IES
UTILITIES INC.

March 14, 1994
NG-94-0999

Mr. John B. Martin
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 DPR-49
Licensee Event Report #94-004

Gentlemen:

In accordance with 10 CFR 50.73 please find attached a copy of the subject Licensee Event Report.

Very truly yours,

David L. Wilson
Plant Superintendent - Nuclear

DLW/JWK/mbm

cc: Director of Nuclear Reactor Regulation
Document Control Desk
U.S. Nuclear Regulatory Commission
Mail Station P1-137
Washington, D. C. 20555

NRC Resident Inspector - DAEC

IE22
1/1

NRC FORM 366 (6-92) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 5/31/95

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

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

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Duane Arnold Energy Center	05000 331	1 OF 8

TITLE (4)
Stand / Filter Units Inoperability Due to Inappropriate Electric Heater Design Setpoints

EVENT DATE (5)			LER NUMBER (6)			REPORT NUMBER (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
										05000
02	14	94	94	004	00	03	14	94	FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9)		THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)					
		20.402(b)		20.405(c)		50.73(a)(2)(iv)	73.71(b)
POWER LEVEL (10)		20.405(a)(1)(i)		50.36(c)(1)	X	50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)		50.36(c)(2)	X	50.73(a)(2)(vii)	OTHER
		20.405(a)(1)(iii)		50.73(a)(2)(i)		50.73(a)(2)(viii)(A)	(Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iv)		50.73(a)(2)(ii)		50.73(a)(2)(viii)(B)	
		20.405(a)(1)(v)		50.73(a)(2)(iii)		50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
John W. Karrick, Technical Support Specialist	(319) 851-7648

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	LV	EHTR	A089	N						

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 February 10, 1994, during a routine surveillance test performed during unusually cold weather conditions, a hot water heating coil for the "B" Control Building Standby Filter Unit (SFU) froze, ruptured, and eventually released hot water and steam into the downstream filter train. The plant was operating at 100% power with no existing Limiting Conditions for Operation (LCO's) in effect.

The root cause of the event was the safety related electric heater sheath temperature trip setpoint being too low. Engineering review and evaluation determined that a potential common mode failure existed. The "A" SFU was declared inoperable resulting in both SFU's being inoperable at the same time.

Both SFU's electric heater trip setpoints were raised to higher, analyzed values. The hot water coil in the "B" SFU was removed and left out when the unit was repaired. Engineering evaluation, equipment calibrations, and procedure development will be performed to complete corrective actions.

There was no effect on plant or personnel safety as a result of this event.

I. DESCRIPTION OF EVENT:

Routine Test:

At 0342 on February 10, 1994, a monthly Surveillance Test Procedure (STP), which includes a ten hour run of both Standby Filter Units (SFU), was commenced for the "B" train SFU after completing the test on "A". The outside air temperature at that time was approximately -17 degrees F.

Electric Heater Trips:

The electric heater for the "B" SFU train tripped three minutes into the test, accompanied by a control room annunciator. Operators took the actions specified in the Annunciator Response Procedure which included verifying the process air temperature was not high (120 degrees F setpoint) and system flow not low (650 scfm). These actions helped determine that the trip was from the heater sheath temperature (750 degrees F setpoint). The heater's sheath consists of an alloy that surrounds the insulator and electric coil to provide corrosion resistance and physical strength for the heater. After cooling down, the heater sheath trip was reset in accordance with the procedure. This trip does not deenergize the SFU fan, therefore, air flow continued through the train at the design flowrate (1000 scfm).

Approximately two minutes after resetting the heater, a second heater trip occurred. Again air temperature was verified to be lower than its trip setpoint and system flow was verified to be normal. After obtaining the Operations Shift Supervisor's concurrence, and with operators monitoring the unit for possible failure mechanisms, the heater was again reset. A third trip occurred approximately three minutes later.

Equipment Declared Inoperable:

The "B" SFU was declared inoperable due to the electric heater tripping and a seven day Limiting Condition for Operation (LCO) was entered at 0442 in accordance with Technical Specifications. At 0447, the "B" SFU was shut down and the surveillance test was exited. At 0607, with an instrument technician present, and under the controls of a Maintenance Action Request, the electric heater was reset and the "B" SFU was restarted. The heater again tripped approximately three minutes after startup and at 0610, the "B" SFU was shut down.

Ruptured Coil Discovered:

Approximately fifteen minutes after the 0610 shut down of the "B" SFU, a Control Building Equipment Room Fire alarm was received. Immediate operator response determined the cause of the fire alarm to be steam entering the SFU equipment room as a result of a ruptured hot water heating coil internal to the "B" SFU. The hot water coil had frozen while air flow continued through the unit, resulting in its expansion and rupturing. After air flow was stopped, the frozen coil had thawed releasing hot water and steam into the SFU. The hot water was immediately isolated from the coil but not before the High Efficiency Particulate Air (HEPA) filters and SFU charcoal bed were wetted.

