



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
SUPPORTING AMENDMENT NO. 104 TO FACILITY OPERATING LICENSE NO. DPR-72
FLORIDA POWER CORPORATION, ET AL.
CRYSTAL RIVER UNIT NO. 3 NUCLEAR GENERATING PLANT
DOCKET NO. 50-302

INTRODUCTION

By letter dated October 26, 1987, as supplemented October 29, November 16, November 20 and November 25, 1987, Florida Power Corporation (FPC or the licensee) requested an amendment to the Technical Specifications (TSs) appended to Facility Operating License No. DPR-72 for the Crystal River Unit No. 3 Nuclear Generating Plant (CR-3). The proposed amendment would change the emergency diesel generator surveillance requirements for loading and auto-connected load verification in Technical Specifications (TS) Section 4.8.1.1.2.d and the corresponding TS bases 3/4.8 to reflect the present load expectations.

BACKGROUND

In August - September 1987, the staff conducted an Operational Safety Team Inspection (OSTI) at Crystal River Unit 3. Two of the concerns raised by the OSTI concerned the Emergency Diesel Generators (EDGs) and were that:

1. The accident load on the EDGs may exceed the rating of the EDG. The maximum auto-connected accident load had been calculated as 3180 KW, and the addition of manually applied loads could exceed the 30-minute rating of 3300 KW. In addition, if inlet combustion air temperatures to the EDG exceed 105°F, the EDG may need to be derated.
2. The licensee had been testing the EDGs at about 3100 KW, which was less than the then-calculated maximum accident load of 3180 KW, and which therefore did not demonstrate the capability of the EDGs to carry that load. TS 4.8.1.1.2.d.4 further requires that the EDG be tested every 18 months for 60 minutes or longer at a load of at least 3000 KW. However, the EDGs are rated at loads between 3000 KW and 3300 KW for only 30 minutes.

In reviewing this situation and verifying loads, the licensee identified a power factor error in the load calculations. When the correct power factor was applied to the existing load calculations, the maximum auto-connected load exceeded the 30-minute rating of the EDG. Diesel generator loads were then recalculated using conservative best estimates based on the actual equipment configuration for each accident scenario and, after deleting certain loads not immediately needed for safety, it was determined that for all accident scenarios

except two, maximum auto-connected EDG loads for one of the two EDGs, EDG "A", would be within the 2000-hour rating. (Loads on EDG "B" do not exceed the 2000-hour rating for any scenario.) The two scenarios, involving large and intermediate size loss-of-coolant accidents (LOCAs), loss of offsite power, and failure of either EDG "B" or emergency feedwater pump "B", result in calculated auto-connected loads in excess of the 2000-hour rating, but within the 30-minute rating of the diesel generator, and less than the proposed higher test level of 3248 KW as discussed below. Certain auto-connected loads not needed for these scenarios, e.g., emergency feedwater pump, could and would be manually tripped prior to 30 minutes. Dropping these loads will reduce the load demand on EDG "A" to a level within the 2000-hour rating.

General Design Criterion-17 (GDC-17) requires that the onsite power supply (diesel generators) for nuclear plants be of sufficient capacity and capability to assure that: (1) specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences, and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents. NRC Safety Guide 9 (and subsequently Regulatory Guide 1.9) describes a basis for selection of a diesel generator of sufficient capacity to implement GDC-17. It indicates that predicted diesel generator loads should not exceed the lower of the 2000-hour rating or 90 percent of the 30-minute rating. Since the maximum accident auto-connected load for the two accident scenarios exceeded the 2000-hour rating for up to 30 minutes until load management actions could be taken to reduce the load, it was necessary for the licensee to either bring the plant into conformance with GDC-17 or to request an exemption from GDC-17. The licensee elected to seek an exemption and to implement a short-term solution to the EDG loading problem while developing a long-term permanent solution.

On December 14, 1987, the licensee requested a temporary exemption from the requirements of GDC-17, in accordance with 10 CFR 50.12(a), until the next refueling outage to implement its interim solution. A subsequent letter on December 16, 1987 provided further information and described testing which would be performed to support the exemption request. The licensee had previously identified various alternatives under consideration to bring the facility into compliance with GDC-17 and committed to submit to the Commission by March 30, 1988 its proposed long-term solution and implementation schedule.

