Niagara Mohawk®

September 11, 2001
NMP2L 2032

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

RE: Nine Mile Point Unit 2
Docket No. 50-410
NPF-69

Subject: ***Supplement 1 to Licensee Event Report 01-002, "Rated Thermal Power Exceeded When Recirculation Flow Control Valve Malfunctioned"***

Gentlemen:

Attached is Supplement 1 to Licensee Event Report 01-002, "Rated Thermal Power Exceeded When Recirculation Flow Control Valve Malfunctioned." Supplement 1 contains the causes and corrective actions from the completed root cause evaluation.

Very truly yours,

Michael F. Peckham
Plant Manager – Unit 2

MFP/KLE/mlg
Attachment

cc: Mr. H. J. Miller, NRC Regional Administrator, Region I
Mr. G. K. Hunegs, NRC Senior Resident Inspector
Records Management

IE22

NRC FORM 366 (1-2001) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 6-30-2001

Estimated burden per response to comply with this mandatory information collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to bjs1@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

LICENSEE EVENT REPORT (LER)

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

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Nine Mile Point, Unit 2	05000410	1 OF 5

TITLE (4)

Rated Thermal Power Exceeded When Recirculation Flow Control Valve Malfunctioned

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
										05000
05	24	2001	2001	– 002 –	01	09	11	2001	FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9)	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply) (11)			
1	20.2201(b)	20.2203(a)(3)(ii)	50.73(a)(2)(ii)(B)	50.73(a)(2)(ix)(A)
POWER LEVEL (10)	20.2201(d)	20.2203(a)(4)	50.73(a)(2)(iii)	50.73(a)(2)(x)
100	20.2203(a)(1)	50.36(c)(1)(i)(A)	50.73(a)(2)(iv)(A)	73.71(a)(4)
	20.2203(a)(2)(i)	50.36(c)(1)(ii)(A)	50.73(a)(2)(v)(A)	73.71(a)(5)
	20.2203(a)(2)(ii)	50.36(c)(2)	50.73(a)(2)(v)(B)	X OTHER Specify in Abstract below or in NRC Form 366A
	20.2203(a)(2)(iii)	50.46(a)(3)(ii)	50.73(a)(2)(v)(C)	License condition 2.F.
	20.2203(a)(2)(iv)	50.73(a)(2)(i)(A)	50.73(a)(2)(v)(D)	
	20.2203(a)(2)(v)	50.73(a)(2)(i)(B)	50.73(a)(2)(vii)	
	20.2203(a)(2)(vi)	50.73(a)(2)(i)(C)	50.73(a)(2)(viii)(A)	
	20.2203(a)(3)(i)	50.73(a)(2)(ii)(A)	50.73(a)(2)(viii)(B)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
D. P. Bosnic, Manager, Technical Support	315-349-7952

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

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
X	AD	CLPG	Helical	Y					

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

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

On May 24, 2001, at 2016 hours and at approximately 100 percent power, Nine Mile Point Unit 2 experienced a malfunction of the B reactor recirculation system flow control valve (FCV) position feedback signal, which resulted in recirculation FCV cycling and reactor power cycling. The FCV cycling lasted approximately 90 seconds and was stopped when hydraulics to the B recirculation FCV were secured. A post event data analysis determined that the estimated core thermal power reached a maximum of 103 percent and a minimum of 73 percent.

A post event evaluation concluded that the transient did not result in violation of any thermal-mechanical design limits. Reactor water samples taken and analyzed shortly after the event showed no detectable increase in activity. The event is reportable in accordance with license condition 2.F. in that the maximum authorized thermal power level was exceeded.

The cause of the B recirculation FCV position indication malfunction was a failure of the rotary variable differential transformer (RVDT) coupling. The cause of the coupling failure was high lateral vibration and displacement of the valve feedback rod coupled with harmonic resonance of the control system A-frame caused by flow induced vibration caused by the reactor recirculation pump. The root cause evaluation also identified weaknesses in the implementation of the Corrective Action Program.

Short term corrective actions included securing hydraulics to the FCV and reducing power to balance flow between recirculation loops. Root cause and design teams were established utilizing industry failure analysis experts to determine the cause of the failure and identify actions needed to prevent recurrence. Further corrective actions included replacing the RVDT couplings and modifying the RVDT support structure's vibrational response.

