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 MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING 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.

LICENSEE EVENT REPORT (LER)

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

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Sequoyah Nuclear Plant (SQN) Unit 2	05000328	1 OF 9

TITLE (4)
Turbine and Reactor Trips Resulting From a Failure of the 'B' Phase Main Transformer Sudden Pressure 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
									NA	05000
08	27	1998	1998	-- 001 --	00	09	28	1998	FACILITY NAME: NA	DOCKET NUMBER: 05000

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

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)
	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 or in NRC Form 366A
	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. Bajraszewski, Licensing Engineer	(423) 843-7749

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
X	FK	RLY	Q011	Y						

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

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

On August 27, 1998, at 1357 Eastern Daylight time, with Unit 2 in power operation at approximately 100 percent, a turbine trip occurred followed by a reactor trip. The event resulted from the initiation of a generator lockout (generator electrical trip) with a subsequent turbine trip initiated by failure of a sudden pressure relay on the 'B' phase main transformer. A review of the condition determined that the transformer did not experience a fault. The reactor protection systems, including feedwater isolation and auxiliary feedwater start, responded to the trip as expected; no anomalies occurred. Operators responded to the trip as prescribed by procedures and stabilized the reactor in the hot standby condition. Subsequent to the event, examination of the sudden pressure relay, Qualitrol Corporation Model No. 900-003-01, identified one rocker arm pin had worn to the degree that proper operation of the device was prevented. The remaining Qualitrol relays on the Units 1 and 2 plant transformers inservice were inspected and replaced, where necessary.

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
SQN Unit 2	05000328	1998 --	001 --	00	2 of 9

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

I. PLANT CONDITIONS

Unit 2 was in power operation at approximately 100 percent.

II. DESCRIPTION OF EVENT

A. Event

On August 27, 1998, at 1357 Eastern Daylight time (EDT), a turbine trip occurred followed by a reactor trip. The event resulted from initiation of a generator lockout (generator electrical trip) with a subsequent turbine trip initiated by failure of a sudden pressure relay [EIIS Code RLY] on the 'B' phase main transformer [EIIS Code FK]. A review of the condition determined that the transformer did not experience a fault. The reactor protection systems, including feedwater isolation and auxiliary feedwater start, responded as expected to the trip; no anomalies occurred. Operators responded to the trip as prescribed by procedures and stabilized the reactor in the hot standby condition.

B. Inoperable Structures, Components, or Systems that Contributed to the Event

None.

C. Dates and Approximate Times of Major Occurrences

TIMELINE

August 27, 1998, at 1357	The generator lockout, with subsequent turbine trip was followed by a reactor trip. The trip signal was initiated by the 'B' phase main transformer sudden pressure relay. The main control room operators stabilized the reactor in Mode 3 (hot standby).

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
SQN Unit 2	05000328	1998 --	001 --	00	3 of 9

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

D. Other Systems or Secondary Functions Affected

None.

E. Method of Discovery

The turbine and reactor trips were annunciated on the main control room panels.

F. Operator Actions

Control room operators responded as prescribed by emergency procedures. The condition was promptly diagnosed, and the necessary actions were taken to stabilize and maintain the unit in a safe condition.

G. Safety System Responses

The plant responded to the turbine and reactor trips as designed.

III. CAUSE OF THE EVENT

A. Immediate Cause

The immediate cause of the event was initiation of a generator lockout (generator electrical trip) signal by the 'B' phase main transformer protection circuit from a failed sudden pressure relay.

B. Root Cause

The root cause of the event was the failure of a sudden pressure relay located on the 'B' phase main transformer. Troubleshooting, following the unit trip, found that the sudden pressure relay had not reset as would be expected. Field examination of the device found the housing interior oily and covered with a dark residue. Disassembly of the relay determined that one rocker arm pin had worn to the degree that proper

operation of the device was prevented (the device was in a constant trip condition). The pin failure mechanism appears to be wear (fretting) resulting from vibration. Oil leakage into the relay housing resulted from either an inadequate factory assembly torque between the protective shield and the relay mechanism to prevent transformer oil leakage or leakage of the silicon fluid from the relay mechanism due to a failure of the bellows assembly.

C. Contributing Factors

None.

