

ILLINOIS POWER COMPANY



CLINTON POWER STATION, P.O. BOX 676, CLINTON, ILLINOIS 61727

March 29, 1990

Docket No. 50-461

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

Subject: Special Report: Supplemental Report on Test Failures of the Division I Diesel Generator at Clinton Power Station (CPS)

Dear Sir:

By SPECIAL REPORTS dated December 20, 1989 and January 11, 1990, Illinois Power (IP) reported valid test failures of the Division I diesel generator (DG1A) as a result of slow starts on November 20, 1989, December 11, 1989 and December 27, 1989. Additionally, by SPECIAL REPORT dated January 29, 1990, IP reported a valid test failure of DG1A as a result of a failure to start on December 30, 1989. The January 11, 1990 and January 29, 1990 SPECIAL REPORTS identified that an Action Plan had been developed to identify the root cause and resolve those factors which may have contributed to the slow starts of DG1A. Additionally, the January 29, 1990 SPECIAL REPORT identified that a failure analysis would be performed on the K19 control relay failure which had caused the DG1A failure to start on December 30, 1989. This supplemental SPECIAL REPORT provides the available results of this Action Plan and K19 control relay failure analysis.

DG1A Action Plan

Detailed assessments of DG1A commenced following the slow start on November 20, 1989. The initial investigation relied upon instrumentation which could be installed with DG1A in service. This initial investigation was previously discussed in the January 29, 1990 SPECIAL REPORT. As described in that SPECIAL REPORT, corrective action for the December 27, 1989 slow start led to the replacement of the Woodward Governor actuator on the 12-cylinder engine (DG1A utilizes tandem 12-cylinder and 16-cylinder diesel engines). The decision to replace the 12-cylinder engine governor was based upon the observed characteristics of the response of DG1A during starting sequences. Instrumentation installed on the DG1A control system circuitry per the Action Plan had not revealed any specific cause for the slow starts outside of the governor itself. Since plant operating conditions precluded installing full instrumentation per the Action Plan prior to the governor replacement, the functional characteristics of the removed governor could not be fully assessed prior to its removal.

As identified in the January 11, 1990 SPECIAL REPORT, prior to replacement of the 12-cylinder engine governor on December 27, 1990, the governors of DGLA were different models. Both models were approved for use on the installed diesels and the governor manufacturer had stated that the two models were interchangeable. Replacement of the governor on the 12-cylinder engine (EGB-13P model 9903-266) resulted in restoring consistency in the models for the two engines. The currently installed governors are both EGB-13P model 9903-265.

Further specific testing of DGLA under the Action Plan was accomplished on February 23, 1990. Test instrumentation was installed to allow monitoring of 24 additional points (10 on the air start system, 4 on the engine governor, 6 on the fuel system, and 4 on the start/control circuitry). In addition to using this test instrumentation, existing pressure gauges, the installed General Electric Transient Analysis Recorder (GETARs), and observations by support personnel were utilized. During the four start attempts on February 23, 1990, all external characteristics of the DGLA response were observed to be normal. The governor actuators responded to the start signals properly, as did the air start motors and fuel pumps. DGLA start times ranged between 9.4 and 8.9 seconds, with the first start being the slowest. Start times of the successive three starts were all within the 9.1 to 8.9 second range that has been characteristic of DGLA starts subsequent to the 12-cylinder engine governor replacement.

The measured pressure and flow characteristics of the air start system indicate that the existing air start system design is adequate. As discussed in the January 29, 1990 SPECIAL REPORT, modifications to the air start piping to improve air start motor performance had previously been recommended for evaluation. A recommendation to proceed with this improvement is being reassessed based upon the data obtained under the Action Plan.

Similarly, fuel system characteristics were also assessed as being adequate. Two modifications, one to provide continuous operation of the fuel priming pumps during diesel generator operation (Field Alteration DGF023), and one to raise the setpoint of the fuel oil day tank level switches to reduce the likelihood of air entrainment during transfer pump testing (Field Alteration DGF002) are being pursued as reliability enhancements. No immediate corrective actions were determined to be required for maintaining fuel system operability.

A central feature of the investigation under the Action Plan has been assessment of governor operation. Following the 12-cylinder governor replacement on December 27, 1989, the relative responses of the 12-cylinder and 16-cylinder engine governors of DGLA were assessed. Using stop watches, the duration of the "full fuel" output stroke of each governor was simultaneously measured. The times for both governors were between 7 and 8 seconds for the duration of the maximum fuel demand signal. The times for DGLA to reach rated speed during these tests were between 8.9 and 9.1 seconds.

During the additional testing conducted on February 23, 1990, a more detailed assessment of the response of the governors was conducted. These tests showed that the magnitude and duration of the input and output pressure signals of each governor booster servomotor were very similar, and that the governor internal actuating fluid pressure built up properly and was maintained throughout the diesel generator acceleration to rated speed. Concurrently, observers stationed at the governors evaluated fuel rack motion. All observation results were favorable.

