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Beaver Valley Power Station, Unit No. 2
Docket No. 50-412 License No. NPF-73
LER 97-001-00

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 97-001-00, 10 CFR 50.73(a)(2)(iv), "Reactor Trip Due to Main Transformer Ground Protection Relay."

Ronald L. LeGrand

R. L. LeGrand
Division Vice President
Nuclear Operations

LB/ds

Attachment

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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 5

TITLE
Reactor Trip Due to Main Transformer Ground Protection Relay

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
01	06	97	97	001	00	02	03	97	Beaver Valley Power Station Unit 1	05000334
									N/A	

OPERATING MODE (9)	1					
POWER LEVEL (10)	98%	20.402(b)	20.405(c)	X	50.73(a)(2)(iv)	73.71(b)
		20.405(a)(1)(i)	50.36(c)(1)		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 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)
R. L. LeGrand, 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	EL	59	G182	Y						

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 January 6, 1997, at 0556 hours, while in Mode 1 at 98% power, Beaver Valley Power Station Unit 2 experienced a reactor trip caused by turbine trip. The turbine trip was caused by the operation of Main Transformer Ground Protection Relay 59-202G which actuated Main Transformer Auxiliary Relay 87-202X1.

Relay 59-202G was functionally tested and found acceptable. Inspection of the potential transformer wiring and contacts revealed some vibration-induced wear on the 22 KV potential transformer primary contacts. It is believed that this condition resulted in a small voltage drop across these contacts which resulted in an increased voltage to the 59-202G relay, causing it to actuate. Several other relays which should have responded had there been an actual 22 KV ground fault were tested with no anomalies noted. In addition, the results of post-trip startup testing, information from the switchyard fault recorder, the absence of other observed electrical protective circuit actuations, and the results of transformer oil samples, support that there was no actual ground on the 22 KV subsystem.

The root cause of the event was identified as inadequate design implementation. The most probable cause of the turbine trip was due to vibration-induced wear on the 22 KV potential transformer primary contacts.

This event was reported pursuant to the requirements of 10CFR50.72(b)(2)(ii) on January 6, 1997. This report is being made pursuant to the requirements of 10CFR50.73(a)(2)(iv) as "Any event or condition that resulted in a manual or automatic actuation of any Engineered Safety Feature (ESF), including the Reactor Protection System (RPS)..."

Secondary plant-related component problems observed prior to the event and during the post-trip recovery were evaluated by the Event Review Team (ERT) and it was concluded they were unrelated to the cause of the trip. It was also concluded by the ERT that these secondary plant problems did not significantly impact post-trip recovery or plant stabilization efforts.

Evaluation has shown that there was no actual ground on the 22 KV subsystem. Post-trip control and protection systems functioned correctly in response to the turbine and reactor trip. Plant parameters were established within their normal control bands shortly after the turbine trip and the plant was placed in a safe, shutdown condition in accordance with procedures. There were no implications to the health and safety of the public as a result of this event.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Beaver Valley Power Station Unit 2	05000412	97	001	00	2 OF 5

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

PLANT AND SYSTEM IDENTIFICATION

Westinghouse Pressurized Water Reactor (PWR)

Main Transformer Ground Protection Relay 59-202G {EL/59/G182}*

Main Generator Backup Ground Protection Relay 50-201G {EL/50/W120}*

Main Generator Primary Ground Protection Relay 59-201G {EL/59/G182}*

Main Generator Backup Ground Protection Relay 51-201G {EL/51/G182}*

Main Transformer Auxiliary Relay 87-202X1 {EL/87/G080}*

Main Generator Potential Transformer 2GEN-PT-CUB {EL/XPT/G080}*

* Energy Industry Identification System (EIIS) Plant System, Component, and Manufacturer Codes are identified in the text as {EIIS:SS/CC/MMMM}.

CONDITIONS PRIOR TO OCCURRENCE

Unit 1: Mode 1, 99% Reactor Power

Unit 2: Mode 2, 98% Reactor Power

DESCRIPTION OF EVENT

On January 6, 1997, at 0556 hours, while in Mode 1 at 98% power, Beaver Valley Power Station Unit 2 experienced a reactor trip caused by turbine trip. The turbine trip was caused by the operation of Main Transformer Ground Protection Relay 59-202G {EIIS:EL/59/G182} which actuated Main Transformer Auxiliary Relay 87-202X1 {EIIS:EL/87/G080}. According to the specification sheet for relay 59-202G, an ASEA Brown-Boveri Type ITE-59G, the relay should only be in service to provide ground protection when backfeed is established to the Main Transformer from the 345 KV system and the main generator links are open. However, the Unit 2 Operating Manual normal system arrangement and plant electrical drawings indicate that this relay has been in service during plant operation since initial startup. The relay is not addressed in the backfeed procedure.

