Appendix R to 10 CFR 50. In Section 2.1, Systems Required for Safe Shutdown, of this SER, the three redundant shutdown methods selected for analysis (Methods A, B, and C) as well as the alternative shutdown method (Method D) are described: "Reactor coolant inventory is maintained with either the reactor core isolation cooling (RCIC) system (Method A), the high pressure coolant injection (HPCI) system (Method B), or either the low pressure coolant injection (LPCI) mode of the residual heat removal (RHR) system or the core spray (CS) system in concert with automatic depressurization system (ADS) (Method C). Shutdown Method D is used for fire scenarios requiring the use of the alternate control stations (ACS). Method D uses HPCI to maintain vessel water level,"

By virtue of these statements which approve ADS and LPCI or LPCS as safe shutdown systems, the BWROG believes that the use of SRV/LPS has been explicitly approved for Peach Bottom Atomic Power Station, Units 2 and 3.

Attachment 3

BWROG Comments
On the NRC (PSA Branch)
Risk Assessment of the
BWROG Position on the Use of
Safety Relief Valves and Low Pressure Systems
As Redundant Safe Shutdown Paths

Introduction:

In a memorandum from Robert M. Pulsifer, Project Manager, Project Directorate 1, Section 2 to Stuart A. Richards, Director, Project Directorate IV & Decommissioning, dated May 24, 2000, documenting the results of an April 25, 2000 meeting between the NRC staff and the BWROG, the following action was requested of the BWROG:

> *The NRC staff asked the BWROG to respond regarding the applicability of the fire protection features (wraps, detectors, sprinklers) removal assumptions in the Probabilistic Safety Assessment Branch risk analysis of the BWROG SRV/LPS position (Rubin to Weiss, April 18, 2000, Attachment 4).*

BWROG Response to Requested Action:

The BWROG does not believe that the assumptions made in the Probabilistic Safety Assessment Branch's risk analysis of the BWROG SRV/LPS position relative to removal of fire protection features (wraps, detectors, sprinklers) are applicable to the BWROG SRV/LPS Position.

The Probabilistic Safety Assessment Branch's risk analysis of the BWROG's Position on SRVs/LPS makes the following assumptions:

1. The SRVs/LPS path is an Alternative Shutdown Path and it is independent of the fire area being evaluated.

2. Fixed suppression and fire detection is installed in the fire area for the purpose of satisfying the requirements of Appendix R Section III.G.3 for an Alternative Shutdown Path. It is further assumed that the fixed suppression system would be removed if SRVs/LPS was credited as the required safe shutdown path.

3. In addition to an SRV/LPS path being available outside of the fire area of concern, a high pressure safe shutdown path is also currently protected within the fire area. The raceway fire barriers on this high pressure safe shutdown system would be abandoned or removed if SRVs/LPS was credited as the required safe shutdown path.

Regarding assumption No. 1 above, BWRs have extensively used SRVs/LPS as Redundant Safe Shutdown Paths in situations where the SRV/LPS path is **not** independent of the fire area under evaluation. As shown in the attached Figure 1, circuits for the SRV/LPS safe shutdown path are routed in the same fire areas as circuits for

HPCI/HPCS, RCIC and other means of achieving and maintaining safe shutdown. It is the BWROG's Position that safe shutdown paths using SRVs/LPS are acceptable Redundant Safe Shutdown Paths. The BWROG considers safe shutdown paths using SRVs/LPS to be redundant and equivalent to safe shutdown paths using HPCI/HPCS, RCIC or any other means of achieving and maintaining safe shutdown. As shown in the attached Figures 1 and 2, BWRs have protected the redundant safe shutdown path that is least affected by the fire. If SRV/LPS was the least affected path, it would be selected as the required safe shutdown path (Refer to Figure 1). Conversely, if HPCI were the least affected path, it would be selected as the required safe shutdown path (Refer to Figure 2). The BWROG also believes that the licensing basis citations provided in Attachment 2 to this letter substantiate the fact that the use of SRVs/LPS has been approved by the NRC staff as a Redundant Safe Shutdown path. Therefore, the assumption that SRVs/LPS are used as Alternative Shutdown Paths and are independent of the fire area under evaluation is not applicable to the BWROGs position on the use of SRVs/LPS as Redundant Safe Shutdown Paths.

With respect to assumption No. 2, since SRVs/LPS have been historically classified as Redundant Safe Shutdown Paths, BWRs have **not** installed suppression systems for the purpose of satisfying the requirements of Appendix R Section III.G.3. Suppression and/or detection located in the fire area would have been installed to satisfy

1. the requirements of Appendix R (e.g., III.G.2.b, III.G.2.c, III.G.2.e, III.F),

2. the NRC Staff positions described in APCSB 9.5-1 and NUREG-0800 or

3. the requirements imposed by the licensee's fire protection engineer or insurance provider.

When SRVs/LPS are designated as the required redundant safe shutdown path for a fire area, some raceway containing circuits for this safe shutdown path may need to be protected using a qualified raceway fire barrier. If a 1-hour rated raceway fire barrier is installed, then automatic suppression and fire detection is installed to satisfy the requirements of Appendix R Section III.G.2.c. If a 3-hour rated raceway fire barrier is installed, then automatic suppression and fire detection need not be installed as stated in Appendix R Section III.G.2.a. This is the same approach that would be used for protecting circuits for HPCI/HPCS, RCIC or any other means of achieving and maintaining safe shutdown when these systems are designated as the required safe shutdown path for a particular fire area. Therefore, the assumption that fixed suppression and fire detection is installed in the fire area for the purpose of satisfying the requirements of Appendix R Section III.G.3 is not a correct assumption. Similarly, the

assumption that the fixed suppression system will be removed if SRVs/LPS are accepted as Redundant Safe Shutdown Paths is also incorrect.

Finally, regarding assumption No. 3, Appendix R Section III.G.1.a and b require that **one** path with the capability to achieve and maintain hot shutdown be free of fire damage and that systems required to achieve and maintain cold shutdown be repaired within 72 hours. Assumption No. 3 depicts a condition beyond that necessary to satisfy the requirements of Appendix R Section III.G.1.a and b. For the fire areas where SRVs/LPS are used as Redundant Safe Shutdown Paths, BWRs have met, and will continue to meet, the requirements of Appendix R Section III.G.1.a and b by assuring the availability of **one** path with the capability to achieve and maintain safe shutdown. The NRC's risk analysis has effectively compared a scenario that meets III.G.1.a and b to a scenario that has additional redundancy protected, in excess of III.G.1.a and b requirements.

