UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30323

Report No.: 50-302/89-28

Licensee: Florida Power Corporation
3201 34th Street, South
St. Petersburg, FL 33733

Docket No.: 50-302 License No.: DPR-72

Facility Name: Crystal River 3

Inspection Conducted: November 6-9, 1989

Inspector: Paul J. Fillion 12/27/89
P. J. Fillion Date Signed

Approved by: Caudle Julian for 12/27/89
T. E. Conlon, Chief Date Signed
Plant Systems Section
Engineering Branch
Division of Reactor Safety

SUMMARY

Scope:

This routine, announced inspection was conducted in the areas of electrical design problems and plant modifications. These issues are ongoing and were looked at in a previous inspection (Report 89-25). This inspection was conducted at FPC's corporate headquarters.

Results:

In the areas inspected, violations or deviations were not identified. Topics addressed during the inspections were:

(a) Instrumentation required for a pinch break LOCA in the high pressure injection system piping.

(b) Emergency diesel generator retrofits.

(c) Design base reconstitution for electrical systems.

(d) Transformer failure root cause analysis.

(e) Limitation of one of the offsite power sources.

(f) Installation of a new source of offsite power.

(g) Licensee Event Reports

Items (a) and (e) deal with problems in the original design of the plant that were only recently recognized by the licensee. Recognition of these problems represent aggressive analysis work by onsite and offsite engineering groups. However, the complex historical circumstances are still under investigation and, therefore, qualitative conclusions about the licensee's overall performance would be premature. Items (c) and (f) deal with major licensee initiatives to improve the safety of the plant; and represent management commitment to go beyond minimum requirements. Item (b) basically describes corrective actions being implemented to bring the plant within its original design basis. Inspection of the work indicates competent engineering effort and determination to meet committments made to the NRC. The transformer failure root cause analysis and response actions are adequate; as is event reporting.

A safety concern (section 2c) involving possible exposure of DC motors to switching surges was identified by the NRC inspector. The concern could have been identified by the licensee because it was brought to their attention in IEN 88-72. To have missed the message of the IEN and its applicability to the plant represents inattention to detail.

Within the areas inspected, the following Inspector Follow-up Items were identified:

- IFI 302/89-28-01, Adequacy of HPI System Flow Indication Instrumentation (section 2.a)
- IFI 302/89-28-02, Possible Exposure of DC Motors to Switching Surges (section 2.c)
- IFI 302/89-28-03, Limitation of the Units 1 and 2 Startup/Standby Transformer (section 2.f)

REPORT DETAILS

1. Persons Contacted

Licensee Employees

*A. E. Friend, Nuclear Principal Licensing Engineer
*R. A. Shires, Nuclear Project Engineer
*P. R. Tanguay, Manager, Nuclear Operations Engineering
*D. A. Shook, Manager, Electrical/I&C Engineering
*C. B. Doyal, Manager, Nuclear Mechanical/Structural Engineering
*E. E. Froats, Supervisor, Nuclear Licensing
*K. B. Baker, Manager, Nuclear Configuration Management
*G. W. Castleberry, Nuclear Engineering Supervisor
*R. C. Widell, Director, Nuclear Operations Site Support
*K. R. Wilson, Manager, Nuclear Licensing
M. Rahman, Senior Nuclear Electrical Engineer
R. Schmiedel, Supervisor, Configuration Management Electrical

Other licensee employees contacted during this inspection included engineers, and administrative personnel.

*Attended exit interview

2. Inspection Details (92701)

This inspection was a continuation of a previous inspection (Report No. 89-25) of electrical and instrumentation issues and plant modifications. Sections 2.a through 2.e deal with new items, whereas the subjects of sections 2.f and 2.g were discussed in the 89-25 report. The inspection was conducted at FPC's corporate headquarters.

a. Instrumentation Required for a Pinch Break LOCA in the High Pressure Injection (HPI) System Piping.

In October, Crystal River cooled down to Mode 3 due to inaccuracy of the HPI System flow indication instrumentation for a postulated pinch break in the HPI piping. The concern was that if a small break LOCA caused by a break in the HPI piping were to occur, and at the same time the HPI pipe became pinched so that flow was restricted, plants with emergency operating procedures calling for the balancing of flows may not be able to cope. If flow out the break was less than one-third the required flow, matching flow in the three good lines to the broken line flow would result in inadequate flow to the RCS. In addition, instrumentation inaccuracy could completely mask the problem so that the Operator would not know that actual flow was less than required.