On December 23, 1987, the Commission approved an exemption from the requirements of GDC-17 permitting the facility to operate with its predicted accident loads for EDG "A" within its 30-minute rating for not more than 30 minutes, provided that: (1) the principal estimated loads are confirmed by test as described by the licensee, (2) operators are trained, and alarms and procedures are provided as described by the licensee, and (3) when required, a dedicated operator will be available for EDG load management. This exemption is valid only through the end of the next refueling outage.

The proposed amendment would change the surveillance requirements for the EDGs to properly reflect their ratings and the predicted accident loads they would be expected to carry. Also, the TS requirement for verifying the auto-connected loads would be updated to reflect the predicted loads in KW.

Specifically, TS 4.8.1.1.2.d.4 would be changed to require 18-month surveillance testing for 60 minutes, at between 3248 KW and 3300 KW (within the 30-minute rating) for between 5 and 6 minutes, and at between 2750 KW and 3000 KW (within the 2000-hour rating) for the remainder of the 60 minutes. In addition, TS 4.8.1.1.2.d.5 would be changed to require verification that auto-connected loads do not exceed 3248 KW.

EVALUATION

1. Diesel Loading

The Crystal River Unit 3 EDGs are rated as follows:

Continuous	2750 KW
2000 hours	2751 - 3000 KW
30 minutes	3001 - 3300 KW

The auto-connected loads in the original plant design were below the 2000-hour rating of the EDGs. However, loads have been added, the largest being the motor-driven emergency feedwater pump. This was added following the TMI-2 accident. This additional load had increased the calculated auto-connected EDG "A" load to within the 30-minute rating range. FPC letter dated May 1, 1980 acknowledged the fact that the calculated EDG load would be within the 30-minute range after the addition of the emergency feedwater pump to the auto-connected load, and committed to future design changes to correct this situation. FPC letter dated May 14, 1980 reported that preliminary test results indicated that the auto-connected load would be within the 2000-hour rating. Although it is now recognized that these tests were not representative of actual accidents loads, the matter was apparently dropped at that time and not pursued subsequently.

Gilbert/Commonwealth, Inc., the licensee's architect/engineer, as reported in their letter of November 16, 1987, under provision of 10 CFR 21, had used a power factor of 0.8 to determine the load KW in calculating the diesel generator loading during the original plant design. In recent calculational updates, it was determined that the load power factor is in the order of 0.9, yielding a total KW load in excess of the diesel generator 30-minute rating.

Using this power factor, the EDG "A" auto-connected loads were calculated to be 3449 KW, with an additional 372 KW of potential manually applied loads. These loads exceeded the 30-minute rating.

Calculations were then prepared based on actual brake horsepower (BHP) requirements of the pumps of the various safety systems, instead of nameplate data as had been previously used. The results of these calculations were an automatic diesel generator loading of 3379 KW with 372 KW of potential manually applied loads. These results also exceeded the EDG 30-minute rating.

Finally, analyses and calculations were prepared by FPC for different scenarios for each of the following design basis accidents coincident with loss of offsite power and failure of either EDG "B" or emergency feedwater pump EFP-2.

1. Loss-of-Coolant Accident
 - a) Large Break
 - b) Intermediate Break
 - c) Small Break
2. Steam Line Break Accident
 - a) Inside Containment
 - b) Outside Containment
3. Feedwater Line Break - Inside Containment
4. Steam Generator Tube Rupture

System flow requirements were established for each pump for each of the above scenarios. These flow requirements were converted to pump BHP via test curves unique to the individual pumps or calculated based on system parameters and finally to motor horsepower and KW loadings via the motor nameplate efficiencies.

The staff reviewed these scenarios, including equipment operation and systems flows, and subject to review and approval of additional supporting documentation as discussed below, found them appropriate, consistent with the system requirements, reflecting reasonably conservative values, and therefore acceptable.

