Indian Point 3
Nuclear Power Plant
P.O. Box 215
Buchanan, New York 10511
914 736 8001

NewYork Power Authority

L. M. Hill
Site Executive Officer

October 13, 1995
IPN-95-103

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

SUBJECT: Indian Point 3 Nuclear Power Plant
Docket No. 50-286
License No. DPR-64
Licensee Event Report # 95-018-00
Manual Reactor Trip Initiated Due To Greater Than Allowable Differential Temperatures For The Main Generator Stator

Dear Sir:

The attached Licensee Event Report (LER) 95-018-00 is hereby submitted as required by 10 CFR 50.73. This event is the type defined in 10 CFR 50.73 (a)(2)(iv).

Also attached are the commitments made by the Authority in this letter.

Very truly yours,

L. M. Hill
Site Executive Officer
Indian Point 3 Nuclear Power Plant

LMH/vjw

Attachments

cc: See next page

IE22
1/1

cc: Mr. Thomas T. Martin
Regional Administrator
Region I
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, Pennsylvania 19406-1415

INPO Record Center
700 Galleria Parkway
Atlanta, Georgia 30339-5957

U.S. Nuclear Regulatory Commission
Resident Inspectors' Office
Indian Point 3 Nuclear Power Plant

List of Commitments

Number	Commitment	Due
IPN-95-103-01	Operations will determine if any additional actions should be required for an event in which there is a leaking generator hydrogen cooler, such as a requirement to vent the service water side of the cooler, and determine the appropriate type of administrative controls in which to incorporate the actions developed.	November 30, 1995.
IPN-95-103-02	A functional test of the hydrogen coolers will be performed after achieving 100% power.	After achieving 100% power.
IPN-95-103-03	Maintenance will evaluate the heat exchanger preventive maintenance program to ensure adequate inspections are being performed in order to preclude recurrence of leaks due to erosion/corrosion. Changes to the preventive maintenance program scope may include performance of visual inspections of heat exchanger tube ends in addition to the presently scheduled PM inspections.	February 15, 1996.
IPN-95-103-04	Engineering will review the final inspection report from the eddy current vendor. An assessment will be performed and a final report will be developed on the causes and corrective actions to prevent recurrence.	January 31, 1996.

NRC FORM 366 (5-92) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 5/31/95

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)
Indian Point 3	05000286	1 OF 6

TITLE (4) Manual Reactor Trip Initiated Due To Greater Than Allowable Differential Temperatures For The Main Generator Stator

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
09	14	95	95	-- 018 --	00	10	13	95		05000
									FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9)	N
POWER LEVEL (10)	54.4

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

	20.402(b)		20.405(c)	✓ 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)
Paul Towne, System Engineer	(914)736-6046

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
E	TK	HX	W120	N						

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

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

On September 14, 1995, at approximately 1938 hours, during a unit shutdown to repair a hydrogen leak on hydrogen cooler 32 of the main generator hydrogen cooling system, reactor operators initiated a manual reactor trip from approximately 54.4% reactor power. The trip was initiated in response to a generator stator high differential temperature alarm on the main generator system. All safeguards equipment responded as expected. The high generator stator differential temperature was caused by a reduction in service water cooling flow through hydrogen cooler 32 as a result of gas binding due to hydrogen gas leakage into the tubes of the heat exchanger. Corrective actions include repair and inspections of the hydrogen coolers, evaluation of heat exchanger preventive maintenance program to ensure adequate inspections are being performed, review and assessment of eddy current test results and development of a report on the causes and corrective actions to prevent recurrence, and determination of whether any actions for a leaking cooler should be proceduralized. This event did not affect the health and safety of the public.

