10 CFR 50.73

A subsidiary of Pinnacle West Capital Corporation

Palo Verde Nuclear Generating Station

Dwight C. Mims
Vice President
Regulatory Affairs and Plant Improvement

Tel. 623-393-5403
Fax 623-393-6077

Mail Station 7605
P. O. Box 52034
Phoenix, Arizona 85072-2034

102-05994-DCM/DCE
April 20, 2009

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2, and 3
Docket No. STN 50-528, STN 50-529, and STN 50-530
License No. NPF 41, NPF 51, and NPF 74
Licensee Event Report 2009-001-00

Enclosed, please find Licensee Event Report (LER) 50-528/2009-001-00 that has been prepared and submitted pursuant to 10 CFR 50.73. This LER reports an unanalyzed condition that was the result of certain alignments of the safety injection system used to recirculate the refueling water tank while in Modes 1 through 4 in each unit.

In accordance with 10 CFR 50.4, copies of this LER are being forwarded to the NRC Regional Office, NRC Region IV and the Senior Resident Inspector. If you have questions regarding this submittal, please contact Ray Buzard, Section Leader, Regulatory Affairs, at (623) 393-5317.

No commitments are being made to the NRC by this letter.

Sincerely,

D. C. Mims

DCM/REB/DCE/gat

Enclosure

cc: E. E. Collins Jr. NRC Region IV Regional Administrator
J. R. Hall NRC NRR Project Manager
R. I. Treadway NRC Senior Resident Inspector for PVNGS

IE22
NRR

NRC FORM 366 (9-2007) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 08/31/2010

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

LICENSEE EVENT REPORT (LER)

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

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Palo Verde Nuclear Generating Station Unit 1	05000528	1 OF 11

4. TITLE

Safety Injection System Recirculation Alignment Results in Unanalyzed Condition

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
									PVNGS Unit 2	05000529
02	18	2009	2009	- 001 -	00	04	20	2009	PVNGS Unit 3	05000530

9. OPERATING MODE

1 / 1 / 1

10. POWER LEVEL

100 / 100 / 100

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR§: *(Check all that apply)*

☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(i)(C)	☒ 50.73(a)(2)(vii)
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☒ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☒ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☒ 50.73(a)(2)(v)(C)	☐ OTHER
☐ 20.2203(a)(2)(vi)	☒ 50.73(a)(2)(i)(B)	☒ 50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER (Include Area Code)
Ray Buzard, Section Leader, Regulatory Affairs	623-393-5317

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

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

14. SUPPLEMENTAL REPORT EXPECTED

☐ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ☒ NO

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR

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

On February 18, 2009, station personnel identified that certain pump and valve alignments of the Safety Injection (SI) system used for periodic surveillance testing and recirculation of the Refueling Water Tank (RWT) could, in conjunction with specific accident scenarios, jeopardize both trains of SI pump minimum flow recirculation capability and affect the operability of SI pumps. Further, these alignments could have resulted in the bypass of Containment sump water to the RWT and adversely impacted the available net positive suction pressure for the SI pumps after a Recirculation Actuation Signal (RAS). Even though these alignments have been performed for many years, the infrequent nature of these alignments and the unlikely occurrence of the specific accident scenarios resulted in very low risk to the plant.

The root causes were determined to be inadequate review and approval of procedure changes and the inadequate review of operating experience. Corrective actions included changes to the procedure change process to include validation of the design configuration bases.

A prior event with similar causes was reported in LER 05-00528/2004-009-01. Due to the timing of both events the corrective actions from this LER could not have prevented the condition being reported now.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTAL NUMBER	REVISION NUMBER	
Palo Verde Nuclear Generating Station Unit 1	05000528	2009	-- 001	-- 00	2 OF 11

17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)*

All times are Mountain Standard Time and approximate unless otherwise indicated.

1. REPORTING REQUIREMENT(S):

This LER is being submitted pursuant to the following 10 CFR 50.73 reporting criteria:

(a)(2)(i)(B) – condition prohibited by Technical Specifications (TS) due to:

Non-compliance with TS 3.0.3 when both trains of Emergency Core Cooling System (ECCS) were inoperable and when both trains of Containment Spray (CS) were inoperable;

Non-compliance with TS LCO 3.6.1 when the Containment was inoperable;

(a)(2)(ii)(B) - unanalyzed condition that significantly degraded plant safety;

(a)(2)(v)(B), (C), and (D) – a condition that could have prevented the fulfillment of a safety function of systems needed to remove residual heat, control the release of radioactive material, or mitigate the consequences of an accident; and

(a)(2)(vii) – condition that resulted in a common cause inoperability of independent trains or channels.