As previously noted, the governor on the 12-cylinder engine (Woodward EGB-13P, model 9903-266 S/N 2113014) was replaced before an in-situ assessment of the starting response of this device could be conducted. Since it is essential to understand what impact operation of this governor had on the DGLA start time, the governor was returned to Woodward for functional testing. The following discussion details the results of this functional testing.

Testing at Woodward (witnessed by an IP engineer) was planned to recreate the conditions surrounding an engine start from standby conditions following a dormant period. However, limitations in the testing facilities did not allow the questionable governor (model 9903-266) to be tested in tandem with an EGB-13P model 9903-265 governor. Therefore, the response characteristics of operating the model 9903-266 governor alone were evaluated. This was done using a test stand with an acceleration rate not to match that of the CPS DGLA.

Ten test starts were conducted. The first test start was expected to be the most representative of the CPS conditions since the slow starts had only occurred following some dormant time. During this first test start, the governor did display a lack of response. However, this test was interrupted by a Woodward Governor engineer who felt that the governor was not responding because of internal air pockets. The subsequent nine test results were very consistent. During these tests, the governor setpoints were assessed as being correct. In all tests, the initial response (zero RPM to 200-300 RPM) of the model 9903-266 governor was observably slower than that known to occur during starts using a 9903-265 model governor. The impact of the slower response of the 9903-266 model actuator is not yet fully understood. However, further testing of the removed governor at Woodward is planned.

K19 Control Relay Failure Analysis

The January 29, 1990 SPECIAL REPORT identified that the relay manufacturer would perform a failure analysis of the K19 control relay. The results of this analysis are presented below.

As identified in the January 29, 1990 SPECIAL REPORT, the DGLA failure to start was caused by a failure of the 2D-2E contact pair of the K19 relay. Failure analysis of the K19 relay (Potter and Brumfield Company type MDR, model number 5095) revealed high contact resistance across the 2D-2E contacts. The small load that this relay contact pair carries (22 mA) has been evaluated as being insufficient to ensure

electrical cleaning of the contactor surfaces following extended usage. This led to circuit interruption, resulting in the DGLA failure to start.

This relay failure is not considered to be related to the observed slow start problem. No further corrective actions are being considered for immediate implementation, however, relay operation is being monitored during routine diesel generator tests. The service history of the K19 relay at CPS provides assurance that the recently installed relay will provide several years of reliable service under normal operating conditions. An appropriate frequency for periodic replacement of this relay is currently being evaluated.

Conclusions

Following replacement of the governor on the 12-cylinder engine on December 27, 1989, no subsequent start attempts have resulted in start times in excess of the 12 second limit of the Technical Specifications, except for the one start attempt that failed due to the K19 control relay malfunction. (As identified above, the December 30, 1989 failure is considered to be independent of the slow start problem.) The objective data strongly suggests that replacement of the 12-cylinder engine governor with a model 9903-265 under the Action Plan has resolved the DGLA slow start problem. Although, as discussed above, the root cause has not been conclusively identified, implementation of the Action Plan has confirmed the effectiveness of corrective actions and effected a thorough investigation.

Further testing of the removed governor at Woodward during April, 1990 is planned. Scheduling of specific dates for this additional testing is dependant upon development of a test method which will more fully assess the performance of this governor under simulated operational conditions. Until this additional testing can be completed, the remaining spare model 9903-266 governor at CPS has been placed on hold to prevent it from being used as a replacement. The results of this additional testing will be provided in an additional supplemental report by May 31, 1990.

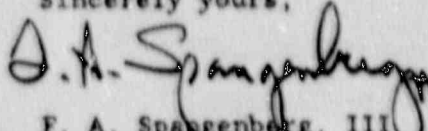
Additionally, the Action Plan testing and analysis results have been reviewed for applicability to the Division 2 (DGLB) and 3 (DGLC) diesel generator units. The DGLA slow start problem has not occurred on either of these two units. DGLB has always had the same model governors (EGB-13P model 9903-265) on both engines and has never displayed a tendency to start slowly. DGLC is a single-engine unit and utilizes a completely different type of governor (Woodward model UG-8). DGLC has never experienced a slow start. The reliability enhancements being considered for the DGLA air start system and fuel system are likewise being considered for DGLB.

The K19 relay problem does not impact DGLC, since DGLC does not utilize this type of relay in any application. DGLB does use a Potter & Brumfield MDR 5095 relay in an application identical to that used in DGLA. This DGLB relay is scheduled to be replaced under MWR D08247 during the current plant outage (PO-3).

Additional Information

As of March 26, 1990, a total of 13 successful, successive, valid tests of DGLA have been completed since the last valid failure on December 30, 1989. The current valid failure count for DGLA is 3 in the last 20 valid tests performed and 8 in the last 100 valid tests performed (only 81 valid tests have been performed for DGLA since receipt of the operating license). Therefore, DGLA continues to be tested on a weekly basis in accordance with Technical Specification Table 4.8.1.1.2-1.

Sincerely yours,



F. A. Spangenberg, III
Manager - Licensing and Safety

DAS/csm

cc: NRC Clinton Licensing Project Manager
NRC Resident Office
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