Status of Redundant Train:

The "A" SFU train had successfully completed the ten hour surveillance test at approximately 0300 on February 10, 1994. Outside air temperatures during the test of the "A" train ranged from +2 degrees F to -17 degrees F. Therefore, the ability of the "A" SFU to perform its design function was not initially in doubt.

Results of Troubleshooting Efforts:

It was determined that the electric heater sheath trip setpoint of 750 degrees F was too low to support continued heater operation that could be necessary in extremely low outside air temperature conditions. At 1517 on February 14, 1994, the "A" SFU was declared inoperable based on it having the same 750 degrees F. setpoint. This rendered both SFU trains inoperable.

Technical Specifications Actions:

With the "B" SFU inoperable, a twelve hour hot shutdown LCO was entered when the "A" SFU was declared inoperable. The heater trip setpoint on the "A" train was raised to 1250 degrees F and the unit was returned to service following testing to demonstrate operability. The twelve hour hot shutdown LCO was exited at 1814 hours on February 14, 1994. On the "B" SFU, the setpoint was increased to 1250 degrees F in conjunction with completing repairs. Post maintenance testing and a ten hour run was completed on the "B" SFU with satisfactory test results. The seven day LCO was exited at 0513 on February 15, 1994.

II. CAUSE OF EVENT:

Root Cause:

The root cause of the event was the lower than required design setpoint of the electric heater sheath temperature trip. This prevented the safety related electric heater from operating at its design capacity. After the hot water heating coil was removed from the "B" SFU, testing performed on the electric heater revealed a peak sheath temperature of approximately 1029 degrees F. The peak sheath temperature occurred three to four minutes after startup followed by a decrease to an equilibrium value of 828 degrees F. Follow up testing and analysis confirms that the sheath setpoint was too low to support the entire range of electric operation. Vendor information indicates that the setpoint should be set at a value not higher than 1300 degrees F.

The cause of the extended inoperability of the "B" SFU was the ruptured hot water heating coil wetting the HEPA filters and charcoal bed which would have significantly decreased the unit's filtration capability during the accident scenario it is designed to mitigate. The hot water heating system and coil are non-safety related components. Among the several functions that the safety related electrical heaters serve is the prevention of freezing of the downstream hot water heater.

Contributing Factors:

1. Original system design was a significant contributing factor to to this event. By design, the SFUs contain two heaters, one electric and one hot water. A leak from or failure of the hot water coil can render the associated SFU train inoperable due to wetting of the HEPA filters and charcoal adsorber and thereby prevent the SFU from fulfilling its intended function. The electric heaters are qualified as safety related equipment. The hot water heating coil is part of a non-safety related system, but is qualified as a seismic category 1 component.

2. Lack of functional tests of the electric heater's thermostats was a contributing factor. The operating thermostat for the "B" SFU was found to be controlling at approximately 88 degrees F. The design setting is 50 degrees F. The difference in this as-found value and the design setting resulted in an additional heater demand of 38 degrees F. Because of the extremely cold weather, the total demand signal was equivalent to that of a 105 degree F. (+88 to -17 degrees F.) temperature differential. The heaters are designed to achieve a 70 degrees F. temperature rise. Had the thermostat been actually set at 50 degrees F., a demand signal equivalent to that from a 67 degrees F. (-17 to +50 degrees F.) temperature differential would have existed which would have been within the design capability of the heater if the high sheath temperature trip design setpoint had been correct.

3. Instrument drift in the non-safety related hot water loop was a contributing factor to the coil freezing. The instruments that control flow to the hot water heater coil were found out-of-tolerance. The temperature transmitter and temperature controller that provide positioning signals to a 3-way heater bypass control valve were found to have drifted such that only approximately 25% heating coil flow existed with a maximum flow signal present. These instruments were on a six year calibration frequency and had been calibrated within the last two years.

4. The absence of previous testing of the electric heaters was a contributing factor. The electric heater's ability to operate at full capacity had not been previously tested. Routine monthly surveillance tests were performed on the entire SFU but were done so with the hot water heating coil in service which, since it is set to control at 55 degrees F, masked electric heater performance.

III. ANALYSIS OF EVENT:

Immediate Concern:

The "A" SFU completed the same ten hour surveillance test during similar conditions (+2 to -17 degrees F) as those when the "B" unit failed. The maintenance performed on the "A" SFU to raise the sheath temperature trip setpoint and set the thermostat did not physically prevent the unit from fulfilling its safety function had it been needed during that time frame. The unit was actually running while the necessary adjustments were made. Therefore, during the time when both SFUs were declared inoperable the "A" unit could have fulfilled the safety function.

