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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

FLORIDA POWER CORPORATION

LOW TEMPERATURE OVERPRESSURE EVENT FREQUENCY, APPENDIX G,

PRESSURE TEMPERATURE LIMITS

CRYSTAL RIVER UNIT 3

DOCKET NO. 50-302

1.0 INTRODUCTION

By letter dated October 31, 1989, the Florida Power Corporation (FPC or the licensee), the licensee for the Crystal River Unit 3 (CR3) plant, submitted information and requested technical specification (TS) changes related to the pressure-temperature (PT) operating limits. This submittal proposed a low temperature overpressurization (LTOP) protection TS based on a non-Appendix G approach. On August 11, 1993, in a meeting with staff, the licensee provided additional information regarding LTOP event frequency in Babcock and Wilcox (B&W) plants and submitted B&W report No. 51-1176431-01, "Crystal River 3 Reactor Vessel Low Temperature Overpressure Protection" dated October 9, 1989. In the safety evaluation that follows, the staff used the results of a survey on overpressurization events. This review is limited to the classification of an overpressurization event as an unanticipated operational occurrence, which formed the basis for the proposed non-Appendix G PT limit and LTOP protection setpoint methodology.

2.0 BACKGROUND

Appendix G to 10 CFR 50 on fracture toughness requirements, specifies fracture toughness for ferritic materials of pressure retaining components of the reactor coolant pressure boundary to provide adequate margin of safety during any condition of normal operation including anticipated operational occurrences. Section III of the ASME code forms the basis for the requirements of Appendix G. The Appendix G Section V.A. provides that the effect of neutron irradiation on the vessel beltline reference temperature be taken into account. Thus, the PT limits and the associated LTOP setpoints and enable temperatures change as irradiation induced embrittlement changes the material nil ductility transition reference temperature. As plants age, the PT operating window continues to narrow and plant operation becomes more constrained. For many plants this process was accelerated with the publication of Regulatory Guide 1.99 Revision 2. The staff recognized this fact as stated in Generic Letter (GL) 88-11, "NRC Position on Radiation Embrittlement of Reactor Vessel Materials and its Impact on Plant Operations" dated July 12, 1988. GL 88-11 proposed that "If...the frequency of an LTOP event that would exceed Appendix G limits is expected to be much less than one per reactor lifetime, then the staff would consider alternatives to Appendix G LTOP setpoints with appropriate justification of adequate safety from the standpoint of fracture prevention." Alternatives to Appendix G limits have

been under staff review and are currently being incorporated into the regulations.

For the following discussion, the staff considers an LTOP event to be one in which the RCS pressure reaches the lower PORV LTOP setpoint. Likewise for this discussion we consider as a precursor, the event which is one mechanical failure or an operator error away from becoming an LTOP event.

3.0 EVALUATION

The primary means of LTOP protection at Crystal River is operator action to terminate the event prior to reaching the LTOP setpoint, with a PORV as a back-up to relieve overpressurization. The licensee has analyzed overpressure transients resulting from high pressure injection (HPI), core flood tank actuation, and full-open failure of the makeup control valve. The licensee estimated that, in the HPI and core flood tank actuation, the RCS pressure will exceed the LTOP limit in less than 10 minutes. However, these events are considered by the licensee to be incredible based on administrative controls which are in place; consequently, the licensee concluded that the limiting event is the full-open failure of the makeup control valve. The licensee provided arguments to show that LTOP events are not anticipated operational occurrences based on two CR3 design features.

3.1 Crystal River 3, Design Features

CR3, being a B&W-designed plant, operates with a nitrogen gas or a steam bubble in the pressurizer at all times except for system hydrotest. The pressure of the pressurizer bubble gives the operator more time to identify, assess and terminate an overpressurization transient. A unique CR3 design feature is that it does not route letdown flow through the decay heat removal system; thus, it is not as susceptible to overpressurization due to inadvertent isolation of the RCS letdown as plants without this letdown design feature. In addition, administrative measures are in place to preclude an LTOP event due to inadvertent high pressure injection when RCS temperature is less than 283 ^{0}F.

The CR3 letdown system is less susceptible to LTOP events initiated by the letdown flow isolation. However, the staff does not believe that operator action will reduce potential overpressurization to such low frequencies to be considered "much less than once in the plant's lifetime." As discussed below, a precursor event to an LTOP due to high pressure injection actuation as a result of operator error has been recorded. Finally, the licensee discussed events at the present pressure limits and not at the projected values which is not a realistic representation of future operation.

The licensee conducted a B&W Owner's Group (B&WOG) operating history survey through February 1989 and found that there were no challenges of the low temperature PORV setpoints or the Appendix G PT limits. That survey covered over 100 reactor years of operation.

The staff conducted a survey of its own data base and found three events involving B&W plants which are relevant to this issue: (1) Oconee Unit 2; February 26, 1992 - The HPI pumps were connected to their power supply and one pump started while the discharge valves remained energized, and could have easily been opened. (RCS temperature was at 100 °F and pressure at 60 psig). This condition existed for 2 hours and 55 minutes and was in violation of existing administrative controls. Had the HPI pumps injected, the operable (required by the TS) LTOP train could not mitigate the resulting LTOP. The event was attributed to operator error; (2) Rancho Seco, May 26, 1987 - During surveillance procedures the LTOP system was rendered inoperable. The event was attributed to operator error; (3) Oconee Unit 1, January 3, 1989 - TS plant cooldown rates were exceeded and the reactor was operated outside the thermal shock operating region. The event resulted from a combination of an unusual event and operator error. In this instance, operator error led to an actual case of PT limits being exceeded.

The staff review noted that, in these events, operator action was used to terminate the event. No analysis or discussion was provided which demonstrated that the Appendix G limit would not have been exceeded without operator action. Since explicit credit was given for operator action as a mitigating system for CR3, these events only confirm the adequacy of the current licensing basis. The events do not provide a basis for changing the licensing basis as these events do indicate an arrival rate for LTOP transients of greater than once in a plant lifetime.

4.0 CONCLUSION

Based on the licensee's submittal and the results of the staff's own event survey, the staff has concluded that the expected frequency of occurrence of an LTOP event for Crystal River Unit 3 has not been demonstrated to be much less than once in the plant's lifetime. Therefore, the licensee's request is denied.

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