Omaha Public Power District
444 South 16th Street Mall
Omaha, Nebraska 68102-2247
402/636-2000

November 30, 1995
LIC-95-0221

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station P1-137
Washington, DC 20555

References: 1. Docket No. 50-285
2. Letter from OPPD (T. L. Patterson) to NRC (Document Control Desk) dated September 22, 1995 (LIC-95-0175)
3. Letter from OPPD (T. L. Patterson) to NRC (Document Control Desk) dated October 2, 1995 (LIC-95-0191)

Subject: Licensee Event Report 95-006 Revision 01 for the Fort Calhoun Station

Please find attached Licensee Event Report (LER) 95-006 Revision 01 dated November 30, 1995. This revision provides additional information regarding the implications of the start of a diesel at the Fort Calhoun Station to full speed. Revisions to the Abstract and Text are denoted by vertical lines in the right margin.

This event no longer meets any of the reporting criteria. However, this report is being submitted voluntarily. If you should have any questions, please contact me.

Sincerely,

T. L. Patterson
Division Manager
Nuclear Operations

TLP/epm

Attachment

c: Winston and Strawn
L. J. Callan, NRC Regional Administrator, Region IV
L. R. Wharton, NRC Project Manager
W. C. Walker, NRC Senior Resident Inspector
INPO Records Center

IE22

NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 4/30/98

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO THE INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), 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)
Fort Calhoun Station Unit No. 1	05000285	1 OF 7

TITLE (4)
Improper Start of Number 1 Diesel Generator to Full Speed on a Reactor Trip

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
08	24	95	95	-- 006 --	01	11	30	95	FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9)	1
POWER LEVEL (10)	100

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

	20.2201(b)		20.2203(a)(2)(v)		50.73(a)(2)(i)		50.73(a)(2)(viii)
	20.2203(a)(1)		20.2203(a)(3)(i)		50.73(a)(2)(ii)		50.73(a)(2)(x)
	20.2203(a)(2)(i)		20.2203(a)(3)(ii)		50.73(a)(2)(iii)		73.71
	20.2203(a)(2)(ii)		20.2203(a)(4)		50.73(a)(2)(iv)	X	OTHER
	20.2203(a)(2)(iii)		50.36(c)(1)		50.73(a)(2)(v)		(Specify in Abstract below or in NRC Form 366A)
	20.2203(a)(2)(iv)		50.36(c)(2)		50.73(a)(2)(vii)		Voluntary

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Erick P. Matzke, Station Licensing Engineer	(402) 533-6855

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

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 15 single-spaced typewritten lines) (16)

On August 24, 1994, at 1114, the Fort Calhoun Station experienced a reactor trip. The reactor trip provided a start signal to the diesel generators (DG-1 and DG-2) as designed. While DG-2 started to idle speed (500 rpm) as designed, DG-1 started to full speed (900 rpm). An initial operability evaluation for DG-1 determined that the diesel had been inoperable for the eight (8) day period prior to the reactor trip due to the inability of the 480V load center load shed relays to perform their design function. Additional engineering analysis has determined that the 480V load center load shed relays could have performed their design function, and therefore, the diesel was operable during that eight (8) day period. The reactor trip is addressed in LER 95-005.

The causes of this event are 1) the operator appears to have operated the generator voltage regulator control switch instead of the governor control switch during the previous surveillance test, 2) there were inadequate administrative controls on this critical parameter, and 3) there is no indication of governor position.

Corrective actions include providing additional administrative controls to ensure that the governor is operated correctly, installation of a modification to provide a positive means of governor indication to the operators, and updating design and training documentation.

BACKGROUND

The Fort Calhoun Station (FCS) Emergency Diesel Generators (DG-1 and DG-2) are designed to furnish a reliable source of 4160 VAC power for safe plant shutdown and for operation of Engineered Safeguards equipment. The diesel generators will energize the Engineered Safeguards buses on either a total Loss Of Off-site Power (LOOP) or a degraded voltage condition concurrent with an accident requiring Safety Injection. The degraded voltage protection logic is referred to as the Off-site Power Low Signal (OPLS). The diesel generators are normally aligned in a standby mode. They are ready to automatically start, come up to rated speed and voltage, and energize the Engineered Safeguards buses when required.

The diesel generators will automatically start and accelerate to idle speed (500 rpm) on any of the following signals 1) reactor trip, 2) containment pressure high signal, 3) pressurizer pressure low signal, 4) manual initiation of safeguards or 5) selecting a diesel start test switch to idle speed. There are three signals that will accelerate the diesel generators to full speed (900 rpm) following an automatic start signal; 1) initiation of either the "A" or "B" channels of OPLS, 2) low voltage on the 4160 VAC safeguards buses, 3) a diesel start test switch selected to full speed. Additionally, if the governor speed control is left in a position other than the lower stop, the diesel will accelerate to a speed other than the idle speed if the diesel receives any idle speed start signal.

