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BGE

November 20, 1997

U.S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit No. 1; Docket No. 50-317; License No. DPR 53
Licensee Event Report 97-009
Automatic Reactor Trip Due to Condenser Vacuum Breaker Opening

The attached report is being sent to you as required under 10 CFR 50.73 guidelines. Should you have questions regarding this report, we will be pleased to discuss them with you.

Very truly yours,

Peter Katz

PEK/JPW/bjd

Attachment

cc: R. S. Fleishman, Esquire
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# CATEGORY 1

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FACIL:50-317 Calvert Cliffs Nuclear Power Plant, Unit 1, Baltimore 05000317
AUTH.NAME AUTHOR AFFILIATION
WILLIAMS,J.P. Baltimore Gas & Electric Co.
KATZ,P.E. Baltimore Gas & Electric Co.
RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 97-009-00:on 971024,automatic reactor trip occurred. Caused by failure to properly terminate electrical lead on condenser vacuum breaker handswitch during prior handswitch maintenance.Over 200 similar connection insp.W/971120 ltr.

DISTRIBUTION CODE: IE22T COPIES RECEIVED:LTR 1 ENCL 1 SIZE: 9
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# LICENSEE EVENT REPORT (LER)

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APPROVED BY OMB NO. 3150-0104
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 LICENISNG 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) | DOCKET NUMBER (2) | PAGE (3) |
|---|---|---|
| Calvert Cliffs, Unit 1 | 05000 317 | 1 OF 08 |

TITLE (4)

Automatic Reactor Trip Due to Condenser Vacuum Breaker Opening

| 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 05000 |
| 10 | 24 | 97 | 97 | -- 009 | -- 00 | 11 | 20 | 97 | 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) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 20.2201(b) | | 20.2203(a)(2)(v) | | 50.73(a)(2)(i) | | 50.73(a)(2)(viii) |
| POWER LEVEL (10) | 100 | | 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) | X | 50.73(a)(2)(iv) | | OTHER |
| | | | 20.2203(a)(2)(iii) | | 50.36(c)(1) | | 50.73(a)(2)(v) | | Specify in Abstract below |
| | | | 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) |
|---|---|
| J. P. Williams, Engineer | 410-495-3617 |

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) | | | | EXPECTED SUBMISSION DATE (15) | MONTH | DAY | YEAR |
|---|---|---|---|---|---|---|---|
| | YES (If yes, complete EXPECTED SUBMISSION DATE). | X | NO | | | | |

ABSTRACT (Limit to 1400 spaces, i.e., approximately15 single-space typewritten lines) (16)

On October 24, 1997 at 0917 a.m., Calvert Cliffs Unit 1 automatically tripped on low condenser vacuum when the condenser vacuum breaker unexpectedly opened. The plant was brought to a safe shutdown condition. This event resulted in no significant consequences to the health and safety of the public. At the time of the event, Unit 1 was operating at 100 percent power.

The cause of this event was a failure to properly terminate an electrical lead on the condenser vacuum breaker handswitch during prior handswitch maintenance. The Plant General Manager formed a Significant Incident Finding Team to investigate. Over 200 similar connections were inspected for a similar deficiency. Additional corrective actions will be taken once the results of the Significant Incident Finding Team investigation are finalized.

I. DESCRIPTION OF EVENT

At 0917 hours on October 24, 1997, Calvert Cliffs Unit 1 Reactor Protective System (RPS) automatically tripped the reactor due to a turbine trip on low condenser vacuum. At the time of the event, Unit 1 was in Mode 1 (Power Operation) at 100 percent power. The low condenser vacuum resulted from the unexpected opening of the main condenser vacuum breaker. Just prior to the trip, craft personnel were conducting repair activities on the gland steam lead drain valve handswitch, which is in close proximity to the condenser vacuum breaker handswitch. Unit 1 was placed in Mode 3 (Hot Standby) while the event was investigated.

Emergency Operating Procedure (EOP)-0, "Post-Trip Immediate Actions," was implemented when the unit tripped. All safety functions were met. Emergency Operating Procedure-0 was completed satisfactorily, and EOP-1, "Reactor Trip," was entered at 0930. All EOP-1 final safety function status checks were completed satisfactorily at 1350. Unit 1 was maintained in Hot Standby, in accordance with Operating Procedure (OP)-4, "Plant Shutdown to Hot Standby," during investigation of the event.

