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NPD2VPO:0542

Beaver Valley Power Station, Unit No. 2
Docket No. 50-412 Licensee No. NPF-73
LER-96-005-00

United States Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

In accordance with Appendix A, Beaver Valley Technical Specifications, the following Licensee Event Report is submitted:

LER 96-005-00, 10 CFR 50.73(a)(2)(v), "Failure of Motor Control Center Auxiliary Control Relays Due to Thermal Aging."

T. P. Noonan

LB/ds

Attachment

IE22/1

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

APPROVED BY OMB NO. 3150-0104
EXPIRES 04/30/98
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)
Beaver Valley Power Station Unit 2	05000412	1 OF 6

TITLE
Failure of Motor Control Center Auxiliary Control Relays Due to Thermal Aging

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
10	11	96	96	005	00	11	11	96	Beaver Valley Power Station Unit 1	05000334
									N/A	

OPERATING MODE (9)	5	20.402(b)		20.405(c)		50.73(a)(2)(iv)	73.71(b)
POWER LEVEL (10)	0%	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)		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
		20.405(a)(1)(iv)		50.73(a)(2)(ii)		50.73(a)(2)(viii)(B)	below and in Text
		20.405(a)(1)(v)		50.73(a)(2)(iii)		50.73(a)(2)(x)	NRC Form 366A)

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (include Area Code)
T. P. Noonan, Vice President Nuclear Operations and Plant Manager	(412) 393-7622

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	ED	RLY	I212	Yes						

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

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

On October 11, 1996, during a re-assessment of NRC Information Notice (IN) 92-27, "Thermally Induced Accelerated Aging and Failure of ITE/Gould AC Relays Used in Safety-Related Applications," it was identified that the failure mechanism described in the IN potentially exists at Beaver Valley Power Station (BVPS) Unit 2 for ITE/Gould J12 relays. The re-assessment was part of an evaluation to address six J12 relay failures which have occurred during the past two years, two in 1995 and four in 1996. None of these caused a loss of component or system safety function. The six J12 relays functioned as designed in response to an Engineered Safety Feature (ESF) signal during testing. Inspection of J12 relays removed during the current refueling outage identified that these relays had the potential to bind. Subsequent bench testing of a suspect J12 relay revealed that this relay will overheat, if mechanically bound, and potentially cause a short circuit. Such a short circuit could result in failure of the control power fuse for the component, rendering the component inoperable. This condition could have prevented the fulfillment of the respective safety function. The J12 relays are used in safety-related circuits. These relays primarily provide alarms, Bypass Inoperable Status Indication (BISI), and thermal overload protection for various motor-operated valves (MOVs), fans and pumps. ITE/Gould J-series relays are not installed at Unit 1.

This event was reported pursuant to the requirements of 10CFR50.72(b)(2)(iii) at 2200 hours on October 11, 1996. This written report is being submitted pursuant to the requirements of 10CFR50.73(a)(2)(v). There were no safety implications to the health and safety of the public.

The root cause of the relay failures is accelerated thermal aging. Evaluation has shown that continuously energized J12 relays have the potential to bind if de-energized, allowed to cool and subsequently re-energized, due to the effects of thermal aging. Corrective actions for this event include: 1) IN 92-27 was re-opened for further evaluation, 2) an engineering evaluation was performed which reviewed both the safety and non-safety-related plant applications for all ITE/Gould J-series relays, 3) two hundred thirteen (213) J12 relays were replaced/removed from service, 4) twelve (12) J13 relays which were identified as continuously energized were replaced, 5) eight (8) J10 relays (4 in safety-related applications and 4 in non-safety-related applications), were replaced, and 5) additional J10 relays, installed in non-safety-related cooling tower and heat trace applications, are scheduled to be replaced as a conservative action prior to completion of the next refueling outage (2R07).

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Beaver Valley Power Station Unit 2	05000412	96	005	00	2 OF 6

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

PLANT AND SYSTEM IDENTIFICATION

Westinghouse - Pressurized Water Reactor (PWR)

480 Volt AC Station Service System {ED}*

Safety Injection System {BQ}*

Chemical and Volume Control System {CB}*

Service Water System {BI}*

Chilled Water System{KM}*

Boron Injection Tank Isolation Valve 2SIS-MOV867B {BQ/ISV}*

Charging Pump Suction Valve from Volume Control Tank 2CHS-LCV115E {BQ/ISV}*

Charging Pump Suction Valve from RWST 2CHS-LCV115D {BQ/ISV}*

Primary Component Cooling Water Heat Exchanger Inlet Valve 2SWS-MOV106B {BI/ISV}*