To reduce the EDG "A" loading, FPC has:

- (a) Realigned motor control center 3AB to Bus "B".
- (b) Provided for automatic load shedding of the battery charger and of heat tracing on EDG "A". The heat tracing has two trains; primary train on EDG "A" and secondary train on EDG "B".
- (c) Recognized that manually adding control complex fans to the EDG can be done after other load management actions have been taken.
- (d) Committed not to align the spare makeup pump MUP-1R to EDG "A", since it draws approximately 80 KW more than MUP-1A. If it should be necessary to align MUP-1R to EDG "A" in the future (only if MUP-1A were out of service), the TS action statement for an inoperable EDG would be entered.

In addition, automatic shedding of the motor-driven emergency feedwater pump at the end of 30 minutes was deleted to improve EFW reliability for other scenarios for which it would be used. This load can still be shed manually.

These changes remove loads not immediately required for safety, do not adversely affect the ability of the plant to mitigate accidents, and are therefore acceptable for the interim solution.

Two single failure cases were assumed to calculate the maximum EDG loading.

- (a) Case 1 is failure of EDG "B", resulting in the emergency safety (ES) equipment required for accident mitigation to be handled by EDG "A". Loads on EDG "A" include the motor-driven emergency feedwater pump (EFW). The

redundant EFW pump is steam turbine-driven, thus EDG "B" does not have an equivalent load because it does not include a motor-driven EFW pump. Therefore, of the two EDGs, EDG "A" has a greater calculated worst-case load requirement, which is less than 3248 KW, and within the 30-minute rating of the EDG.

- (b) Case 2 is the failure of the steam turbine-driven auxiliary feedwater pump "B", where both EDGs are available. Thus, both train A and B of the ES equipment are available for operation and redundant sets of other ES pumps will be operating in parallel. In this case, EDG "A" is calculated to be loaded to less than Case 1, and is also within the 30-minute rating.

These single failures result in the highest EDG "A" loading, and therefore, their use to determine the maximum EDG loading is acceptable.

All scenarios, except two, result in auto-connected loads on the EDGs which are within the continuous rating or the 2000-hour rating of the EDGs, which satisfies the requirements of GDC-17. The worst-case scenarios, intermediate or large-break loss-of-coolant accident in conjunction with loss of offsite power and failure of EFG "B" or emergency feedwater pump "B", result in calculated auto-connected loads on EDG "A" within its 30-minute rating. As discussed above, the staff concluded that such operation does not satisfy the requirements of GDC-17.

The licensee has proposed interim and long-term solutions with regard to GDC-17. For the long-term solution, FPC is studying several options to increase the diesel generator loading margins. Among these options are modifying the existing diesels, replacing the diesels, or adding additional on-site power sources. The licensee has committed to develop and implement a long-term resolution which, along with an implementation schedule, will be submitted by March 30, 1988 for NRC review and approval.

The interim resolution proposed by the licensee utilizes manual load management by the reactor operators to assure that EDG loads will not remain within the 30-minute rating for longer than a total of 30 minutes. To support this approach, the following actions have been taken:

1. The major loads on the EDG have been tested under conditions as close as possible to expected accident parameters to verify the calculated accident loads. Region II personnel have reviewed test procedures and witnessed tests as feasible. Preliminary test results have been submitted by letter dated January 7, 1988. Additional information addressing testing and other concerns raised by the staff in a meeting on January 20, 1988, was submitted by letter dated February 1, 1988. Information in these submittals, although not yet final, confirms that the test loads on the EDG are below the calculated value. Flows from SWP-1A and RWP-2A have been throttled by locked valves which will be replaced during the next refueling outage by fixed orifices. The licensee states that the resultant flows are adequate to assure performance of the system functions, and will document the basis

for these changes. Final documentation of test results is scheduled for submittal by the licensee by February 29, 1988, and is not expected to change the conclusion that measured loads are below the calculated values.