Each main condenser at Calvert Cliffs is equipped with one motor-operated vacuum breaker valve, which is normally closed at power. The valve is opened following plant shutdown to break vacuum in the main condenser shells. The vacuum breaker valve is controlled from Panel 1C02 in the Control Room.

II. CAUSE OF EVENT

The cause of the reactor trip was a valid RPS signal generated as a result of a turbine trip. This trip is enabled when reactor power is greater than 15 percent of rated thermal power. The turbine trip was caused by a loss of condenser vacuum, which was a direct result of opening the main condenser vacuum breaker valve (1-MOV-6717).

Following the event, the Plant General Manager formed a Significant Incident Finding Team (SIFT) to determine the cause(s) of the event, initiate corrective action(s), and formulate recommendations to prevent recurrence. The SIFT concluded that the cause of this event was failure to properly terminate a lead attached to the vacuum breaker control switch (1-HS-6717), during previous switch maintenance and the subsequent failure of the inspection process to identify the faulty termination. A stray strand of wire on the vacuum breaker control switch was inadvertently moved during maintenance on the gland steam lead drain valve control switch (1-HS-4651), causing the vacuum breaker valve to open.

During the Unit 1 outage in September 1997, craft personnel had performed maintenance on the condenser vacuum breaker handswitch, which is located just below the gland steam lead drain valve handswitch in Control Room Panel 1C02. The maintenance activity associated with the condenser vacuum breaker handswitch involved removing a lead from the handswitch in order to replace the wire label. Specifically, this activity required removing the wires from the handswitch, removing the old heat shrink label, installing a new label, and re-terminating the wires to the handswitch. This particular model of handswitch employs a compression style terminal connection, as opposed to a ring or spade lug (Figure 1). Attaching the bare wire to the handswitch terminal involves inserting the wire strands between two small metal plates and tightening the associated screw which clamps the wire strands in place. The lead which was being re-labeled is located on the bottom of the handswitch and the handswitch is located at the side of the panel. This physical arrangement makes it extremely difficult to see the lead as it is being inserted into the compression-style terminal.

On October 24, craft personnel again entered Panel 1C02 to replace the gland steam lead drain valve handswitch. While taking voltage readings to verify that power had been removed to the gland steam lead drain valve handswitch, a wire bundle was moved. The movement of the wiring caused the stray wire strand on the vacuum breaker control switch to make contact with a second terminal on the handswitch. The stray strand of wire effectively "jumpered" voltage to the vacuum breaker valve-open relay coil, causing the vacuum breaker to open. (Figures 2 and 3)

Significant Incident Finding Team interviews with craft personnel who performed the termination to the vacuum breaker handswitch during the Unit 1 outage, revealed that visual inspections of the termination had been done at the conclusion of the maintenance activity. However, an inspection mirror was not used to perform the inspection. The SIFT concluded that without the use of an inspection mirror, the single wire strand would have been extremely difficult to discover due to the physical arrangement and location of the handswitch in Panel 1C02. Even with the aid of an inspection mirror, the SIFT had to perform a very close inspection of the handswitch to identify the stray wire strand.

As part of the SIFT investigation, an identical handswitch to the one used for the vacuum breaker was obtained to assess the difficulty in making proper terminations. Craft personnel made several terminations to the identical handswitch. On one termination, the subsequent inspection found one strand of wire bent 90 degrees and contacting the adjacent terminal. This replicated the configuration found in Panel 1C02 and provided additional validation that

the wire strand had separated from the remaining wire strands during the outage work in September 1997.

III. ANALYSIS OF EVENT

This event is considered reportable in accordance with 10 CFR 50.73(a)(2)(iv), "Any event or condition that resulted in a manual or automatic actuation of any engineered safety feature (ESF), including the reactor protection system (RPS)."

This event resulted in no significant consequences to the public health and safety. The RPS automatically tripped the reactor, based on a turbine trip. The turbine trip (loss of load) was a direct result of a loss of condenser vacuum. The loss of vacuum was caused by inadvertent opening of the main condenser vacuum breaker valve. All safety systems functioned as designed during the event.