Corrective action taken before returning to Mode 1 was:

(1) Installed instrumentation which had the proper accuracy.

(2) Since the new instrumentation did not meet all the design criteria required by regulations the licensee provided a justification for operation until the spring 1990 refueling outage.

Corrective action to be taken during the spring 1990 outage will bring the system within requirements.

The inspection focused on work done by the licensee in 1983 to comply with Regulatory Guide 1.97, "Implementation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident." If the HPI System flow indication had been properly designated as a RG 1.97 Type A variable in 1983, the instrumentation inaccuracy problem would have been identified at that time. An FPC engineer, who was the B&WOG Chairman for the RG 1.97 work, stated, and provided documentation, that tended to show that the B&WOG agreed that the postulated pinch break accident was not a credible event at the Crystal River plant. If so, HPI System flow indication need not be a Type A variable. The licensee's position is that they received information for the first time in October 1989 that the pinch break accident was indeed a credible accident. The new information led to the cooldown and corrective actions described at the beginning of this section. To track review of the Licensee Event Report, which was not issued at the time of the inspection, and determination by the NRC of circumstances surrounding the cause of this event the matter is identified as inpsector follow-up item 302/89-28-01, Adequacy of HPI System Flow Indication Instrumentation.

b. Emergency Diesel Generator Retrofits

During the spring 1990 refueling outage the emergency diesel generators and their auxiliaries will be retrofitted to increase the engines' output horsepower rating. Refer to letter from FPC to the NRC dated September 21, 1989, for details of the diesels modifications. Modifications aimed at reducing the electrical load on the generator will also be implemented, see reference (2) listed below. Following completion of the modifications the long term (30 minutes to seven days) loading on the "A" EDG will be generally less than the increased continuous rating of 2850 kw. In certain scenarios loading on the "A" EDG is projected to be in the 2000 hr rating of 2850 to 3000 kw. The longest duration for which the "A" EDG is within the 2000 hr rating is 23 hours and the loading is calculated to be 2880 kw, see reference (1) listed below. Load values for the "B" EDG are similar. Therefore, the diesel generators will be in full compliance with their licensing and design basis.

A new continuous rating for the diesel generators is established by installing a series turbocharger which allows production of extra horsepower. Factory tests were performed to establish new 200-hr and 30-minute ratings. The NRC inspector reviewed the diesel engine qualification test report. These tests were witnessed by FPC engineers at the Colt Co. plant in Beloit, Wisconsin. Status of the modification packages and plans for post modification testing were discussed. Project responsibilities and schedule were also discussed.

Conclusions drawn were that diesel generator related modifications, which are considered very important from a safety standpoint, are proceeding according to schedule and agreed upon commitments. Factory type-testing was valid, and on-site post modification testing will be extensive and thorough.

References:

(1) Letter from FPC to NRC on "Long Term Emergency Diesel Generator Loading" dated September 15, 1988.

(2) Letter from FPC to NRC on "Emergency Diesel Generator Upgrade Program" dated August 11, 1989.

c. Possible Exposure of DC Motors to Switching Surges

On October 25, 1989, the licensee reported that an environmental qualification (10 CFR 50.49) problem with limitorque operators for emergency feedwater steam valves had been discovered and corrected. As part of the follow-up action to this report, the NRC inspector reviewed a typical elementary diagram for the DC powered motor operated valves in the steam driven emergency feedwater system. The elementary diagram showed that the shunt field may be vulnerable to switching surges because a path for the field discharge current has not been provided. NRC Information Notice No. 88-72, "Inadequacies in the Design of DC Motor Operated Valves," addressed this problem. The NRC inspector inquired as to how IEN 88-72 had been dispositioned by the licensee. A Project Engineer in the Site Engineering Services group stated that the IEN had been closed out, and agreed that the switching surge problem may not have been properly addressed. The Project Engineer and a Licensing Engineer agreed that the NRC inspector had identified a potential safety significant problem, and they stated the matter would be resolved in a timely and rigorous manner. The matter is identified as inpsector follow-up item 302/89-28-02. Possible Exposure of DC Motors to Switching Surges.

d. Enhanced Design Base Document (EDBD) Development and Calculation Review for Electrical Systems

The licensee has undertaken a formal and comprehensive project to consolidate all electrical system design basis requirements and the corresponding evidence that the as-built electrical installation meets those requirements. Officially, the project began on September 28, 1989, however, some document gathering work has been in progress since July 1989. The project is actually part of a much larger, multisystem configuration management program. Of the thirty-seven EDBDs being developed three are electrical; Emergency Diesel Generators, A.C. Power and D.C. Power.

