March 1, 2006

MEMORANDUM TO: Cynthia D. Pederson, Director
Division of Reactor Safety
Region III

FROM: Edwin M. Hackett, Deputy Director ***/RA/***
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

SUBJECT: DRESDEN NUCLEAR POWER STATION - FINAL RESPONSE TO TASK INTERFACE AGREEMENT 2005-009, REGARDING EMERGENCY DIESEL GENERATOR TESTING (TAC NOS. MC8249 AND MC8250)

Your memo of August 29, 2005, submitted Task Interface Agreement (TIA) 2005-009 requesting assistance from the Office of Nuclear Reactor Regulation (NRR) in assessing the adequacy of the emergency diesel generator surveillance testing procedure at the Dresden Nuclear Power Station (Dresden), and whether it meets the technical specification Surveillance Requirement (SR) 3.8.1.15 requirements. Your TIA requested NRR assistance to resolve the following issues:

1. Emergency diesel generator (EDG) surveillance testing, while potentially in compliance with licensee commitments and respective technical specifications (TS), does not envelope the predicted loss of offsite power-loss-of-coolant accident load requirements. This concern relates to the adequacy of current TS SRs.

2. EDG surveillance procedures require testing at a power factor for only 10 minutes of the 24-hour endurance test. Region III questions whether this test meets TS SR 3.8.1.15.

The Electrical Engineering Branch in NRR's Division of Engineering, assessed your request and we provided a copy of the proposed response for your review on January 9, 2006. We received your comments on January 26, 2006, and incorporated them. Enclosed is the final response that applies to Dresden only.

Docket Nos. 50-237 and 50-249

Enclosure:
Final Response to TIA 2005-009

cc w/encl: B. Holian, RI
A. Blough, RI
C. Casto, RII
V. McCree, RII
M. Satorius, RIII
A. Howell, RIV
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301-415-2277

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FINAL RESPONSE TO TASK INTERFACE AGREEMENT 2005-009,

EMERGENCY DIESEL GENERATOR SURVEILLANCE TESTING

AT DRESDEN NUCLEAR POWER STATION

1.0 INTRODUCTION

On August 12, 2005, the Division of Reactor Safety, Region III, completed a safety system design and performance capability biennial baseline inspection at the Dresden Nuclear Power Station (Dresden). The emergency diesel generators (EDGs) were chosen as the system to be reviewed. During the inspection, the inspectors identified concerns related to the level of compliance with Dresden Technical Specification (TS) Surveillance Requirement (SR) 3.8.1.15 (related to 24-hour endurance testing) and the associated bases.

Region III, in a memorandum from C. Pederson to C. Haney, dated August 29, 2005, requested that the Office of Nuclear Reactor Regulation (NRR) resolve the following issues associated with the licensing and conformance with TS SR 3.8.1.15 at Dresden:

1. EDG surveillance testing, while potentially in compliance with licensee commitments and respective TS, does not envelop the predicted loss of offsite power (LOOP)-loss-of-coolant accident (LOCA) load requirements. This concern relates to the adequacy of current TS SRs.

   Specifically, Region III requested an answer to the following question:

   Does the current endurance test at 2340 - 2600 kW for 24 hours provide reasonable assurance that the EDGs will be able to carry 2851 kW for an extended period during a design-basis accident or are the values within the TS SR non-conservative?

2. EDG surveillance procedures require testing at a power factor for only 10 minutes of the 24-hour endurance test. Region III questions whether this test meets TS SR 3.8.1.15.

   Specifically, Region III requested an answer to the following question:

   Does the licensee's test approach of loading the EDG to 1550 - 1600 kVAR for 10 minutes meet the supporting regulatory analysis and intent of the TS requirements?

NRR provided a proposed response to these questions for RIII's review on January 9, 2006, and received comments from RIII on January 26, 2006. This final response incorporated those comments.

ENCLOSURE

2.0 EVALUATION

In response to the task interface agreement questions, the Dresden TS SR 3.8.1.15 requirements were compared with the SR in Standard Technical Specifications (STS), NUREG-1433, Rev. 2, for boiling-water reactor plants. The Dresden EDG size and testing were compared with the recommendations in Regulatory Guide (RG) 1.9, Rev. 2, dated December 1979, and RG 1.9, Rev. 3, dated July 1993.

Question 1

Does the current endurance test at 2340 - 2600 kW for 24 hours provide reasonable assurance that the EDGs will be able to carry 2851 kW for an extended period during a design-basis accident or are the values within the TS SR non-conservative?