2. DESCRIPTION OF STRUCTURE(S), SYSTEM(S) AND COMPONENT(S):

The Safety Injection System (SI) consists of two redundant trains with each train divided into the ECCS and the Containment Spray (CS) (EIIS: BP) systems. The systems function together to mitigate the consequences of analyzed accidents. The ECCS consists of two redundant trains of High Pressure Safety Injection (HPSI)(EIIS: BQ) and Low Pressure Safety Injection (LPSI) (EIIS: BP) systems. During an accident, such as a Loss of Coolant Accident (LOCA), a Safety Injection Actuation Signal (SIAS) (EIIS: JE) starts the HPSI, LPSI, and CS pumps (EIIS: P) together, and aligns the HPSI and LPSI pumps to inject borated water from the Refueling Water Tank (RWT) (EIIS: BQ – TK) into the Reactor Coolant System (RCS) (EIIS: AB). Should the Containment Building (EIIS: NH) pressure increase to its set point during the accident, the Containment Spray Actuation Signal (CSAS) (EIIS: BE) actuates to align containment spray from the RWT via

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTAL NUMBER	REVISION NUMBER	
Palo Verde Nuclear Generating Station Unit 1	05000528	2009	-- 001	-- 00	3 OF 11

17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)*

the CS pumps and shutdown cooling heat exchangers (EIIS: BP-HX) to reduce pressure and temperature inside the Containment Building.

Figures A and B at the end of this report provide simplified diagrams of the SI system.

The RWT is the borated water source for ECCS and CS. It is vented to the Fuel Building ventilation exhaust system (EIIS: VG) upstream of the Fuel Building ventilation exhaust radiation monitor (EIIS: IL).

To prevent overheating of the SI pumps and resulting damage during low flow conditions, minimum flow (mini-flow) recirculation piping is provided on each of the SI pump discharge lines (three per train). Each of the mini-flow lines contains a motor-operated isolation valve. Each train's three mini-flow lines join together and a common solenoid-operated isolation valve is provided downstream. The mini-flow recirculation from each train is routed to the RWT through a single pipe common to both trains. When the mini-flow recirculation path is not available during normal operations, the respective SI pump is declared inoperable.

When the RWT level decreases to a set point during an accident, a Recirculation Actuation Signal (RAS) (EIIS: JE) occurs. The RAS automatically turns off the LPSI pumps and opens the suction valves (not shown on the figures) for each train from the respective ECCS containment sump. The RAS also automatically closes the mini-flow recirculation motor- and solenoid-operated isolation valves to eliminate mini-flow back to the RWT, which would otherwise bypass the containment and RCS injection, resulting in the reduction of ECCS containment sump inventory.

The SI piping arrangement also permits full-flow from the HPSI, CS or LPSI pumps to be directed to the common RWT return pipe. For full-flow recirculation using the "A" LPSI or CS pump, discharge flow is routed through manually operated valve SIA-V460 and through the common RWT return pipe manually operated valve SIE-V298. Similarly, the "B" train full-flow recirculation, using CS or LPSI pump flow, is routed through manually operated valve SIB-V464 and through the common return pipe valve SIE-V298. These three valves are normally locked-shut in accordance with operating procedures. These procedurally controlled alignments provide a means of recirculating the RWT for operations such as surveillance testing, cooling the RWT prior to a refueling outage, and

to minimize RWT boron stratification. Figure A provides a simplified diagram of CS "A" in the full-flow recirculation alignment.

The HPSI full-flow recirculation alignment uses the HPSI mini-flow recirculation line with the mini-flow line orifice bypass valve open to achieve full flow. The mini-flow recirculation line, as noted above, is isolated automatically upon receipt of a RAS.

The RWT operations procedure provides direction to manually insert a Safety Equipment Status System (SESS) (EIIS: li) alarm when the SI system is aligned for full-flow recirculation of the RWT. This provides visual and audible alarms to identify inoperable or bypassed required equipment when engineered safety feature system actuations occur, such as a SIAS or CSAS. Operator actions to identify the cause of the alarm and correct the condition are procedurally directed. The expected response to the SESS alarm would to be to restore the proper system alignment.

