



March 15, 1996  
NG-96-0670

Mr. Hubert J. Miller  
Regional Administrator  
Region III  
U. S. Nuclear Regulatory Commission  
801 Warrenville Road  
Lisle, IL 60532

Subject: Duane Arnold Energy Center  
Docket No: 50-331  
Op. License No: DPR-49  
Licensee Event Report #95-013, Rev. 1  
File: A-118a

Gentlemen:

Please find attached a copy of the subject Licensee Event Report in accordance with 10CFR50.73. The following commitment is being revised in this letter.

A detailed analysis of HPCI operability with water in the turbine exhaust line will be completed by May 1, 1996.

The above commitment is being revised due to additional time being required to formalize the detailed analysis. The initial conclusions made in the original LER as to operability of the HPCI system are unchanged at this time.

Sincerely,

A handwritten signature in cursive script, appearing to read "Gary Van Middlesworth".

Gary Van Middlesworth  
Plant Manager - Nuclear

cc: Director of Nuclear Reactor Regulation  
Document Control Desk  
U. S. Nuclear Regulatory Commission  
Mail Station P1-37  
Washington, D. C. 20555-0001  
NRC Resident Inspector - DAEC

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Handwritten initials "JE22" followed by a vertical line, possibly indicating a date or a signature.

## LICENSEE EVENT REPORT (LER)

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

FACILITY NAME (1)

Duane Arnold Energy Center

DOCKET NUMBER (2)

05000-331

PAGE (3)

1 OF 5

TITLE (4)

HPCI Inoperability Due To Water in HPCI Turbine Steam Exhaust Line

| 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 |
| 12             | 21  | 95   | 95             | -- 013            | -- 01           | 03              | 15  | 96   | FACILITY NAME                 | DOCKET NUMBER |
|                |     |      |                |                   |                 |                 |     |      |                               | 05000         |
|                |     |      |                |                   |                 |                 |     |      | FACILITY NAME                 | DOCKET NUMBER |
|                |     |      |                |                   |                 |                 |     |      |                               | 05000         |

| OPERATING MODE (9) | 1   | THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11) |                   |                  |   |
|--------------------|-----|---|-------------------|------------------|---|
| POWER LEVEL (10)   | 100 | 20.2201(b)  | 20.2203(a)(2)(v)  | 50.73(a)(2)(i)   | 50.73(a)(2)(viii)                             |
|                    |     | 20.2203(a)(1)   | 20.2203(a)(3)(i)  | 50.73(a)(2)(ii)  | 50.73(a)(2)(x)                                |
|                    |     | 20.2203(a)(2)(i)  | 20.2203(a)(3)(ii) | 50.73(a)(2)(iii) | 73.71   |
|                    |     | 20.2203(a)(2)(ii)   | 20.2203(a)(4)     | 50.73(a)(2)(iv)  | OTHER   |
|                    |     | 20.2203(a)(2)(iii)  | 50.36(c)(1)       | 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

Robert Murrell, Licensing Specialist

TELEPHONE NUMBER (Include Area Code)

(319) 851-7900

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

| CAUSE | SYSTEM | COMPONENT | MANUFACTURER | REPORTABLE TO NPRDS |  | CAUSE | SYSTEM | COMPONENT | MANUFACTURER | REPORTABLE TO NPRDS |
|-------|--------|-----------|--------------|---------------------|--|-------|--------|-----------|--------------|---------------------|
|       |        |           |              |                     |  |       |        |           |              |                     |
|       |        |           |              |                     |  |       |        |           |              |                     |
|       |        |           |              |                     |  |       |        |           |              |                     |

## SUPPLEMENTAL REPORT EXPECTED (14)

YES

X NO

## EXPECTED SUBMISSION

MONTH

DAY

YEAR

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

On December 21, 1995, with the plant at 100% power, following a successful Surveillance Test Procedure (STP) run of the High Pressure Coolant Injection (HPCI) system on December 15, 1995, water was found in the HPCI turbine steam exhaust line. HPCI was declared inoperable pending resolution. The water was drained and a preliminary operability determination concluded that the water in the line did not prevent HPCI from fulfilling its safety function and HPCI was declared operable on December 22, 1995. The presence of the water was detected due to increased leakage of the water past an exhaust line check valve which subsequently caused HPCI steam exhaust line drain pot alarms. Historical documentation identifies the potential for water to become trapped in the exhaust line due to vacuum conditions created by steam condensation following HPCI operation.

