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DAHLBERG,K.A. Niagara Mohawk Power Corp.
RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 95-002-00:on 950130,TS required shutdown completed & testing of Div II EDG governor revealed facility operating outside design basis due to design deficiency.Div I EDG governor & governor oil replaced.W/950301 ltr.

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March 1, 1995
NMP2L 1527

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

RE: Docket No. 50-410
LER 95-02

Gentlemen:

In accordance with 10CFR50.73 (a)(2)(i)(A) and (a)(2)(vii), we are submitting LER 95-02, "Technical Specification Required Shutdown, Operation Outside of the Design Basis, and Potential Common Cause Failure of the Emergency Diesel Generators Caused by a Design Deficiency."

Telephone reports of this event were made in accordance with 10CFR50.72 (b)(1)(i)(a) at 1228 hours on January 29, 1995 and in accordance with 10CFR50.72 (b)(1)(ii)(B) at 1140 hours on February 13, 1995.

Very truly yours,

K. A. Dahlberg
Plant Manager - NMP2

KAD/JTP/lmc
Attachment

xc: Mr. Thomas T. Martin, Regional Administrator, Region I
Mr. Barry S. Norris, Senior Resident Inspector

080004



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NRC FORM 366 (6-89)

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMB NO. 3150-0104
EXPIRES: 4/30/92

ESTIMATED BURDEN PER RESPONSE TO COMPLY WTH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

# 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 8 |

TITLE (4) Technical Specification Required Shutdown, Operation Outside of the Design Basis, and Potential Common Cause Failure of the Emergency Diesel Generators Caused by a Design Deficienc

| 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 NAMES | DOCKET NUMBER(S) |
| 0 1 | 3 0 | 9 5 | 9 5 | — 0 0 2 | — 0 0 | 0 3 | 0 1 | 9 5 | N/A | 0 5 0 0 0 |
| | | | | | | | | | N/A | 0 5 0 0 0 |

| OPERATING MODE (9) | 1 | THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11) | | | | | |
|---|---|---|---|---|---|---|---|
| POWER LEVEL (10) | 1 0 0 | 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) | X 50.73(a)(2)(vii) | OTHER (Specify in Abstract below and in Text, NRC Form 366A) | | |
| | | 20.405(a)(1)(iii) | X 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 |
| Mr. Raymond J. Dean, Manager Technical Support NMP2 | 3 1 5 3 4 9 - 4 2 4 0 |

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 | |
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| X | E K | 0 0 6 5 | W 2 9 0 | Y | | | | | | | |
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| 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)


On January 26, 1995, at 12:35 hours, Nine Mile Point Unit 2's (NMP2) Division I Emergency Diesel Generator (EDG) was declared inoperable and a Limiting Condition of Operation (LCO) was entered after it failed its monthly Technical Specification (TS) required surveillance test. Repairs could not be completed before the 72-hour LCO expired, so NMP2 initiated a TS required plant shutdown at 1225 hours on January 29, 1995. At this time, NMP2 was operating at approximately 100% rated core thermal power. At 1241 hours, the Division II EDG was declared inoperable when, during the performance of troubleshooting, the EDG had to be manually shut down and was not available to automatically restart. An Unusual Event was declared because both EDGs were inoperable. NMP2 entered Mode 3, "Hot Shutdown" at 0023 hours on January 30, 1995, thus completing the TS required shutdown. Further investigation of the Division I governor failure and subsequent testing of the Division II EDG governor revealed, at 1140 hours on February 13, 1995, that NMP2 was operating outside of its design basis.

The preliminary root cause of this event is an inadequate design. Governor operating temperatures exceeded the manufacturer's specifications because of a design deficiency in the cooling water piping to the governor cooler.

The EGB actuator and the governor oil were replaced for both the Division I and the Division II EDGs. Cooling water tubing to both governor coolers was modified to increase cooling water flow through the coolers. The EGB actuators and governor oils were sent to the manufacturer for further analysis.

## I. DESCRIPTION OF EVENT

On January 26, 1995, at 12:35 hours, Nine Mile Point Unit 2's (NMP2) Division I Emergency Diesel Generator (EDG) was declared inoperable and a Limiting Condition of Operation (LCO) was entered after it failed its monthly Technical Specification (TS) required surveillance test. Repairs could not be completed before the 72-hour LCO expired, so NMP2 initiated a TS required plant shutdown at 1225 hours on January 29, 1995. At this time, NMP2 was operating at approximately 100% rated core thermal power. At 1241 hours, the Division II EDG was declared inoperable when, during the performance of troubleshooting, the EDG had to be manually shut down and was not available to automatically restart. The Division II EDG remained inoperable because of governor temperature concerns. An Unusual Event was declared because both EDGs were inoperable. NMP2 entered Mode 3, "Hot Shutdown" at 0023 hours on January 30, 1995, thus completing the TS required shutdown. Further investigation of the Division I governor failure and subsequent testing of the Division II EDG governor revealed, at 1140 hours on February 13, 1995, that NMP2 was operating outside of its design basis.