As outlined in the BWROG Position on the Use of Safety Relief Valves and Low Pressure Systems as Redundant Safe Shutdown Paths, Report No. GE-NE-T43-00002-00-03-R01, it is the BWROG assessment that there is no risk increase associated with using a low pressure shutdown methodology for redundant post-fire safe shutdown. The risk associated with using SRV/LPS is comparable to that of using a high pressure system shutdown method.

Attachment 3

BWROG Comments
On the NRC (PSA Branch)
Risk Assessment of the
BWROG Position on the Use of
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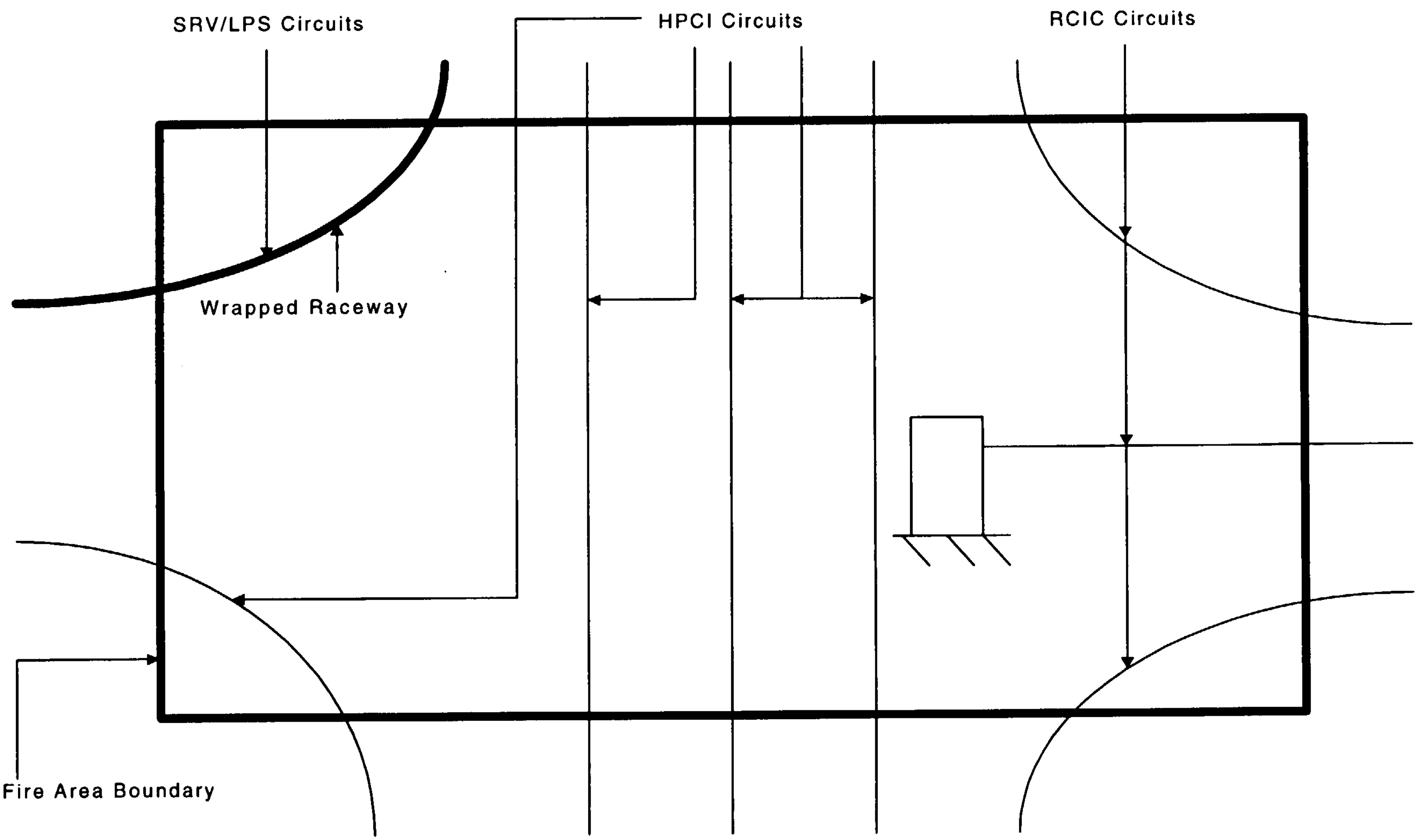

Figure 1 - SRV/LPS Protected as Required Safe Shutdown Path

Attachment 3

BWROG Comments
On the NRC (PSA Branch)
Risk Assessment of the
BWROG Position on the Use of
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As Redundant Safe Shutdown Paths