HPCI has been run successfully four times since the December 15, 1995 run with varying amounts of water found in the exhaust line after two of these four runs. The water was drained from the line after each HPCI run. A detailed analysis of HPCI operability with water in the exhaust line is in progress. The HPCI exhaust line check valve has been inspected and repaired and the downstream isolation valve will be inspected during the next cold shutdown. There was no effect on safe operation of the plant.

## LICENSEE EVENT REPORT (LER)

## TEXT CONTINUATION

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| Duane Arnold Energy Center | 05000-331            | 95             | --                   | 013                | -- | 01       |    |   |

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

**Description of Event:**

On December 15, 1995 the plant was operating at 100% power. Surveillance Test Procedure (STP) 45D001-Q, "HPCI (High Pressure Coolant Injection) System Quarterly Operability Test", was successfully completed and HPCI was declared operable at 2345 hours. The STP was run for an unrelated HPCI problem reported in LER 95-12. Drain pot high level alarms were received at approximately one hour intervals immediately following the HPCI run. (A drain pot is installed in the HPCI turbine steam exhaust line to collect water from steam in the exhaust line as it cools following HPCI turbine operation.) The alarm frequency then decreased to six hour intervals but by December 19, 1995 the alarms were still present. Corrective Maintenance Action Request (CMAR) A28177 was then written to investigate the alarms.

On December 21, 1995, during the CMAR investigation, approximately 170 gallons of water were drained from the exhaust line between isolation valve V22-0017 and check valve V22-0016. See Figure 1. The source of this water was not immediately known and the effect of this water on HPCI operability was also unknown. Therefore, at 1003 hours, the HPCI auxiliary oil pump was placed in "pull-to-lock" to prevent HPCI operation. HPCI was declared inoperable and a 14 day Limiting Condition for Operation (LCO) was entered. HPCI was then test run without incident from 2151 to 2222 hours on December 21, 1995, but not declared operable. Following this run, approximately one cup of water was drained from the exhaust line.

On December 22, 1995, following investigation of the cause of the water in the exhaust line and following preliminary analysis of the effect on HPCI operability, the Plant Operations Committee determined that HPCI was capable of performing its safety function. (See later paragraphs for cause and analysis.) At 1735 hours, HPCI was declared operable and the LCO was exited.

On December 27, 1995, HPCI was test run again without incident. Following this run, approximately 300 gallons of water were drained from the exhaust line. On January 5, 1996, HPCI was test run again without incident and no water was found in the exhaust line following the run. On January 11, 1996, HPCI was successfully test run again and 380 gallons of water were drained from the exhaust line following the run.

**Cause of Event:**

Following HPCI turbine operation, steam condensation cycles cause vacuum conditions within the exhaust line as the steam cools. This vacuum is sufficient to draw water from the torus into the exhaust line. Vacuum breakers V22-0063 and V22-0064 (See Figure 1) open upon sufficient vacuum in the exhaust line to allow water in the vertical exhaust line leg to drain to the torus. However, they may not prevent water from entering the exhaust line initially. If valve V22-0017 does not promptly close following turbine operation, the 58 foot length of 16 inch pipe between valves V22-0017 and V22-0016 provides additional vacuum to draw water into the exhaust line from the torus and water may be drawn into the section of pipe between the two valves. The geometry of valve V22-0017 is such that a dam exists that will not allow water in the bottom half of the horizontal pipe between the two valves to drain out to the torus, even when V22-0017 is open. It is believed that valve V22-0017 was open long enough following HPCI operation on December 15 and 27 and on January 11 to draw water into the exhaust line in this manner. Chemical analysis of the water drained from the exhaust line supported the conclusion that the water came from the torus.

