December 12, 2001
NG-01-1404

Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station 0-P1-17
Washington, D.C. 20555-0001

Subject: Duane Arnold Energy Center
Docket No: 50-331
Op. License No: DPR-49
Licensee Event Report #2001-006-00
File: A-120

Dear Sirs:

Please find attached the subject Licensee Event Report (LER) submitted in accordance with 10CFR50.73. There are no new commitments contained within this report.

Should you have any questions regarding this report, please contact this office.

Sincerely,

Dean Curtland for

Rob Anderson,
Plant Manager - Nuclear

cc: Mr. James Dyer
Regional Administrator, Region III
U. S. Nuclear Regulatory Commission
801 Warrenville Road
Lisle, IL 60532

NRC Resident Inspector - DAEC

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NRC FORM 366 (1-2001) U.S. NUCLEAR REGULAT

LICENSEE EVENT REPORT (LER)

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

APPROVED BY OMB NO. 3150-0104 EXPIRES 6-30-2001

Estimated burden per response to comply with this mandatory information collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to bjs1@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 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.

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TITLE (4)
Manual Reactor Scram Due to Loss of Instrument AC

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER 05000
10	17	2001	2001	– 006 –	00	12	12	2001	FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9)	1
POWER LEVEL (10)	100

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

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

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Clare J. Bleau, Nuclear Licensing	319-851-7925

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

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
X	EF	INVT	E209	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 October 17, 2001, while operating at 100% power, operators inserted a manual reactor scram due to decreasing reactor water level. The low level was caused by a sequence of events initiated by a loss of Division 1 Instrument AC bus 1Y11 due to a failure of inverter 1D15 coincident with the alternate power supply, regulating transformer 1Y1A, being out of service for preplanned maintenance. The loss of 1Y11 caused a plant transient that required the operating crew to insert a manual scram in anticipation of reaching an automatic scram setpoint on low Reactor Pressure Vessel (RPV) level. All control rods fully inserted upon initiation of the manual scram. Reactor level dropped low enough (+119.5") to initiate High Pressure Coolant Injection (HPCI), Reactor Core Isolation Cooling (RCIC), Low Pressure Coolant Injection-Loss of Offsite Power (LPCI-LOOP) select, and Reactor Water Cleanup (RWCU) outboard isolation. Reactor level was recovered using RCIC and "B" Reactor Feed Pump (RFP). HPCI was out of service for preplanned maintenance. "B" RFP and RCIC received trips when reactor level reached the high level trip setpoint (211"). RCIC was restarted for level control and a second manual scram was inserted in anticipation of a low level automatic scram. The "B" RFP was restarted for level control and was used to restore level. At 195" RCIC was secured, and at 211" the "B" RFP tripped for the second time.

Three circuit boards in the inverter were determined to be the likely cause of the failure and were replaced. The three original boards were removed and sent to the vendor for failure analysis. No problems were detected.

There were no actual safety consequences associated with this event. There was no impact on public health and safety.

LICENSEE EVENT REPORT (LER)

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

I. Description of Event:

On October 17, 2001 at 0610 hours while operating at 100% power, the Division I Instrument AC bus 1Y11 unexpectedly de-energized due to loss of its normal power supply, inverter 1D15, coincident with its alternate power supply, regulating transformer 1Y1A, being out of service for preplanned maintenance. The loss of 1Y11 caused the 1A RFP minimum flow valve to fail open. This fail open feature resulted in a low suction pressure trip of the "A" RFP which caused a plant transient that required the operating crew to insert a manual scram at 0611 hours in anticipation of reaching an automatic scram setpoint on low RPV level. All control rods fully inserted upon initiation of the manual scram. Reactor level dropped low enough (119.5") to initiate HPCI, RCIC, LPCI-LOOP select, and RWCU outboard isolation. Reactor level was recovered using RCIC and "B" RFP. HPCI was out of service for preplanned maintenance. At 0613 hours "B" RFP and RCIC received trips when reactor level reached 211". RCIC was restarted for level control and at 0632 hours a second manual scram was inserted in anticipation of a low level automatic scram. At 0633 hours the "B" RFP was restarted for level control and was used to restore level. At 195" RCIC was secured, and at 211" the "B" RFP tripped for the second time.

Operators were dispatched to clear tags on the Instrument AC regulating transformer 1Y1A, in order to restore power to 1Y11. The bus was stripped, re-energized, and the individual loads restored one at a time. The "A" RFP was started and reactor level control was established on the startup feedwater regulating valve.

After testing, repairs, and a pre-planned forced outage, the reactor was taken critical at 12:14 on October 22, 2001 and synchronized to the grid at 16:41 on October 23, 2001.

II. Cause of Event:

Background

The Instrument AC System is a safety-related system that provides 120 VAC to various control, instrumentation boards, racks, recorders, radiation and neutron monitors, and benchboards. The system is divided into two independent and redundant subsystems supplied by two independent distribution panels 1Y11 and 1Y21 from two independent 125 VDC inverters 1D15 and 1D25. Each inverter has a backup 480 VAC to 120 VAC regulating transformer 1Y1A and 1Y2A. A third source of power is available from instrument AC transformers 1Y1 and 1Y2.