IV. ANALYSIS OF THE EVENT

The plant safety systems responses during and after the unit trip were consistent with the responses described in the Updated Final Safety Analysis Report, and accordingly, the event did not adversely affect the health and safety of plant personnel or the general public.

V. CORRECTIVE ACTIONS

A. Immediate Corrective Actions

Control room operators responded as prescribed by emergency procedures. The condition was promptly diagnosed, and the necessary actions were taken to stabilize and maintain the unit in a safe condition.

B. Corrective Actions to Prevent Recurrence

Subsequent to the event, several Qualitrol sudden pressure relays located on other transformers were removed and inspected. Of the 21 total Unit 1 and 2 installed devices, 20 relays have been inspected with 13 requiring replacement (3 due to oil leakage and 10 for fretting). The one remaining device that has not

been inspected is located on a transformer that is not currently in service and has not been in service since initial installation. Discussions with the manufacturer determined that the acceptable "break-away" torque, between the protective shield and the relay mechanism, is between 900 to 1,200 inch-pounds. To prevent oil leakage into the relay housing and ensure reduced mechanism vibration, "break-away" torque is being verified on each of the devices, both new and old. Of the 17 new devices that were examined, 9 met the vendor torque criteria. Where unacceptable torque values are found, the device is being retorqued to 1,200 inch-pounds before installation.

VI. ADDITIONAL INFORMATION

A. Failed Components

The sudden pressure relay, Qualitrol Corporation Model No. 900-003-01, was examined and found to have failed (the devise was in a constant trip condition). Detailed inspection of the component identified significant wear on the rocker arm pins. One of the rocker arm pins had worn to the degree that proper operation of the device was prevented. In addition to this failure mechanism, the wear products (particles of metal [brass with a high percentage of copper content]) were accumulated and trapped in an oil film around the exposed electrical switch wiring as it attached to the connector. This condition could have lead to arcing and subsequent actuation of the auxiliary trip relays within the plant. The oil within the electrical switch enclosure is attributed to either a low torque on the protective shield, resulting in an incomplete seal on the o-ring that seals the relay mechanism or failure of the bellows assembly and leakage of the silicon fluid into the housing.

Analysis of the failed devices, examination of the "as constructed" configuration, and tests ongoing at the

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
SQN Unit 2	05000328	1998	-- 001	-- 00	6 of 9

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

TVA Central Laboratories presently indicate that excessive vibration is being seen by the relay mechanism. This vibration appears to be the result of:

1. The transformer's 60 Hertz pulsation and the resultant vibrations at some harmonic of 60 Hertz.

2. The natural resonant frequency of the mounted assembly which includes the sudden pressure relay, pipe, flanges, and isolation valve.