DESCRIPTION OF EVENT

On September 14, 1995, at approximately 1607 hours, a unit shutdown was initiated to repair a hydrogen leak in hydrogen cooler 32 (HX) of the main generator (TB) hydrogen cooling system (TK). At approximately 1925 hours, annunciation of the Generator Stator High Temperature alarm (TA) occurred on the control room supervisory panel SEF (IB). The operators reviewed Alarm Response Procedure ARP-8 and checked the indications provided by the generator stator temperature digital datalogger (DAL) and digital-analog recorder (TR). As required by procedure, the operators confirmed the validity of the differential temperature condition on the gas discharge temperatures of the main generator stator and at approximately 1938 hours, with reactor power at approximately 54.4%, initiated a manual reactor trip.

Both reactor trip breakers opened, all rods fully inserted, and a turbine trip occurred as required. All safeguards equipment responded as required. Deviation Event Report 95-2104 was initiated by the Shift Technical Advisor (STA) and a four hour non-emergency report (No. 29333) provided to the NRC. Operations personnel initiated a post trip review (No. 95-02) and an investigation of the event. Engineering performed a review and evaluation of the problem and identified corrective actions.

The main generator is cooled by hydrogen gas through four coolers whose heat sink is service water. Hydrogen gas pressure is approximately 50 psig above service water pressure.

Resistance temperature detectors (RTD) are used to monitor the hydrogen gas temperatures. The RTDs output is converted and recorded by a Digitec datalogger and a digital-analog recorder. The Digitec datalogger is a software driven device which also receives a generator load signal from which it develops a differential temperature limit signal. The datalogger provides an output that actuates the high differential temperature alarm on the supervisory panel.

The cause of the high differential temperature alarm was assessed by engineering who determined that the hydrogen gas outlet temperature of south west hydrogen cooler 32 began to increase prior to the increase in differential gas discharge temperatures across the generator stator. Subsequently, the rate of decrease in the temperatures on the west side of the stator began to lag behind the rate of decrease in the temperatures from the east side which caused these temperatures to diverge resulting in an increase in overall differential temperature. The overall decrease in individual temperatures results from less stator core heat generation during power reduction.

The distribution of stator temperature readings between east and west sides of the stator were observed to be gradual with no spikes. A stator fault such as localized arcing or cooling tube plugging would cause only the temperatures of the affected coil to rise which was not observed. A phase imbalance would cause the temperatures for only the stator coils of the affected phase to increase. Temperature recordings for the event showed the differential temperature phenomenon affected all three phases equally. A review of recordings from the Critical Functions Monitoring System (CFMS) between 1600 hours and 2000 hours on September 14, 1995, showed no anomalies in the operation of the main generator system other than the high stator differential temperature.

Engineering concluded the high generator stator differential temperature condition was not caused by stator coil arcing, cooler tube plugging, or generator electrical phase imbalance. Engineering's assessment of the temperature distributions across the stator of the main generator showed the gas discharge temperatures from the coils were closest at the top and bottom of the stator, but furthest apart between east and west sides. Engineering concluded that the cause of the high generator stator differential temperature condition was a hydrogen gas leak into the service water side of hydrogen cooler 32 that resulted in gas binding and cooling flow reduction in the hydrogen cooler. The indicated differential temperature was approximately 9.4 degrees C which exceeded the variable procedural limit of 7 degrees C for the power level at that time.

Loss of pressure in the main generator hydrogen cooling system resulted from a leak in a tube of hydrogen cooler 32. Engineering personnel performed an eddy current inspection to determine the cause of the leak. The eddy current testing was unable to detect any severe damage in the tube, but did detect that there was some active damage mechanism operating in the tubesheet area of the tube. Because eddy current testing is "blind" in the tubesheet area due to the large masking effect of the tubesheet, and the testing found the tube condition along the length of the tube had not changed appreciably since the last inspection in 1992, a visual inspection was performed in the leaking tube.

