

June 12, 1981

Docket No. 50-29
LS05-81-06-047

Mr. James A. Kay
Senior Engineer-Licensing
Yankee Atomic Electric Company
25 Research Drive
Westborough, Massachusetts 01581



Dear Mr. Kay:

SUBJECT: SEP TOPIC VIII-2, DIESEL GENERATORS
YANKEE ROWE

Enclosed is a revised copy of our evaluation of Systematic Evaluation Program (SEP) Topic VIII-2. This report has been revised to reflect the comments on matters of fact contained in your letters of January 20 and April 27, 1981.

Diesel generator testing will be considered by the staff during our new generic program for the enhancement of diesel generator reliability that is being pursued by the Power Systems Branch. Because of this new generic activity, diesel generator testing is no longer a consideration in the SEP.

This evaluation will be a basic input to the staff's safety evaluation report for this topic for your facility unless you identify changes needed to reflect the as-built conditions at your facility. This topic assessment may be revised in the future if your facility design is changed or if NRC criteria relating to this topic are modified before the integrated assessment is completed.

Sincerely,

Dennis M. Crutchfield, Chief
Operating Reactors Branch No. 5
Division of Licensing

Enclosure:
As stated

cc w/enclosure:
See next page

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OFFICE >	SEPB:DL	SEPB:DL	SEPB:DL	ORB#5:DL:PM	ORB#5:DL:PM	AD:SA:DL
SURNAME >	RSchott.dk	RHermann	WRussell	RCaruso	DCrutchfield	GJainas
DATE >	6/15/81	6/9/81	6/10/81	6/11/81	6/11/81	6/11/81



UNITED STATES
NUCLEAR REGULATORY COMMISSION

WASHINGTON, D. C. 20555

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See next page

Mr. James A. Kay

cc

Mr. James E. Tribble, President
Yankee Atomic Electric Company
25 Research Drive
Westborough, Massachusetts 01581

Greenfield Community College
1 College Drive
Greenfield, Massachusetts 01301

Chairman
Board of Selectmen
Town of Rowe
Rowe, Massachusetts 01367

Energy Facilities Siting Council
14th Floor
One Ashburton Place
Boston, Massachusetts 02108

Director, Criteria and Standards
Division
Office of Radiation Programs
(ANR-460)
U. S. Environmental Protection
Agency
Washington, D. C. 20460

U. S. Environmental Protection
Agency
Region I Office
ATTN: EIS COORDINATOR
JFK Federal Building
Boston, Massachusetts 02203

Resident Inspector
Yankee Rowe Nuclear Power Station
c/o U.S. NRC
Post Office Box 28
Monroe Bridge, Massachusetts 01350

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SEP TECHNICAL EVALUATION

TOPIC VIII-2
DIESEL GENERATORS

FINAL DRAFT

YANKEE ROWE

Docket No. 50-29

July 1980

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SEP TECHNICAL EVALUATION

TOPIC VIII-2 DIESEL GENERATORS

YANKEE ROWE

1.0 INTRODUCTION

The objective of the review is to determine if the onsite AC generator for the Yankee Rowe 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 Design Criterion 17.

Criterion III, "Design Control," of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 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 load 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

Yankee Rowe utilizes three redundant diesel generators, each of which feeds an independent 480 V safety bus. The generators are rated at 500 kVA, 0.8 Power Factor (PF), continuous; no 30-minute rating is specified. The worst-case loading of generators 1 and 3 are identical and more severe than that of generator 2; the use of protective trips is identical for all three generators. The discussion and evaluation which follows addresses the more heavily-loaded generators and is conservative for generator 2.

3.1 Diesel-Generator Loading

Discussion. In the event of a safety injection signal concurrent with a loss of offsite power, the generator assumes an automatically sequenced load of 414 kVA at a power factor greater than 0.8.¹⁴ This is the maximum automatically connected step load change, and represents 83% of continuous generator capacity.

Evaluation. The worst-case automatically-connected load to any generator is 414 KVA at a power factor greater than 0.8. Therefore, generator loading complies with the limit of R.G. 1.9.

3.2 Bypass of Protective Trips

Discussion. On May 10, 1977, YAEC provided a list of protective trips which render the diesel generators incapable of responding to an

automatic emergency start signal. The only diesel generator protective trip is overspeed, which is not bypassed under emergency conditions.

Evaluation. The overspeed protective trip is not bypassed under emergency conditions. There are no other diesel generator protective trips. Therefore, the diesel generator protective trips meet the requirements of BTP ICSB 17.

3.3 Diesel Generator Testing

Discussion. Yankee Rowe Technical Specifications, paragraph 4.8.1.1.2, require diesel-generator testing as follows:

- (1) At least once per 31 days on a STAGGERED TEST BASIS by:
 - (a) Verifying the fuel level in the day fuel tank,
 - (b) Verifying gravity flow from the storage system to the day tanks,
 - (c) Verifying the diesel starts from ambient condition,
 - (d) Verifying the generator is synchronized, loaded to ≥ 200 kW, and operates for ≥ 2 hours, and,
 - (e) Verifying the diesel generator is aligned to provide standby power to the associated emergency busses.
- (2) At least once per 31 days by verifying the fuel level in the fuel storage tank,
- (3) At least once per 18 months during shutdown by:
 - (a) Subjecting the diesel to an inspection in accordance with procedures prepared in conjunction with

its manufacturer's recommendations for this class of standby service,

- (b) Verifying the generator capability to reject a load of ≥ 275 Amperes without tripping,
- (c) Simulating a loss of offsite power in conjunction with a safety injection test signal, and:
 - 1 Verifying de-energization of the emergency busses.
 - 2 Verifying the diesel starts from ambient condition on the auto start signal, energizes the emergency busses with permanently connected loads, energizes the auto connected emergency loads through the load sequencer and operates for ≥ 5 minutes while its generator is loaded with the emergency loads.
- (d) Verifying the diesel generator operates for ≥ 60 minutes while loaded to ≥ 400 kW.
- (e) Verifying that the high pressure safety injection pump breakers on each emergency bus delay 10 ± 3 seconds in closing on the bus.

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 and frequency not specified
- (b) Acceptable; voltage and frequency not specified
- (c) Minimum load is 400 kW; minimum duration is 60 minutes

- (d) Acceptable
 - (e) Not addressed
 - (f) Not addressed
 - (g) Covered under monthly test
 - (h) Not addressed
- (2) Not addressed
- (3) (a) Automatic start components not addressed
- (b) Minimum load is 200 kW
- (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 Yankee Rowe diesel generator loading complies with current licensing criteria, as the total for each generator, does not exceed the RG 1.9 continuous limits. The maximum automatic step load change is 83% of continuous generator rating. The bypass of diesel generator protective trips meet 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 SEP Topics III-1, Seismic qualification, and III-12, Environmental Qualification.

5.0 REFERENCES

1. Final Safety Analysis Report, Paragraph 8.3.1.1.5, updated through January 1978.
2. "480 V One Line Diagram," Drawing 9699-FE-1J, Rev. 8, dated May 2, 1978.
3. Yankee Nuclear Power Station Technical Specifications, Paragraph 4.8.1.1.2, updated through Amendment 49.
4. Letter, YAEC (J. L. French) to NRC (ONRR) dated May 10, 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," BPT ICSB17 (PSB).
13. Letter, YAEC (J. A. Kay) to NRC (D. M. Crutchfield) dated January 20, 1981.
14. Letter, YAEC (J. A. Kay) to NRC (D. M. Crutchfield) dated April 27, 1981.