The inspection consisted of discussion with the engineer responsible for the Enhanced Design Base Document work and the engineer responsible for the calculation work. Project definition and scope documents were reviewed, and they served as a framework for discussion. The NRC inspector became familiar with individual project activities, milestone dates and the reasons thereof.

One facet of the project, not explicitly defined in scope documents, is that any calculations, documents, or written analysis that contribute to the design basis requirement or provide supporting evidence will be reviewed in terms of stated or implied assumptions. Any assumptions which, in the opinion of the reviewer, are questionable will be listed for verification by walkdown or other means.

The NRC inspector concluded that the project scope documents are comprehensive and clearly state the objectives. The methodology which was developed by the licensee for creating an Enhanced Design Basis Document is straight-forward and logical. An EDBD for the Decay Heat Removal System was presented by the licensee as an example.

e. Transformer Failure

As reported in LER 89-31, ESF transformer 3A, a 4160-480 volt dry type transformer, failed. NRC Inspection Report No. 89-22 discusses the circumstances surrounding this event and the ensuing plant transient. This inspection focused on the root cause analysis of the failure.

The NRC inspector reviewed a transformer analysis report produced by the Transformer and Switch Division of Brown Boveri Power Equipment, Inc. This report concluded that the location of the expelled high-voltage (HV) turns as well as the presence and location of carbon residue implies that there was a layer to layer fault at the front of the center coil HV winding. This fault resulted in magnetic forces causing several layers to shift.

The NRC inspector inquired as to the direction of the root cause analysis and responsive actions in light of the Brown Boveri report. A Nuclear Principal Licensing Engineer and a System Engineer stated that the following actions would be taken:

(1) During the spring 1990 refueling outage, the other safety-related 4160-480 volt transformer would be visually inspected, meggered and ratio tested.

(2) The possibility of creating a maintenance procedure for the 4160-480 volt transformers would be explored.

The NRC inspector concluded that these actions were appropriate and sufficient.

f. Limitation of the Units 1 and 2 Startup/Standby Transformer

As discussed in NRC Report No. 89-25, section 2.d, the Units 1 and 2 startup/standby transformer has significantly less capacity than stated in the FSAR. The NRC inspector reviewed the licensee's file on the long standing degraded grid voltage issue. Degraded grid voltage studies were performed by all licensees during the 1976 to 1981 period. One of the key submittals made by the licensee related to this issue was "CR-3 Electrical Distribution System Review Summary," Rev. 7, dated November 18, 1980. Two cases from this study are of particular interest:

(1) Table 11 gives the voltage at each bus when the Unit 3 emergency buses are loaded and aligned to the Units 1 and 2 S/S transformer; the same transformer winding is also loaded to 10.2 mVA from Units 1 and 2; and two 3500 HP induced draft fans on Unit 1 are started. Calculated voltage at the emergency bus was 4059 volts (0.976 of 4160 volt nominal) when grid voltage was the expected low.

(2) Table 5 gives the voltage at each bus when the Unit 3 emergency buses are aligned to the Units 1 and 2 S/S transformer; the same transformer winding is also loaded to 10.2 mVA from Units 1 and 2; and a large safety-related motor is starting. Calculated voltage at the emergency bus was 3944 Volts (0.948 of 4160 Volt nominal) when grid voltage was the expected low.

When the Table 11 case is looked at in relation to the event described in LER 89-13 one realizes that the 1980 calculation must be in error, because, if it were correct, starting one boiler feed pump on Unit 1 would not have operated the degraded voltage protection relay. The Table 5 case appears to be at odds with the analysis done after the LER 89-13 event, because then it is concluded that

emergency loads cannot be started if the Units 1 and 2 S/S transformer is preloaded to 1.5 mVA or greater. LER 89-13-01 states "... original design failed to consider starting currents in the loading scheme of the transformer."