Load shed circuitry is in place to maintain diesel generator loading within the engine load limits. In the unlikely event of a Loss of Coolant Accident (LOCA) and a LOOP, the following five load shed circuits must operate to trip sufficient loads to allow automatic loading of the Emergency Diesel Generators and maintain initial loading within the engine loading limits:

1. OPLS 4160 VAC Load Shed trips all 4160 VAC loads except the 4160 VAC/480 VAC transformers using auxiliary relays which are actuated by the OPLS lockout relays. The OPLS 4160 VAC load shed can be considered an instantaneous load shed (the only time delay being the time required for the relay/breaker to operate).

2. OPLS 480 VAC Load Shed trips selected 480 VAC loads using auxiliary relays, actuated by the OPLS lockout relays, located in the 480 VAC Safety Injection Actuation Signal (SIAS) Load Shed panels. OPLS 480 VAC load shed can be considered an instantaneous load shed (the only time delay being the time required for the relay/breaker to operate).

3. 480 VAC SIAS Load Shed operated by the SIAS lockout relays load sheds selected 480 VAC loads using auxiliary relays located in the 480 VAC SIAS Load Shed panels. The SIAS 480 VAC load shed can be considered an instantaneous load shed (the only time delay being the time required for the relay/breaker to operate).

4. Loss of voltage to selected MCC contactors results in seal-in circuits being deenergized. The loads are prevented from restarting when the Diesel Generator reenergizes the MCC. Contactor dropout can be considered an instantaneous load shed (the only time delay being the time required for the contactor to operate).

5. 480 VAC Load Center Load Shed operates using a time verses voltage undervoltage relay and a fixed time delay relay to initiate load shed via auxiliary relays.

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

Data contained in engineering analysis, EA-FC-93-027, "Loss of Voltage IAV Relay Setpoints" (the initials "IAV" meaning undervoltage) shows a time delay to trip of a breaker of 3.15 seconds (worst case including uncertainties).

DETAILED EVENT DESCRIPTION

Fort Calhoun Station was operating at 100% power on August 24, 1995, when the reactor tripped. The reactor trip is detailed in LER 95-005. On a reactor trip, DG-1 and DG-2 both receive an auto-start signal to start the engines and accelerate them to idle speed. Both diesel generators started as designed, however, DG-1 accelerated to full speed. After recovery actions were completed, the control room operators performed a normal shutdown of DG-1.

A review of the post trip sequence of events records from the plant computer found no indication of initiation of either the "A" or "B" channels of OPLS during this event. In addition, there was no evidence of a 4160 VAC undervoltage condition during the event.

Since an acceleration signal is not sealed in for a bus undervoltage condition, the low voltage condition would have had to exist for the seven seconds (approximate time) that it takes for the diesel to accelerate from idle speed to full speed. Thus, if an inadvertent or transient signal was only briefly present the diesel generator would not have had time to accelerate to full speed. Therefore, it may be concluded that, the loss of voltage relays was not responsible for accelerating DG-1 to 900 rpm.

A full speed test is actuated by a manually operated key lock test switch (43-2A/D1 or 43-2B/D1) on the diesel control panel (AI-30A). Operator action is required to initiate this start, and would only be performed if the diesel generator failed to auto start.

Since the cause of the full speed start could not be readily identified, MWO 952826 was initiated to troubleshoot the diesel generator governor control circuitry. As part of the troubleshooting effort, the engine was given an idle speed start signal and verified to accelerate to idle speed. The engine was then manually accelerated to 900 rpm and loaded. All engine parameters were normal. The engine was then unloaded and shut down normally. The governor controls worked as designed and no problems were noted. The diesel was then started per OP-ST-RPS-0008, "Reactor Manual Trip Test," which initiates a reactor trip auto start signal. The engine started and accelerated to idle speed as designed.

Following each shutdown of the diesel engines, there is a procedural step that requires the governor control switch be held in the "LOWER" position for at least 15 seconds. This step ensures that the governor is set up for an idle speed start the next time it is run. If this step were omitted, the engine would automatically accelerate to full speed on any start signal. Discussions with operations and engineering personnel indicate that the step to run down the governor was included in plant procedures to reduce the rate of wear on the engine due to starting it to fast speed. More detailed consideration of the interaction of plant equipment has raised the concern of the ability of the diesel to perform its intended safety function after a full speed start under certain conditions.

Prior to the August 24, 1995 incident, DG-1 had last been run on August 16, 1995,

for its normal monthly surveillance test. A review of the completed test procedure showed that the step to run the governor to its idle speed position had been signed off. It is suspected that the step may have been inadvertently performed on the diesel generator voltage regulator switch, which is identical to the governor control switch. The switches are next to each other. Both switches are used during the monthly surveillance test. At the end of the test, only the governor switch is required to be operated in the "LOWER" position.