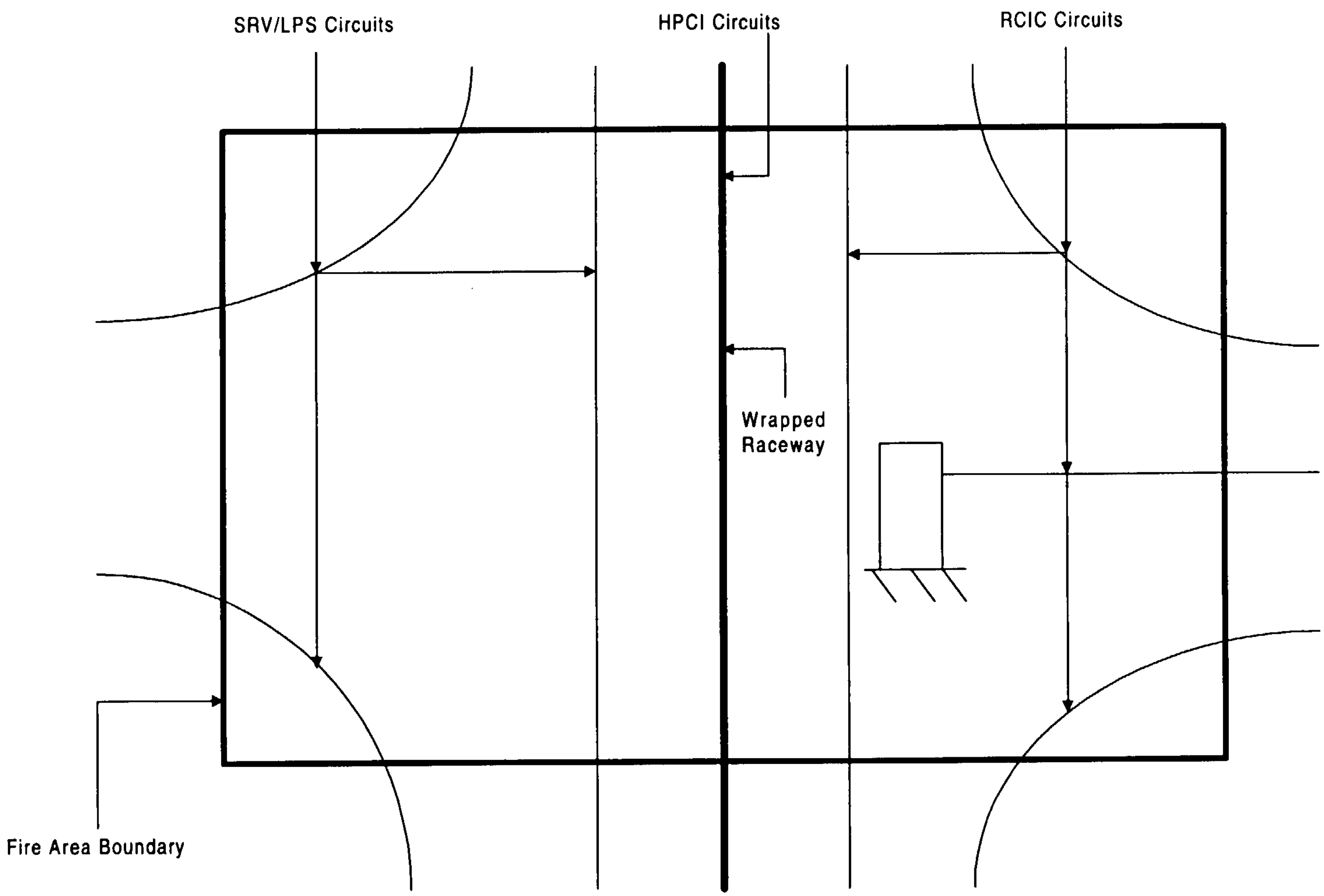

Figure 2 - HPCI Protected as Required Safe Shutdown Path

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SUBJECT: ***BWR Owners' Group Appendix R Fire Protection Committee Use of Safety Relief Valves and Low Pressure Systems as Redundant Safe Shutdown Paths, GE Report No. GE-NE-T43-00002-00-03-R01, August 1999***

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1.) **Attachment 1** – Provides a step-by-step narrative discussion of how plant specific operating procedures (derived from BWR EGP, Rev. 4) can be used to achieve and maintain hot shutdown conditions using SRV/LPS.

2.) **Attachment 2** – Provides citations of plant specific licensing documents, which the BWROG believes supports its contention that after 1982, the staff explicitly approved SRV/LPS as a redundant means of achieving post-fire safe shutdown.

3.) **Attachment 3** – Provides the BWROG response regarding the applicability of the fire protection feature (wraps, detectors, sprinklers) removal assumptions in the Probabilistic Safety Assessment Branch risk analysis of the BWROG SRV/LPS position (Rubin to Weiss, April 18, 2000)

The BWROG believes that the information provided with this letter resolves all of the remaining open issues between the BWROG and the Staff related to this subject. Based on this response, we expect that the NRC will be able to issue an SER on the subject BWROG Report endorsing the use of Safety Relief Valves and Low Pressure Systems as acceptable Safe Shutdown Paths. This acceptance would allow the use of Safety Relief Valves and Low Pressure Systems as Redundant Post-Fire Safe Shutdown paths meeting the requirements of Appendix R Section III.G.1 and 2 (and the equivalent sections of NUREG-0800, C.5.b.1 and C.5.b.2). It would also allow the use of Safety Relief Valves and Low Pressure Systems as Alternative Safe Shutdown Paths meeting the requirements of Appendix R Section III.G.3 (and the equivalent sections of NUREG-0800, C.5.b.3). Alternative shutdown is used in those areas where separation of redundant safe shutdown trains cannot be accomplished in accordance with the requirements of Appendix R Section III.G.2.

If you have any questions about the information provided here or if you would like a meeting to discuss this response, please contact Tom Gorman (PPL) at (610) 774-7762, or George Stramback (GE) at (408) 925-1913.

Sincerely,

J. M. Kenny

James M. Kenny, Chairman
BWR Owners' Group

Attachments

cc: JA Gray, BWROG Vice Chairman
BWROG Primary Representatives
BWROG Appendix R Committee
FA Emerson, NEI
TG Hurst, GE
GB Stramback, GE
KK Sedney, GE

Attachment 1

Achieving and Maintaining Hot Shutdown
using
Safety Relief Valves and Low Pressure Systems

Introduction:

In a memorandum from Robert M. Pulsifer, Project Manager, Project Directorate 1, Section 2 to Stuart A. Richards, Director, Project Directorate IV & Decommissioning, dated May 24, 2000, documenting the results of an April 25, 2000 meeting between the NRC staff and the BWROG, the following action was requested of the BWROG:

> *The BWROG will provide the staff with a step-by-step narrative discussion of how plant-specific operating procedures (derived from BWR EPG Rev. 4) can be used to achieve and maintain hot shutdown conditions using the SRV/LPS (rather than HPCI, RCIC, or condensate/feedwater or other possible shutdown systems) after a reactor scram which occurs with a 100 percent power history, to the extent that latent and decay heat would be of sufficient magnitude to permit continuation of this mode of plant operation.*
>
> *[Such a plant-specific operating procedure would be needed to meet the hot shutdown capability of Appendix R, Section III.G.1.a, and the intent of Appendix R as stated in the Statement of Considerations in Federal Register, Section Q, Associated Circuits, November 19, 1980 (45 FR 76609). As described in Appendix R, Section III.G.1.b, cold shutdown capability may not be available for up to 72 hours due to potential fire damage to shutdown cooling components. Therefore, the NRC staff and the BWROG agreed that hot shutdown capability is required in Appendix R, Section III.G.1.a.]*

BWROG Response to Requested Action:

Currently, most BWRs are using the BWR Owners' Group Emergency Procedures and Severe Accident Guidelines (EPG/SAG). The differences between EPG Revision 4 and EPG/SAG relative to this issue are not significant, therefore, the information provided below reflects the content of EPG Revision 4.