The Calvert Cliffs Updated Final Safety Analysis Report defines a loss of load event as any event which results in reduction of the steam generators' heat removal capacity through the loss of secondary steam flow. Closure of all main steam isolation valves, turbine stop valves, or turbine control valves will cause a loss of load event. For the loss of load event, the safety analysis does not credit a reactor trip based on turbine trip. The safety analysis assumes the reactor is tripped based on high pressurizer pressure. Additionally, this event does not result in any fuel pin failures. Therefore, the radiological dose limits of 10 CFR Part 100 are not approached.

The most limiting criteria for a loss of load event is the Reactor Coolant System pressure upset limit of 2750 psia and the secondary pressure upset limit of 1100 psia. The automatic opening of the primary and secondary safety valves ensures these limits are not exceeded. The Updated Final Safety Analysis Report, Chapter 14, bounds the plant conditions which resulted from this event (i.e., reactor trip based on turbine trip). Therefore, no significant safety consequences resulted from this event.

IV. CORRECTIVE ACTIONS

Short Term

A. The Plant General Manager established a SIFT to determine the cause(s) of the event, initiate corrective action(s), and formulate recommendations to prevent recurrence.

B. The SIFT also inspected approximately 200 connections on similar switches in the Unit 1 Control Room. No similar deficiencies were noted.

Additional corrective actions will be implemented based upon the final results of the SIFT investigation.

V. ADDITIONAL INFORMATION

A. Affected Component Identification

| Component or System | IEEE 803 EIIS Funct | IEEE 805 System ID |
|---|---|---|
| Handswitch | HS | SH |
| Vacuum Breaker | VACB | SH |

B. Previous Similar Events

No previous similar reported events were identified which were the direct result of a stray strand of wire causing inadvertent equipment operation.

NOTE: This make/model handswitch employs a compression style terminal connection. Attaching a wire involves inserting the wire strands between two small metal plates, then the screw is tightened which clamps the wire strands in place. There is no electrical connector applied, such as ring lug, spade lug, etc.