FACILITY NAME (1)	DOCKET (2) NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Nine Mile Point, Unit 2	05000410	2001	-- 002 --	01	2 OF 5

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

I. Description of Event

On May 24, 2001, at 2016 hours with the unit at approximately 100 percent power, Nine Mile Point Unit 2 experienced a malfunction of the B reactor recirculation system flow control valve (FCV) position indication signal. This malfunction caused cycling of the recirculation FCV which resulted in recirculation flow and reactor power cycling. A post event data analysis determined that, during the power cycling the estimated maximum core thermal power was 103 percent and the estimated minimum power was 73 percent.

The cycling of the FCV lasted approximately 90 seconds and was stopped when hydraulics to the B recirculation FCV were secured by the operators. During the transient, reactor vessel water level attained a maximum of 188 inches and a minimum of 182 inches. At the start of the event, reactor pressure was 1020 psig and reached a minimum of 996 psig. B recirculation loop flow reached a minimum of approximately 20 million pounds per hour (mlb/hr) and a maximum of approximately 50 mlb/hr.

The initial indication of a problem was a reactor water high level alarm followed by several feedwater heating and main steam reheater level control alarms. Approximately 60 seconds into the event, control room operators determined that the B recirculation FCV was cycling. At 2017 hours, approximately 90 seconds into the event, hydraulics to the B recirculation FCV were secured. At this point reactor power stabilized at approximately 99 percent. At 2027 hours, a power reduction was started in order to balance recirculation flow in the A and B loops. At 2042 hours, the power reduction was completed with reactor power at 87.5 percent.

Both A and B recirculation loop FCVs have primary and backup position indication. At the time of the transient, both A and B loop FCVs were using their primary position indication. The hydraulics to the B loop FCV were secured locking the valve in a partially open position. On May 27, 2001, a review of the May 24 transient was completed by the Station Operations Review Committee. Later, on May 27, 2001, the B loop FCV backup position indication and controller were placed in service. On May 28, 2001, the A loop FCV backup indication and controller were placed in service and a power ascension to full power began. Later on May 28, 2001, the unit attained 100 percent power. On June 5, 2001, with the unit at 100 percent power, the B loop FCV backup position indication failed. In this instance, an automatic lockup of the valve occurred on a high rate of change of indicated valve position. No power transient resulted from this failure. However, hydraulics to the valve were secured locking the valve in a partially open position. Power was then reduced to approximately 92 percent power to balance recirculation loop flows.

The B recirculation FCV (2RCS*HYV17B) is a 24 inch hydraulic Fisher Control valve, model SS-150. The control circuitry for the FCV uses position indication provided by a rotary variable differential transformer (RVDT). The primary RVDT is connected to the FCV position indication shaft by a coupling. The coupling, part number 8488-12.5mm-6, is manufactured by Helical Products Company, Incorporated. As the FCV position indication shaft rotates the coupling transmits this rotation to the RVDT which generates a voltage signal representative of valve position. Since November 1997, there have been five previous coupling failures, three failures for the A loop FCV and two failures for the B loop FCV. Four of the previous failures have been of the original style coupling and one of the failures has been with a modified coupling. The coupling that failed on May 24, 2001, was a modified coupling that had been installed on May 18, 2001.

On July 21, 2001, the plant was shutdown to inspect the recirculation flow control system. While shutdown, the RVDT couplings were replaced with an enhanced design, and the A-frame that supports the RVDT and position indicating shaft assembly was modified to change its harmonic resonance frequency. Vibration monitoring instrumentation was installed to confirm the effectiveness of the changes. The plant was restarted on July 28, 2001.

II. Cause of Event

The cause of the power excursion is loss of valve position indication feedback resulting in the flow control system repositioning the valve. The position feedback malfunction was lost due to a failure of the RVDT coupling. The cause of the coupling failure was high lateral vibration and displacement of the valve feedback rod resulting in high cycle fatigue failure of the coupling. The most likely causes of the vibration and displacement were the physical 90 degree rotation of the valve upper bearing assemblies during maintenance activities in 1995 and 1996, coupled with harmonic resonance of the control system A-frame caused by flow induced vibration initiated by the reactor recirculation pump. The increased vibration of the coupling and RVDT led to high cycle fatigue failures of the couplings and localized overload failures of the RVDT bearings.

