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

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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)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Dresden Nuclear Power Station, Unit 3	05000249	1 of 9

TITLE (4)
High Pressure Coolant Injection System Inoperable due to Gland Seal Leak Off Condenser Drain Pump Low Level Shut Off Switch Failure Caused by A Misaligned Switch Lever Arm

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
									N/A	05000
12	29	97	97	014	00	01	28	98	N/A	05000

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR § (Check one or more) (11)							
POWER LEVEL (10)	099		20.2201(b)		20.2203(a)(2)(v)		50.73(a)(2)(i)		50.73(a)(2)(viii)
			20.2203(a)(2)(i)		20.2203(a)(3)(i)		50.73(a)(2)(ii)		50.73(a)(2)(x)
			20.405(a)(1)(ii)		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)	X	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)
D. Smith, Plant Engineering	(815) 942-2920 ext 3087

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
B	BJ	LS	M235	Y						

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE).	X	NO				

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

On December 29, 1997, at approximately 0234 hours, following a manual start of the Unit 3 High Pressure Coolant Injection (HPCI) System gland seal leak off (GSLO) condenser drain pump, the drain pump failed to automatically shut off and the HPCI Gland Seal Condenser Hotwell Level HI/LO Alarm annunciated. Based on a review of available information, the operating shift concluded that HPCI was Operable. A subsequent Engineering Department walkdown during the following shift identified that the pump may be air bound. HPCI was declared inoperable at 1945 hours on December 29, 1997. The likely cause for failure of the GSLO condenser drain pump to shut off is a failure of the GSLO condenser drain pump low level stop switch in the closed position. Inspection of the pump stop level switch found that the lever arm to float shaft set screw was not tightly secured and that the lever arm to switch mechanical linkage was not properly aligned. The float shaft and lever arm alignment was adjusted and the set screw secured tightly. All four level switches were inspected and minor adjustments performed. The level switches were successfully functionally tested and HPCI declared operable on December 31, 1997 at 1721 hours. The cause for the loose set screw and misalignment was not determined. The drain pump stop level switch had been installed on September 7, 1997 following a previous level switch failure. The safety significance of this event is minimal due to other safety systems being available for operation.

PLANT AND SYSTEM IDENTIFICATION:

General Electric - Boiling Water Reactor - 2527 MWt rated core thermal power

Energy Industry Identification System (EIIS) Codes are identified in the text as [XX] and are obtained from IEEE Standard 805-1984, IEEE Recommended Practice for System Identification in Nuclear Power Plants and Related Facilities.

EVENT IDENTIFICATION:

High Pressure Coolant Injection (HPCI) [BJ] System Inoperable due to Gland Seal Leak Off Condenser Drain Pump Low Level Shut Off Switch Failure Caused by a Misaligned Switch Lever Arm

A. PLANT CONDITIONS PRIOR TO EVENT:

Unit: 3 Event Date: 12-29-97 Event Time: 0234 CST

Reactor Mode: 1 Mode Name: Run Power Level: 099

Reactor Coolant System Pressure: 1000 psig

There were no structures, systems or components inoperable at the beginning of this event which contributed to the level switch failure.

B. DESCRIPTION OF EVENT:

This LER is being submitted pursuant to 10 CFR 50.73(a)(2)(v)(D) which requires reporting of any event or condition that alone could have prevented the fulfillment of the safety function of a system required to mitigate the consequence of an accident.

On December 29, 1997, at approximately 0234 hours following restoration from Dresden Instrument Surveillance (DIS) 2300-01 HPCI Steam Line High Flow Isolation Master Trip Unit Calibration, the Unit 3 HPCI gland seal leak off (GSLO) condenser drain pump was manually started to verify the system was in standby per Dresden Operating Procedure (DOP) 2300-01, HPCI System Standby Operation. The drain pump failed to automatically shut off on GSLO condenser hotwell low level and the HPCI Gland Seal Condenser Hotwell Level HI/LO alarm annunciated. The drain pump was manually secured from the Control Room. An operator was dispatched and reported that there was no visible level in the condenser hotwell sightglass. Operations documented this condition on Problem Identification Form (PIF) D1997-08825, and an Action Request was initiated. The repair was made a priority maintenance issue. The low level alarm condition was discussed with the Unit 2 Shift Supervisor regarding similar alarms which had recently occurred on Unit 2. The Unit 3 Supervisor reviewed Dresden Annunciator response procedure, (DAN) 902 (3)-3 H-11, HPCI Gland Seal Condenser Level HI/LO, the RUFSAR, Red Phone Call Log, LCO Log and the HPCI Design Basis Document to determine if there were any GSLO condenser level requirements which could affect HPCI operability. The GSLO drain pump was determined to be operable based on the ability of the pump to run and autostart to prevent HI level in the condenser.