Containment Air Recirculation Cooling Coils Return Header Isolation Valve 2SWS-MOV155-2 {BI/ISV}*

2SWS-P21B Discharge Valve 2SWS-MOV102B {BI/ISV}*

Checking or Interlocking Relays {ED/03}*

Thermal Overload Relays {ED/49}*

Circuit Breaker Position Relays {ED/52}*

Time Delay Relays {ED/62}*

Alarm Relays {ED/74}*

Lock-out Relays (ED/86}*

480 Volt AC Motor Control Center (MCC) MCC-2-E04 {ED/MCC}*

*Energy Industry Identification System (EIIS) plant system and component codes are identified in the text as {EIIS:SS/CC}.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Beaver Valley Power Station Unit 2	05000412	96	005	00	3 OF 6

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

CONDITIONS PRIOR TO OCCURRENCE

Unit 1: Mode 1, 100% Power
Unit 2: Mode 5, 0% Power

There were no structures, systems or components that were inoperable at the start of the event that contributed to the event.

DESCRIPTION OF THE EVENT

On October 11, 1996, while shutdown in Mode 5, during a re-assessment of NRC Information Notice (IN) 92-27, "Thermally Induced Accelerated Aging and Failure of ITE/Gould AC Relays Used in Safety-Related Applications," it was identified that the failure mechanism described in the IN potentially exists at Beaver Valley Power Station (BVPS) Unit 2 for ITE/Gould J12 relays. The re-assessment was part of an evaluation to address six J12 relay failures which have occurred during the past two years, two in 1995 and four in 1996. None of these caused a loss of component or system safety function. The six J12 relays functioned as designed in response to an Engineered Safety Feature (ESF) signal during testing. All six of these J12 relays were thermal overload relays {EIIS:ED/49}. Inspection of J12 relays removed during the current refueling outage (2R06) identified that these relays had the potential to b[illegible] Subsequent bench testing of a suspect J12 relay revealed that this relay will overheat, if mechanically bound, and potentially cause a short circuit. Such a short circuit could result in failure of the control power fuse for the component, rendering the component inoperable. This condition could have prevented the fulfillment of the respective safety function. The J12 relays are used in safety-related circuits. These relays primarily provide alarms {EIIS:ED/74}, Bypass Inoperable Status Indication (BISI) {EIIS:ED/49}, and thermal overload protection for various motor-operated valves (MOVs), fans and pumps. These relays are also used as checking or interlocking relays {EIIS:ED/03}, circuit breaker position relays {EIIS:ED/52}, time delay relays {EIIS:ED/62} and lock-out relays (EIIS:ED/86}. ITE/Gould J-series relays are not installed at Unit 1.

IN 92-27, issued by the NRC on April 3, 1992, was concerned with failures of ITE/Gould J10 relays which occurred at Millstone in 1991 and Seabrook in 1987. These failures were characterized by relays in "ganged" configurations (horizontally mounted shoulder to shoulder on a universal mounting strip) which exhibited visible signs of accelerated thermal aging - e.g., discoloration, embrittlement and cracking of the movable plastic armature carrier which surrounds the core and coil and the retainer for the magnetic yoke assembly. The Millstone relay failures resulted in short circuits, which blew the control power fuses and rendered the associated MOVs inoperable. The IN was evaluated for applicability at Beaver Valley Power Station and results documented in a Nuclear Engineering Department (NED) report dated May 10, 1993. It was determined that Unit 1 did not have the potential J-series relay problems identified in the IN and subsequent investigations were confined to Unit 2. NED reported that Unit 2 did not have the "ganged" mounting configuration which the IN had identified as a major contributor to the accelerated aging. Based upon temperature data obtained from instruments in the affected rooms, MCCs and relays, the report indicated that room ambient temperatures (which were lower than temperatures used in qualified life calculations for the J10 relays) have resulted in lower cabinet temperatures and thereby slowed the aging process. Finally, the report concluded that the BVPS Unit 2 J10 relays are not subject to the accelerated aging that was experienced at Millstone and Seabrook.