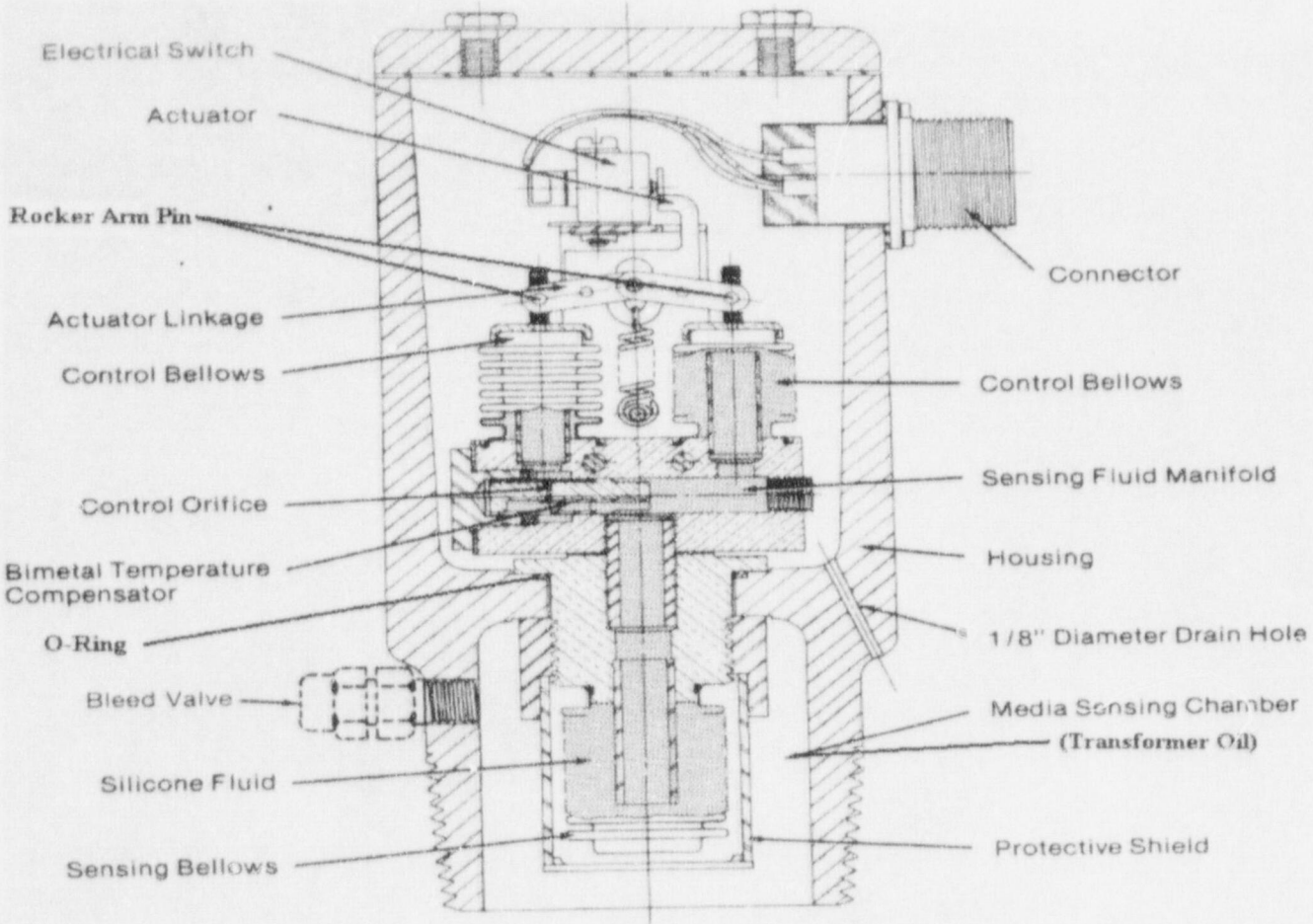
3. The natural resonant frequency of the relay mechanism (control bellows, rocker arm pins, actuator linkages, etc.) that is within the device.

The largest amount of fretting was found on the transformers with the sudden pressure device mounted in a configuration consisting of a flange, threaded pipe, and gate valve. This mounting configuration was installed during the last transformer bank outages to correct an interference problem with an originally installed butterfly valve. Slight fretting has also been observed on two devices still mounted with the original butterfly valve. Further analysis and testing is ongoing to resolve these vibrational issues.

No fretting or vibrational issues have been observed on the plant common station service transformers which provide the offsite power feeds to the plant.

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
SQN Unit 2	05000328	1998	-- 001	-- 00	7 of 9