This question is for the EDG kW rating versus the EDG loads, and the SR testing period for EDG endurance testing. The pertinent information relating to EDG rating and the SR are as follows:

Dresden EDG Rating, and Loads (kW)

	EDG Ratings		**EDG Calculated Loads**	
	Continuous	10 Percent Overload - 2000 Hr	Short-term (less than 10 minutes)	Long-term (greater than 10 minutes)
kW	2600	2860	2228	2851
pf	0.8	0.8	0.88	0.88

Dresden TS SR 3.8.1.15 requires the following:

> Verify each DG [diesel generator] operating within the power factor limit operates for 24-hours:
>
> a. For $ 2 hours loaded $ 2730 kW and #2860 kW (105 percent to 110 percent of continuous rating); and
>
> b. For the remaining hours of the test loaded $ 2340 kW and #2600 kW (90 percent to 110 percent of continuous rating)

RG 1.9, Rev. 3, Section C.2.2.9 (Endurance and Margin Test) states:

> Demonstrate full-load carrying capability at a power factor between 0.8 and 0.9 for an interval of not less than 24 hours, of which 2 hours are at a load equal to 105 to 110 percent of the continuous rating of the emergency diesel generator, and 22 hours are at a load equal to 90 to 100 percent of its continuous rating.

RG 1.9, Rev. 3, Section C.1.3 also states:

> At the operating license stage of review, the predicted loads should not exceed the continuous rating of the diesel generator unit.

RG 1.9, Rev. 2, Section C.14 states:

> Load equal to the continuous rating should be applied for the time required to reach engine temperature equilibrium, at which time, the rated short-time load should be applied for a period of 2 hours. Immediately, following the 2-hour short-time load test, load equal to the continuous rating should be applied for 22 hours.

RG 1.9, Rev. 2, Section C.2 states:

> At the operating license stage of review, the predicted loads should not exceed the short-time rating of the diesel generator unit.

STS (NUREG-1433, Rev. 2), SR 3.8.1.14 requires every [18 months]:

> Verify each DG operates for $ 24 hours:
>
> a. For $ [2] hours loaded $ [3100] kW and # [3400] kW and
>
> b. For the remaining hours of the test loaded $ [2850] kW and # [3150] kW

Technical Bases

The endurance test for the EDGs is to demonstrate that each machine is in operational readiness to assume the design-basis accident loads even when the redundant EDG has failed. A test of 24 hours is considered to be a reasonable duration to ascertain if the EDG capability continues to remain intact for a potentially long-term operation much greater than 24 hours to bring the plant to a safe shutdown following a design-basis event.

The tests performed should most closely simulate the actual stresses on the machine to gain confidence in its readiness. The test challenges whether the fuel system will continue to supply fuel in order to keep up with the maximum and varying load demand, the excitation system will produce sufficient magnetic field to maintain voltage, and the voltage regulator will maintain the voltage within acceptable limits. During this test, the engine is expected to continue to supply the motive power without exceeding operational limits on the support systems. This can be achieved only when the diesel engine is loaded to its expected design-basis loading conditions, and when the generator is producing sufficient voltage and current that reflect design-basis accident loading.

The mechanical systems generally reach steady state conditions in 2 hours, but the capability to endure a long period of operation can be confirmed only through a test of a longer duration. The electrical stresses reach the maximum only when maximum current is drawn from the generator to supply full load and when reactive power compensates for loads with a lagging power factor. The lagging power factor on the load demands more work from the excitation system to bring up the voltage to required power factor conditions. Operation at these

conditions heats the electric conductors and magnetic frame in the machine and demands maximum output from support systems. If these capabilities are not periodically demonstrated, the technical bases for declaring the EDG to be operable lack credibility.

Technical Assessment

The EDG LOOP-LOCA long-term loads at Dresden are at 2851 KW. The current test practice of approaching 2860 kW load for approximately 2 hours does not meet the intent of the SR, while it may appear to be consistent with RG 1.9, Rev. 2. The provisions of RG 1.9, Rev. 2 are applicable if the actual design-basis LOCA loads are such that in the first 2 hours, the loading requires entry into the short-time rating and then the loading comes down to continuous rating. Several plant evaluations have shown an initial spike in the accident loading for the first 2 hours, but the steady state emergency core cooling (ECCS) loading decreased to continuous rating of the EDG. If the long term accident loads require the short-term loading capability of the EDG, the endurance test needs to reflect such loading conditions to verify EDG capability.

The staff has clarified this position in RG 1.9, Rev. 3, in the discussion section where it states: "... the sum of the total loads at the operating license stage should not exceed the continuous rating of the emergency diesel generator." Under Section C.2.2.9 titled "Endurance and Margin Test," the SR is expected to demonstrate a margin in the EDG rating at 105 to 110 percent of the continuous loading capability. This test would become a margin test only when the actual accident loading is less than the tested limits.