On January 26, 1995 at 1235 hours, with NMP2 operating at approximately 100% rated thermal power, the Division I EDG, 2EGS*EG1, failed to satisfy the acceptance criteria of the Operations Surveillance Procedure, N2-OSP-EGS-M@001, "Diesel Generator and Diesel Air-Start Valve Operability Test - Division I and II." While running the diesel for surveillance testing, with the diesel generator fully loaded at approximately 4400 KW, for approximately 15 minutes, a reverse power condition occurred. The diesel output breaker was ordered tripped open as a result of the reverse power condition. When the output breaker was tripped open, the diesel automatically shutdown. Operators declared the Division I EDG inoperable, and LCO 3.8.1.1, "AC Sources - Operating" was entered, which requires that the inoperable diesel generator be restored to operable status within 72 hours or be in at least Hot Shutdown within the next 12 hours and in Cold Shutdown within the following 24 hours. After the Division I EDG failure, the Division II EDG was satisfactorily tested per Technical Specifications.

To troubleshoot the problem, the Division I EDG was run unloaded with instrumentation to monitor the 2301 electronic board portion of the governor. Approximately two hours into the run, the EDG experienced frequency oscillations and automatically tripped. A review of the data indicated the most probable cause was the 2301 electronic board, but a subsequent review indicated that the problem might extend to the hydraulic portion of the governor, the "EGB actuator." Only the 2301 electronic board was replaced due to the availability of parts, and the EDG was run unloaded for tuning and testing of the 2301 electronic board. Approximately two hours into the run, the EDG exhibited similar frequency oscillations and automatically tripped, eliminating the 2301 electronic board as the only failed component.

Further troubleshooting involved the EGB actuator portion of the governor. The temperature of the governor case was measured at 226 degrees Fahrenheit (F) and thought to be excessive. The case temperature is measured and according to the manufacturer, the governor oil temperature is 10 degrees F higher. With the EDG shutdown in standby, cooling water flow to

## I. DESCRIPTION OF EVENT (Cont'd.)

the EGB actuator was checked, by disconnecting the tubing, and believed to be adequate. The EGB actuator was replaced, and the system engineer determined that per the Woodward (governor manufacturer) manual, the maximum operating oil temperature for the EGB actuator Mobil DTE-Medium oil is 200 degrees F. The EDG was run for tuning and testing. Upon observing the governor case temperature was approaching 200 degrees F, the system engineer requested a normal shutdown of the EDG. During the normal shutdown process, the case temperature rapidly increased to 222 degrees F. As a result, the EDG was shutdown using the emergency stop pushbutton.

Maintenance inspected the governor cooler to verify that no blockage existed in the tubing, and installed flow instrumentation. The EDG was run again to gather data on governor cooling water flows. The data indicated that at high temperatures the governor cooler was not receiving adequate cooling water flow.

The Division II EDG was then run to determine its temperature profile. The temperature data indicated a governor case temperature up to 242 degrees F. Based on the elevated temperatures and the fact that the cooling water supply lines were not blocked, the inadequate flow through the cooler appeared to be caused by an inadequate pressure differential across the cooler. The inadequate pressure differential allowed water within the cooler to flash to steam which caused unstable/inadequate cooling water flow.

At 1225 hours on January 29, 1995, as the LCO for the Division I EDG was about to expire, operators commenced a normal reactor shutdown. An attempt was made to perform a normal shutdown of the Division II EDG, but was unsuccessful because of an unrelated failure in the engine's pneumatic control system. At 1241 hours, the Division II EDG was declared inoperable because, while attempting to manually shut down the EDG, the LOCA bypass switch was placed in bypass, preventing the EDG from automatically starting. The EDG remained inoperable because of the elevated governor temperature. An Unusual Event was declared because both the Division I and Division II EDGs were inoperable. NMP2 entered Hot Shutdown at 0023 hours on January 30, 1995, thus completing the required plant shutdown. The Unusual Event was terminated at 1210 hours on January 30, 1995 after NMP2 reached Cold Shutdown.