There was no effect on the continued safe operation of the plant, personnel safety or public safety as a result of this event. Variations in plant operating modes would have had no effect on the severity of this event.

Past Operability:

The hot water heating coil that ruptured is part of the non-safety related secondary heat loop. The heat for this system is provided by an electrical hot water heater or the plant secondary heating loop via the system's hot water injection pump. The hot water is circulated through the loop and heating coils by separate recirculating pumps. Both the hot water heater and hot water injection pumps are powered from Motor Control Center (MCC) 1B35. The recirculating pumps are powered from MCC 1B32. In the event of the Design Basis Accident (DBA), a Loss Of Offsite Power (LOOP) is assumed to occur simultaneously. MCC 1B35 is load-shed on such a LOOP signal to help reduce load on the Standby Diesel Generators. Therefore, with respect to the safety function of the SFU system, the hot water loop would continue to recirculate but lose its heat source, creating the potential for freezing and failure of the coils if the electric heater trips. The water and steam could then dampen the filter train and significantly reduce the filtration and adsorption capabilities of the SFU. Based on engineering analysis, inlet air temperatures would have to be less than approximately +15 degrees F to cause the electric heaters to trip at the former design trip setting of 750 degrees F. with the thermostat set at its design value of 50 degrees F. Design bases for the SFU system specify a value of -30 degrees F. for winter conditions. Therefore, the design setpoints were insufficient to support the -30 degrees F. bases and the possibility of this failure mode did exist in the past.

Safety Function:

General Design Criterion 19 of 10 CFR Part 50, Appendix A requires "Adequate radiation protection shall be provided to permit access and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of 5 rem whole body, or its equivalent to any part of the body, for the duration of the accident."

Standby Filter Unit operation and shielding design for the Control Building as well as other factors are considered in the analysis used to meet this criterion. Based on the above discussion the possibility existed for failure of the SFUs to complete their portion of the protection needed to meet the criterion. However, the probability of this failure was low in that a loss of coolant accident with a release through the elevated release point that subsequently falls to building intake level would have had to occur concurrent with both a loss of offsite power and a cold (less than +15 degrees F.) weather condition.

IV. CORRECTIVE ACTIONS:

Immediate Actions Completed:

1. The ruptured hot water coil was removed from the "B" SFU and the connections were capped off.

2. The HEPA filters and charcoal were replaced and tested satisfactorily in the "B" SFU.

3. The electric heater sheath temperature trip setpoints were raised to 1250 degrees F on both the "A" and "B" SFUs.

4. The electric heater's operating thermostats for both units were functionally tested and adjusted to their 50 degrees F. setting. This test has been established as a routine maintenance task to be performed annually.

5. Calibrations were performed on the hot water loop control instruments that serve the "A" SFU.

6. Operational tests were performed satisfactorily on both SFUs after the thermostat and heater trip adjustments were made.

7. A review was performed as to the susceptibility of the Standby Gas Treatment System (SBGT) to this type of failure. The SBGT system is not prone to this failure mode because a differential temperature controller is used for its electric heater. Also, there is not a hot water heating coil installed in the SBGT system.

Long Term Actions:

1. An Engineering evaluation will be performed to determine if expected reliability of the SFU system would be significantly enhanced by the elimination or restriction of water interfaces with the system. This evaluation will include a decision as to whether or not the removal of the hot water coil in the "A"

   SFU will be performed. These evaluations will be completed by April 30, 1994.

2. A procedure will be developed to test the capacity of the electric heaters annually. The test will be developed by June 30, 1994.

V. ADDITIONAL INFORMATION:

A. Previous Similar Events

A review of DAEC LERs identified LER 82-064, LER 84-026 and LER 86-20 which involved the inoperability of the Standby Filter Units. LER 82-064 involved electric heater trips associated with the sheath temperature trip setpoint. However, the hot water heating coil operated properly during that event which masked the need for the current 1250 degrees F. setpoint.

B. EIIS System and Component Codes

VI - Control Building Environmental Control System
NA - Control Building
BH - Emergency/Standby Gas Treatment System
LV - Plant Hot Water System

C. Manufacturers and Model Numbers

The hot water heating coil was manufactured by Aerofin Corporation (A089), AE Number AB6239. The SFUs were manufactured by Layne and Roderick Inc., Model number 00727. The electric heaters were manufactured by Chromalox EL Weigand Division/Emerson Electric (C332), model number 106-071012-001.

This report is being submitted pursuant to 10CFR50.73(a)(2)(v)(D) and 10CFR50.73(a)(2)(vii)(D).