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FACIL: 50-410 Nine Mile Point Nuclear Station, Unit 2, Niagara Moha 05000410

AUTH. NAME	AUTHOR AFFILIATION
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RECIP. NAME	RECIPIENT AFFILIATION

SUBJECT: LER 87-043-00: on 870711, reactor scram on high steam dome pressure occurred due to electrohydraulic control (EHC) sys tube rupture. Caused by excessive vibration in tubing. Unit shutdown & EHC sys secured. Tubing replaced. W/870807 ltr.

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TITLE: 50.73 Licensee Event Report (LER), Incident Rpt, etc.

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	NRR/DREP/RAB	1	1	NRR/DREP/RPB	2	2
	NRR/PMAS/ILRB	1	1	REG FILE 02	1	1
	RES DEPY GI	1	1	RES TELFORD, J	1	1
	RES/DE/EIB	1	1	RGN1 FILE 01	1	1
EXTERNAL:	EG&G GROH, M	5	5	H ST LOBBY WARD	1	1
	LPDR	1	1	NRC PDR	1	1
	NSIC HARRIS, J	1	1	NSIC MAYS, G	1	1

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NRC Form 366 (9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/88

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Nine Mile Point Unit 2	0 5 0 0 0 4 1 0	1 OF 0 6

TITLE (4)
Reactor Scram due to Turbine EHC Tube Rupture

EVENT DATE (5) MONTH	DAY	YEAR	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	REPORT DATE (7) MONTH	DAY	YEAR	OTHER FACILITIES INVOLVED (8) FACILITY NAMES	DOCKET NUMBER(S)
0 7	1 1	8 7	8 7	— 0 4 3 —	0 0	0 8	0 7	8 7	N/A	0 5 0 0 0
									N/A	0 5 0 0 0

OPERATING MODE (9): 2
POWER LEVEL (10): 0 0 4

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check one or more of the following)* (11)

[ ]	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 *(Specify in Abstract below and in Text, NRC Form 366A)*
[ ]	20.405(a)(1)(iii)	[ ]	50.73(a)(2)(i)	[ ]	50.73(a)(2)(viii)(A)		
[ ]	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 AREA CODE	
Robert G. Randall, Supervisor Technical Support	3 1 5	3 4 9 - 2 4 4 5

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

CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS
X	T G	T B G	G 0 8 0	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 fifteen single-space typewritten lines)* (16)

While in the startup mode on July 11, 1987 at approximately 1146 hours, a reactor scram on high steam dome pressure occurred due to an Electro-Hydraulic Control (EHC) system tube rupture. Reactor pressure was 955 psig and coolant temperature at 534°F. At 1141 hours the turbine tripped on low EHC fluid pressure, and the open bypass valve began drifting closed. As the bypass valve closed, reactor pressure began increasing. Before the control room operator could manually scram the reactor, the reactor auto scrammed on high steam dome pressure (1027 psig recorded). The root cause for the EHC tube failure was excessive vibration due to speed signal noise. Speed signal noise induced hydraulic fluid vibration in the tubing. Contributing factors were valve cycling during preoperational testing and an unidentified condition causing the turbine to roll off turning gear.

Immediate corrective actions were to secure the EHC system, reset the scram and bring the unit to a shutdown condition per the approved procedure. Further corrective actions were to replace the ruptured tubing, reduce speed signal noise, add supports to vertical runs of tubing and inspect other EHC supply tubing for possible weak spots.

IE22 1/1

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	PAGE (3)
Nine Mile Point Unit 2	0 5 0 0 0 4 1 0	8 7	— 0 4 3	— 0 0	0 2 OF 0 6

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

I. DESCRIPTION OF EVENT

While in the startup mode on July 11, 1987 at approximately 1146 hours, a reactor scram occurred due to an Electro-Hydraulic Control (EHC) system tube rupture. Prior to the scram, reactor power was approximately 4%, with reactor pressure at 955 psig and coolant temperature at 534°F.

One hour prior to the event, NMPC operators were preparing to commence several turbine valve cycling surveillance tests. The NMPC licensed control room operator had commenced turbine shell warming and was attempting to keep the turbine on turning gear. Turbine control valves (TCV) were partially open for shell warming and one bypass valve (BPV-1) was approximately 40% open. At 1141 hours, a turbine trip occurred on low EHC fluid pressure. While responding to the alarms, the control room operator noticed that the second EHC pump had auto started to maintain fluid pressure at approximately 300 psig. Operators were immediately dispatched to the EHC pump skid and the Main Stop Valve (MSV) and TCV area to check for leaks.