If the voltage regulator control switch were operated in the "LOWER" position instead of the governor control switch, the following events would occur the next time the diesel generator was started.

1. The diesel would accelerate to the same speed (frequency) that it had the last time that it had been running.

2. The generator output voltage would be at a lower voltage than the last time it had been operating.

The physical evidence that suggests that the voltage regulator switch was mispositioned when DG-1 was last run is as follows:

1. The diesel was shut down from a frequency of between 59.5 and 59.7 Hz. Following the plant trip, DG-1 started and accelerated to nearly the same frequency, 59.3 to 59.7 Hz, suggesting the governor switch had not been adjusted after the last diesel run. Following an actual emergency start, the diesel generator would be accelerated to its emergency speed setting of about 61.7 Hz.

2. The diesel generator was shut down from a voltage setting of between 4180 and 4200 VAC. Following the plant trip, DG-1 came up to a voltage of between 3952 to 3995 VAC, providing additional evidence that the voltage control switch may have been adjusted in the "LOWER" direction, instead of the governor control switch.

An interview was held with the operator in charge of performing the diesel generator surveillance test. The operator is familiar with the procedural requirement to hold the governor control switch in the "LOWER" position for at least 15 seconds. The operator was confident that he had operated the proper switch, but, stipulated that the physical evidence pointed to the contrary.

Following the event an analysis was performed to determine if DG-1 was inoperable over the period of time when the governor was last run to its full speed position until the reactor trip occurred (08/16/95 through 08/24/95). The results of the analysis were presented to the Plant Review Committee (PRC) on August 28, 1995. The analysis concluded that if a diesel generator was at full speed prior to the initiation of load shed by the OPLS circuitry under degraded voltage conditions, the 480 VAC load centers would be re-energized by the diesel generator before operation of the 480 VAC load center load shed time delay relay. This would cause the 480 VAC safeguards and non-safety related loads to be picked up as dead loads. This analysis, when applied to existing design basis accident analysis, concluded that there was a reasonable probability that the diesel generator would not be able to successfully operate the loads required for a design basis event in this abnormal condition. The loading of normally sequenced Engineered Safeguards and non-safety related loads and dead loads is considered to be a condition outside the plant

design basis.

The PRC concurred with the conclusion of the analysis at 1552. A one-hour non-emergency notification was made to the NRC on August 28, 1995, at 1644 pursuant to 10 CFR 50.72(b)(1)(ii)(B).

Engineering analysis (EA-FC-95-027 "Diesel Generator Offnormal Loading Due to a Full Speed Start ETP-6.5-DGT") was performed to determine the operability of DG-1 during the period in question. The analysis assessed the ability of the diesel to accelerate the 4160V and 480V Engineered Safety Feature (ESF) loads following a design basis Loss Of Coolant Accident (LOCA) with a subsequent degraded grid voltage. The analysis concluded that DG-1 was operable under the conditions discovered on August 24, 1995.

The sequence of events modeled were those associated with the automatic ESF response to a Large Break LOCA followed by an Offsite Power Low Signal (OPLS) actuation due to a degraded offsite power condition. The OPLS was assumed to occur after the final ESF load on ESF Train A had begun to accelerate to full speed. The computer model used to determine equipment response provides a best estimate analysis of the plant's ability to respond to a design basis accident during the eight days prior to the reactor trip of August 24, 1995 at 1115 hours.

The results of the DG-1 transient load model indicated that DG-1 would initially attempt to accelerate the 480V Load Center powered ESF loads and non-safety loads (i.e., an air compressor, and condenser vacuum pump). After a short period of time the 480V Load Center loads would be tripped by undervoltage relays and be resequenced on DG-1 at their normal load sequence times. DG-1 was shown to be able to successfully sequence the ESF loads in this condition. Consequently, it was concluded that DG-1 and the ESF equipment supplied by DG-1 are operable with the DG-1 governor positioned at the full speed setting.

Although this event does not meet the reporting criteria of 10CFR50.73, it is being voluntarily reported as a condition that may be of generic interest.

SAFETY SIGNIFICANCE

Since additional engineering analysis has demonstrated the diesel generator was operable there was no impact on the operation of the plant due to this incident.

CONCLUSIONS

The causes of this event were identified as 1) the wrong switch was manipulated by the operator, 2) the inability to detect DG governor position by the operator, 3) inadequate administrative controls, and 4) a failure to implement governor position indication, identified by the PRC in April of 1995, in a timely fashion.

