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New York Power Authority

Robert J. Barrett
Plant Manager

May 2, 1996
IPN-96-054

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 # 96-009-00
Manual Reactor Trip Initiated Due To Greater Than Allowable Differential Temperature For The Main Generator Stator

Dear Sir:

The attached Licensee Event Report (LER) 96-009-00 is hereby submitted as required by 10 CFR 50.73. This event is of the type defined in 10 CFR 50.73 (a)(2)(iv).

The Authority is making no new commitments in this LER.

Very truly yours,

Robert J. Barrett
Robert J. Barrett
Plant Manager
Indian Point 3 Nuclear Power Plant

Attachment

cc: See next page

070034

IE22

05-286 S

cc: Mr. Thomas T. Martin
Regional Administrator
Region I
U. S. Nuclear Regulatory Commission
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U.S. Nuclear Regulatory Commission
Resident Inspectors' Office
Indian Point 3 Nuclear Power Plant

NRC FORM 366 (5-92)

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

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

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.

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TITLE (4) Manual Reactor Trip Initiated Due To Greater Than Allowable Differential Temperature 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
										05000
04	02	96	96	-- 009 --	00	05	02	96	FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9): N

POWER LEVEL (10): 13

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)(		(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)(		
	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)
Al Froebrich, Watch Engineer	(914) 736-8206

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

	YES (If yes, complete EXPECTED SUBMISSION DATE).	✓	NO	EXPECTED SUBMISSION DATE (15)			

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

On April 2, 1996, with the plant in startup, reactor operators initiated a manual reactor trip from approximately 13 percent power. The trip was initiated in response to a generator stator high differential temperature alarm for the main turbine generator (MTG). Primary systems functioned properly. The high generator stator differential temperature was caused by a reduction in service water cooling flow through the 33 hydrogen cooler of the main generator. The reduction of cooling flow was due to gas binding in the cooling system's high point, and inadequate balance of the cooling water flow between the four coolers. Corrective actions included venting and flow balancing the coolers; revision of the MTG system operating procedure and Alarm Response Procedure for temperature balancing and venting of the coolers, setpoints, trip criteria, applicability of alarm, guidance on operation of the MTG Data Logger; trained Operators in the use of the MTG Datalogger. This event had no effect on the health and safety of the public.

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

DESCRIPTION OF EVENT

Note: The Energy Industry Identification System Codes are identified within the brackets { }

On April 2, 1996, a plant startup was in progress and prior to synchronization of the turbine to the grid, operations was investigating a main turbine generator (MTG) {TB} stator high differential temperature alarm {TA}. At approximately 1322 hours, after turbine roll the Shift Technical Advisor (STA) reviewed the MTG Datalogger {DAL} of the Turbine Supervisory Instrumentation (TSI) {IT}. The MTG Datalogger indicated the MTG stator high differential temperature alarm was locked-in with the highest reading of approximately 3.49 degrees C with a limit of 3.5 degrees C. Operations knew the alarm had been locked-in for an extended period of time prior to startup. Operations questioned the locked-in alarm without the MTG excited and determined that to clear the alarm the Datalogger must be reset. The TSI design is such that the alarm will remain locked-in until reset at the Datalogger even when alarm conditions are clear. The Shift Manager (SM) made a decision to continue with the synchronization and loading of the turbine-generator based on the belief that the stator temperatures were within specifications and converging following turbine roll. At approximately 1455 hours, Operations synchronized the turbine to the grid and increased power. At approximately 1536 hours, power was about 13 percent and Operations called I&C to reset the Datalogger. During this time, Operations was monitoring stator temperature by the MTG Temperature Recorder {TR}. During load increase, the STA reviewed the output of the recorder and Datalogger, and did not notice any change from previous readings. At approximately 1550 hours, I&C personnel arrived in the control room and reset the Datalogger, but the alarm did not clear. The Alarm Response Procedure (ARP) requires the alarm to be verified by observing the stator RTD temperatures indicated on the Datalogger. I&C notified the Control Room Supervisor (CRS) who then reviewed the Datalogger readings. The CRS observed that the readings indicated that the stator differential temperature had exceeded the ARP setpoint limit.

Operations assessed the Datalogger readings with Engineering and determined that the readings were valid and that they exceeded the limit in ARP-8, which requires a turbine trip.

At approximately 1612 hours, Operators initiated a manual reactor trip and a turbine trip occurred automatically. At the time of the reactor trip, reactor power was at approximately 13 percent, reactor coolant temperature at approximately 550 degrees F, reactor coolant pressure at approximately 2235 psig, and pressurizer level at approximately 25 percent. Operations informed the NRC at approximately 1824 hours, of a four-hour non-emergency notification (log No. 30225) reporting a manual reactor trip as a result of a high differential temperature alarm on the main generator stator.