Further investigation of the Division I governor failure and subsequent testing of the Division II EDG governor revealed that NMP2 was operating outside of its design basis since initial plant startup because the governor temperatures would not have allowed the EDGs to maintain required loads for extended periods of time. According to the Woodward governor manual, the recommended operating range for the EGB actuator is 140-200 degrees F oil temperature. Temperatures of the Division I and II EGB actuator cases were monitored to be 226 degrees F and 242 degrees F, respectively. Discussions with the manufacturer established that Woodward

## I. DESCRIPTION OF EVENT (Cont'd.)

Governor Company considered the EGB actuators unreliable at governor oil temperatures above 200 degrees F.

According to engineering calculation "Safety Related System Post Accident Operability Times," NMP2 EDG testing requirements are based on 30 days of operation following an accident. For the emergency diesel generator systems (including the Division III EDG) and diesel generator ventilation, the operability period is based on the assumption of restoring offsite power within 30 days, or affecting repairs within 30 days of the accident. Due to the elevated EGB actuator temperatures measured during the investigation of this event, long term reliability of either governor could not be assured. For this reason, it was concluded that NMP2 was operating outside its design basis.

## II. CAUSE OF EVENT

The root cause of this event is an inadequate design. Governor operating temperatures exceeded the manufacturer's specifications because of a design deficiency in the cooling water piping to the governor cooler. The design did not provide enough cooling flow to the governor cooler.

The failed EGB actuators and governor oil from both Division I and II EDGs were sent to the manufacturer for further failure analysis to obtain details on the failure mode. An additional root cause evaluation will be completed following the manufacturer's testing and any significant changes to the root cause will be provided, if necessary, in a supplement to this Licensee Event Report (LER).

Contributing causes to this event were:

1. Ineffective managerial methods (management followup did not identify problems). The first recorded Division I EDG governor failure occurred during initial plant startup testing, in 1986. No formal root cause analysis program, such as the one presently in use, existed at that time. A newer model governor was recommended for replacement by the manufacturer which contained several improvements over the original design providing more reliable service over a broader temperature range. For this reason, it was assumed that the failure could be attributed to the old model governor, which was simply replaced with the new model.

2. Inadequate root cause evaluation (management followup did not identify problems). The Division II EDG governor failed in 1992. Again, because of the upgrades to the design of the replacement governor, no formal root cause evaluation was performed. The apparent root cause was noted as the old governor design which would be corrected with the upgraded replacement.

## III. ANALYSIS OF EVENT

This event is reportable in accordance with 10CFR50.73(a)(2)(i)(A), "the completion of any nuclear plant shutdown required by the plant's Technical Specifications," and 10CFR50.73(a)(2)(vii), "any event where a single cause or condition caused at least one independent train or channel to become inoperable in multiple systems...designed to...mitigate the consequences of an accident."

The plant onsite AC power system has a standby AC power system to provide power supply for operation of the plant emergency systems and engineered safety features during and following the emergency shutdown of the reactor, in the event of a LOCA and loss of offsite power, or any other Design Basis Accident (DBA) and loss of offsite power. The standby AC power system consists of three standby diesel generators, one dedicated to each of the two independent divisions of the plant emergency distribution system, and the third is dedicated to the High Pressure Core Spray System (HPCS).

In the event of a loss of offsite power or degraded offsite voltage condition, the diesel generators automatically start, accelerate to rated speed, voltage, and frequency, and pick up loads sequentially. In case of unavailability of any one diesel generator, the remaining two diesel generators will be capable of feeding all the loads necessary for safe shutdown of the unit in the event of any DBA and loss of offsite power.

The operating histories of both the Division I and Division II EDGs were evaluated. The Division II EDG had a cumulative run time of 22 days before its governor failed and was replaced in June of 1992. Similarly, the Division I EDG had a cumulative run time of 28 days before this most recent governor failure and replacement. It should be noted that the newer design governor lasted for 28 days while the original design lasted for 22 days. From these two data points and the fact that both EDGs consistently passed their 24 hour full load runs each refueling cycle, NMP2 is confident that the new design governor previously installed in the Division II EDG with approximately 10 days of accumulated service time would function, if required, a minimum of 24 hours at full load. Therefore, NMP2 has concluded that in the unlikely event of a DBA with the Division I EDG inoperable and the Division II EDG governor experiencing elevated operating temperatures, the Division II EDG would have operated for at least 24 hours.