During Shift Two on December 29, 1997, the HPCI System Engineer, upon inspection of the HPCI condenser hotwell, found that the level was below the bottom of the sight glass. The HPCI system engineer determined that the abnormally low level in the hotwell could result in air entrainment in the drain pump suction. This determination was based on a previous event (LER 97-009, Docket number 05000249) where failure of the low level drain pump stop switch resulted in air entrainment in the pump suction and a reduction in the pump capacity. The system engineer documented this degraded condition and the possibility of the drain pump being air bound on PIF #D1997-08840.

An Operability Evaluation was initiated to evaluate the condition of HPCI. A copy of LER 3-97-009 was attached to the PIF and provided to the Shift Manager at approximately 1700 hours on December 29, 1997.

At 1945 hours on December 29, 1997, following review of the Engineering Department PIF #D1997-08840 and information contained in LER 3-97-009, the Shift Manager declared the Unit 3 HPCI system inoperable, prior to receiving results from the pump functional test. A 14 day LCO was entered per Technical Specification 3.5.A. An ENS notification was made at 2004 hours on December 29, 1997. Troubleshooting commenced during Shift Two on December 30, 1997. During troubleshooting, it was determined that the HPCI drain pump was air bound and the system remained inoperable.

Operability Assessment Determination

There was no indication in the HPCI Gland Seal Condenser Level HI/LO Annunciator response procedure that a low level condition could cause the HPCI condenser drain pump to be inoperable. The Unit Shift Supervisor was not cognizant of the previous event where HPCI became inoperable due to a low level pump stop switch failure. [During that event (LER 3-97-009), the gland steam exhauster tripped resulting in a GSLO condenser high pressure alarm. The HPCI turbine was manually tripped and HPCI declared inoperable. The exhaust fan trip was caused from condenser high level. The high level resulted from air entrainment in the pump following failure of the low level stop switch to shut the pump off at the required low level.] The low level alarm condition was discussed with the Unit 2 Shift Supervisor regarding similar alarms which had recently occurred on Unit 2. The Unit 3 Shift Supervisor's review of available documentation did not indicate that there was a potential HPCI operability issue. As a result, HPCI remained operable. The Unit 3 HPCI condenser hotwell low level alarm condition was identified as an emergent concern. A PIF and AR were initiated.

Dresden Administrative Procedure (DAP) 07-31, Operability Determination, provides for operability issue screening, normally within one 8 hour shift, but allows up to 24 hours, commencing at the time of Shift Manager notification. Additional time constraints are contained within the implementing procedure. During this event, the Operability Issue Screening commenced at approximately 1700 hours on December 29, 1997, following receipt of the Engineering Department PIF. Operations declared HPCI inoperable at 1945 hours on December 29, 1997; well within the time limits prescribed in DAP 07-31. Once HPCI was declared inoperable, the Operability Determination was terminated. The four hour ENS notification was made at 2004 hours on December 29, 1997; within the reportability time requirements.

The Shift Manager declared HPCI inoperable when he concluded there was firm evidence that the HPCI system was potentially inoperable. This is consistent with existing expectations regarding LCO entry at time of discovery unless there is firm evidence that identifies a specific time reference. Examples would include clear documentation that an improper maintenance or testing occurred that is clearly identified through a work package or surveillance.

Troubleshooting/Inspection Summary

The GSLO condenser hotwell level control switches were verified to be installed at the proper heights, functionally tested, flushed, inspected, and functionally tested a second time in accordance with plant procedures and approved work packages. All four hotwell level control and alarm switches operated properly with the exception of the high level alarm switch which did not actuate initially until it was manually cycled.

A functional test of GSLO condenser drain pump was performed. The test identified that the pump was initially air bound and did not lower level in the hotwell. Following the venting of air from the pump discharge, the pump operated normally and pumped down the hotwell. The pump functional test was satisfactorily repeated. With the hotwell at the pump shut-off level, the GSLO drain pump control switch was momentarily placed in START and then returned to AUTO. The pump started and immediately stopped on the low level pump stop switch without receiving the low level alarm.