2. Control room alarms have been provided which will alert the operators initially when the diesels are operating in the 30-minute rating and again when 5, 24, and 29 minutes of that period have expired. The added alarms will be located on the electrical section of the annunciator panel in order to place them in close proximity to the diesel generator load KW meter. The added elapsed time indicator, which accumulates the time the diesel generator operates above the 3000 KW load level, will be located below the electrical section annunciator panel. Modifications to the control room panels and annunciator system have been evaluated by the licensee to assure that information presented is clear and can be readily perceived by the operators and that no new human engineering discrepancies (HEDs) have been introduced.
3. Operators are well-trained in the facility's symptom-based emergency operating procedures and have received additional training and guidance to better equip themselves to manage diesel generator loads by tripping those which are not required for any particular scenario in order to bring the loads within the 2000-hour rating in a timely manner. The licensee has stated that when load management is necessary, a dedicated operator will be available to accomplish that function. The licensee has also implemented an EDG load configuration management program for Cycle 7 to assure that EDG loads remain below the TS surveillance test value of 3048 KW. Battery load management should also be practiced as necessary to assure maintenance of adequate battery capacity, particularly during the period when the battery charger has been shed from the bus.

This interim solution is considered acceptable by the staff only until the next scheduled refueling outage. Auto-connected EDG loads will exceed the 2000-hour rating for only two very unlikely accident scenarios, and then only if loss of offsite power occurs and either EDG "B" or emergency feedwater pump "B" fails. The licensee has supplied reliability assessments which indicate that the probability of simultaneous occurrence of all the failures necessary to produce the highest load on EDG "A" is between 10^{-7} and 10^{-8} .

Based on the above, and subject to review and approval of the final test report and other supporting documentation, the staff concludes that: (1) the licensee's load calculations and preliminary test results are acceptable, (2) loads not needed to mitigate any particular design basis accident scenario can be tripped within 30 minutes to bring the load on EDG "A" to within the 2000-hour rating, and (3) the diesel generators will remain operable so that accident consequences previously analyzed will not be affected by the proposed interim operation. The staff therefore finds the proposed interim operation acceptable for one refueling cycle.

2. Related EDG Issues

In the FPC letter of November 16, 1987, two voltage dip tabulations resulting from block loading of the EDG were submitted. These voltage dips were obtained (a) from load/voltage curves supplied by the diesel manufacturer, and (b) by calculation based on an equation supplied by the diesel manufacturer. These

voltage dip values were for the 4160V bus. These are acceptable provided that FPC confirms these values by testing not only the 4.16KV level, but also for the low voltage (e.g., 480 volt level) of the onsite electrical distribution system.

Another EDG concern is the possible operation of the EDG units with ambient room temperatures above 105°F, which could result when the outside temperature is above 95°F. Derating of the EDGs is required above an air inlet temperature of 105°F. In their letter of November 20, 1987, FPC committed to resolve this issue prior to the time when ambient temperatures above 95°F are expected. FPC should submit the specific resolution prior to March 30, 1988, for NRC review and approval.

3. TS Amendment

As discussed above, the worst-case auto-connected EDG loading is calculated to be less than the higher testing level called for in the proposed TS (3248 KW for 5-6 minutes). The remainder of the one-hour test period would be between 2750 KW and 3000 KW (the 2000-hour rating of the EDG).

Approval has been given, as discussed above, for plant operation with diesel loads within the EDG 30-minute rating for a total of no more than 30 minutes. Thereafter, EDG operation would be within the 2000-hour rating. As discussed above, preliminary test results confirm that actual loads are below the calculated loads. SWP-1A and RWP-2A flows have been throttled and the licensee states that the resultant flows are adequate to assure performance of the system functions. The final test report and support for the reduced flows will be submitted by February 29, 1988.

Based on the above, the staff concludes that until the long-term solution is implemented, the proposed TS changes reflect the worst-case loading of the EDG, and would adequately demonstrate the ability of the existing EDG configuration to carry the predicted auto-connected accident loads without consuming an excessive amount of the allowable operating time within the 30-minute rating, or exceeding that rating.

Therefore, subject to review and approval of the licensee's final test report and supporting documentation, the staff concludes that the proposed TS changes are acceptable until the next refueling outage, by which time the plant is to be in conformance with the requirements of GDC-17. At that time, prior to operation or to any EDG testing under the affected TS sections, further revised TSs will be required.

ENVIRONMENTAL CONSIDERATION

This amendment involves a change in the installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 or changes to a surveillance requirement. We have determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding

that this amendment involves no significant hazards consideration and there has been no public comment on such finding. Accordingly, this amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of this amendment.

CONCLUSION

We have concluded, based on the considerations discussed above, that:
(1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (2) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Dated: February 19, 1988

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