Demonstration of margin for the EDG is essential in the accident mitigation mode of the ECCS operation because of the following reasons:

- The current drawn by motors under pump runout conditions (supply flow against an existing pipe break) could be higher than the calculated values using the typical pump curves

- The motor characteristics may have changed due to rewinding or other plant modifications

- The flow conditions would be different if only one EDG is operating and therefore, the current consumption could be higher

- The intake air temperature for the diesel engine could influence the maximum output of the engine when the environmental temperature is higher

The Dresden EDG continuous rating is 2600 KW whereas the worst-case LOOP-LOCA load is 2851 KW. Therefore, the licensee's current practice to test EDGs at the values indicated below, albeit in compliance with the TS SRs, is non-conservative since the test loads do not envelope design basis power demands:

a. For $ 2 hours loaded $ 2730 kW and # 2860 kW and

b. For the remaining hours of the test loaded $ 2340 kW and # 2600 kW

The licensee should submit an amendment request to the Nuclear Regulatory Commission (NRC) to change these TS SRs to envelop design basis loads (refer to NRC Administrative Letter 98-10, Disposition of Technical Specifications that are Insufficient to Assure Plant Safety, dated December 29, 1998).

Question 2

Does the licensee's test approach of loading the EDG to 1550 -1600 kVAR for 10 minutes meet the supporting regulatory analysis and intent of the TS requirements?

The pertinent information relating to EDG kVAR rating and the SR is as follows:

Dresden EDG Rating, and Loads (kVAR)

	EDG Ratings		**EDG Calculated Loads**	
	Continuous	10 Percent Overload - 2000 Hr	Short-term (less than 10 minutes)	Long-term (greater than 10 minutes)
kVAR	1950	2145	1155	1557
pf	0.8	0.8	0.88	0.88

SR 3.8.1.15, EDG 24-hour endurance run requires the licensee to verify each DG operating within the power factor limit operates for > 24 hours:

a. For ≥ 2 hours loaded ≥ 2730 KW and ≤ 2860KW; and

b. For the remaining hours of the test loaded ≥ 2340 KW and ≤ 2600 KW.

The Note 2 of SR 3.8.1.14 of Dresden TS (load test) states:

> If grid conditions do not permit, the power factor limit is not required to be met. Under this condition, the power factor shall be maintained as close to the limit as practicable.

RG 1.9, Rev. 3, Section C.2.2.9 (Endurance and Margin Test) states:

> Demonstrate full-load carrying capability at a power factor between 0.8 and 0.9 for an interval of not less than 24 hours, of which 2 hours are at a load equal to 105 to 110 percent of the continuous rating of the emergency diesel generator, and 22 hours are at a load equal to 90 to 100 percent of its continuous rating.

RG 1.9, Rev. 2, does not address a specific requirement for load testing at a particular power factor or kVAR.

STS (NUREG-1433, Rev. 2), SR 3.8.1.14, Note 3 (regarding the load test) states:

> If performed with DG synchronized with offsite power, it shall be performed at a power factor # [0.9]. However, if grid conditions do not permit, the power factor limit is not required to be met. Under this condition, the power factor shall be maintained as close to the limit as practicable.

Technical Assessment

Dresden EDG LOOP-LOCA long-term loads (> 10 minutes) are 1557 kVAR. The licensee's current reactive load test is conducted within a band of 1550 to 1600 kVAR equivalent to 0.83 - 0.86 power factor for a duration of 10 minutes. This test does not demonstrate the capability of the EDG to support the ECCS loading while maintaining the power factor within acceptable limits equivalent to the 24-hour endurance test.

The STS offered some provisions to accommodate cases when the plant conditions cannot allow generation of sufficient kVAR to match design basis kVAR loading. The guidance is to continue to run the test as close as possible to the actual ECCS loading conditions.

Under Section C.2.2.9 of RG 1.9, Rev. 3, titled "Endurance and Margin Test," the SR is expected to demonstrate full-load carrying capability at a power factor between 0.8 and 0.9 for interval of not less than 24 hours. The licensee's testing program is contrary to the staff position conveyed in RG 1.9, Rev. 3 to perform the test for 24 hours. The STS requires the reactive load to be at a power factor of # [0.9] (plant-specific power factor based on the worst-case design- basis loading) as long as grid conditions permit testing.

Therefore, the staff finds that the licensee must perform the load test for the duration (24 hrs) at a power factor that envelops the actual ECCS loading of # 0.88. Hence, the licensee's current TS SR at Dresden is non-conservative in that it does not demonstrate performance of the EDG under worst case loading and power factor for design-basis conditions.

3.0 CONCLUSION

The current EDG endurance test performed by the Dresden Station, at 2340-2600 kW for 22 hours and 2730-2860 kW for 2 hours, is not consistent with the intent of the surveillance for establishing the operability of the EDG. The current test does not envelop the actual power demand requirements for the machine during design-basis events. The licensee should submit a TS amendment request to modify the non-conservative SRs.

The licensee's current EDG endurance test program, at a kVAR much lower than the actual kVAR demand after the initial 10 minutes of the test during the design-basis accident, is not consistent with the intent of the surveillance for establishing operability of the EDG because it does not stress the excitation system adequately to demonstrate that the EDG will meet the required demand during design-basis events. Hence, the licensee's current TS SR at Dresden is non-conservative in that it does not demonstrate performance of the EDG under worst case loading and power factor for design-basis conditions.

Principal Contributor: T. Koshy, NRR