Relay 59-202G was functionally tested and found acceptable. Inspection of the potential transformer wiring and contacts revealed some vibration-induced wear on the 22 KV potential transformer {EIIS:EL/XPT/G080} primary contacts. It is believed that this condition resulted in a small voltage drop across these contacts which resulted in an increased voltage to the 59-202G relay, causing it to actuate. Main Generator Backup Ground Protection Relay 50-201G {EIIS:EL/50/W120}, Main Generator Primary Ground Protection Relay 59-201G {EIIS:EL/59/G182}, and Main Generator Backup Ground Protection Relay 51-201G {EL/51/G182}, which should have responded had there been an actual 22 KV ground fault, were tested with no anomalies noted. In addition, the results of post-trip startup testing, information from the switchyard fault recorder, the absence of other observed electrical protective circuit actuations, and the results of transformer oil samples from the Main, 2C and 2D transformers, support that there was no actual ground on the 22 KV subsystem.

Secondary plant-related component problems observed prior to the event and during the post-trip recovery were evaluated by the Event Review Team (ERT) and it was concluded they were unrelated to the cause of the trip. It was also concluded by the ERT that these secondary plant problems did not significantly impact post-trip recovery or plant stabilization efforts.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Beaver Valley Power Station Unit 2	05000412	97	001	00	3 OF 5

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

CAUSE OF EVENT

The root cause of the event was identified as inadequate design implementation. Relay setting sheet BVT-TM-16 normal system alignment (NSA) information for relay 59-202G was not reflected in the revised Elementary Diagram 12241-E-8BE, and consequently was not used in the development of the associated Operating Manual procedures. The most probable cause of the turbine trip was due to vibration-induced wear on the 22 KV potential transformer primary contacts.

ANALYSIS OF EVENT

An Event Review Team (ERT) was formed on January 6, 1997, to conduct a review of this event in accordance with plant procedures. The following information was provided in the ERT Report.

Main Transformer Ground Protection Relay 59-202G is an ABB type ITE-59G model 211E1175 provided for ground fault protection on the 22 KV side (delta side) of the Main Transformer, when the transformer is being energized from the 345 KV system (backfeed). The type ITE-59G is a low pickup overvoltage relay which responds to 50 or 60 Hz voltages. The relay has a third harmonic blocking circuit which renders it insensitive to 180 Hz voltages.

Under backfeed conditions, the 22 KV system changes from a "grounded" system to an "ungrounded" system. Under ungrounded (backfeed) conditions, the phase to ground voltages are balanced. However, the third-harmonic voltages will appear in phase with each other and the relay will see three times the third-harmonic component of the phase to neutral voltages. The relay is a low-pickup overvoltage relay, but is designed to ignore third-harmonic voltages. During normal system operation (reactive grounded system) the normal zero sequence voltage swings will be amplified. The 59-202G relay is installed to monitor these zero sequence voltages on an ungrounded system. Since these voltages will be amplified in a grounded system, the relay may inadvertently actuate.

Review of this protection scheme identified that it was not intended to be in service during normal plant operation. This was indicated on relay 59-202G's setting sheet (BVT-TM-16); however, it was not identified on Elementary Diagram 12241-E-8BE or in Operations Manual 2OM-35.4C, "Power Supply Control Switch List," or 2OM-35.4L, "Backfeed No. 2 Main Transformer" to be "cut-out" during normal plant operation. Relay 59-202G has the lowest effective setpoint and was not intended to coordinate with generator ground protection, which is designed to protect the generator during operation for ground faults.

Initial troubleshooting tested relay 59-202G and the relay's "as found" condition was satisfactory. It was identified that the relay was operating on the low side of its setpoint tolerance. It was also identified that the target took a few seconds to operate. It is suspected that since the trip was immediate, the trip condition apparently cleared prior to the relay target operating.

The original 59-202G relay which initiated the event was sent to the Duquesne Light Company (DLC) Standards Laboratory for special testing. Tests included a Surge Withstand Capability (SWC), harmonic and a thermal stress test. This special testing did not identify any problems with the relay.