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

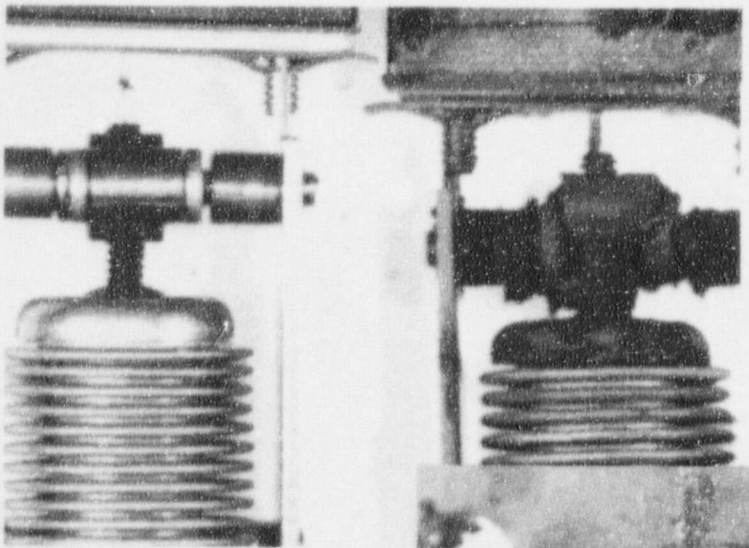


QUALITROL 900 SERIES "RAPID PRESSURE RISE" RELAY

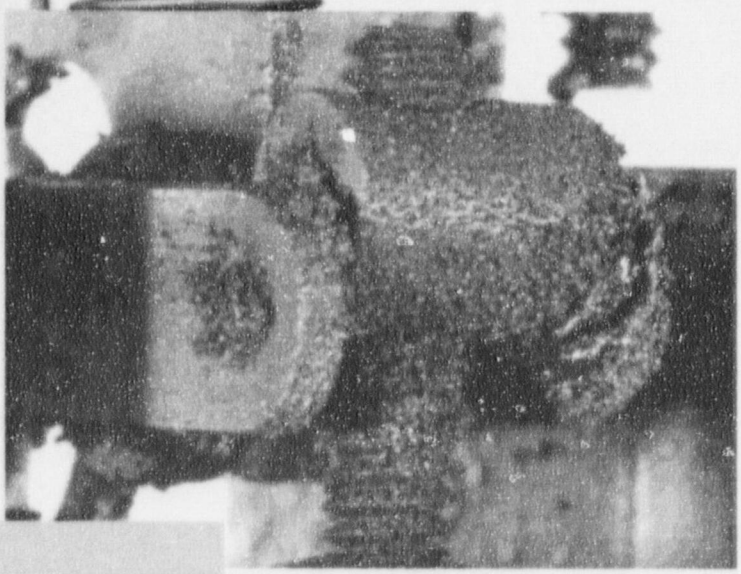
PRINCIPLE OF OPERATION: Changes in the transformer's internal pressure deflects the **Sensing Bellows** and responding **Control Bellows** that are part of a sealed system filled with **Silicon Fluid**. A small **Control Orifice** in the line of one of the **Control Bellows**, whose effective area is varied with temperature by a **Bimetal Temperature Compensator**, causes differential deflection of the two **Control Bellows**. The resultant "cocking" of the **Actuator Linkage** trips the **Electrical Switch** at unsafe rates of pressure rise. When the two **Control Bellows** again reach equilibrium, the **Electrical Switch** automatically resets itself.

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
SQN Unit 2	05000328	1998 --	001 --	00	8 of 9

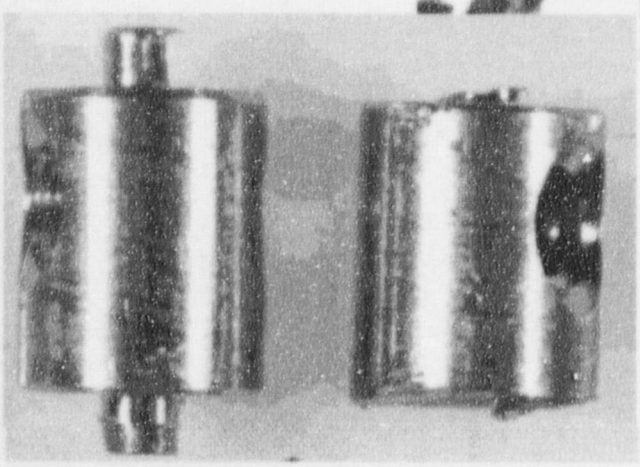
TEXT (If more space is required, use additional copies of NRC Form 366A) (17)



Left: Side-by-side comparison of a rocker pin assembly from the new relay (left) and the failed relay (right). Note that each relay has two assemblies and bellows.



Right: One of the pin assemblies was out of alignment on one rocker in the failed relay. Brass corrosion deposits were all around this area.



Left: Pins from each rocker (from the failed relay) after cleaning. The pin on the left still had nubs on each end which fit into the rocker arms; however, some evidence of wear was present. The pin on the right is the same one shown above.

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
SQN Unit 2	05000328	1998	-- 001	-- 00	9 of 9

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

B. Previous LERs on Similar Events

A review of previous events identified three other events (50-327/86026, 90022, and 95010) associated with the failure of the sudden pressure relay. Those failures resulted from a shorted micro-switch, shorted wiring terminal, or a failure of the nonorificed control bellows. Actions taken for those failures would not have prevented the event described by this LER. Following the 1995 event, Qualitrol sudden pressure relays at SQN were replaced.

C. Additional Information

None.

VII. COMMITMENTS

None.