A J12 relay failure occurred on June 2, 1995 in the circuit for the charging pump suction valve from the volume control tank, 2CHS-LCV115E {EIIS:BQ/ISV}, when the valve would not open manually from the Control Room (CR) benchboard control switch. J12 relays are similar to J10 relays in that they have the same J20M magnet block assembly. Based upon a root cause analysis performed at the time, and follow-up engineering investigations, it was initially recommended to replace all active J12 relays. However, additional evaluations by NED concluded that the J12 relays have a substantial safety margin, based upon an 85 degree centigrade environment over a 40 year period. A modification was proposed for the MCC enclosures to install passive ventilation louvers to lower the temperature in the panels, thereby eliminating the need to replace the J12 relays. This proposed modification is currently being re-evaluated for impact upon replacement relays.

A second J12 relay failure occurred on December 11, 1995 in the circuit for the charging pump suction valve from the refueling water storage tank (RWST), 2CHS-LCV115D {BQ/ISV}.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Beaver Valley Power Station Unit 2	05000412	96	005	00	4 OF 6

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

Similar to the 2CHS-LCV115E failure, this valve could not be operated from the CR benchboard. The MOVs responded as designed to an ESF actuation signal during testing. Inspection of the two failed relays revealed that the movable plastic armature carrier which surrounds the core and coil, and the retainer for the magnetic yoke assembly, became discolored from blue to brown, embrittled and cracked. Both relays were replaced with new J12 relays from stock. Neither of the failures resulted in a short circuit which could have caused control power fuse failure.

During 2R06, four J12 relay failures were identified in the following circuits: 1) boron injection tank isolation valve 2SIS-MOV867B {BQ/ISV} on September 12, 1996, 2) containment air recirculation cooling coils return header isolation valve 2SWS-MOV155-2 {BI/ISV} on September 26, 1996, 3) primary component cooling water heat exchanger inlet valve 2SWS-MOV106B {BI/ISV} on October 3, 1996, and 4) service water pump 2SWS-P21B discharge valve 2SWS-MOV102B {BI/ISV} on October 4, 1996. These thermal overload relay failures were identified when their respective valves failed to stroke closed from the CR benchboard during testing. Inspection of the first three relays showed signs of thermal aging, with discoloration of the armature cover, and visible cracking, although not as severe as the two relays which failed in 1995. The fourth relay did not appear degraded. During trouble-shooting tests, these J12 relays functioned normally, once their associated circuit breakers were cycled. The four MOVs also responded as designed to a test ESF actuation signal. These relays were also replaced with new J12 relays from stock. None of the four failures resulted in a short circuit which could have caused control power fuse failure.

A review team was organized on October 5, 1996 to evaluate the J12 relay failures and their potential impact upon plant safety and startup from the current outage. IN 92-27 was re-opened for further evaluation, and industry operating experience information from Nuclear Network, NPRDS and other plants was evaluated during the ensuing investigations.

CAUSE OF EVENT

The root cause of the J12 relay failures was determined to be age-related thermal degradation of the phenolic armature assembly and retainer which surrounds the relay's magnetic yoke assembly and coil. Phenolic aging is attributed to heat induced by the relay coil. The failed class J12 relays, model J121A1T2212, manufactured by ITE/Gould Company had been in service, continuously energized, for approximately nine years. These relays are approximately eighteen years old, based upon the manufacturer data on the relays.

ANALYSIS OF EVENT

During the past two years, six ITE/Gould J12 relays in thermal overload (49X) applications have failed, resulting in the failure of the associated safety-related motor operated valve (MOV) to stroke from the CR benchboard during testing. These valves responded as designed upon receipt of an ESF signal, since the thermal overload relays are bypassed in this mode of operation. Examination of these failed relays revealed signs of thermal degradation in five of them. Subsequent examination of the J12 relays ultimately replaced prior to failure revealed that a large number exhibited similar signs of thermal aging. In the more severe examples, the movable plastic armature carrier which surrounds the core and coil, and the retainer for the magnetic yoke assembly, was discolored from blue to brown, embrittled and cracked. The first two failures identified in 1995 also had broken plastic fragments within the magnet case that could have prevented full armature movement. Bench testing of a suspect J12 relay has shown that this relay will overheat, if mechanically bound, and potentially cause a short circuit. Such a short circuit could result in failure of the control power fuse for the component, rendering the associated component inoperable. This condition could have prevented the fulfillment of the respective safety function.

Four of the six relay failures occurred in the same 480 Volt AC motor control center - MCC-2-E04 {EIIS:ED/MCC}. This MCC had the highest internal temperature as indicated by data obtained in 1993 via a temperature logger mounted inside MCCs which contained ITE/Gould J-series relays.