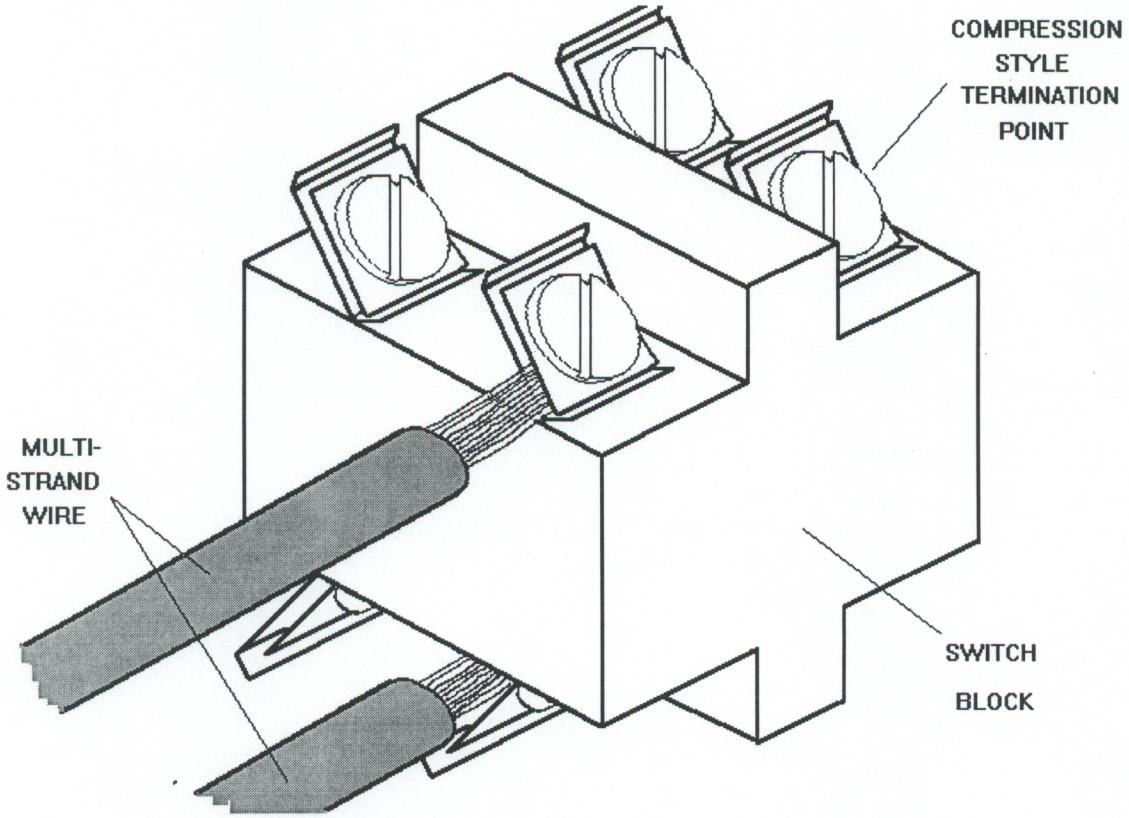



FIGURE 1
GENERAL HANDSWITCH ARRANGEMENT

The stray wire strand was long enough, and projected away at such an angle that it was close to touching an adjacent terminal point on 1-HS-6717. The stray strand was not touching the terminal until, as concluded by the investigation team, the worker brushed this hand against the wire bundle when he started working on 1-HS-4651.

Movement of the wire bundle caused the stray strand to touch the adjacent terminal. This action electrically connected ("shorted"/"jumpered") terminals 6 and 8 on 1-HS-6717.