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

Once water is in this section of the exhaust line, it is trapped except for possible minor leakage through valve V22-0016 to the drain pot. (The possibility of water becoming trapped in the exhaust line following HPCI operation was documented in 1973 General Electric correspondence.) The vacuum breakers were verified to be operable and leakage past check valve V22-0016 was measured and found to be acceptable but increased from the previous refuel outage test. This increased leakage past check valve V22-0016 resulted in the additional and prolonged drain pot alarms that ultimately caused HPCI to be declared inoperable as discussed above. Valve V22-0016 was subsequently inspected and repaired on January 11, 1996.

**Analysis of Event:**

The decision to declare HPCI inoperable on December 21 was made due to the unexpected amount of water found in the exhaust line and the unknown effect on HPCI operability. The determination made on December 22 that HPCI was operable was based on engineering judgment, supported by the following:

- Water was found in the exhaust line only between valves V22-0017 and V22-0016, and not in the HPCI turbine.
- The HPCI exhaust line is horizontal with no vertical loop seals.
- The horizontal pipe where the water was found should be no more than half full.
- The pipe diameter increases from 16 inches to 20 inches downstream of V22-0017, decreasing potential water slug velocity in the downstream piping during HPCI operation.
- General Electric Service Information Letter 480 has been implemented at DAEC, providing a softer HPCI startup transient.
- Vacuum breakers V22-0063 and V22-0064 were verified to be operable.
- Non-intrusive monitoring of V22-0017 operation indicated normal disc to seat contact upon flow reduction, indicating that its isolation function is operable and leak rate testing found seat leakage within the acceptable range.

A subsequent test of the HPCI system on January 11, 1996 showed that the exhaust line could potentially be more than half full of water. The potential to be more than half full is supported by a more detailed engineering review of the V22-0017 valve geometry (i.e., the valve seat is physically above the pipe centerline). Also by this date, it was determined that water in the line could potentially form a solid water slug upon HPCI initiation. Preliminary analysis supported by General Electric determined that in spite of these two changes from the December 22 operability determination, the HPCI system would still be able to fulfill its safety function. Work on a final detailed analysis is underway.

When HPCI was declared inoperable, the Reactor Core Isolation Cooling and low pressure core cooling systems were verified to be operable in accordance with plant Technical Specifications. This event had no effect on safe operation in this or any other mode of operation.

LICENSEE EVENT REPORT (LER)  
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**Corrective Actions:**

In addition to the actions discussed above, the following corrective actions are being taken:

- With support from General Electric, a detailed analysis of HPCI operability with water in the turbine exhaust line will be performed. This analysis will be completed by May 1, 1996.
- The HPCI exhaust line will continue to be drained following each HPCI run until the detailed analysis has been reviewed by the Operations Committee. This is implemented via Operations Department Shift Orders.
- Valve V22-0017 will be opened and inspected during the next cold shutdown. CMAR A28281 has been written for this inspection. This will be completed no later than December 31, 1996.
- Valve V22-0016 was repaired under CMAR A28570 on January 11, 1996.

**Additional Information:****A. Previous Similar Events:**

None of the 26 LERs reporting HPCI related inoperabilities since 1984 report a similar problem.

**B. EIS System and Component Codes:**

HPCI---BG  
Turbine---TRB  
Isolation Valve---ISV  
Check Valve---V  
Oil Pump---P  
Drain Pot---DRN  
Vacuum Breaker---VACB

C. Valve V22-0017 is Anchor Darling model 1484-3. Valve V22-0016 is Anchor Darling model 1514-3.

This event is being reported pursuant to 10CFR50.73(a)(2)(v).