The point of the foregoing discussion is that some doubt has been cast on the validity of calculations which may still be the basis for concluding that system voltage is adequate or that degraded voltage relays are properly set. This warrants future inspection. Although, ultimately, the Configuration Management Program (section 2.d) will rerun calculations, and thereby provide assurance that the design basis is being met. However, the foregoing discussion did not address the safety significance of the Units 1 and 2 S/S transformer situation. To meet the design basis of a second source of offsite power as stated in GDC-17, the Units 1 and 2 S/S transformer must meet the capacity requirements and time constraints of the following scenario: Loss of the primary source of offsite power and loss of the onsite power sources, but not an accident condition. Since this scenario allows time for operator action, such as shedding Units 1 and 2 loads, the Units 1 and 2 S/S transformer could have met its design basis as a second source of offsite power. It did not meet the requirements as a primary source of offsite power. The licensee has stated that the Units 1 and 2 S/S transformer had rarely been used as a primary source.

Violations or deviations were not identified, although, the situation is receiving additional inspection. The matter is identified as inspector follow-up item 302/89-28-03, Limitation of the Units 1&2 Startup/Standby Transformer.

g. New Startup - Standby Transformer

As discussed in NRC Report No. 89-25 section 2.e, new 230 kV circuit breakers, a new transformer, 4160 volt cable and associated equipment, relaying and controls will be installed to provide a second source of offsite power equal in capacity to the present primary source. This inspection (89-28) focused on project status, design details and engineering performance associated with this project.

The project manager stated that the goal of having the new source of offsite power operational at the end of the spring 1990 refueling outage appeared to be achievable. He stated the critical path was either the 4160 volt cable installation or the modification packages preparation and review time.

Specific items discussed between the NRC inspector and the Project Manager included but were not limited to:

(1) Design of the approximately 1100-foot duct bank. References 1 and 2 were presented for the NRC's review.

(2) A copy of the cable pulling tension calculations was requested by the NRC. These calculations are in the review stage, and will be submitted when finalized.

(3) Type of cable.

(4) Surge protection for the cable.

(5) The purchase order for the 4160 volt cable was awaiting management approval.

(6) Control cable routing and purchasing.

Installed spare control cable, running between the power plant and the switchyard, will be utilized.

The NRC inspector did not identify any safety concerns within the areas covered. Project design represented a high quality engineering effort.

References:

(1) Black and Veatch Co. drawing No. 15797-CEEC-E 2001, Ductbank and Raceway Arrangement, issued for bids October 20, 1989

(2) Drawing No. 15797-CEEC-E 2002, Underground Utilities Electrical Manhole and Duct Bank Details, issued for bids October 20, 1989

3. Review of Licensee Event Reports (92700)

(Closed) LER 89-31, "Failure of a 480 Volt Engineered Safeguards Transformer caused Temporary Interruption of Decay Heat Cooling and a Plant Operational MODE Change," was reviewed, and may be closed in consideration of the discussion in NRC report No 89-22, section 2 and this report, section 2.e.

(Closed) LER 89-33, "Incorrect Design Assumption Caused Inadequate Setpoint for Second Level Undervoltage Relay System and Leads to Operation Outside the Plant Design Basis," was reviewed, and may be closed in consideration of the discussion in NRC Report No. 89-25, section 2.c.

(Closed) LER 89-35, "Inadequate Design Controls Lead to Safety Related Components Being Subjected To Voltages Higher Than Maximum Rated Voltage," was reviewed, and may be closed in consideration of the discussion in NRC Report No 89-25, section 2.b.

4. Exit Interview

The inspection scope and results were summarized on November 9, 1989, with those persons indicated in paragraph 1. The inspector described the areas inspected and discussed in detail the inspection results. Proprietary information is not contained in this report.

Item Number	Description and Reference
302/89-28-01	IFI - Adequacy of HPI System flow indication instrumentation, section 2.a.
302/89-28-02	IFI - Possible exposure of DC Motors to switching surges, section 2.c.
302/89-28-03	IFI - Limitation of the Units 1 and 2 startup/standby transformer, section 2.f.