The entry conditions for the EPGs are symptomatic of both emergencies and events that may degrade into emergencies. The guidelines specify actions appropriate for both. As such, use of Emergency Operating Procedures developed from these EPGs is an appropriate response to a fire event should the plant symptoms dictate such a response.

The EPGs are organized to provide guidance for operator response to a full range of transients and accidents using all available systems. Since the EPGs provide guidance for the use of all systems capable of performing a function, some simplifying assumptions must be made in order to describe how these procedures could be used to maintain hot shutdown using SRV/LPS. For purposes of this response, it will be assumed that all other systems with the capability to perform the same functions as SRV/LPS are, at some

point in the fire scenario, damaged by the fire. Therefore, in the narrative that follows, the following assumptions are made relative to the extent of fire damage.

(1) The reactor is successfully scrammed. This occurs either because the fire causes an automatic scram or because the operator's ability to control the unit is degraded and the operator decides to manually scram the unit.

(2) The MSIVs are closed.

(3) Automatic functions are unavailable due to fire damage.

(4) One loop of RHR, with a heat exchanger, is available.

(5) A sufficient number of SRVs is available to control reactor pressure and to rapidly depressurize the reactor, if required.

(6) Necessary support systems, such as service water systems and electrical distribution systems, are available to assure the proper operation of the systems described above.

(7) All other systems capable of performing RPV inventory control (HPCI, RCIC, HPCS, Condensate/Feedwater, CRD, etc.) are, at some point, lost due to the fire damage.

For the fire event described above, the RPV Control Guideline of Revision 4 to the EPGs would apply. The purpose of the RPV Control Guideline is to restore and maintain RPV level within a satisfactory range, shut down the reactor, control reactor pressure and, ultimately, cool the RPV to cold shutdown conditions. The entry conditions are any of the following:

(1) Reactor pressure vessel (RPV) water level below the low level scram setpoint,

(2) Drywell pressure above the high drywell pressure scram setpoint,

(3) A condition which requires reactor scram and the reactor power is above the APRM downscale trip or cannot be determined, or

(4) RPV pressure above the high pressure scram setpoint.

The initial conditions of a reactor scram and MSIV closure described above would result in an increase in reactor pressure and a decrease in reactor level. These conditions would result in an entry condition into The RPV Control Guideline. Upon entry into the RPV

Attachment 1

Achieving and Maintaining Hot Shutdown
using
Safety Relief Valves and Low Pressure Systems

Control Guideline, the operator is instructed to enter and execute the three segments of the procedure (level control, pressure control and power control) concurrently.

The Power Control segment of the RPV Control Guideline verifies that the reactor is shutdown and the control rods are inserted. Through this step, hot shutdown is achieved. Hot shutdown is maintained as long as the reactor remains sub-critical with all control rods but one fully inserted. The requirements of Appendix R Section III.G.1.a to achieve and maintain hot shutdown are satisfied by this step. For the scenario being postulated, once a scram has been achieved, the remaining challenge to the reactor is limited to reactor vessel inventory loss due to boil-off.

The RPV Pressure Control segment of the RPV Control Guideline controls pressure such that safety relief valve cycling is minimized and suppression pool limits are not exceeded. SRVs are used to depressurize the RPV. Once the RPV pressure is reduced to below the pressure interlock of the RHR shutdown cooling system, the RHR system is put into service. Once RHR shutdown cooling is in service, (either normal shutdown cooling or the alternate shutdown cooling mode) normal reactor shutdown procedures are used.

The Level Control segment of this EPG will instruct the operator to maintain level above the low level scram setpoint. If level cannot be maintained above the low level scram setpoint, then the level control segment of this EPG will instruct the operator to maintain level above the top of active fuel (TAF).

To maintain level, the Level Control segment will instruct the operator to inject with Condensate/Feedwater, CRD, HPCI, RCIC, HPCS, RHR or Core Spray. Based on the assumptions described above, RHR would eventually be the only available source of injection not damaged by the fire. The RHR system, however, is a low pressure system and injection using RHR is not possible until reactor pressure reaches approximately 300 psia.

In a controlled depressurization of the reactor that reduces reactor pressure at a rate of less than 100° F/hr, the Technical Specification Limit[1], it will take approximately 1 hour and 20 minutes[2] to reach the reactor pressure at which RHR injection is possible. Depending on the timing of the fire damage to the other sources of injection, however, reactor level may reach TAF, due to boil off, prior to reactor pressure reaching the level where RHR can inject. The following examples provide information on the typical times to reach TAF in a BWR given fire damage to various systems:

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[1] For BWRs, this cooldown rate is an "operating limit", not a "safety limit". Cooldown in excess of 100° F/hr will not have adverse consequences on the integrity of the RPV or attached piping. The possibility of an ADS blowdown is included in the design basis of the Reactor Coolant System.

[2] **Basis**: Reactor Pressure$_{init.}$ = 1050 psia corresponding to 550° F; Reactor Pressure$_{RHR\ inject.}$ = 300psia corresponding to 417° F; {550° F – 417° F}/ 100° F/hr. = 1.33 hr.

Attachment 1

Achieving and Maintaining Hot Shutdown
using
Safety Relief Valves and Low Pressure Systems

(1) If the fire damage stops all high pressure injection at the same time that the reactor is scrammed and the MSIVs are closed, reactor level will reach TAF in approximately 25 minutes.

(2) If the fire damages all high pressure injection capability, except feedwater in a plant with a steam driven feedwater system, at the same time as (1) above, and feedwater operates (i.e. coasts down) until it is tripped by the high water level trip, then reactor level will reach TAF in approximately 35 minutes.

(3) If the fire damage is identical to that described in (2) above except that CRD is not damaged and is maximized by the operator after 10 minutes, then reactor level will reach TAF in approximately 1 hour.

It is evident from these cases, that the specific fire damage and the timing of this damage will have an effect on whether or not rapid depressurization of the reactor will be required. These cases also reflect analyses performed using decay heat values indicative of a full power operating history.