Using the 24 hour minimum run time of either the Division I or Division II EDG with the other failed, NMP2 calculated the change in core damage frequency using the NMP2 Individual Plant Examination (IPE). The resultant change from 5.5E-6 per year to 5.7 E-6 per year was not significant. The probability of restoring an offsite power line to NMP2 was also evaluated from the IPE. There is a 98 percent probability that one offsite source of electrical power would be restored within 24 hours.

## III. ANALYSIS OF EVENT (Cont'd.)

Finally, in the extremely unlikely event that a DBA occurred, offsite power was not restored, the failed governor was not replaced and Division II EDG governor failed after 24 hours of loaded operation following the DBA, the core would already be cooled down. Using Station Blackout Special Operating Procedures N2-SOP-01 and N2-SOP-02, the operators can maintain core cooling with the unaffected Division III (HPCS) EDG, a Service Water pump and the diesel driven fire pump with no other sources of AC electrical power. The Division III EDG is a completely different design, manufactured by General Motors, and does not use the same governor design as the Division I and II EDGs.

Therefore, based on an insignificant increase in core damage frequency if at least one EDG operates for 24 hours following a loss of offsite power, the high probability of restoring offsite power within 24 hours, and the other defense-in-depth measures to provide for core cooling, the event described in this LER did not have the potential to significantly affect the health and safety of the public or plant workers.

Division I EDG testing was done and the diesel was available at 0142 hours on February 1, 1995, and was declared operable at 0150 hours on February 2, 1995. The Division II EDG testing was done and the diesel was available at 2123 hours on February 1, 1995, and was declared operable at 0045 hours on February 2, 1995.

## IV. CORRECTIVE ACTIONS

The following corrective actions were taken:

1. The EGB actuator portion of the Division I EDG governor and the governor oil were replaced. Because the Division II EDG governor was also operating at a high temperature, its EGB actuator and governor oil were replaced.

2. The governor cooler's cooling water tubing for both the Division I and Division II EDGs were modified by rerouting the discharge lines of the governor coolers to the engine jacket water discharge line. This change provided sufficient differential pressure to maintain the governor oil within the vendor recommended temperature range of 140-200°F.

3. Upon completion of maintenance and the modification, the Division I and Division II EDGs were satisfactorily tested.

4. The monthly surveillance procedure N2-OSP-EGS-M@001, "Diesel Generator and Diesel Air-Start Valve Operability Test - Division I and II," has been revised to record governor temperatures with a pyrometer.

## IV. CORRECTIVE ACTIONS (Cont'd.)

5. The apparent root cause performed for the Division II EDG governor replacement in 1992 was reviewed with the personnel involved. Those personnel were counseled on the expectation that root cause evaluations are sufficiently detailed to identify the true root cause for equipment failures.

6. Since 1992 the process of evaluating the root cause of operational events has steadily improved. These improvements include: several distinct improvements to the root cause evaluation process; inclusion of root cause evaluation in the Deviation/Event Reporting (DER) process; and improved trending of deviations and their causes. Because of these improvements the cause of the failed Division I EDG governor on January 26, 1995 was discovered.

Future corrective actions are:

1. The failed Division I EGB actuator and governor oil and Division II's EGB actuator and governor oil were sent to the manufacturer for further failure analysis to more clearly define the cause of the event. A formal root cause evaluation will be completed following manufacturer's testing.

2. A review of all EDG operating parameters will be performed to determine if other critical temperatures should be trended as part of the EDG reliability program. This will be completed by June 30, 1995.

## V. ADDITIONAL INFORMATION

A. Failed component:

The EGB actuator portion of the Woodward governor on Division I's diesel generator. The Woodward model number is EGB50 P/LS, and the Cooper-Bessemer part number is 2-02G-048-001.

B. Previous similar events:

NMP2 has experienced two (2) previous events that involved inoperability of both Division I and Division II EDGs. LER 88-44, Supplement 1 describes an event where a common mode failure of non-category IE component could disable the category IE emergency start/stop circuit. LER 88-65, Supplement 1 describes an event where non-safety related post-lube pilot valves had been installed in the safety related lube oil systems of both Division I and II EDGs. The corrective actions from these LERs would not have prevented this event.

## V. ADDITIONAL INFORMATION (Cont'd.)

C. Identification of components referred to in this LER:

| COMPONENT | IEEE 803 FUNCTION | IEEE 805 SYSTEM ID |
|---|---|---|
| Emergency Diesel Generator | DG | EK |
| Diesel Generator Governor | 65 | EK |
| Governor Cooler | CLR | EK |