While operators were checking for leaks, the EHC pumps were secured. However, the bypass valve began to drift closed due to the lack of fluid pressure. With all BPVs closed, reactor pressure began increasing. Therefore, the EHC pumps were restarted to attempt to reopen BPV-1 and control reactor pressure. At this time, the NMPC operators notified the control room that the one inch diameter EHC Fluid Actuator Supply (FAS) header to TCV-4 had ruptured. Before the control room operator could reduce reactor power, the reactor scrammed on high steam dome pressure (1027 psig recorded).

Immediate corrective actions were to follow the scram procedure to bring the unit to a shutdown condition and to secure the EHC system. Subsequently, the scram was reset, Radwaste department notified of the fluid spill and the Fire department alerted as a precaution. In addition, a work request was initiated to repair EHC tubing.

II. CAUSE OF EVENT

The root cause for the EHC tube rupture was excessive fluid vibration due to speed signal noise. Speed signal noise was created when the turbine would roll off its turning gear during shell warming mode. Contributing factors were an unidentified condition that causes the turbine to roll off turning gear during BPV operation and valve cycling during preoperational testing.

The tubing failure was a through-wall circumferential crack, originating at the toe of the socket weld connecting the EHC FAS header to TCV-4. An inspection of the failed tubing by NMPC Engineering and Materials groups revealed that the failure resulted from fatigue of the tubing material. The tubing is one-inch diameter Type 304 stainless steel with a minimum wall thickness of 0.083 inches. The non-safety related socket weld was not defective. Further analysis indicates the fatigue failure was caused by excessive vibration due to high pressure fluid surges.

Investigation by General Electric (GE) revealed the source of vibration was speed signal noise. The speed signal noise was created by the low frequency output of the Frequency to Voltage (F/V) converter cards when the turbine would roll off its turning gear during shell warming mode. The cause for the turbine rolling off its turning gear at low power levels and with one BPV open has not been determined. However, the increased turbine speed introduced a speed error into the TCV positioning units, causing the low frequency output to the F/V cards and preventing the TCVs from fully opening when in shell warming mode, as required. The resultant effect of the speed signal noise was hydraulic fluid vibrations due to oscillations of the servo valve in the TCV actuators. The vibration is magnified when the TCVs are partially open, instead of full open, for shell warming.

Valve cycling during preoperational testing was also noted as possibly contributing or adding stress to EHC tubing. Valve cycling during surveillance testing has been identified by other nuclear facilities that have experienced tube rupture as further contributing to this problem. Additional supports were added to vertical runs of FAS tubing to further dampen existing vibration.

III. ANALYSIS OF EVENT

This event has no adverse safety consequences. Normal plant protection and scram systems responded as designed to safely shutdown the reactor during the high pressure/turbine trip transient. The turbine generator is not required to effect or support safe shutdown of the reactor or to perform in the operation of reactor safety features. In addition, the turbine overspeed protection system is designed to fail safe upon a hydraulic line break. The fail safe action is a turbine trip.

An EHC line break event is analyzed in the FSAR as a turbine trip without bypass capability. At low power, the transient is terminated by high neutron flux or high vessel pressure. This is a much more severe transient at full power. However, the resulting overpressure transient is clearly below the reactor coolant pressure boundary (RCPB) transient pressure limit. Yet, this transient can result in challenges to safety systems such as Reactor Core Isolation Cooling (RCIC), High Pressure Core Spray (HPCS), and Safety Relief Valves (SRVs).

The EHC tubing failure is not an isolated event. At least one other facility (Brunswick) has experienced this same failure. Corrective actions taken at Brunswick have been evaluated for applicability and incorporated at Nine Mile Point Unit 2.

The EHC system was returned to service on July 24, 1987. The unit had been shutdown since July 11, 1987 due to this event and other plant conditions.