In each of the three cases described above, reactor level would reach TAF prior to reactor pressure reaching the level at which RHR could inject. Based on reactor level reaching TAF, the RPV Level Control section of the RPV Control Guideline would instruct the operator to rapidly depressurize the reactor at a rate greater than 100° F/hr. to allow injection using the available low pressure system.

In any case, during the time it takes for the reactor to depressurize to the reactor pressure at which low pressure systems can inject, the EPGs instruct the operator to line up and start any pumps with the ability to inject into the reactor at any pressure. During this time, the EPGs also expect that operators will take actions to attempt to re-establish injection and to reverse the RPV level trend. Since adequate core cooling is assured as long as RPV level remains above TAF, the EPGs instruct the operator to delay rapid depressurization until reactor level reaches TAF to provide the operator with the maximum amount of time for taking other corrective actions. [Note: At least one BWR does not inhibit ADS, but rather allows ADS to automatically depressurize the reactor when level reaches –129″. In this case, however, due to the timers installed in the ADS automatic logic, the actual depressurization does not occur until approximately the same level as when the operator performs this function manually.] If other systems could be restored or if the fire damage evolves over a longer period of time (i.e. 1.5 hours), rapid depressurization would not be required. For the scenario being postulated here, none of these other options are assumed to become available.

Throughout this entire process, the reactor remains in hot shutdown and adequate core cooling exists. If reactor level reaches TAF, the EPGs instruct the operator to rapidly

depressurize the reactor. After rapidly depressurizing the reactor, the reactor can remain in hot shutdown for an extended period of time unless decay heat is removed by using either RHR in the shutdown cooling or alternate shutdown cooling mode. Cold shutdown would be achieved and maintained by using RHR in the shutdown cooling or the alternate shutdown cooling mode. RHR is placed in the alternate shutdown cooling mode by directing injection flow through the open SRVs into the suppression pool where decay heat is removed by RHR suction being directed through the RHR heat exchanger. At this point the requirements of Appendix R Section III.G.1.b to achieve cold shutdown will be satisfied.

The actual amount of time that it will take to reach cold shutdown is a function of many variables such as, operating history, the extent of fire damage and the timing of the fire damage. In any case, including those cases where high pressure systems are available, the actual time will be dictated by reactor thermal hydraulics and physics. The amount of time that hot shutdown can be maintained, in the event that proceeding to cold shutdown is restricted for some reason, is similar for cases using high pressure systems and low pressure systems.

In the case of the scenario postulated above, however, the time to reach cold shutdown is not critical since the equipment required to maintain the plant in a safe and stable hot shutdown condition is also adequate for maintaining the plant in a safe and stable cold shutdown condition.

Attachment 2

Licensing Basis Citations
Demonstrating Acceptance of the Use of
Safety Relief Valves and Low Pressure Systems
As Redundant Safe Shutdown paths

Introduction:

In a memorandum from Robert M. Pulsifer, Project Manager, Project Directorate1, Section 2 to Stuart A. Richards, Director, Project Directorate IV & Decommissioning, dated May 24, 2000, documenting the results of an April 25, 2000 meeting between the NRC staff and the BWROG, the following action was requested of the BWROG:

> *The BWROG will provide citations (such as date of document, title of document, issuing organization, sender, addressee) for plant-specific licensing documents (e.g., licensee submittals and NRC staff SEs), which the BWROG believes support its contention that after 1982 the staff explicitly approved SRV/LPS as a redundant means of post-fire safe shutdown. The NRC staff will obtain these documents through its NUDOCS document retrieval system. The BWROG will identify at which points, and in what way, the documents provide approval (e.g., "at this point, if taken in context, the word 'safe' actually means "redundant", and therefore, the NRC staff was approving SRV/LPS as an Section III.G.2 "redundant train" means of post-fire safe shutdown capability").*

BWROG Response to Requested Action:

Provided below are specific references to supporting documentation from a number of BWRs which the BWROG believes supports the contention that after 1982 the NRC staff explicitly approved SRV/LPS as a redundant means of post-fire safe shutdown. Within the referenced documentation certain terms are consistently used. An understanding of the meaning of these terms is key to the BWROG positions provided for each licensee. The terms of interest are the following:

> **Safe Shutdown Systems:** This term is used to describe the redundant safe shutdown systems that are relied upon in a licensee's post-fire safe shutdown analysis to meet the requirements of Appendix R Sections III.G.1 and 2.
>
> **Alternative (or in some documents Alternate) Safe Shutdown Systems:** This term is used to described the systems relied upon in the licensee's post-fire safe shutdown analysis to meet the requirements of Appendix R Section III.G.3. [**Note**: Alternative Safe Shutdown is required when one redundant safe shutdown train cannot be protected in accordance with the separation requirements of Appendix R Sections III.G.1 and/or III.G.2.]

Attachment 2

Licensing Basis Citations
Demonstrating Acceptance of the Use of
Safety Relief Valves and Low Pressure Systems
As Redundant Safe Shutdown paths

Examples of Specific Licensing Citations from SERs:

(1) Perry Nuclear Power Plant, Units 1 and 2:
Refer to SSER 3 Section 9.5.1.4.2 (1), Safe Shutdown Capability, page 9-3.

Discussion: This section of this SSER describes the redundant systems used for hot and cold shutdown in the post-fire safe shutdown analysis. For hot shutdown, either reactor core isolation cooling (RCIC) or a combination of the pressure relief system (automatic depressurization system, ADS) and the residual heat removal (RHR) system are used. This same section of this SSER concludes that the systems used for safe shutdown during a fire are acceptable and in accordance with Appendix R. By virtue of these statements which approve ADS and RHR as safe shutdown systems, the BWROG believes that the use of SRV/LPS has been explicitly approved for Perry Nuclear Power Plant, Units 1 and 2.

(2) Grand Gulf Nuclear Station, Units 1 and 2:
Refer to SSER for Amendment No. 82, dated 8/23/91, page 29, 30 and 31.

