Florida Power
CORPORATION

August 10, 1990
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U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Was'ington, D.C. 20555

Subject: Crystal River Unit 3
Docket No. 50-302
Operating License No. DPR-72
Technical Specification Change Request No. 174
Additional Information

References:
1. FPC to NRC letter No. 3F1089-23, dated October 31, 1990
2. NRC to FPC letter, dated July 11, 1990
3. NRC to FPC letter, dated July 3, 1979

Dear Sir:

Florida Power Corporation (FPC) submits the attached additional information on operator response to a MODE 3 loss-of-coolant-accident (LOCA) as requested by Reference 2. This information provides detailed background discussion of the factors considered during the evaluation of the proposed change to Technical Specifications (Reference 1). FPC specifically weighed the increased low temperature overpressure protection against the minimal decrease in LOCA mitigation capabilities resulting from this change. The attached evaluation demonstrates that there is adequate time available to manually initiate Emergency Core Cooling System flow to the core following a LOCA initiated at the subject plant operating conditions.

Sincerely,

Rolf C. Widell, Director
Nuclear Operations Site Support

Attachment
RCW/BPW

xc: Regional Administrator, Region II
Resident Inspector

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INTRODUCTION

Florida Power Corporation (FPC) submitted Technical Specification Change Request No. (TSCRN) 174 "Pressure/ Temperature Limits" (Reference 1) on October 31, 1989. TSCRN 174 contained revised Reactor Coolant System (RCS) pressure/ temperature limit curves for Crystal River Unit 3 (CR-3) and proposed a new Low Temperature Overpressure (LTOP) protection Technical Specification. The proposed Technical Specification requires deactivating the Core Flood Tanks (CFT) and High Pressure Injection (HPI) prior to entering the LTOP region of plant operation. This is done in order to preclude an LTOP event due to inadvertent actuation of either of these systems. CR-3 currently employs these aspects of an LTOP protection approach under administrative control whenever RCS temperature is less than 280°F. TSCRN 174 proposes to raise the RCS temperature at which the CFT and HPI trains are removed from service from 280°F to 283°F. This results in a small (3°F) decrease in the range of LOCA protection afforded by these systems.

FPC weighed the increased LTOP protection against the minimal decrease in LOCA mitigation capabilities resulting from this proposed change. The likelihood of an LTOP event was compared to that of a LOCA at these reduced RCS pressures and temperatures. The thermal and membrane stresses in the reactor coolant system are significantly reduced in the lower modes. A postulated crack which does not propagate under operating conditions (when the crack driving forces are much higher) would not be expected to do so under reduced temperature and pressure conditions. Furthermore, the probability of a break of the main RCS loop piping is considered extremely small based on the extensive leak-before-break analysis FPC has performed and with which the NRC has agreed. All of the above factors supported the conclusion that the decrease in Emergency Core Cooling System (ECCS) capability was comparatively insignificant.

NRC REQUEST FOR ADDITIONAL INFORMATION

The following discussion addresses the operator response to a LOCA occurring during operational MODE 3 with reactor coolant temperature at or below 283°F and system pressure at 555 psig.

A. Symptoms and operable alarms that would alert an operator to the existence of a Loss of Coolant Accident (LOCA).

The following is only a partial list of such indicators. There are many other indications which could potentially alert the operator to the existence of this condition.

- o Lower than normal or decreasing reactor coolant system pressure indication
- o Higher than normal makeup line flow rate indication
- o Full open indication for the makeup control valve
- o Decreasing makeup tank level indication
- o Makeup tank low level alarm
- o Makeup tank low-low level alarm
- o Lower than normal or decreasing pressurizer level indication
- o Pressurizer low level alarm(s)
- o Reactor coolant inventory low alarm
- o Gamma radiation high alarm
- o Gamma monitor warning alarm
- o High radiation alarm-particulate and iodine channels
- o Reactor Building temperature high alarm
- o Reactor Building pressure high alarm
- o Reactor Building sump level high alarm

B. The time available following identification of a large or small break LOCA for operator action to initiate makeup flow such that the criteria of 10CFR50.46 are not violated.

FPC chose an approach to determine the amount of time available for operator action predicated on keeping the core covered with reactor coolant following a loss of coolant accident (LOCA). While this is a simplified approach when compared to a complete 10CFR50.46 evaluation, it is reasonable for this purpose. The evaluation determined the time needed to boil off the reactor coolant volume above the core for a LOCA initiated at a point in time following reactor shutdown.

FPC evaluated two time cases. The first case calculated boiloff time for a LOCA twelve (12) hours after plant shutdown is started. This point in time was selected because it is the amount of time Technical Specifications specify for placing the plant in MODE 4 (RCS Temperature less than $280^{\circ}F$) from full power to comply with an action statement. It is considered the shortest period of time for cooling the plant down to the subject initial conditions, and results in the highest available decay heat. A second case calculated boiloff time for a realistic shutdown from full power to MODE 4. Forty-one (41) hours was selected for this case. This is the time it took to reach Mode 4 during the recent CR-3 cooldown for Refuel 7. The time needed to perform this cooldown varies depending on the activities scheduled for the shutdown and is only intended to illustrate a typical cooldown timeframe.

The 12-hour case resulted in a boiloff time in excess of 20 minutes and the 41-hour case demonstrated greater than 30 minutes was available to restore ECCS flow prior to uncovering the core. The following assumptions were made for this evaluation.