Both reactor trip breakers opened, all rods fully inserted, and a turbine trip occurred as required. All safeguards equipment responded as required. A Deviation Event Report was initiated by the STA and Operations conducted a post trip review (No. 96-01) and an investigation of the event. Engineering performed a review and evaluation of the event, and issued a report identifying the causes and recommended corrective actions. The Independent Safety Engineering Group (ISEG) and the Tactical Assessment Group (TAG) performed a review of the basis for the decision to continue startup and synchronize to the grid with an alarm existing for the MTG stator differential temperature. A post trip review of the Datalogger indicated that the stator differential temperature was below the alarm limit at turbine synchronization with no appreciable increase up to 13 percent power, but had started diverging after reaching 13 percent power and exceeded the setpoint limit prior to the reset of the Datalogger.

The alarm that necessitated a turbine trip was the MTG stator high differential temperature alarm which is generated by a Datalogger of the turbine supervisory instrumentation. The Datalogger is a software driven device manufactured by Digitec that receives a signal from the MTG stator resistance temperature detectors (RTDs) used to monitor hydrogen gas temperatures. The MTG stator temperature signal is also sensed by a strip chart recorder. The Datalogger provides an output to the high differential temperature alarm on the Control Room Supervisory Panel, two CRTs, and a printer. The Datalogger program produces a variable differential temperature limit based on generator load and the program compares the highest stator RTD with the lowest and generates the absolute value of the difference between the two. The differential temperature limit becomes the setpoint against which the maximum measured differential temperature is compared.

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

When the measured value exceeds the limit, the Datalogger actuates the stator high differential temperature alarm and a printout of parameters at the time of the alarm.

Engineering's assessment of the event determined that the MTG cold gas outlet temperature for hydrogen cooler 33 of the MTG hydrogen cooling system {TK} was above the cold gas outlet temperatures of the remaining three hydrogen coolers, resulting in a rise in stator differential temperature. The stator temperature readings showed that the temperatures on the east side of the generator stator diverged from the west side, resulting in an increase in the overall differential temperature. The distribution of stator temperature readings at the time of the trip shows that the readings were closest at the top and bottom of the stator, but furthest apart between east and west. Engineering concluded that the high stator differential temperature was a result of inadequate cooler operation and not a stator fault.

Engineering determined that the inadequate cooler operation was a result of gas binding, and inadequate cooler flow and balancing between the four coolers. The gas binding within the cooler was attributed to entrained air and hydrogen gas intrusion into the cooler's service water system. Engineering determined the gas intrusion was not a result of a fault in the 33 hydrogen cooler, but due to leakage and migration within expected limits during stagnant flow conditions. Engineering observed smaller amounts of gas that were vented from the other three coolers. Engineering's assessment concluded that the low supply flow of the hydrogen cooler's service water was due to the cooler service water flows being governed by a discharge header temperature control valve which responded to the low generator load condition and cold service water by throttling the temperature control valve almost closed. The reduced service water flow in hydrogen cooler 33 and inadequate flow balancing caused decreased heat transfer resulting in a higher gas outlet temperature from cooler 33. When the cooling for hydrogen cooler 33 was reduced, the measured temperatures diverged and exceeded the alarm setpoint. The annunciator on the control room supervisory panel for the MTG stator differential temperature alarm was set to actuate when the Datalogger senses a stator differential temperature that is above a ramp of 3.5 to 6.9 degrees C between 0 and 100 percent generator load respectively, or if the stator differential temperature is above 8 degrees C at any time. At the time of the reactor trip, readings of the Datalogger indicated a differential temperature of 6.8 degrees C with a setpoint of approximately 3.7 degrees C. An alarm signal was initiated when the differential temperature limit was exceeded.

The ISEG/TAG's assessment of management's decision to continue startup with an alarm up determined that there was a reasonable basis for the decision. Operators appropriately entered procedure ARP-8 when the stator high differential temperature alarm did not clear as expected after the turbine was brought up to speed. Datalogger readings showed that prior to turbine roll the differential temperature was approximately 5.5 degrees C. Subsequent to the turbine roll and prior to synchronization the differential temperature decreased to 3.49 degrees C, with an alarm setpoint limit of 3.5 degrees C. A review of operator actions and responses to ARP-8 indicated that required actions listed in ARP-8 were performed by the operators. However, three steps were not done at the time operations decided to continue startup; to vent the coolers, to request I&C to verify calibration of the RTDs, and to reset the alarm on the datalogger. The alarm was locked-in prior to startup and per the ARP was being investigated. Operations did not vent the coolers at the time because the coolers had been vented on the previous shift and the recorder temperatures indicated that temperatures were converging. Operations did not request I&C to verify calibration of the RTDs, because the RTD recordings indicated that the individual RTDs used in the alarm function appeared to be indicating satisfactorily. ARP-8 requires the condition that brought up the alarm to be cleared prior to resetting the alarm. Operators did not attempt to reset the datalogger because they believed an alarm condition existed due to a section of the datalogger being out of service (blank Datalogger CRT). The ARP requires that I&C be notified for a failed Datalogger.