The PRC was first made aware of the potential for a diesel generator to re-energize 480 VAC loads prior to 480 VAC load center load shed in April of 1995. In that incident, which occurred on March 27, 1995, DG-2 was given an idle speed auto-start signal during Engineered Safeguards surveillance testing. Instead of accelerating to idle speed, DG-2 accelerated to 800 rpm. When an OPLS signal was manually initiated with DG-2 at near rated speed and voltage, the diesel generator output breaker closed so quickly, that there was insufficient time for the 480 VAC load center load

shed to occur. Design Engineering presented the same conclusion that the loading of normally sequenced Engineered Safeguards and non-safety related loads and dead loads is considered to be an unanalyzed condition for plant operation. The PRC concluded that since this event resulted from a refueling functional test, and would not be expected to occur at power, that the event did not meet any of the reporting criteria of 10 CFR 50.72 or 10 CFR 50.73. System Engineering was tasked with placing this control in procedures involving diesel generator starts or governor manipulation and present resolution to the PRC when completed.

The PRC questioned the adequacy of the administrative control in June of 1995 when System Engineering informed the PRC that the requirement to hold the governor in the "LOWER" position for at least 15 seconds had been incorporated into the appropriate procedures. The PRC was informed of the possibility that the governor could inadvertently be left in the full speed position by missing a procedure step. It was also noted that a number of other Technical Specifications related controls are implemented procedurally.

The desire for a governor position supervisory circuit was first identified in April of 1995. Design Engineering was tasked to evaluate the feasibility of the circuit. The evaluation results were provided to PRC on September 7, 1995. It indicated the feasibility of providing indication and recommended issuing a modification request to install the supervisory circuit.

The original plant design required that the diesel generators start and be ready for automatic loading in 10 seconds, in the event of a DBA coincident with a LOOP. From an original architect engineer document, the diesel generator starts at time 0.0, receives a full speed signal at 2.5 seconds (undervoltage relay actuation plus 0.5 seconds for bus voltage decay) into the event and is ready-to-load at 9.5 seconds into the event. The possible effects of malfunctions of other equipment, like diesel generator full speed operation without sufficient 480 VAC load shed time, during the automatic operations sequence were not provided.

Records of discussions between the architect engineer and the diesel generator vendor, suggest that the possibility of governor misposition was considered in the original design. At that time it appears that it was deemed acceptable to allow an operator to run the governor back. The same document noted that the governor should be run back to idle after engine shutdown. A detailed discussion of how critical these actions were to proper operation was not provided.

A review of the generic implications of this event on other equipment important to safety was conducted by a multi-disciplinary committee, the PRA Oversight Committee. No other equipment was identified that could operate in a fashion similar to the DG during their discussions.

CORRECTIVE ACTIONS

The following corrective actions will be or have been implemented as a result of this event:

1. Modification request 95-15 was submitted to provide positive governor position indication to the operators. The modification will be installed by December 31, 1995.

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2. Operators are now required to use independent verification that the diesel governor has been run back when a Diesel Generator (DG)is shut down. This guidance has been incorporated into all applicable procedures.

3. A review of the DG operating and testing procedures has been conducted to ensure that the operability of the DG is adequately addressed.

4. Engineering Assistance Request EAR 95-117 is evaluating the feasibility of replacing the control switches that are being used on the diesel generator voltage regulator and governor control switches with distinctly different styles. This evaluation will be completed by December 31, 1995.

5. The design basis documents will be updated by December 31, 1995, to provide a detailed discussion of the idle speed start affects on diesel generator operation.

6. Training documents have been reviewed to assure that an accurate, detailed discussion of DG idle speed start requirements exist. Training on this material has been provided to all licensed and nonlicensed operators.

7. All licensed and non-licensed operators will receive training on the importance of self-checking and peer-verification. This training will be completed by February 29, 1996.

8. A "best estimate" analysis of the DG loading capability has been completed. The effect of this analysis on the safe operation of the plant has been evaluated and incorporated into revision 1 to LER 95-006. The PRA oversight committee met to further discuss possible generic implications of this event. Although no specific problems were identified based on a preliminary review, a more systematic study was recommended. OPPD's Nuclear Safety Review Group (NSRG) will perform a study to identify other equipment with similar susceptibilities. This NSRG study and subsequent PRA Oversight Committee review will be completed by August 31, 1996.

SIMILAR EVENTS

Two other cases of diesel generators accelerating to full speed were discovered during a review of past Incident Reports (IR). The first event (IR 900431) occurred September 29, 1990, during a normal plant shutdown. When the turbine was tripped the diesels started as expected except that DG-1 accelerated to full speed. The incident appeared to have occurred because an operator did not effectively use a procedural checklist. The IR indicates that those who reviewed the IR at that time had no operability concerns, based on the belief that governor position did not affect diesel operability.

The second event, that occurred in March of 1995, has already been discussed in the conclusions section.