- An initial reactor power level of 2544 MWt (Rated Thermal Power).
- A large break LOCA occurs in a hot leg. The hot leg break results in a lower liquid level in the reactor vessel than for a cold leg break.
- The primary coolant in the loops was assumed to be immediately lost from the system through the break.
- The core decay heat rate was 1.0 times the ANS 5.1, 1979 Standard and the core had been irradiated for an infinite period of time. This is conservative since the design residence time of a fuel assembly in the core is approximately six years.
- No ECCS water enters the reactor vessel during the evaluation.
- RCS and RB pressures are approximately equal to 35 psia following the break; the fluid in the RCS is saturated.
- Subsequent liquid losses from the RV are caused by decay heat addition only. At the assumed initial RCS pressure and temperature conditions, liquid losses due to flashing and heat from RV internals metal surfaces was neglected.
- Decay heat rates used to calculate boiloff time were held constant for the amount of time required to completely vaporize the RV liquid above the top of the core.

C Describe the actions needed to manually initiate makeup flow, and the time needed to complete these actions.

C.1 <u>Case I:</u>

A large break LOCA initiated from the subject RCS condition would result in a rapid decrease in RCS pressure immediately following the break. The resultant pressure would be below the shutoff head for the decay heat removal pumps such that LPI would be operational. Two trains of the Decay Heat Removal System are aligned to Low Pressure Injection (LPI) while the plant is operating in this region (Mode 3). While automatic actuation of the LPI system on low RCS pressure is bypassed during plant cooldown (in order to prevent an Engineered

Safeguards (ES) actuation on low RCS pressure), automatic actuation on high reactor building pressure would still occur.

The LPI system has been shown capable of providing heat removal for an accident at full reactor power. Therefore, for an accident at these reduced RCS pressures and temperatures with automatic actuation of the LPI system, the core remains covered.

C.2 Case II

Based upon the large break LOCA evaluation discussed in Case I, the limiting event is a smaller break loss of coolant accident. In this case, the reactor coolant system pressure does not get low enough for LPI to be fully functional. Again, the preferred operator action is to initiate LPI and maximize flowrate as soon into the event as possible. The operator has the capability of manually initiating LPI from the main control room. Automatic initiation of LPI may occur depending on reactor building pressure following the break. However, operator action is still required to reduce RCS pressure and to ensure LPI is fully functional.

Abnormal operating procedure AP-380 "Engineered Safeguards Actuation" provides operator actions in response to an automatic or manual ES actuation. This procedure specifically addresses the condition of relatively low RCS pressure combined with low (or no) LPI flow. The method used in AP-380 to obtain the required minimum LPI flow as quickly as possible is to reduce RCS pressure to minimize the back pressure seen by the LPI pumps. The following steps are taken (in the order they appear) until LPI flow has been sufficiently increased.

- The automatic flow control valves for LPI are verified to be open
- The power operated relief valve (PORV) is opened
- The RCS high point vents are opened

These steps are sufficient to reduce RCS pressure and, allow for LPI system operation. These steps can be accomplished from the main control room. Ten minutes has been conservatively assumed as a completion time for these actions. Based on the required actions taken and the completion time assumed, LPI flow to the reactor vessel would be established and this event terminated before the core would become uncovered.

C.3 Additional Sources of RCS Makeup:

Additional sources of makeup flow are available to mitigate the effects of a LOCA. Normal makeup flow (from the running makeup pump), High Pressure Injection (HPI), and the Core Flood Tanks (CFT) can also serve as sources of water to the RCS. Normal makeup flow would be immediately available to the RCS at event initiation. HPI and CFT which have been deactivated for LTOP, would be available following restoration of the system(s). The following discussion addresses the availability of these sources.

C.3.1 Normal Makeup:

The proposed LTOP Technical Specification continues to allow unrestricted operation of the normal running makeup pump. The operator has the capability of taking manual control of the makeup control valve (MUV-31) and maximizing flow to the RCS through this flowpath. However, this is considered an interim action until a source of adequate long-term cooling can be initiated.

C.3.2 High Pressure Injection and Core Flood Tanks:

The HPI and Core Flood Systems are deactivated at an approximate RCS temperature of 283°F as part of the proposed LTOP Technical Specification. Operator action outside the control room is necessary to restore these systems once they have been deactivated. The actions involve physically "racking in" the breakers for the makeup (HPI) pumps, closing the breakers, and then aligning the device to the corresponding ES position. Thirty minutes has been conservatively selected to allow for completion of these actions.

C.4 Additional Considerations:

The provision allowing both HPI flowpaths to be rendered inoperable in Mode 4 was granted as Amendment No. 21 to Appendix A of the CR-3 Operating License (Reference 3). This amendment revised Technical Specification 3.5.3 (d) to allow for "racking out" the HPI isolation valve breakers at RCS temperatures less than 280°F. This was based upon precluding an inadvertent HPI actuation as a credible LTOP event for CR-3. As part of this amendment process, FPC reviewed the necessity of having HPI operable at RCS temperatures less than 280°F. Based on this review, FPC concluded that the HPI system could be isolated when the RCS temperature is less than 280°F since the LPI system would provide adequate makeup to the RCS in the event of an accident. The NRC staff, in the Safety Evaluation Report written for Amendment No. 21, verified this conclusion. The NRC concluded that "... in the unlikely event of a loss of coolant accident which does not depressurize the reactor coolant system such that low pressure injection is functional, the operators have adequate time (greater than 30 minutes) to initiate HPI [for the plant at these initial conditions]. This assumes no credit for makeup flow." The proposed LTOP Technical Specification requires HPI be deactivated prior to entering the revised LTOP region (RCS temperature of 283°F). The small incremental change in RCS temperature (3°F) does not compromise the conclusions reached in this previous evaluation. It remains valid for an RCS temperature of 283°F.