3. INITIAL PLANT CONDITIONS:

On February 18, 2009, at 18:00 (discovery date), Palo Verde units 1, 2, and 3 were operating in Mode 1, Power Operation, at approximately 100% power at normal operating temperature and pressure. No systems, structures, or components were out of service that contributed to this reported condition.

4. EVENT DESCRIPTION:

On October 30, 2007, the Component Design Basis Review (CDBR) project identified that using HPSI full-flow recirculation may degrade the mini-flow recirculation capabilities of both trains of CS and LPSI during a safety injection actuation. The engineering evaluation of the condition concluded that HPSI full-flow recirculation would cause a reduction in the mini-flow recirculation for the LPSI and CS pumps; however, the mini-flow rate would be above the minimum needed for pump cooling.

On February 12, 2009, station personnel reviewed the HPSI full-flow conclusion as part of a review of operability determinations for issues identified by the CDBR and questioned whether using a LPSI or CS pump for full-flow recirculation of the RWT could impact the mini-flow

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTAL NUMBER	REVISION NUMBER	
Palo Verde Nuclear Generating Station Unit 1	05000528	2009	-- 001	-- 00	5 OF 11

17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)*

recirculation of the other SI pumps as a result of the increased pressure in the individual mini-flow recirculation lines. Station personnel concluded on February 18, 2009, that the full-flow recirculation of the RWT using either a CS or LPSI pump could potentially adversely impact one or more SI pumps' mini-flow rates because of the resulting increased pressure in the mini-flow lines.

SI system pressures and flows for LPSI and CS full-flow recirculation were evaluated using a system hydraulic design model. The evaluation of the full-flow recirculation alignments determined:

- Use of a LPSI pump at flow rates greater than 2500 gallons per minute (gpm) would reduce the opposite train LPSI mini-flow recirculation below the minimum requirement.
- Use of a LPSI pump at flow rates greater than 3200 gpm would reduce mini-flow recirculation of both CS trains below the minimum requirement.
- Use of a CS pump at flow rates greater than 2450 gpm would reduce mini-flow recirculation of the same train LPSI pump below the minimum requirement.
- Use of a CS pump at flow rates greater than 2600 gpm would reduce mini-flow recirculation of the opposite train LPSI pump below the minimum requirement.
- Use of a CS pump at flow rates greater than 3150 gpm would reduce mini-flow recirculation of the opposite train CS pump below the minimum requirement.

HPSI pump discharge pressure will overcome the elevated mini-flow return line pressure and is not adversely affected by LPSI or CS full-flow recirculation.

For LOCAs that depressurize the RCS below the discharge pressure for each SI pump, the reduction in mini-flow rate does not adversely impact the pumps since they will provide RCS injection and containment spray flow at rates sufficient to ensure pump cooling.

It was also determined if normal SI system alignment is not restored prior to a RAS, the CS and LPSI full-flow recirculation alignment could result in a containment bypass flow path to the RWT. Figure B at the end of the report provides a simplified diagram of the CS full-flow recirculation flow path if alignment was not restored prior to a RAS occurring. The bypass flow path could also adversely affect SI pump available net positive suction head (NPSH) because containment sump level would decrease.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTAL NUMBER	REVISION NUMBER	
Palo Verde Nuclear Generating Station Unit 1	05000528	2009	-- 001	-- 00	6 OF 11

17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)*

For LOCAs that do not result in a RAS the containment bypass path would not occur.

The RWT full-flow recirculation alignment has been used in Modes 1 and 3 to either cool the RWT prior to a refueling outage or to minimize the potential for boron stratification. The alignment has also been used for periodic SI system check valve surveillance testing. The station began using LPSI for full-flow recirculation in 1987. After identifying problems with boron stratification in the RWT in 1990, procedure changes were made to allow LPSI, CS and HPSI full-flow recirculation alignments. In 1998, the SI system check valve surveillance test procedure was changed to allow the full-flow recirculation alignment, in accordance with the RWT operations procedure, for on-line testing.

5. ASSESSMENT OF SAFETY CONSEQUENCES:

There was no actual impact to the health and safety of the public that occurred during the times when the CS and LPSI pumps were placed on full-flow recirculation of the RWT. The condition did not result in any challenges to the fission product barriers or result in the release of radioactive materials. The 10 CFR 100 offsite dose criteria were never challenged or exceeded.

