

SEP TECHNICAL EVALUATION

TOPIC VIII-2

ONSITE EMERGENCY POWER SYSTEMS - DIESEL GENERATOR HADDAM NECK

1.0 INTRODUCTION

The objective of the review is to determine if the onsite AC generator for the Haddam Neck Nuclear Station has sufficient capacity and capability to supply the required automatic safety loads during anticipated occurrences and/or in the event of postulated accidents after loss of offsite power. The requirement that the onsite electric power supplies have capacity and capability to complete the required safety functions is contained in General

Criterion III, "Design Control," of Appendix B, "Quality Assurance Criteria for Nuclear Power Plant
10 CFR Part 50 includes a requirement that measures be provided for verifying or checking the adequacy of design by design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program.

Regulatory Guides, IEEE Standards, and Branch Technical Positions which provide a basis acceptable to the NRC staff for compliance with GDC17 and Criterion III include: Regulatory Guide 1.9, "Selection of Diesel Generator Set Capacity for Standby Power Supplies;" Regulatory Guide 1.108, "Periodic Testing of Diesel Generators Used as Onsite Power Systems at Nuclear Power Plants"; IEEE Standard 387-1977, "Criteria for Diesel Generator Units Applied as Standby Power Supplies for Nuclear Power Stations;" BTP ICSB2, "Diesel-Generator Reliability Qualification Testing"; and BTP ICSB17, "Diesel Generator Protective Trip Circuit Bypasses."

Specifically, this review evaluates the loading of the diesel-generator, bypasses of protective trips during accident conditions and periodic testing. The SEP reviews for Topics III-1 and III-12 will evaluate the diesel-generator qualification.

2.0 CRITERIA

2.1 Diesel Generator Loading. Regulatory Guide 1.9, "Selection of Diesel-Generator Set Capacity for Standby Power Supplies," provides the basis acceptable to the NRC staff for loading diesel-generator units. The following criterion is used in this report to determine compliance with current licensing requirements:

- (1) The automatically-connected loads on each diesel-generator unit should not exceed the 2000-hour rating. (Loads must be conservatively estimated utilizing the nameplate ratings of motors and transformers with motor efficiencies of 90% or less. When available, actual measured loads can be used.)

2.2 Bypass of Protective Trips. Branch Technical Position (BTP) ICSB 17, "Diesel-Generator Protective Trip Circuit Bypasses," specifies that:

- (1) The design of standby diesel generator systems should retain only the engine overspeed and the generator differential trips and bypass all other trips under an accident condition
- (2) If other trips, in addition to the engine overspeed and generator differential, are retained for accident conditions, an acceptable design should provide two or more independent measurements of each of these trip parameters. Trip logic should be such that diesel-generator trip would require specific coincident logic.

2.3 Diesel Generator Testing. Regulatory Guide 1.108, "Periodic Testing Of Diesel Generator Units Used as Onsite Electrical Power Systems at Nuclear Power Plants", states that:

- (1) Testing of diesel-generator units, at least once every 18 months, should:
 - (a) Demonstrate proper startup operation by simulating loss of all ac voltage and demonstrate that the diesel generator unit can start automatically and attain the required voltage and frequency within acceptable limits and time.
 - (b) Demonstrate proper operation for design-accident-loading sequence to design-load requirements and verify that voltage and frequency are maintained within required limits.
 - (c) Demonstrate full-load-carrying capability for an interval of not less than 24 hours, of which 22 hours should be at a load equivalent to the continuous rating of the diesel generator and 2 hours at a load equivalent to the 2-hour rating of the diesel generator. Verify that voltage and frequency requirements are maintained. The test should also verify that the cooling system functions within design limits.
 - (d) Demonstrate proper operation during diesel-generator load shedding, including a test of the loss of the largest single load and of complete loss of load, and verify that the voltage requirements are met and that the overspeed limits are not exceeded.

- (e) Demonstrate functional capability at full-load temperature conditions by rerunning the test phase outlined in (a) and (b), immediately following (c), above.
- (f) Demonstrate the ability to synchronize the diesel generator unit with offsite power while the unit is connected to the emergency load, transfer this load to the offsite power, isolate the diesel-generator unit, and restore it to standby status.
- (g) Demonstrate that the engine will perform properly if switching from one fuel-oil supply system to another is a part of the normal operating procedure to satisfy the 7-day storage requirement.
- (h) Demonstrate that the capability of the diesel-generator unit to supply emergency power within the required time is not impaired during periodic testing under (3), below.
- (2) Testing of redundant diesel-generator units during normal plant operation should be performed independently (nonconcurrently) to minimize common failure modes resulting from undetected interdependences among diesel-generator units. However, during reliability demonstration of diesel-generator units during plant preoperational testing and testing subsequent to any plant modification where diesel-generator unit interdependence may have been affected or every 10 years (during a plant shutdown), whichever is the shorter, a test should be conducted in which redundant units are started simultaneously to help identify certain common failure modes undetected in single diesel-generator unit tests.

(3) Periodic testing of diesel-generator units during normal plant operation should:

(a) Demonstrate proper startup and verify that the required voltage and frequency are automatically attained within acceptable limits and time. This test should also verify that the components of the diesel-generator unit required for automatic startup are operable.

(b) Demonstrate full-load-carrying capability (continuous rating) for an interval of not less than one hour. The test should also verify that the cooling system functions within design limits. This test could be accomplished by synchronizing the generator with the offsite power and assuming a load at the maximum practical rate.