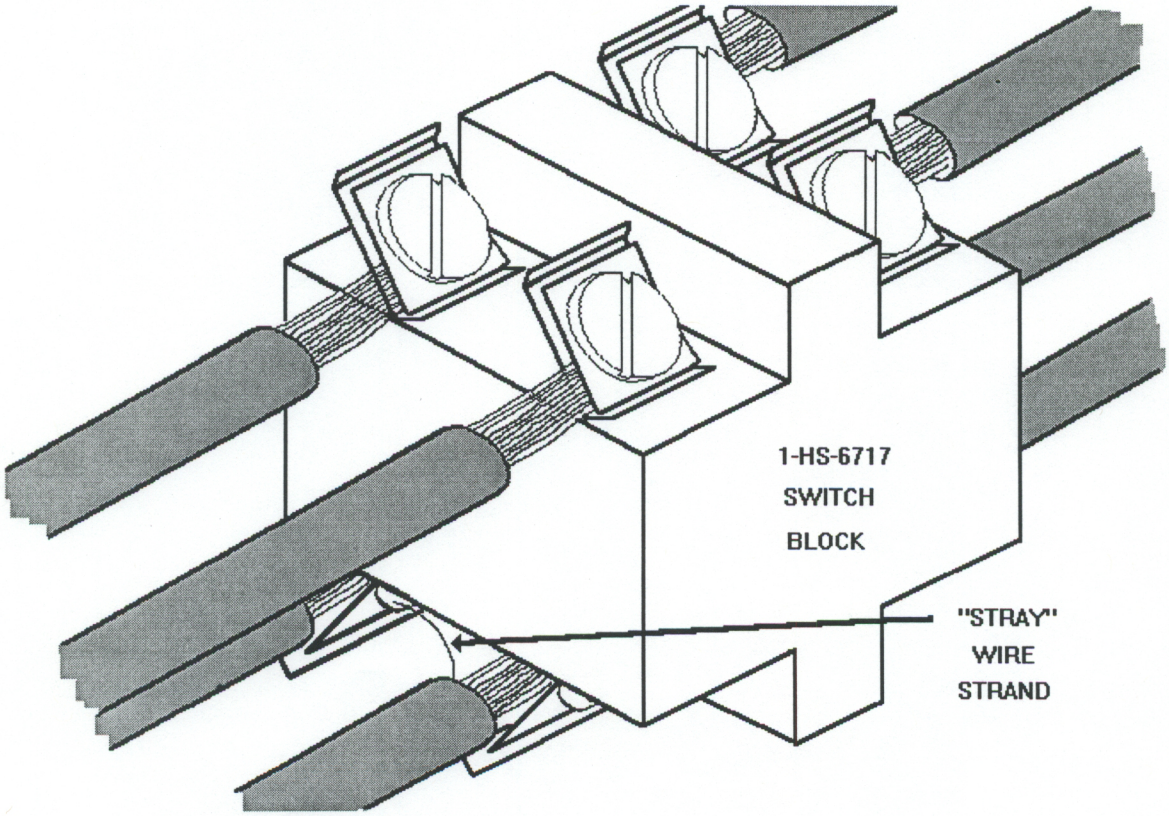
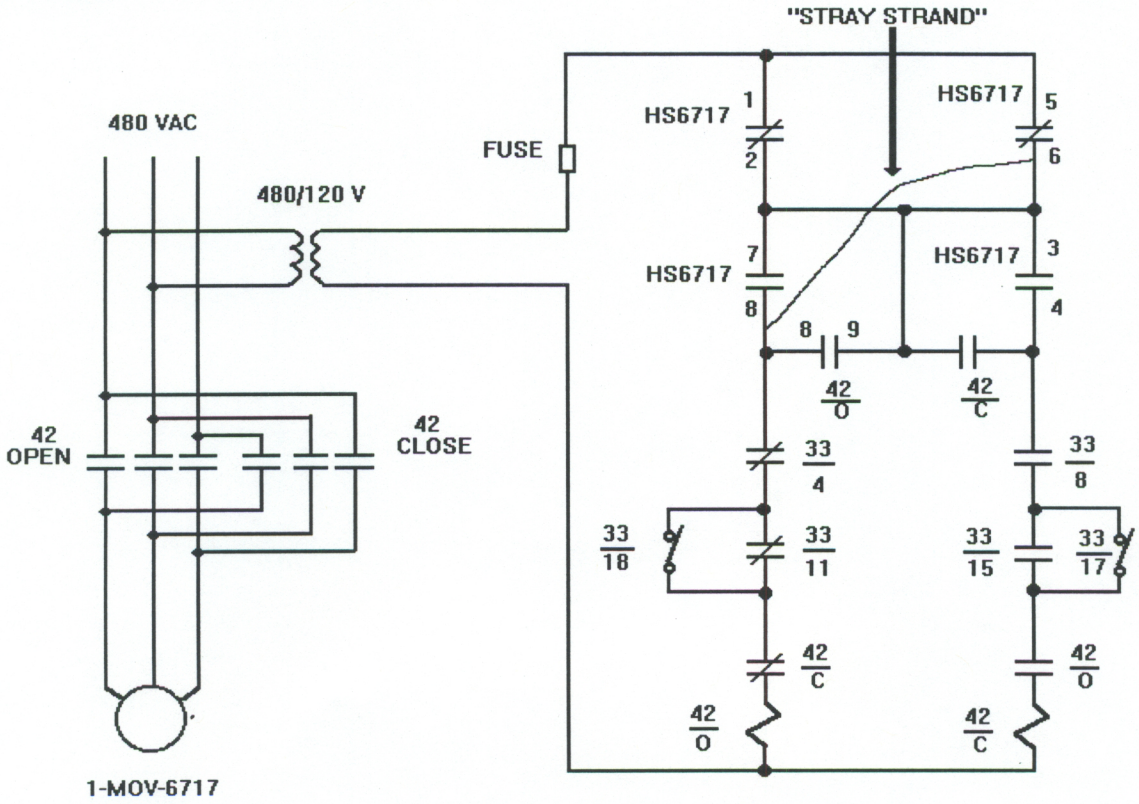



FIGURE 2
GENERAL HANDSWITCH ARRANGEMENT SHOWING STRAY WIRE STRAND

Upon contact, the stray strand "jumpered" voltage from terminal point 8 to terminal point 6. This provided a voltage path to the VALVE-OPEN relay coil (42/0) in the 1-MOV-6717 control circuit.

The VALVE-OPEN relay contacts then shut and applied power to the motor of 1-MOV-6717. This started to drive the valve open. Next, a SEAL-IN contact (42/0, 8-9) closed as would be expected per circuit design. This continued applying voltage to the VALVE-OPEN relay coil, allowing the valve to stroke full open.




This stray wire strand had the exact same effect as would occur if an Operator positioned 1-HS-6717 to the VALVE-OPEN position; (shutting handswitch contacts 7-8). As such, the wire strand caused no physical damage to the circuit, nor did it cause the circuit fuse to blow.

FIGURE 3
STRAY WIRE STRAND ENERGIZES VALVE-OPEN RELAY