After the trip Operations confirmed that they had vented the hydrogen coolers on April 1 and earlier on the day of the trip. During turbine startup operators had to make multiple service water adjustments to the hydrogen coolers. Post trip, operations vented the 33 cooler and observed the differential temperature decrease and return to approximately the same as the other coolers. Operations verified that service water line up to the hydrogen coolers was in accordance with valve Check Off List procedure COL-RW-2 and that venting was performed. Venting is required by the MTG System Operating Procedure SOP-TG-4.

The position of the outlet valves that control service water from each of the hydrogen coolers were full open in accordance with procedure COL-RW-2 (Revision 27). The service water from the coolers is discharged to a header that contains a temperature control valve (TCV). The temperature of the service water for all four coolers is maintained by a temperature control loop which monitors hydrogen gas temperature in the MTG and controls the position of the TCV.

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TCV controls the combined outlet of the four hydrogen coolers and assures generator cold gas temperatures do not exceed a specified limit. A post trip check verified proper operation of the TCV.

CAUSE OF EVENT

The cause of the event (manual reactor trip) was a required operator action to an alarm for a high differential temperature of the hydrogen gas discharged from the generator stator coils. The high differential temperature of the hydrogen gas was due to gas binding within the 33 hydrogen cooler and a reduction of service water flow through hydrogen cooler 33 as a result of inadequate cooling water flow balance between the four hydrogen coolers. Lack of operator knowledge of the Datalogger contributed to the event. The inadequate venting and cooling flow balancing of the hydrogen coolers was caused by the omission of relevant information in written communication (procedures). The system operating procedure for the MTG did not contain adequate guidance for hydrogen cooler venting and service water flow balancing. The alarm response procedure for the stator high differential temperature did not have adequate guidance to determine if limits were exceeded, to trip the reactor/turbine, to determine the cause of the alarm, and to clear the alarm by venting and balancing the coolers. Operators had no procedural guidance for operation of the Datalogger.

CORRECTIVE ACTIONS

The following corrective actions have been performed to address the causes of the event:

- Procedure SOP-TG-4 was revised to include the following changes:
  - Added requirement to balance the generator hydrogen cooler outlet temperatures by venting and adjusting the hydrogen cooler outlet service water isolation valves so that outlet temperatures are within specified limits and approximately equal.
  - Added specific cooler venting criteria to ensure additional venting is performed to assure that all of the gases have been evacuated from the coolers.

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

- ▲ Added guidance for monitoring generator stator temperatures and their limits, require verification that hydrogen cooler gas outlet temperatures are within normal limits, and requires balancing and venting when not within limits.

- ▲ Added guidance for the operation of the MTG RTD Datalogger.

- A lesson plan was developed for the MTG Datalogger and Operators trained on its functions and operator responsibilities when using it.

- Procedure COL-RW-2 was revised to require that each hydrogen cooler outlet isolation valve be positioned in accordance with the requirements of procedure SOP-TG-4.

- Alarm Response Procedure ARP-8 was revised as follows:

  - ▲ Added guidance and clarified procedure steps for determining if limits have been exceeded and clarified actions for tripping the reactor and turbine.

  - ▲ Added guidance for determining the cause of an alarm and clearing by reference to procedure SOP-TG-4 for venting and balancing the MTG hydrogen coolers.

  - ▲ Revised step to address tripping the reactor when permissive P-7 is not illuminated and transitioning into Emergency Operating Procedure E-0, and tripping of the turbine when permissive P-7 is illuminated without directing the user to E-0.

  - ▲ Added that a failure of the Datalogger's large CRT is not a MTG Datalogger failure.

  - ▲ Added to the alarm verification requirement guidance concerning when the high temperature alarm is not applicable, when to go to procedure SOP-TG-4 to determine cause and to clear the alarm by ensuring coolers are vented, flow is balanced, and the service water temperature control valve is operating properly.

  - ▲ Added requirement to reduce load to decrease generator stator differential temperature and clear alarm when the alarm is caused by a differential temperature between any two valid stator RTD indications.

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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 an Engineered Safety Feature (ESF), including the Reactor Protection System (RPS). During plant startup, a high differential temperature alarm on the main generator stator was assessed by operations and determined to be valid and exceeded the procedural limit. The Alarm Response Procedure (ARP-8) requires a turbine trip. Operations initiated a manual reactor trip and a trip of the turbine occurred automatically.

A review of Licensee Event Reports (LERs) for the past three years for similar events in which there was a manual reactor trip identified LERs 95-018, and 95-012. LER-95-018 was for a similar event where hydrogen gas binding caused reduced cooling in the 32 hydrogen cooler which resulted in a stator high differential alarm. However, the gas binding was caused by a cooling tube failure. The reactor was tripped due to a high stator differential temperature alarm during a unit shutdown to repair the cooler.

SAFETY SIGNIFICANCE

This event had no effect on the health and safety of the public. Operators took conservative action in accordance with procedures and tripped by tripping the reactor. The plant is designed for a reactor and 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 or manual operator action. The plant is analyzed for a major load loss as a result of a turbine trip. Engineering determined that the generator stator high differential temperature alarm condition, when caused by a malfunctioning or unbalanced hydrogen cooling system, will not damage the generator stator.