The plant was in an unanalyzed condition when either LPSI or CS was aligned for full-flow RWT recirculation. In this alignment, mini-flow rate requirements for other SI pumps may not have been met under some accident scenarios and the potential existed for pumping water from the containment sump to the RWT if a RAS had occurred without the system being realigned.

The identified full-flow recirculation alignments could have prevented the fulfillment of the safety functions of the SI systems to remove residual heat and mitigate the consequences of an accident. This could have occurred through a combination of pump damage due to the lack of mini-flow recirculation and the loss of available NPSH after RAS actuation. Additionally, the alignments could have resulted in the loss of the safety function to control the release of radioactive material as a result of the containment bypass flow after a RAS occurs.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTAL NUMBER	REVISION NUMBER	
Palo Verde Nuclear Generating Station Unit 1	05000528	2009	-- 001	-- 00	7 OF 11

17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)*

The core damage frequency (CDF) and large early release frequency (LERF) were analyzed for the durations that the LPSI and CS pumps were in full-flow recirculation in the 18 months ending in February 2009. The exposure durations when LPSI and CS were used for RWT full-flow recirculation during the 18 month period were 102 hours in Unit 1, 75 hours in Unit 2, and 43 hours in Unit 3. Specific individual alignment durations ranged from 16 minutes to 15.5 hours. The analysis concluded that the risk to the units was not increased significantly. The exposure durations during this 18 month period are expected to be representative of prior periods of operation.

6. CAUSE OF THE EVENT:

The direct cause of the full-flow recirculation alignments was that plant procedures directed the alignments.

Three root causes were identified:

A. The process for cross-organizational and technical review of operating and surveillance test procedures that directed the full-flow recirculation alignments did not ensure the impact of plant configuration changes on design bases was adequately considered.

B. Inadequate technical rigor was applied to evaluations and reviews of documentation, including operating experience. The reviews of NRC Bulletin 88-04, *Potential Safety-Related Pump Loss*, and NRC Information Notice 91-56, *Potential Radioactive Leakage to Tank Vented to Atmosphere*, presented opportunities to identify that the full-flow recirculation alignments may degrade mini-flow recirculation of other SI pumps and establish a containment bypass flow path. The reviews of the above operating experience did not identify the unanalyzed conditions.

C. The implementation of the 10 CFR 50.59 program was inadequate when the affected procedures were revised to include the full-flow recirculation alignments. The conditions created by the procedure changes were not identified when performing the 10 CFR 50.59 review.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTAL NUMBER	REVISION NUMBER	
Palo Verde Nuclear Generating Station Unit 1	05000528	2009	-- 001	-- 00	8 OF 11

17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)*

7. CORRECTIVE ACTIONS:

The station discontinued use of the RWT LPSI and CS full-flow recirculation methods and the respective portions of the procedures were placed on administrative hold to prevent their use. The RWT common return line isolation valve SIE-V298 was tagged shut to prevent the alignments.

The actions to prevent recurrence for the identified root causes are listed below:

A. The following two items are actions to prevent recurrence of the procedure process root cause:

The station will develop validation criteria relative to procedure impacts on plant configuration control, including criteria and references to locked valve, breaker, and component tracking. The validation criteria will be incorporated into the station's procedure process review checklists.

The locked valve, breaker, and component tracking procedure will be revised to explain the reason for locking the identified components and the consequences of not maintaining the components' locked position.

B. The root cause related to questioning attitude and technical rigor in document reviews was a historical site issue related to the NRC finding for the dry ECCS containment sump suction pipe (EA-04-221). The corrective actions to prevent recurrence were addressed in NRC Confirmatory Action Letter CAL 4-07-004.

C. The inadequate 10 CFR 50.59 implementation cause is similar to the root cause identified in Notice of Violation (NOV) for the containment sump dry pipe (EA-05-051). The corrective actions included significant changes to improve the 10 CFR 50.59 process.