Troubleshooting/Inspection Results

The HPCI condenser hotwell level alarm and control system are comprised of four level switches. Level switches 2300-LLAS-1 and 2300-LLAS-2 provide the respective condenser hotwell High and Low level alarms. Level switches 2300-LCS-1 and 2300-LCS-2 provide for automatic pump start and stop control. A functional test per DIS 2300-15, High Pressure Coolant Injection (HPCI) Gland Seal Condenser Level Control/Alarm Switch Functional Test, was performed to obtain as found conditions. Acceptable performance was obtained for level switches: 3-2300-LLAS-2 (Low Level Alarm), 3-2300-LCS-1 (Pump Stop), and 3-2300-LCS-2 (Pump Start). Level switch 3-2300-LLAS-1 (High Level Alarm) did not actuate initially until it was manually cycled. Additional inspections were performed to evaluate material conditions of all four level switches.

All four switches were flushed and a significant amount of corrosion products was flushed from the pump stop switch (3-2300-LCS-1) and the low level alarm switch (3-2300-LLAS-2). Although possible, it is unlikely that any of the material flushed from the level switches caused the pump stop switch to malfunction due to the vertical orientation of the float chamber and the level switch standpipe. The vertical orientation would typically result in any scale or crud falling down into the vertical sensing leg.

The level switches were visually inspected to determine if there were any binding conditions or mechanical linkage problems which could affect switch performance. The following summarizes conditions observed:

LCS-1 (Pump Stop): The set screw, securing the lever arm to the mated float shaft, was found slightly loose. When the screw was further loosened, an approximate 1/2 inch lever arm travel occurred before movement of the float shaft was observed. (Bench testing of a spare switch found that proper switch operation is dependent on the orientation of the lever arm on the float shaft.) The packing nut was found in contact with the lever arm. This condition did not appear to cause any restriction of lever arm movement. The packing nut was then tightened finger tight against the packing gland. The lever arm set screw was securely tightened and the mercury switch toggle movement was verified to actuate within the limits of the float travel.

LLAS-2 (Low Level Alarm): The packing nut was found in contact with the lever arm. It did not appear to restrict lever arm movement. The packing nut was then tightened finger tight. Switch mechanism travel and actuation were verified to perform satisfactorily.

LLAS-1 (High Level Alarm): The packing nut was approximately 1/4 turn from the lever arm. The packing nut was then tightened finger tight. No restrictions were identified. Switch mechanism travel and actuation were verified to perform satisfactorily.

LCS-2 (Pump Start): The packing nut was loose and would not engage the threads. The float/mechanical linkage acted sluggish when manually actuated. Although this switch passed the functional check, a determination was made to replace this level switch due to the identified material conditions.

Level Switch Functional Performance:

Two vintages of level switches are installed in the HPCI GSLO condenser level control system. The initial switch design located on LCS-2 (Pump Start) [replaced during this investigation], and LLAS-2 (Low Level Alarm) have a solid lever arm which connects the float shaft to the switch mechanical linkage. A tapered threaded bolt provides the mechanical connection between the float shaft and the lever arm. The current vintage level switches, which have been installed as replacements on level switches LLAS-1 (High level alarm), LCS-1 (Pump Stop) and LCS-2 (Pump Start), have a set screw which provides a contact fit between the slotted float shaft and the lever arm. The lever arm, which slides over the float shaft, has a circular punchout with a flat spot as a mating surface to the float shaft. A locking nut is provided to secure the set screw in place. Switch actuation occurs at the upper and lower ends of float travel, approximately 3/8 inch from the low end of travel (low level - open toggle) and at approximately 1/2 inch from the upper end (toggle closed) during upward float travel. With the set screw loose, an approximate 1/4 inch of free travel [measured at the end of the lever arm] occurs before the float shaft contacts the lever arm. Bench testing of a spare current vintage level switch found that proper switch operation is dependent on the orientation of the lever arm on the float shaft. Consistent level switch operation was observed with the lever arm flat spot securely tightened against the float shaft mating surface. The set screw makes contact on the rounded portion of the level shaft rather than the flat face. For the newer level switch design, manually raising and lowering the float by rotating the lever arm could cause the lever arm to change position (rotate) on the float shaft depending on the amount of turning torque applied to the lever arm. Except for the above described differences, the float chamber, float assembly/shaft, packing gland, gland nut, and level switch mechanism are the same for both the current and earlier vintage level switches.