IV. CORRECTIVE ACTIONS

Immediate corrective actions were to follow the scram procedure to bring the unit to a shutdown condition and to secure the EHC system. Subsequent corrective actions are as follows:

1. The ruptured EHC tubing was replaced. Other EHC FAS tubing was inspected and was found to be acceptable. Inspections included visual and penetrant examinations of various welds in the tubing. The visual and penetrant inspections will be repeated during the Test Condition 1 outage. Visual inspections will be performed throughout the power ascension program to monitor the structural integrity and vibration of EHC tubing.

2. Existing FAS tubing supports were evaluated and found to be sufficient and properly installed in accordance with GE instructions. To further dampen system vibration due to frequent valve cycling, additional supports were added to vertical runs of FAS tubing to the control valves.

3. The cause for the turbine rolling off its turning gear at low power levels and with one BPV open has not been determined. However, the turbine and interrelated systems will be closely monitored during power ascension testing so that the cause may be identified and corrected.

4. The F/V low turbine speed cut-off was increased to eliminate speed signal noise up to 20 RPM. This adjustment minimizes the potential to introduce speed signal noise into the system.

5. To reduce the noise on the speed signals, a separate wire was run from each Frequency to Voltage (F/V) converter card (A18 and A20) directly to ground in accordance with GE field line-up instructions.

6. The TCV opening bias for shell warming on the TCV amplifier was adjusted so that the TCV amplifier is saturated to fully open these valves.

7. The turbine valves were cycled several times during post-maintenance testing to ensure that speed signal noise was reduced. In addition, a turbine speed simulator test was conducted to demonstrate proper operability of the speed and load control units. Testing entailed inputting a frequency into the F/V cards to simulate an 800 RPM speed signal. Results of this test and the other post maintenance tests were satisfactory. Thus, the EHC system was demonstrated fully operational on July 24, 1987.

8. To prevent the possibility of another tube rupture, NMPC Engineering and GE personnel will closely monitor the EHC and other turbine systems during power ascension testing to ensure that significant sources of vibration or electronic noise are identified and corrected.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	PAGE (3)
Nine Mile Point Unit 2	0 5 0 0 0 4 1 0	8 7	— 0 4 3	— 0 0	0 6 OF 0 6

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

V. ADDITIONAL INFORMATION

A. Components referred to in this LER

Component	IEEE 803 EIIS Funct	IEEE 805 System ID
Electro-Hydraulic Control (EHC)	N/A	TG
Turbine Bypass Valves (BPV)	PCV	SB
Turbine Control Valves (TCV)	FCV	SB
Main Stop Valves (MSV)	SHV	SB
Reactor Core Isolation Cooling (RCIC)	N/A	BN
High Pressure Core Spray (HPCS)	N/A	BG
Safety Relief Valves (SRV)	PCV	N/A
Control Rods	N/A	AA
Reactor	RCT	AD
Turbine	TRB	TA
Hydraulic Fluid	N/A	TG
Tubing	TBG	TG
Speed Control Unit	SC	JJ
Load Control Unit	N/A	JJ
Servo Valve	N/A	JJ
Converter	CNVR	JJ

B. Previous Similar Events - None

C. Failed Components

One inch diameter EHC FAS tubing - Type 304 Stainless Steel

NMP26441

NIAGARA MOHAWK POWER CORPORATION

NIAGARA MOHAWK

301 PLAINFIELD ROAD
SYRACUSE, NY 13212

THOMAS E. LEMPGES
VICE PRESIDENT—NUCLEAR GENERATION

August 7, 1987

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

RE: Docket No. 50-410
LER 87-43

Gentlemen:

In accordance with 10 CFR 50.73, we hereby submit the following Licensee Event Report:

LER 87-43 Is being submitted in accordance with 10 CFR 50.73 (a) (2) (iv), "Any event or condition that resulted in manual or automatic actuation of any Engineered Safety Feature (ESF), including the Reactor Protection System (RPS). However, actuation of an ESF, including the RPS, that resulted from and was part of the preplanned sequence during testing or reactor operation need not be reported."

A 10 CFR 50.72 (b) (2) (ii) report was made at 1258 hours on July 11, 1987.

This report was completed in the format designated in NUREG-1022, Supplement No. 2, dated September 1985.

Very truly yours,

Thomas E. Lempges

Thomas E. Lempges
Vice President
Nuclear Generation

TEL/PB/mjd

Attachments

cc: Regional Administrator, Region 1
Sr. Resident Inspector, W. A. Cook

IE22
1/1