The organizational and/or programmatic root cause of the repeated failures is inadequate implementation of the Corrective Action Program. Some specific areas for improvement were: inadequate causal investigations and inadequate control of the change process for approved corrective/preventive actions. The weaknesses in the Corrective Action Program have been previously identified through industry and peer evaluations and improvement activities are currently underway to correct the weaknesses.

III. Analysis of Event

This event is reportable in accordance with license condition 2.F. of the Nine Mile Point Unit 2 license, in that rated thermal power was exceeded. An evaluation of estimated thermal power was completed and concluded that the maximum estimated thermal power attained during the transient was 103 percent. A review of data collected by the General Electric Transient Analysis Recording System indicated that the event began when the B recirculation FCV position indication went from approximately 76 percent indicated open to 86 percent indicated open. The data also shows that the B recirculation FCV cycled three times during the 90 second event. There were no Neutron Monitoring system alarms activated as a result of the event and reactor power did not reach the Reactor Protection System trip setpoint. An evaluation performed by Niagara Mohawk and concurred with by Global Nuclear Fuels (the fuel vendor) concluded that the transient did not result in violations of any thermal-mechanical design limits and did not have implications on current or future fuel reliability limits. Reactor water samples taken and analyzed shortly after the event showed no detectable increase in activity. A review of the offgas radiation monitor data showed no detectable rise in activity. An evaluation of the rate change of the FCV during the event concluded that the rate of change ranged from 6.85 percent per second to 9.98 percent per second which is less than the Technical Specification limit of 11 percent per second.

An evaluation of the impact of the vibration concluded that there is reasonable assurance that the valves will continue to perform their intended design function and maintain their structural integrity.

During the event no Emergency Core Cooling Equipment started or should have started.

A Probabilistic Risk Assessment (PRA) screening of the event concluded that the event was not risk significant since the reactor trip set point was not exceeded.

Based on the above, the event did not pose a threat to the health and safety of plant personnel or the public.

FACILITY NAME (1)	DOCKET (2) NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Nine Mile Point, Unit 2	05000410	2001	-- 002 --	01	4 OF 5

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

IV. Corrective Actions

1. Secured hydraulics to the B loop FCV to lock the valve in position.
2. Reduced power to balance recirculation loop flow.
3. Established design team and root cause team utilizing industry failure analysis experts and personnel from other utilities to determine the cause and provide corrective actions to prevent recurrence.
4. Replaced existing failed primary couplings, in both loops, with couplings of an upgraded design.
5. Replaced backup position indication, in both loops, with equipment of a different design.
6. Modified the harmonic resonance frequency of the flow control valve A-frame, in both loops, so that it does not reinforce vibration at the pump flow frequency.
7. A team has been formed to monitor effectiveness of completed corrective actions, evaluate additional vibrational data, and determine further repair actions.
8. Corrective Action Program improvement activities are being undertaken as a result of previous industry and peer evaluations.
9. A root cause mentor is being utilized to improve root cause skills of the organization.
10. Change the maintenance procedure for the FCVs to add information on the importance of proper orientation of the upper and lower bearings and the controls to ensure that the orientation is maintained. The procedure changes will be completed by December 31, 2001.

V . Additional Information

A. Failed Components

RVDT coupling, Manufactured by Helical Products Company, Incorporated, part number 8488-12.5mm-6.

B. Previous similar events:

Since November 1997 five failures of the RVDT coupling have occurred prior to the failure on May 24, 2001.Three of the previous failures were associated with the A loop FCV and two with the B loop FCV. The previous failures did not result in Licensee Event Reports.

C. Identification of components referred to in this Licensee Event Report

Components	IEEE 805 System ID	IEEE 803A Function
Recirculation System	AD	N/A
Reheat System	SB	N/A
Feedwater System	SJ	N/A
Annunciator	IB, AD, SB	LA
Valve	AD	FCV
Coupling	AD	CPLG
Transformer	AD	XPT
Reheater	AD	RHTR