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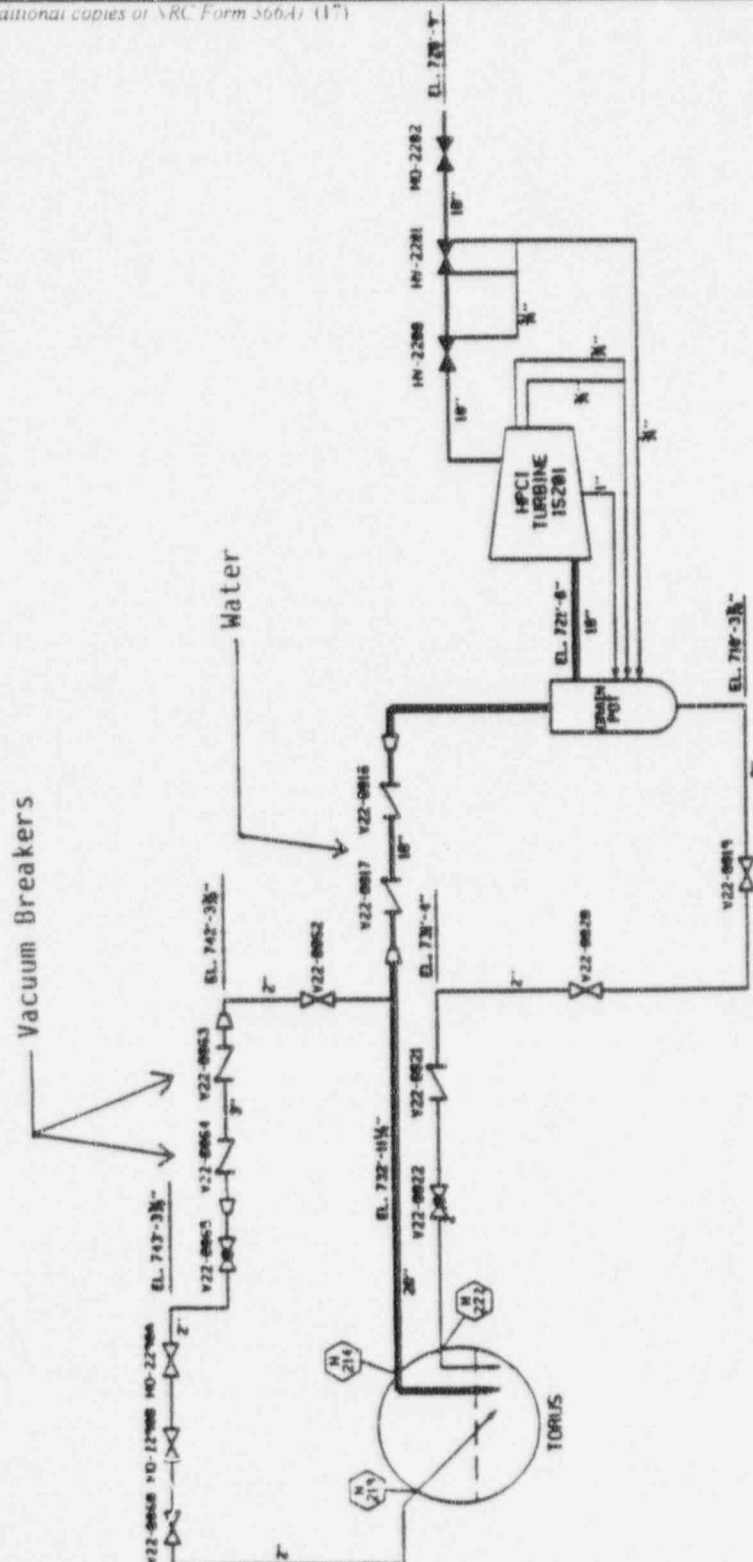


Figure 1  
HPCI System Exhaust Line