Discussion: This section of this SSER states that the safe shutdown method relied on by the licensee would be the ADS valves for depressurization and the RHR system for makeup operating in the LPCI mode. These systems would be protected in lieu of showing the availability of either RCIC or HPCS. This same section of this SSER concludes that the systems used for safe shutdown during a fire are acceptable and in accordance with Appendix R. By virtue of these statements which approve ADS and LPCI as safe shutdown systems, the BWROG believes that the use of SRV/LPS has been explicitly approved for Grand Gulf Nuclear Station, Units 1 and 2.

(3) Clinton Power Station, Unit 1:
Refer to SSER 6, page 9-33, 9-34 and 9-35, Safe-Shutdown Capability.

Discussion: This section of this SSER states that the pressure relief system (automatic depressurization system and safety/relief valves) and the RHR system, including the LPCI mode, are among the systems used to maintain the reactor in the hot shutdown condition. This section goes on to discuss that the reactor core could become uncovered for a short period of time from the effects of the fire, but that the staff concluded that the time that the core would be uncovered would be too short to result in damage to the fuel. This same section of this SSER concludes that the systems used for safe shutdown during a fire are acceptable. By virtue of these statements which approve ADS and LPCI as safe shutdown

systems, the BWROG believes that the use of SRV/LPS has been explicitly approved for Clinton Power Station, Unit 1.

(4) Washington Nuclear Project Number 2, WNP-2:
Refer to SER for WNP-2 FSAR Amendment 37 (TAC 63528) dated November 11, 1987, Docket No. 50-397.

Discussion: In Section 3.2 of this SER entitled 'Areas Where Alternate Safe Shutdown is Required', the following statement is made: "The licensee examined the need for alternate safe shutdown of the facility in any of the 61 fire areas. Based on the examination, the licensee has concluded that a fire in any fire area will not require an alternate safe shutdown capability, except for the main control room." In Section 3.1 of this same SER entitled 'Systems Required For Safe Shutdown', the following statement is made: "In the event of a fire, other than in the control room, seven Automatic Depressurization System (ADS) valves are opened to reduce reactor pressure. Once the reactor pressure is sufficiently reduced, one train of Residual Heat Removal (RHR) system is initiated in the Low Pressure Coolant Injection (LPCI) mode of operation in order to maintain an adequate reactor coolant inventory." Finally, in the cover letter transmitting this SER, the following statement is made: "...the proposed method of providing fire protection and safe shutdown capability for WNP-2 will satisfy the criteria of Appendix A to BTP APCSB 9.5-1 and the requirements of 10 CFR 50 Appendix R, Items III.G and III.L." By virtue of these statements which approve ADS and LPCI as safe shutdown systems, the BWROG believes that the use of SRV/LPS has been explicitly approved for WNP-2.

(5) Peach Bottom Atomic Power Station, Units 2 and 3:
Refer to SERs for Peach Bottom Atomic Power Station, Units 2 and 3, dated May 04, 1984 and September 16, 1993.

Discussion: In SER dated May 4, 1984, section 2.1 entitled 'Systems Required for Safe Shutdown', the following statement is made: "Reactor coolant inventory can be maintained by either the reactor core isolation cooling (RCIC) system, the high pressure coolant injection (HPCI) system during high pressure conditions or the low pressure coolant injection (LPCI) system or the core spray (CS) system in conjunction with the automatic depressurization system during low pressure conditions." In Section 4.0 entitled 'Conclusion', the following statement is made: "Based on our review, we conclude that the licensee has adequately identified the systems needed for post-fire safe shutdown...".

Similarly, in an SER dated September 16, 1993, the NRC concluded that the safe shutdown capability at Peach Bottom, satisfies the requirements of Section III.G

and III.L of Appendix R to 10 CFR 50. In Section 2.1, Systems Required for Safe Shutdown, of this SER, the three redundant shutdown methods selected for analysis (Methods A, B, and C) as well as the alternative shutdown method (Method D) are described: "Reactor coolant inventory is maintained with either the reactor core isolation cooling (RCIC) system (Method A), the high pressure coolant injection (HPCI) system (Method B), or either the low pressure coolant injection (LPCI) mode of the residual heat removal (RHR) system or the core spray (CS) system in concert with automatic depressurization system (ADS) (Method C). Shutdown Method D is used for fire scenarios requiring the use of the alternate control stations (ACS). Method D uses HPCI to maintain vessel water level,"

By virtue of these statements which approve ADS and LPCI or LPCS as safe shutdown systems, the BWROG believes that the use of SRV/LPS has been explicitly approved for Peach Bottom Atomic Power Station, Units 2 and 3.

Attachment 3

BWROG Comments
On the NRC (PSA Branch)
Risk Assessment of the
BWROG Position on the Use of
Safety Relief Valves and Low Pressure Systems
As Redundant Safe Shutdown Paths

Introduction:

In a memorandum from Robert M. Pulsifer, Project Manager, Project Directorate 1, Section 2 to Stuart A. Richards, Director, Project Directorate IV & Decommissioning, dated May 24, 2000, documenting the results of an April 25, 2000 meeting between the NRC staff and the BWROG, the following action was requested of the BWROG:

> *The NRC staff asked the BWROG to respond regarding the applicability of the fire protection features (wraps, detectors, sprinklers) removal assumptions in the Probabilistic Safety Assessment Branch risk analysis of the BWROG SRV/LPS position (Rubin to Weiss, April 18, 2000, Attachment 4).*

BWROG Response to Requested Action:

The BWROG does not believe that the assumptions made in the Probabilistic Safety Assessment Branch's risk analysis of the BWROG SRV/LPS position relative to removal of fire protection features (wraps, detectors, sprinklers) are applicable to the BWROG SRV/LPS Position.

The Probabilistic Safety Assessment Branch's risk analysis of the BWROG's Position on SRVs/LPS makes the following assumptions:

1. The SRVs/LPS path is an Alternative Shutdown Path and it is independent of the fire area being evaluated.

2. Fixed suppression and fire detection is installed in the fire area for the purpose of satisfying the requirements of Appendix R Section III.G.3 for an Alternative Shutdown Path. It is further assumed that the fixed suppression system would be removed if SRVs/LPS was credited as the required safe shutdown path.

3. In addition to an SRV/LPS path being available outside of the fire area of concern, a high pressure safe shutdown path is also currently protected within the fire area. The raceway fire barriers on this high pressure safe shutdown system would be abandoned or removed if SRVs/LPS was credited as the required safe shutdown path.