Review of the Beaver Valley Substation fault recorder did not identify any system disturbance prior to the trip. System Operations also confirmed that there were no grid anomalies on the 345 KV power grid at the time of the event. Note that a ground fault on the Main Transformer delta side would not be seen on the 345 KV system.

Main Generator Ground Protection Relays (50-201G, 59-201G and 51-201G) which would be expected to operate for an actual 22 KV ground fault were tested and found to be functionally satisfactory.

A check of the relay 59-202G input circuit was performed. The circuit was checked for continuity, grounds and tight connections with satisfactory results. It was noted that there was evidence of wear on the primary contacts of the 22 KV potential transformers from vibration.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Beaver Valley Power Station Unit 2	05000412	97	001	00	4 OF 5

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

Also, oil samples were obtained and analyzed from the Main, 2C and 2D transformers with normal results, supporting that a fault had not occurred in the transformers.

The ERT concluded that the most probable cause of the turbine trip was due to vibration-induced wear on the 22 KV potential transformer primary contacts. This condition resulted in a small voltage drop across these contacts that resulted in an increased voltage to the 59-202G relay. The "as-found" trip setpoint of the 59-202G relay was 17.1 VAC and the measured voltage at full power was found at 11.5 VAC. Therefore, the increased contact resistance would have only had to produce a 5.6 VAC increase for it to actuate. Actuation of 59-202G actuated relay 87-202X1 which, in turn, closed the trip contacts associated with the Main Generator exciter field breaker, turbine, main generator output breakers and Bus 2A, 2B, and 2D supply air circuit breakers (ACBs).

The ERT performed an evaluation of secondary plant-related component problems observed prior to the event and during the post-trip recovery and concluded they were unrelated to the cause of the trip. It was also concluded by the ERT that these secondary plant problems did not significantly impact post-trip recovery or plant stabilization efforts.

CORRECTIVE ACTIONS

1. Procedures 2OM-35.3C and 2OM-35.4L were revised by January 10, 1997 such that relay 59-202G will only be in service during main transformer backfeed operations. The output of this relay was cut-out (disconnect switches open) January 10, 1997.

2. Elementary diagram 12241-E-8BE was revised January 7, 1997.

3. The relay setting sheet for relay 59-202G (BVT-TM-16) will be revised by March 15, 1997 to provide additional clarification that relay 59-202G protection is cut-out except during backfeed.

4. Selected parameters were monitored during plant startup on January 15, 1997 during field flashing of the generator and the power ascension to confirm that there was no 22 KV ground path. This monitoring determined that there is not a ground on the 22 KV system.

5. The Main Generator exciter diodes were checked during plant startup on January 15, 1997 and found to be satisfactory.

6. The contacts on the Unit 2 22 KV Regulator potential transformers and the 22 KV Metering and Relay potential transformers were cleaned and lubricated and assessed to be fully functional. These contacts will be replaced during the next refueling outage (2R7).

7. A Preventive Maintenance Procedure will be written and implemented by the next refueling outage for each respective Unit (Unit 1 - 1R12, Unit 2 - 2R7) to periodically inspect the contacts of the 22 KV Regulator potential transformers and the 22 KV Metering and Relay potential transformers.

8. An extent of condition review will be performed for both Units by March 15, 1997 to determine if there are other relay setting sheet conditions that are different than those specified by the controlled drawings.

9. The relay setting sheet, procedures, and drawings for the Unit 1 ground protection relay comparable to Unit 2 relay 59-202G were reviewed by January 9, 1997 and determined to be correct.

10. The Nuclear Engineering Department will evaluate a setpoint change, to reduce the potential for inadvertent actuation on the Unit 2 Main Generator Ground Protection Relays by April 30, 1997. Setpoint changes, if required, will be implemented by the completion of refueling outage 2R7.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Beaver Valley Power Station Unit 2	05000412	97	001	00	5 OF 5

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)(ii) on January 6, 1997. This report is being made pursuant to the requirements of 10CFR50.73(a)(2)(iv) as "Any event or condition that resulted in a manual or automatic actuation of any Engineered Safety Feature (ESF), including the Reactor Protection System (RPS)..."

SAFETY IMPLICATIONS

Evaluation has shown that there was no actual ground on the 22 KV subsystem. Post-trip control and protection systems functioned correctly in response to the turbine and reactor trip. Plant parameters were established within their normal control bands shortly after the turbine trip and the plant was placed in a safe, shutdown condition in accordance with procedures. There were no implications to the health and safety of the public as a result of this event.

SIMILAR EVENTS

A review of Licensee Event Reports for the past two years identified no similar events.