Inverters 1D15 and 1D25 (Elgar Model # INV 253-1-108) are the primary sources of power for the Instrument AC Control Power System. The inverters are energized from 125 VDC panels 1D10 and 1D20, respectively, and supply regulated AC power to the loads. If the battery charger fails, or if a loss of the 480 VAC system supplying the charger occurs, the 125 VDC station batteries will automatically provide power to the inverters. When power is restored to the battery charger, it will resume supplying the inverter and recharge the 125 VDC battery.

The inverters convert the DC power to 120 VAC and feed it to a static switch. Inverters 1D15 and 1D25 change the incoming DC power into a continuous source of reliable 120 VAC. This DC to AC conversion continues as long as input voltage remains above 105 VDC.

A silicon controlled rectifier (SCR) bridge circuit performs the DC to AC conversion. This solid-state system transforms the incoming DC current into a stepped AC waveform. The AC signal is then filtered and synchronized with the alternate AC power source to maintain a close frequency and phase relationship between the inverter output and the alternate AC power source (regulating transformer 1Y1A or 1Y2A).

Causal Factor Review

The equipment manufacturer, Elgar Corporation, and the equipment service provider, Static Power Conversion Services (SPCS), were contacted to aid in the troubleshooting. Initially, no firm cause for the failure could be determined nor did either vendor have any operating experience with an event of this type. SPCS and DAEC Engineering personnel agreed that replacement of three circuit boards (analog logic, DC/DC converter, and transducer) would eliminate the most likely cause of the failure. This determination was based on the operator's recollection of the as-found status of 1D15 after the event and the functions performed by those circuit boards selected. The original boards removed from 1D15 were sent to Elgar for failure analysis.

Initially, the failure analysis indicated that the DC/DC converter board had several lifted pads or faulty solder joints which could have caused interruption of control power to the analog logic assembly which would cause the inverter to shut off. Further analysis concluded that the board was not faulty and the lifted pads or faulty connections may have been introduced when the board was removed from the cabinet. A final report has not yet been received from Elgar but telephone conversations with them indicate that no defects with the boards have been identified to date. At this point, there is no plan to submit any supplemental information.

Other causal factors were also investigated. In particular, perturbations on the 125 VDC System, which provides input to the inverter, were searched for around the time of the event. Parameters such as equipment evolutions, switching, undervoltage, overvoltage, voltage ripple, momentary loss of input, were reviewed, if available. None of the data that was available surrounding the event substantiated the theory that the trip was caused by a DC System input problem.

An inverter maintenance history review was conducted. For more than the past ten years the operating experience of the instrument AC power supplies and the associated distribution system has been very good. Until this last recent event, no other significant event or maintenance issues have occurred.

Security records of personnel access to the switchgear room where the inverter is located were also reviewed. No problems were identified.

As a result, no definitive root cause has been determined for the failure of the inverter.

III. Assessment of Safety Consequences :

As noted above, the HPCI system was out of service prior to this event for preplanned maintenance. The other train of Instrument AC remained operable throughout the event. The plant did scram as expected after manually inserting a scram signal, and core thermal power limits were not exceeded during the transient. This event did not affect the availability of other systems needed to maintain safe shutdown conditions, remove residual heat, control the release of radioactive material, or mitigate the consequences of an accident. There were no actual safety consequences associated with this event. There was no affect on public health and safety as a result of this event.

The calibration and maintenance sequence the plant was in had been completed successfully several times in the past. As a result, no problem was anticipated with the lineup which had the regulating transformer out of service following calibration of the inverter.

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

Other inverters in the plant have circuit boards similar to the ones originally identified as suspect. However, since no defects were ultimately identified, no potential generic consequences were identified for these other inverters or boards.

IV. Corrective Actions:

Completed Actions:

The three circuit boards in 1D15 determined by the Elgar Corporation and Elgar equipment service provider, SPCS, to be the likely location of the failure were replaced. (CWO A56587, completed 10/21/01)

An internal inspection of 1D15 was performed including a check of all fuses and a close bench inspection of all circuit boards. No abnormalities were found. (CWO A56587, completed 10/21/01)

1D15 was powered up and tested. Both the regulating transformer input and DC bus input to the transducer circuit board were simulated. A load bank was used to simulate actual plant load conditions. The inverter performed as expected throughout two days of testing both under adverse (high load, transient inputs) and normal operating conditions. (CWO A56587, completed 10/21/01)

The inverter was returned to service and has been running continuously without incident since October 21, 2001.

Follow-up Actions:

The three original circuit boards were removed and replaced in 1D15 and were sent to Elgar for analysis. No abnormalities were found.

An evaluation of Feedwater System improvements to minimize the susceptibility to low suction pressure trips is being performed under an Action Request. (AR 28336, due 1/11/02).

V. Additional Information:

Previous Similar Occurrences:

A review of LERs at DAEC over the last 3 years did not find any previous similar events involving inverter failures.

LER 2001-003 also involved a manual scram due to decreasing reactor water level. The low level was caused by a RFP minimum flow valve failing open similar to this event. However, the valve failed open due to a failed resistor in the minimum flow valve controller. The corrective actions would not be expected to prevent a trip caused by an inverter failure.

EIIS System and Component Codes:

Instrument AC: EF Inverter: INVT Model Number: Elgar Model # INV 253-1-108

A 10CFR50.72(b)(2)(iv)(B) notification was made on October 17, 2001. This report is being submitted pursuant to 10CFR50.73(a)(2)(iv)(A).