Regarding assumption No. 1 above, BWRs have extensively used SRVs/LPS as Redundant Safe Shutdown Paths in situations where the SRV/LPS path is **not** independent of the fire area under evaluation. As shown in the attached Figure 1, circuits for the SRV/LPS safe shutdown path are routed in the same fire areas as circuits for

Attachment 3

BWROG Comments
On the NRC (PSA Branch)
Risk Assessment of the
BWROG Position on the Use of
Safety Relief Valves and Low Pressure Systems
As Redundant Safe Shutdown Paths

HPCI/HPCS, RCIC and other means of achieving and maintaining safe shutdown. It is the BWROG's Position that safe shutdown paths using SRVs/LPS are acceptable Redundant Safe Shutdown Paths. The BWROG considers safe shutdown paths using SRVs/LPS to be redundant and equivalent to safe shutdown paths using HPCI/HPCS, RCIC or any other means of achieving and maintaining safe shutdown. As shown in the attached Figures 1 and 2, BWRs have protected the redundant safe shutdown path that is least affected by the fire. If SRV/LPS was the least affected path, it would be selected as the required safe shutdown path (Refer to Figure 1). Conversely, if HPCI were the least affected path, it would be selected as the required safe shutdown path (Refer to Figure 2). The BWROG also believes that the licensing basis citations provided in Attachment 2 to this letter substantiate the fact that the use of SRVs/LPS has been approved by the NRC staff as a Redundant Safe Shutdown path. Therefore, the assumption that SRVs/LPS are used as Alternative Shutdown Paths and are independent of the fire area under evaluation is not applicable to the BWROGs position on the use of SRVs/LPS as Redundant Safe Shutdown Paths.

With respect to assumption No. 2, since SRVs/LPS have been historically classified as Redundant Safe Shutdown Paths, BWRs have **not** installed suppression systems for the purpose of satisfying the requirements of Appendix R Section III.G.3. Suppression and/or detection located in the fire area would have been installed to satisfy

1. the requirements of Appendix R (e.g., III.G.2.b, III.G.2.c, III.G.2.e, III.F),

2. the NRC Staff positions described in APCSB 9.5-1 and NUREG-0800 or

3. the requirements imposed by the licensee's fire protection engineer or insurance provider.

When SRVs/LPS are designated as the required redundant safe shutdown path for a fire area, some raceway containing circuits for this safe shutdown path may need to be protected using a qualified raceway fire barrier. If a 1-hour rated raceway fire barrier is installed, then automatic suppression and fire detection is installed to satisfy the requirements of Appendix R Section III.G.2.c. If a 3-hour rated raceway fire barrier is installed, then automatic suppression and fire detection need not be installed as stated in Appendix R Section III.G.2.a. This is the same approach that would be used for protecting circuits for HPCI/HPCS, RCIC or any other means of achieving and maintaining safe shutdown when these systems are designated as the required safe shutdown path for a particular fire area. Therefore, the assumption that fixed suppression and fire detection is installed in the fire area for the purpose of satisfying the requirements of Appendix R Section III.G.3 is not a correct assumption. Similarly, the

assumption that the fixed suppression system will be removed if SRVs/LPS are accepted as Redundant Safe Shutdown Paths is also incorrect.

Finally, regarding assumption No. 3, Appendix R Section III.G.1.a and b require that **one** path with the capability to achieve and maintain hot shutdown be free of fire damage and that systems required to achieve and maintain cold shutdown be repaired within 72 hours. Assumption No. 3 depicts a condition beyond that necessary to satisfy the requirements of Appendix R Section III.G.1.a and b. For the fire areas where SRVs/LPS are used as Redundant Safe Shutdown Paths, BWRs have met, and will continue to meet, the requirements of Appendix R Section III.G.1.a and b by assuring the availability of **one** path with the capability to achieve and maintain safe shutdown. The NRC's risk analysis has effectively compared a scenario that meets III.G.1.a and b to a scenario that has additional redundancy protected, in excess of III.G.1.a and b requirements.

As outlined in the BWROG Position on the Use of Safety Relief Valves and Low Pressure Systems as Redundant Safe Shutdown Paths, Report No. GE-NE-T43-00002-00-03-R01, it is the BWROG assessment that there is no risk increase associated with using a low pressure shutdown methodology for redundant post-fire safe shutdown. The risk associated with using SRV/LPS is comparable to that of using a high pressure system shutdown method.

Attachment 3

BWROG Comments
On the NRC (PSA Branch)
Risk Assessment of the
BWROG Position on the Use of
Safety Relief Valves and Low Pressure Systems
As Redundant Safe Shutdown Paths