Engineering investigation has shown that the potential exists for multiple failures of continuously energized J12 relays in safety-

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Beaver Valley Power Station Unit 2	05000412	96	005	00	5 OF 6

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

related systems to occur, with the potential for loss of the respective system safety function, if the plant's electrical systems were challenged by a Loss of Offsite Power (LOOP) event. J12 relay failures due to binding can occur when a normally continuously energized relay is de-energized during a LOOP, allowed to cool and is re-energized. Station Blackout is considered to be the most limiting event for this failure mode. Based upon the actual failure rate of the J12 relays observed to date, multiple failures following Station Blackout are considered by Engineering to have a low probability.

CORRECTIVE ACTIONS

Information Notice 92-27 was re-opened on October 5, 1996, for further evaluation. This will be completed by December 31, 1996.

The following corrective actions were taken to address the ITE/Gould J12 relay concerns:

1. J12 relays in the plant were identified and categorized as to normal state (energized/de-energized), function (interlock, annunciation, etc.), safety classification (safety vs. non-safety related) and operability status relative to most recent test of component function (e.g., stroking of valve).

2. 203 active J12 relays were replaced with Allen-Bradley 700PT400A1 relays (for most of the J12s with a timing function) or with General Electric Company (GE) CR120B02202 relays (for J12s without a timing function). Some J12s with a timing function were replaced with GE relays without a timer. The change from time delay to instantaneous was justified because the function was alarm only. Ten J12 relays were removed from service (retired in place). This was completed by October 25, 1996.

The following corrective actions were taken relevant to other ITE/Gould J-Series relays:

1. J10 relay applications were reviewed, with four J10s identified as safety-related. These were used in Category I heat trace panels, with two of four continuously energized for annunciator alarms. Four J10s were identified in non-safety related applications, with long term energization, in turbine drains valve control. All eight of these J10 relays were replaced with GE CR120B02202 relays by October 26, 1996. Additional J10 relays, installed in non-safety-related cooling tower and heat trace applications, are scheduled to be replaced as a conservative action prior to completion of 2R07.

2. J13 relay applications were reviewed, with six of 28 J13s installed in each EDG control circuit continuously energized and used for alarm indication. The six alarm relays in each of the two EDGs were replaced with new J13 relays. Adjacent J13 relays were inspected for signs of thermal degradation and found to be in satisfactory condition. This was completed by October 26, 1996.

3. J11 relay applications were reviewed and it was determined that they are normally de-energized and not used in safety - related applications. J11 relays are latching relays used in Cooling Tower valve control which are not subject to the failure mode of the J12s and will not be replaced.

4. J14 relay applications were reviewed and it was determined that these are latching relays in EDG control circuits, which are not continuously energized and not subject to the failure mode of the J12s. Hence the J14 relays will not be replaced.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Beaver Valley Power Station Unit 2	05000412	96	005	00	6 OF 6

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

REPORTABILITY

This event was reported pursuant to the requirements of 10CFR50.72(b)(2)(iii) at 2200 hours on October 11, 1996. This written report is being submitted pursuant to the requirements of 10CFR50.73(a)(2)(v) as an event or condition that alone could have prevented the fulfillment of the safety function of structures or systems that are needed to mitigate the consequences of an accident.

SAFETY IMPLICATIONS

The observed failures of J12 relays at BVPS Unit 2 to date have involved relays in applications as thermal overloads in motor operated valve control circuits. None of the six failures involved the type observed at Millstone, wherein relay failure caused a short circuit, blew the control power fuse and resulted in a loss of control power. The BVPS Unit 2 valves responded as designed upon receipt of an ESF signal, since failed thermal overload relays are bypassed in this mode of operation. In four of the six failures, the relays began working again, after the breakers were cycled. None of the actual failures have resulted in the loss of a safety system function. None of the failures occurred during functional testing of engineered safety feature automatic actuation, such as Safety Injection (SI).

Engineering review of EDG Operational Surveillance Test results indicates that J12 relays in safety-related MCCs have functioned as designed during routine Loss of Offsite Power (LOOP) scenarios. The actual failure rate of the J12 relays observed to date is low. Multiple failures of the type postulated, following Station Blackout (a low probability event in itself) are considered by Engineering to have a low probability.

Based upon the above information, there were no safety implications to the health and safety of the public due to this event.

SIMILAR EVENTS

A review of Licensee Event Reports submitted during the past two years has shown no similar events.

ADDITIONAL INFORMATION

Component: Class J12 relay, Model J121A1T2212, with J20M magnet block assembly and G10JA116 coil

Manufacturer: ITE/Gould