LICENSEE EVENT REPORT (LER)
CONTINUATION SHEET

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTAL NUMBER	REVISION NUMBER	
Palo Verde Nuclear Generating Station Unit 1	05000528	2009	-- 001	-- 00	9 OF 11

17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)*

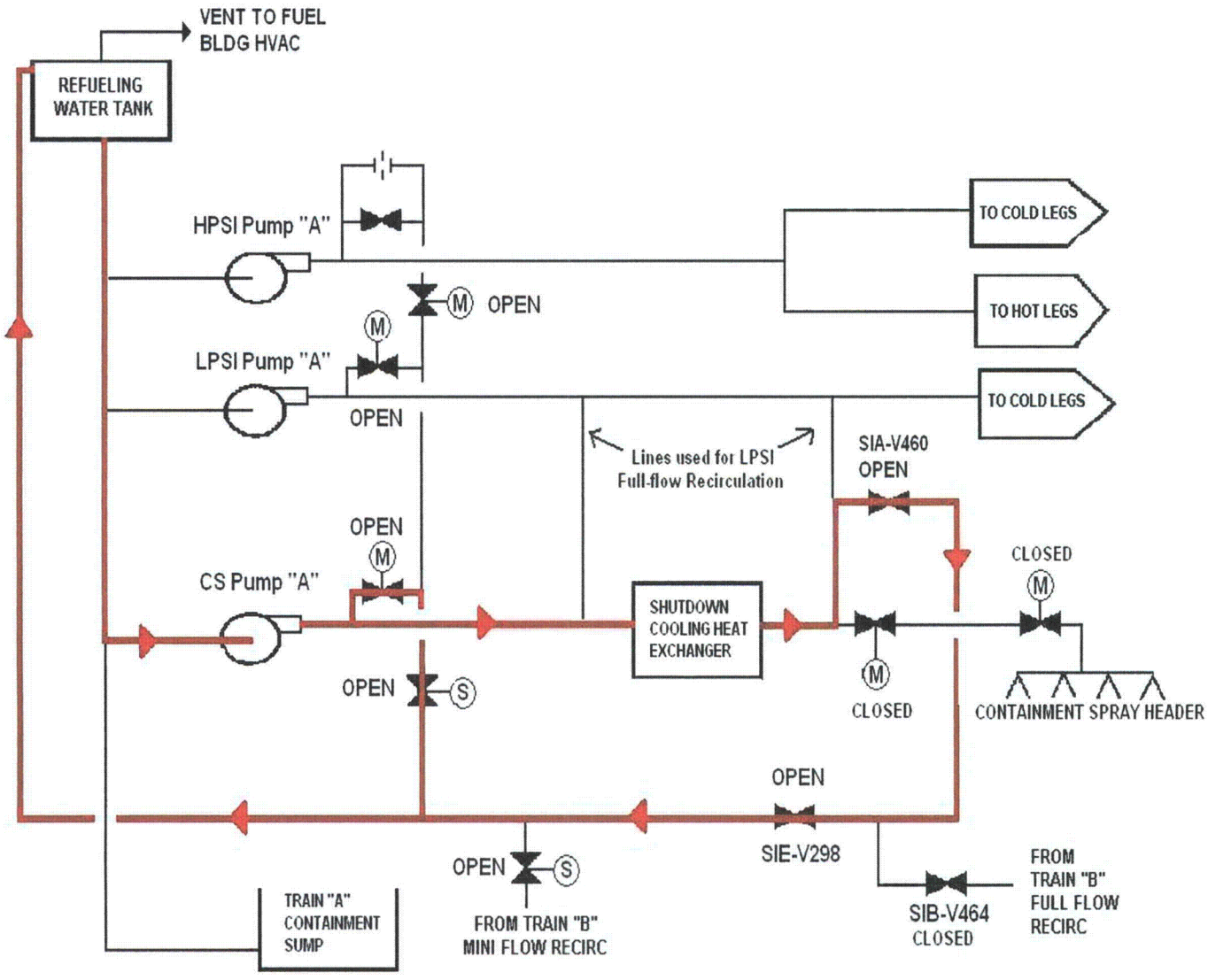
8. PREVIOUS SIMILAR EVENTS:

The root causes are similar to the causes reported in LER 05-00528/2004-009-01. Due to the timing of both events the corrective actions from this LER could not have prevented the condition being reported now.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTAL NUMBER	REVISION NUMBER	
Palo Verde Nuclear Generating Station Unit 1	05000528	2009	-- 001	-- 00	10 OF 11