(4) The interval for periodic testing under (3), above (on a per diesel-generator unit basis) should be no more than 31 days and should depend on demonstrated performance. If more than one failure has occurred in the last 100 tests (on a per nuclear unit basis), the test interval should be shortened in accordance with the following schedule:

(a) If the number of failures in the last 100 valid tests is one or zero, the test interval should be not more than 31 days.

(b) If the number of failures in the last 100 valid tests is two, the test interval should be not more than 14 days.

- (c) If the number of failures in the last 100 valid tests is three, the test interval should be not more than 7 days.
- (d) If the number of failures in the last 100 valid tests is four or more, the test interval should be not more than 3 days.

3.0 DISCUSSION AND EVALUATION

The redundant diesel generators' loading and use of protective trips are identical. Therefore, the discussion and evaluation of one diesel generator, which follows, is identical for the other diesel generator.

3.1 Diesel-Generator Loading

Discussion. On July 27, 1979, CYAPCo provided a list of loads automatically connected to the diesel generators in the event of a LOCA concurrent with a loss of offsite power.¹ The submitted load lists utilizing nameplate ratings to determine load values indicate a total load of 2619 kW on each generator. Using a 90% efficiency factor, as specified in RG 1.9 when nameplate ratings are used, the calculated maximum load for each generator is 2910 kW.

The maximum step load change is 1238 kW (45% of continuous capacity), which occurs ten seconds after the diesel generator start signal. Haddam Neck Technical Specifications require a two-hour full load test of each diesel generator monthly.²

Evaluation. The calculated maximum automatically-connected load to either generator is 2910 kW. The diesel generators rated load capacity is 2950 kW for 30 minutes and 2850 kW continuous.³ Therefore, the total automatically-connected load, which is 99% of the generator 30-minute

rating and 102% of the continuous rating, exceeds the RG 1.9 diesel generator loading limits of 90% of the 30-minute rating and 100% of the continuous rating.

3.2 Bypass of Protective Trips

Discussion. On May 16, 1977, CYAPCo provided a list of protective trips which render the diesel generators incapable of responding to an automatic emergency start signal.⁴ The protective trips which are not bypassed under emergency conditions are overspeed, differential, overcurrent, and reverse power. None of the trip parameters use multiple sensors and coincident logic.

Evaluation. The overcurrent and reverse power protective trips are not bypassed under emergency conditions. Neither trip uses redundant parameter sensors and coincident logic. Therefore, the diesel generator protective trips do not meet the requirement of BTP ICSB 17.

3.3 Diesel Generator Testing

Discussion. Haddam Neck Technical Specifications, paragraph 4.5, require diesel-generator testing as follows:

- (1) Manually initiated demonstration of the ability of the diesel generators to start and deliver power up to the expected maximum emergency loading, when operating in parallel with other power sources. This test will be conducted monthly on each diesel generator. Normal plant operation will not be affected. The duration of the test shall be at least two hours.
- (2) Demonstration of the readiness of the systems to automatically start and restore power to vital equipment by initiating a loss of normal ac power supply to each emergency power system separately. This test will be conducted during each refueling interval.

Evaluation. Diesel-generator testing defined in the plant Technical Specifications address the criteria listed in paragraph 2.3 to the following extent:

- (1) (a) Voltage, frequency and time limits not specified
 - (b) Voltage and frequency limits not specified
 - (c) Load level and duration not specified
 - (d) Not addressed
 - (e) Not addressed
 - (f) Not addressed
 - (g) Not addressed
 - (h) Not addressed
- (2) Not addressed
- (3) (a) Automatic start components not addressed; voltages frequency and time limits not specified
 - (b) Acceptable
- (4) Not addressed.

The Technical Specifications do not meet current licensing criteria for diesel-generator testing. Diesel-generator failure data will be extracted by NRC from Licensee Event Reports and will be considered in the final evaluation of testing adequacy.

4.0 SUMMARY

The Haddam Neck diesel generator loading does not comply with current licensing requirements as the total calculated load exceeds RG 1.9 30-minute and continuous limits by 9% and 2%, respectively. The bypass of diesel generator protective trips is also not in agreement with current NRC staff guidelines. Diesel generator testing, as specified by plant Technical Specifications, does not meet current licensing criteria. The review of qualification of the diesel generators will be completed with SEF Topics III-1, Seismic Qualification, and III-12, Environmental Qualification.

5.0 REFERENCES

1. Memorandum, NUSCO (E. P. Perkins) to NRC (T. V. Wambach) dated July 27, 1979
2. Technical Specifications for the Connecticut Yankee Atomic Power Company, Haddam Neck Plant, Paragraph 4.5, dated December 27, 1974.
3. Final Design and Safety Analysis, Paragraph 9.5, updated through April 1, 1977.
4. Letter, CYAPCo (D. C. Switzer) to NRC (A. Schwencer) dated May 16, 1977.
5. General Design Criterion 17, "Electric Power System," of Appendix A, "General Design Criteria of Nuclear Power Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."
6. General Design Criterion III, "Design Control," of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

7. "Standard Criteria for Class IE Power Systems and Nuclear Power Generating Stations," IEEE Std. 308, 1974, paragraph 5.2.4.
8. "Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Stations," IEEE Std. 387, 1977.
9. "Selection of Diesel Generator Set Capacity for Standby Power Supplies," Regulatory Guide 1.9.
10. "Periodic Testing of Diesel Generators Used as Onsite Power Systems at Nuclear Plants," Regulatory Guide 1.108.
11. "Diesel-Generator Reliability Qualification Testing", BTP ICSB2 (PSB).
12. "Diesel-Generator Protective Trip Circuit Bypasses," BTP ICSB17 (PSB).