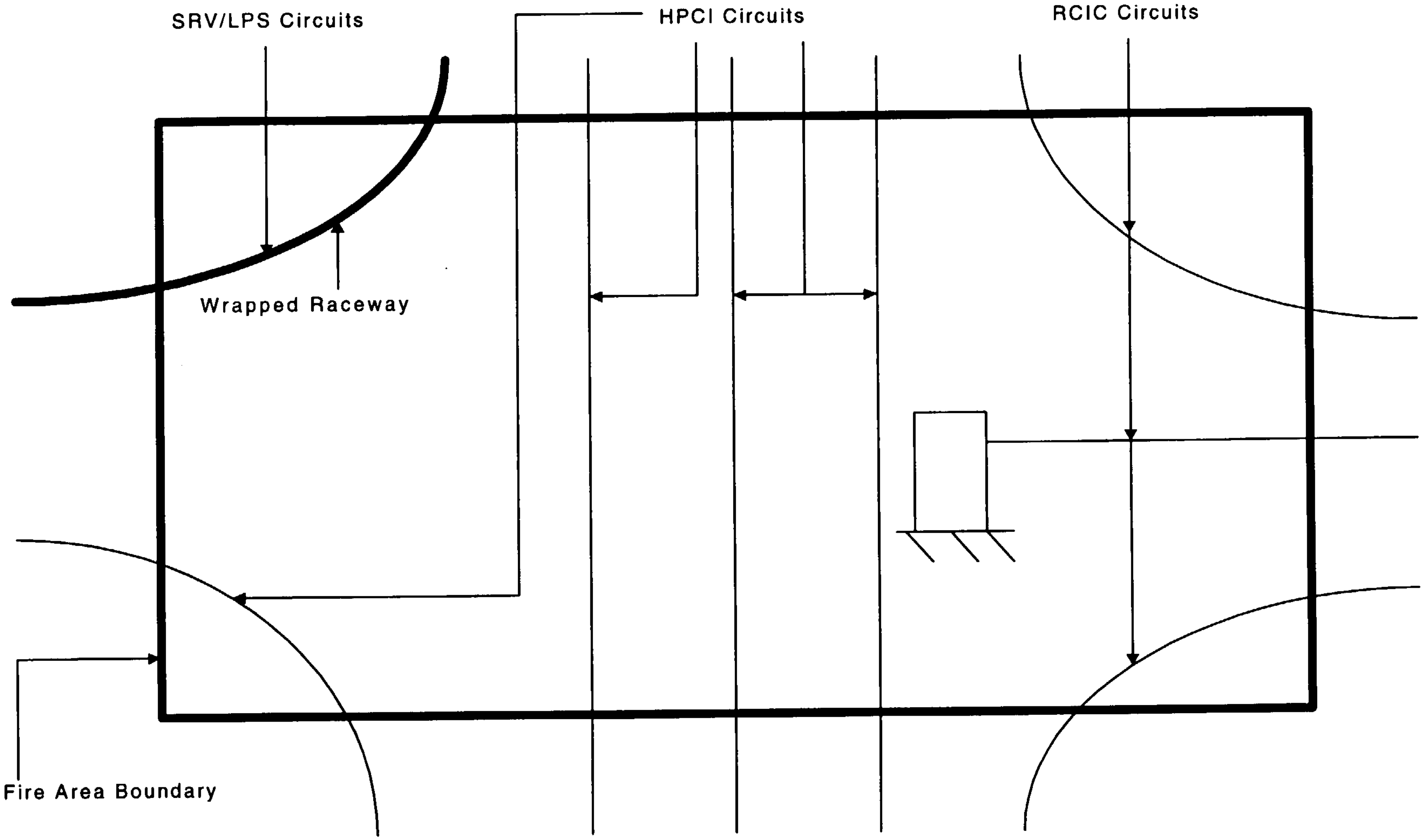

Figure 1 - SRV/LPS Protected as Required Safe Shutdown Path

Attachment 3

BWROG Comments
On the NRC (PSA Branch)
Risk Assessment of the
BWROG Position on the Use of
Safety Relief Valves and Low Pressure Systems
As Redundant Safe Shutdown Paths

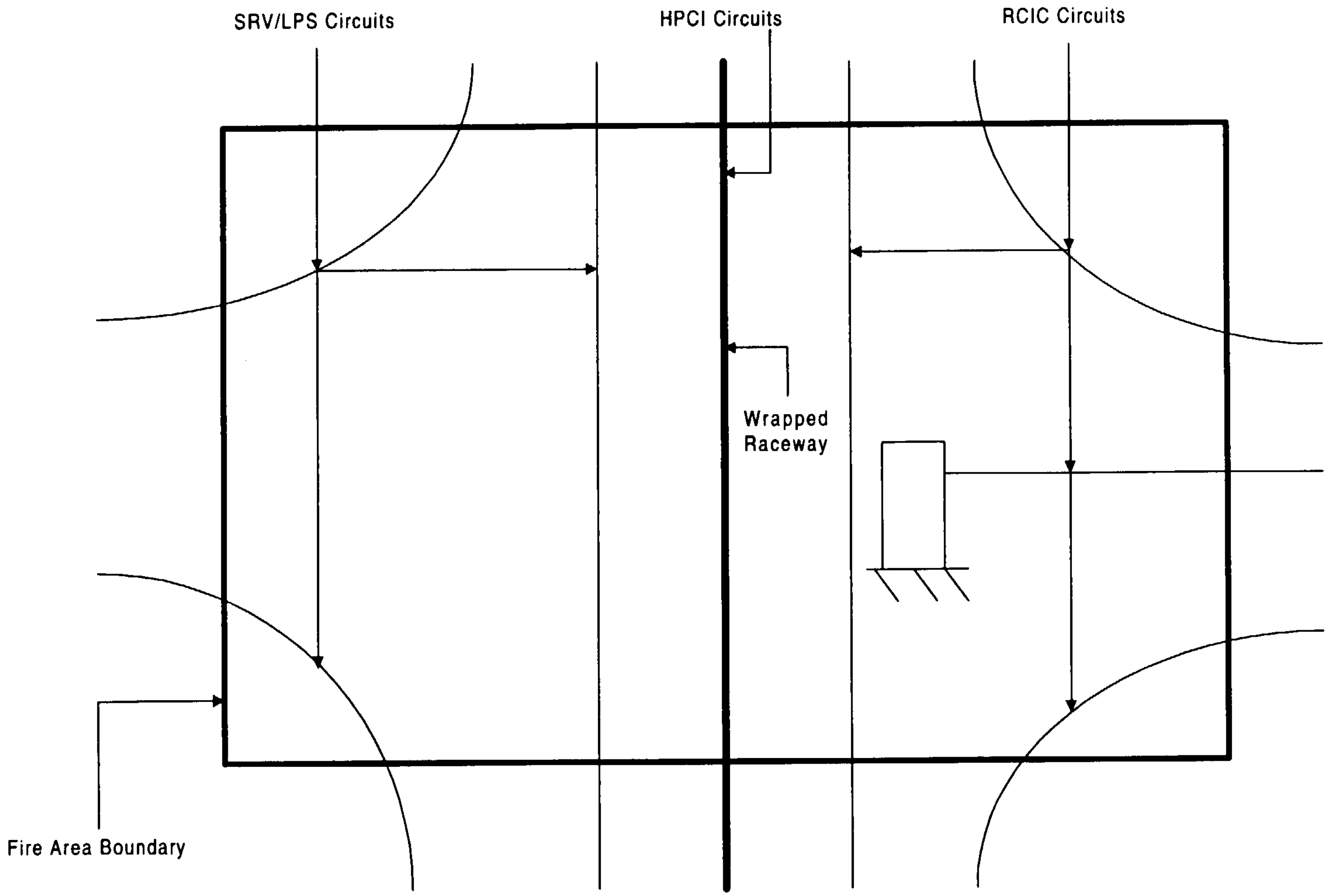

Figure 2 - HPCI Protected as Required Safe Shutdown Path