17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)*

Figure A – Containment Spray System Full-flow Recirculation Alignment



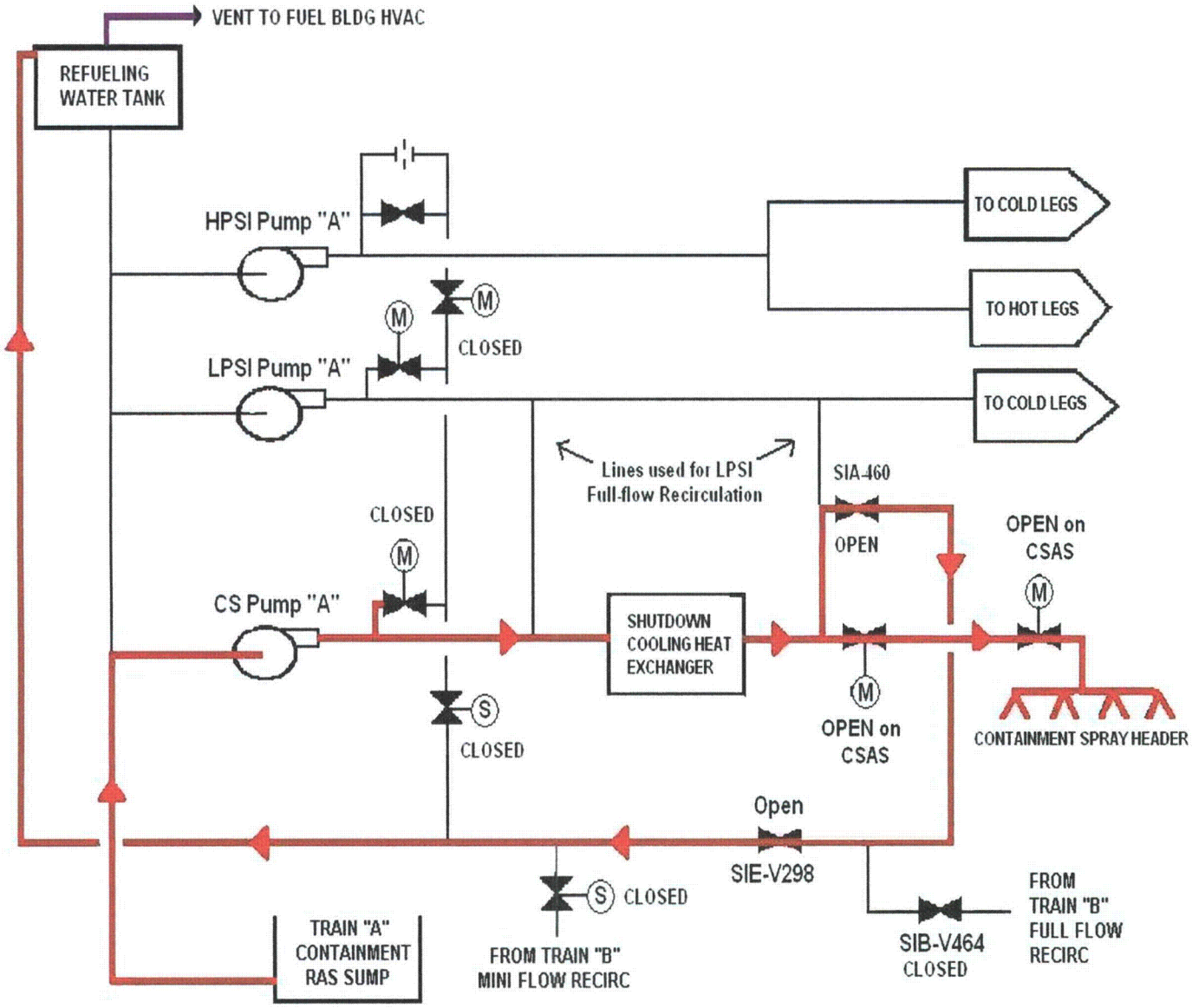
Note

This is a simplified drawing for the Containment Spray full-flow recirculation alignment only. It does not include all of the piping or valves that would be used for LPSI full-flow recirculation.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTAL NUMBER	REVISION NUMBER	
Palo Verde Nuclear Generating Station Unit 1	05000528	2009	-- 001	-- 00	11 OF 11

17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)*

Figure B – Post "RAS" Containment Spray System Full-flow Recirculation Alignment



Note

This is a simplified drawing for the Containment Spray full-flow recirculation alignment only. It does not include all of the piping or valves that would be used for LPSI full-flow recirculation.