A NYPA and a contractor metallurgist performed a visual inspection and determined that the damage appeared to be turbulence induced pitting that was confined to the inlet ends of the inlet and return passes of the heat exchanger where the flow entering the tube is turbulent. Based on the visual inspection results, eddy current testing and visual inspections were performed on all the hydrogen coolers to verify their tube condition. The inspection and testing revealed a large number of tube ends that were degraded as a result of inlet end erosion/corrosion. The heat exchangers were eddy current tested during the 1992 outage and a visual inspection was performed. However, the visual inspection was only performed on the more accessible top end of the heat exchanger, which appeared satisfactory, and assumed the bottom end would be the same. Although the preventive maintenance (PM) program contains the requirement to test and inspect heat exchangers, it does not contain an adequate scope for the hydrogen cooler heat exchangers.

Engineering reviewed the inspection results from the 1992 refueling outage and verified that all other service water heat exchangers, which were eddy current tested and could be susceptible to a similar attack, were also visually inspected at both ends during the 1992 refueling outage.

CAUSE OF EVENT

The cause of the event was a high differential temperature for the hydrogen gas discharged from the generator stator coils due to a reduction of service water cooling flow through hydrogen cooler 32. Reduced service water flow was a result of gas binding within the service water side of the heat exchanger of the hydrogen cooler. Gas binding was due to the leakage of hydrogen gas through a damaged tube in the heat exchanger into the service water. Heat exchanger tube damage was due to inlet end erosion/corrosion.

A contributing cause was an inadequate preventive maintenance program scope for the hydrogen cooler heat exchangers. The existing PM program requires leak testing and identifies eddy current testing as an acceptable method but does not specifically require visual inspections of heat exchangers in areas that are blind to eddy current testing.

CORRECTIVE ACTION

The following corrective actions have been or will be performed to address the causes identified for this event and to prevent recurrence:

- Maintenance performed troubleshooting of the leak in hydrogen cooler 32. The leaking tube in hydrogen cooler 32 was plugged. The inlet tube ends of all four hydrogen coolers were sleeved except one which could not be sleeved and was plugged. Eddy current test results were reviewed to verify that applicable tube degradation would be contained within the length of the sleeve. Repairs to the hydrogen coolers and installation testing were successfully completed on October 11, 1995.

- Operations will determine if any additional actions should be required for an event in which there is a leaking generator hydrogen cooler, such as a requirement to vent the service water side of the cooler, and determine the appropriate type of administrative controls in which to incorporate the actions developed. The determination will be completed by November 30, 1995.

- A functional test of the hydrogen coolers will be performed after achieving 100% power.

- Maintenance will evaluate the heat exchanger preventive maintenance program to ensure adequate inspections are being performed in order to preclude recurrence of leaks due to erosion/corrosion. Changes to the preventive maintenance program scope may include performance of visual inspections of heat exchanger tube ends in addition to the presently scheduled PM inspections. The evaluation will be completed by February 15, 1996.

- Engineering will review the final inspection report from the eddy current vendor. An assessment will be performed and a final report will be developed on the causes and corrective actions to prevent recurrence. The report will be completed by January 31, 1996.

ANALYSIS OF EVENT

This event is reportable under 10 CFR 50.73 (a)(2)(iv). The licensee shall report any event or condition that resulted in a manual or automatic actuation of any Engineered Safety Feature (ESF), including the Reactor Protection System (RPS). While performing a scheduled unit shutdown, a high differential temperature alarm was actuated for the main generator stator. In accordance with procedure ARP-8, the alarm data was determined to exceed limits, validated, and the reactor manually tripped.

Similar events in which there was a manual reactor trip were reported in Licensee Event Reports 95-012, 91-003. Events in which there was an automatic reactor trip were reported in Licensee Event Reports 92-015, 92-013, 91-005, 91-004.

SAFETY SIGNIFICANCE

This event did not affect the health and safety of the public. Operators took conservative action in accordance with procedures and tripped the turbine and reactor which maintained the plant within design basis. The plant is designed and analyzed for a major load loss as a result of a turbine trip. Trips, automatic control actions and alarms will be initiated by deviations of system variables within the steam and power conversion system. The reactor would have tripped from a turbine trip signal as a result of generator/electrical faults.