On December 24, 1997, inspection and troubleshooting for a non-reportable condition was performed on the Unit 2 HPCI GSLO condenser hotwell low level alarm and low level pump stop switch. Spurious low HPCI Gland Seal Condenser hotwell alarms had been received during hotwell pump down. Pump operation was visually observed and determined to be operating properly. All four level switches were inspected and functionally tested in the as found and as left condition. The low leg sensing line was flushed. The low level pump stop switch lever arm was adjusted and the set screw tightly secured. Following work completion, a successful functional check was performed. Lessons learned from this event were incorporated into the inspections and troubleshooting performed on the Unit 3 level switch.

Failure Mechanism Considerations:

The Unit 3 HPCI Condenser drain pump switches were inspected to evaluate potential failure mechanisms. The results are as follows:

* Misalignment of the lever arm (rotation) to the float shaft - Improper alignment of the lever arm to the float shaft could result in insufficient travel of the switch toggle mechanism for the proper switch operation. The set screw for the current vintage level switch contacts the lever arm on its rounded surface. Misalignment could occur during level switch operation if the set screw becomes loose. Misalignment may also occur during manual actuation (rotation) of the lever arm if the set screw is not tightly secured. Maintenance activities could also result in incorrect alignment if the lever arm is adjusted or removed and the sensitivity of the alignment conditions not known. Misalignment or rotation is less likely on the older switch vintage due to the type of lever arm locking device.

* Binding - Packing Gland to float shaft. This condition may be caused by excessive pressure being placed on the packing gland by the packing gland nut. Binding could result in sluggish or no lever arm (switch) operation. This condition is best identified during visual inspection/functional test .

* Binding - Packing Gland Nut to Lever Arm. Identified during visual inspection. Adjustments could be made following determination of as-found conditions.

* Foreign material build up on the switch mechanism - This condition could prevent or restrict switch toggle operation. Identified during visual inspection with cleaning performed as required.

* Float failure - Float filling with water thus preventing full upward travel during operation. This condition is less likely with the pump start and high level float switches due to the floats typically not being immersed during HPCI operation. The presence of fluid accumulating in the float could be detected during functional checks, or during HPCI operation and/or standby condition for the low level switch. A review of maintenance history and the HPCI event data base did not reveal any float failures. This failure mechanism is judged to be very unlikely.

* Rotation or failure of the mercury switch - Rotation in the clip holder or falling out of the clip holder could result in switch discontinuity during switch toggle operation. This condition would be identified during visual inspection. Corrective measures entail securing the mercury bulb in the correct orientation.

* Debris (crud/scale) buildup in the float chamber preventing sufficient float travel - This condition could be best identified during a visual inspection/functional test. Any accumulated debris could be periodically flushed from the float chamber to minimize this failure mode potential. Crud/scale buildup in the float chamber is less likely to occur due to the orientation of the float chamber and the vertical standpipe.

C. CAUSE OF EVENT:

Conditions which contributed to Operations Personnel not recognizing the potential for HPCI being inoperable following receipt of a low condenser hotwell level alarm and ultimately affecting their timeliness in declaring HPCI Inoperable:

1. Operations personnel were not cognizant of the previous event where the HPCI GSLO condenser low level condition resulted in the condenser hotwell drain pump being inoperable. (NRC Cause Code E).

2. The potential to cause air binding in the HPCI GSLO drain pump during a low level alarm condition is not identified in DAN 902 (3) - 3 H-11, HPCI Gland Seal Condenser Hotwell Level HI/LO Annunciator Response Procedure.(NRC Cause Code D)

Conditions which caused or contributed to the hotwell condenser level switch failure:

1. The root cause of this event is attributed to misalignment of the switch lever arm to float lever shaft due to a loose set screw. This event and the resultant failure analysis identified several failure mechanisms which if prevented will improve level switch reliability. Because the failure mechanisms were previously unknown, they were not included in functional test procedure DIS 2300-15. (NRC Cause Code E).

2. Based on this investigation and the unreliable performance of these level switches, it is believed that the installed switches are not the most appropriate level switch for the current application. Even though older vintages of the switches have been replaced with a more recent design, there has been no noted increase in switch reliability (NRC Cause Code B).

D. SAFETY ANALYSIS

Following HPCI system initiation, turbine and valve stem steam leak-off is collected by the HPCI turbine GSLO system and is condensed in the GSLO condenser. The condensate is then returned to the HPCI booster pump suction by the GSLO drain pump. Air binding of the drain pump will reduce the pump's capacity to pump down the hotwell which will result in flooding of the GSLO condenser and excessive leakage from the turbine glands and stop and control valve stems during HPCI operation. Although this condition alone will not prevent HPCI from operating, excessive steam leakage into the HPCI room could result in a HPCI system isolation due to high room temperature.

With the HPCI system inoperable due to failure of the GSLO condenser drain pump stop switch, the Isolation Condenser [BL], Automatic Depressurization System [BJ], and Low Pressure Emergency Core Cooling Systems (LPCI [BO], Core Spray [BM]) were available to provide reactor pressure and inventory control during any postulated design basis accident. For these reasons, the safety significance of this event is considered to be minimal.

E. CORRECTIVE ACTIONS:

1. All four hotwell level control switches were functionally tested, flushed, and inspected. Adjustments were made as needed to ensure proper operation of the float and switch mechanism. (Complete)

2. The GSLO condenser drain pump was vented and functionally tested satisfactorily. (Complete)

3. A letter describing the circumstances and the decision making process and the importance of the HPCI Condenser hotwell level control subsystem, has been provided to all Dresden Station Licensed Operators. (Complete)

4. Dresden Annunciator procedure DAN 902 (3) -3 H-11, was revised to clarify operator actions and evaluate HPCI operability following receipt of a HPCI GSLO condenser hotwell low level alarm. (Complete)

5. Revise Dresden Instrument Surveillance DIS 2300-15 to incorporate inspection results from this investigation to address the identified failure mechanisms. (249-180-97-01401)

6. Schedule performance of revised Dresden Instrument Surveillance DIS 2300-15 for both Units 2 and 3 during their respective work window. This will allow performance data to be collect for trending purposes. (249-180-97-01402, 03, 04)

7. Re-evaluate frequency for performance of Dresden Instrument Surveillance DIS 2300-15 based on the results of HPCI surveillances performed during calendar year 1998. (249-180-97-01405)

8. Evaluate alternative level switches and level switch elevations for the HPCI GSLO condenser hotwell level control and alarms. (249-180-97-01406)

F. PREVIOUS OCCURRENCES:

LER/Docket	Title
97-013-00/05000237	HPCI System Declared Inoperable Due to Excessive Cycling of the Gland Seal Condenser Hotwell Drain Pump due to Pump Stop Level Switch Malfunction.

On June 6, 1997, during scheduled performance of Dresden Operability Surveillance (DOS) 2300-03, High Pressure Coolant Injection System Operability Verification, the High Pressure Coolant Injection (HPCI) Gland Seal Leak Off (GSLO) condenser hotwell drain pump began cycling (on/off) excessively. The cause for the excessive pump cycling was attributed to failure (sticking) of the HPCI condenser hotwell pump stop level control switch 2-2300-LCS-1 in the open position. Corrective actions for this event were to replace the defective switch and functionally verify operability. The corrective actions from this event would not have prevented this event from occurring.

97-009-00/05000249	HPCI System Declared Inoperable Following Gland Seal Leakoff Condenser Hotwell High Level Due to Drain Pump Stop Switch Failure.

On September 5, 1997, at 1438 with Unit 3 in Mode 1(Run) while performing the quarterly High Pressure Coolant Injection (HPCI) system operability verification, the gland seal leak off (GSLO) condenser hotwell high level alarm was received while rolling the turbine to full speed following the turbine warm-up. The gland steam exhauster tripped resulting in a GSLO condenser high pressure alarm.

The HPCI turbine was manually tripped from the control room. The HPCI System was declared inoperable and the appropriate Technical Specification actions were taken. The cause of this event was the failure of the GSLO condenser drain pump low level stop switch to shut off the pump at the required low level due to a rotated mercury bulb. This resulted in cavitation/air entrainment in the pump suction and air accumulation in the discharge pressure regulating valve sensing line causing a reduction in the pump capacity.

Corrective actions for this event replaced the defective switch and performed an internal boroscope of the level control and alarm instrumentation piping. Following replacement, level switch operation was functionally verified. The corrective actions from this event would not have prevented this event from occurring.

G. COMPONENT FAILURE DATA:

Manufacturer	Nomenclature	Model Number
Mercoid Corporation	Level Switch	123-2

An industry wide NPRDS data base search was performed on Mercoid Corporation, Model 123 level switches for HPCI System application. One level switch failure was identified. Failure was caused by the mercury bulb coming loose from its holder.