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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Subject: Waterford 3 SES
Docket No. 50-382
License No. NPF-38
Request For Additional Information Regarding Technical Specification Change Request NPF-38-171

Gentlemen:

By letter dated August 11, 1995 Waterford 3 proposed a change to the Technical Specifications that would reduce the minimum reactor coolant cold leg temperature of TS 3.2.6 by 3 degrees. In the initial proposal Waterford 3 stated that "the impact of this temperature reduction on the accident analyses documented in the FSAR and the set of transients used to provide limits and setpoints in the Core Operating Limit Supervisory System (COLSS) and Core Protection Calculator System (CPCS) were investigated. Some events are insensitive to the change or have already been analyzed at a cold leg temperature less than that proposed by this change. One event (loss of condenser vacuum) has been reanalyzed with the 3°F lower cold leg temperature. Those events that provide input to the COLSS and CPC setpoints are analyzed just prior to startup of the next cycle." While examples of the events evaluated were provided, a description of all events and transients evaluated was not provided. In a subsequent conversation, the NRC review staff requested additional information that specifically identified the disposition of the events and transients listed in Chapter 15 of the Updated Final Safety Analysis Report. This information is included in the attached report entitled "Evaluation of 3°F Reduction in the Minimum Cold Leg Temperature for Waterford Unit 3 Cycle 8.

This submittal provides additional details related to the subject proposed change. This additional information has no affect on the previously provided no significant hazards determination.

If you should have any questions concerning the above, please contact Paul Caropino at (504) 739-6692.

Very truly yours,

R.F. Burski
Director
Nuclear Safety

RFB/PLC/ssf
Attachment

cc: L.J. Callan, NRC Region IV
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EVALUATION OF 3°F REDUCTION IN THE MINIMUM COLD LEG TEMPERATURE FOR WATERFORD UNIT 3 CYCLE 8

Introduction

Waterford Technical Specification 3.2.6 mandates that the reactor coolant cold leg temperature shall be maintained between 544°F and 558°F for power levels larger than 30%. A 3°F reduction on the minimum cold leg temperature was requested by Waterford 3 in order to prevent a possible violation of the Technical Specification in the future cycles. An analysis value of 539°F, that includes a 2°F measurement uncertainty, has to be considered in the safety analyses as the minimum core inlet temperature.

The impact of the 3°F reduction on the minimum cold leg temperature on both the directly visible non-LOCA Design Basis Events (DBEs) documented in the Updated Final Safety Analysis Report (UFSAR) and the set of transients performed to provide limits and setpoints in the Core Operating Limit Supervisory System (COLSS) and the Core Protection Calculator System (CPCS) were investigated. The events are divided into two categories, those events sensitive to the temperature reduction and those events insensitive to the change.

Analysis

Events Insensitive to the Minimum Cold Leg Temperature Reduction

Events which are insensitive to the 3°F reduction on the minimum cold leg temperature are those events for which either the variation of cold leg temperature does not impact the transient or the maximum temperature is used in the limiting cases. The events that use maximum temperature are:

1.0 Increased Heat Removal Events

1.1 Moderate frequency events

- Decrease in feedwater temperature
- Increase in feedwater flow
- Increased main steam flow
- Inadvertent opening of a steam generator atmospheric dump valve

1.2 Infrequent events

- Decrease in feedwater temperature with a concurrent single failure of an active component
- Increase in feedwater flow with a concurrent single failure of an active component
- Increased main steam flow with a concurrent single failure of an active component
- Inadvertent opening of a steam generator atmospheric dump valve with a concurrent single failure of an active component

1.3 Limiting fault events

- Hot Full Power steam system piping failures post trip return to power
- Hot Zero Power steam system piping failures post trip return to power
- Steam system piping failures inside and outside containment Modes 3 & 4 with all full length CEAs on bottom
- Steam system piping failures pre trip power excursion

2.0 Decreased Heat Removal Events

2.1 Infrequent events

- Loss of normal feedwater flow

2.2 Limiting fault event

- Feedwater system pipe break

3.0 Decrease in RCS Inventory Events

3.1 Limiting fault event

- Primary sample or instrument line break
- Steam generator tubs rupture
- Inadvertent opening of a pressurizer safety valve

The maximum core inlet temperature was used in the limiting cases for the events listed above. This maximizes the initial steam generator pressure which engenders a higher blowdown flow and a larger cooldown of the primary system for the increased heat removal events after either opening of the valves or initiation of a postulated pipe break.

Use of the maximum core inlet temperature also maximizes the energy contents on both primary and secondary systems which could result in a bigger offsite dose releases for the feedwater system pipe break and the decrease in RCS inventory events. For the loss of normal feedwater flow event, the higher energy content requires that more steam generator liquid be vaporized and hence increases the chance of steam generator dryout.

The following events are not affected by minimum inlet temperature:

4.0 Reactivity Anomaly Events

4.1 Moderate frequency events

- Uncontrolled CEA bank withdrawal from subcritical conditions
- Uncontrolled CEA bank withdrawal from low power conditions
- Uncontrolled CEA bank withdrawal at power
- Full length and subgroup CEA drops
- Reactor power cutback without turbine runback
- Inadvertent Boron dilution
- Startup of an inactive reactor coolant pump

4.2 Limiting fault event

- Inadvertent loading of a fuel assembly into the improper position

5.0 Increase in RCS Inventory Events

5.1 Moderate frequency event

- CVCS malfunction
- Inadvertent operation of the ECCS during power operation

5.2 Infrequent event

- CVCS malfunction with a concurrent single failure of an active component

6.0 Radioactive Release from a Subsystem of Component

- Radioactive waste gas system leak or failure
- Liquid waste system leak or failure
- Postulated radioactive releases due to liquid containing tank failure
- Design basis fuel handling accident
- Spent fuel cask drop accident

7.0 Miscellaneous Event

- Asymmetric steam generator transient

The results of the events listed above are not affected by the core inlet temperature. The 3°F reduction on the minimum cold leg temperature, hence, will not invalidate the results of these events.

Events Sensitive to the Minimum Cold Leg Temperature Reduction

The 3°F temperature reduction may have an impact on those events for which the minimum core inlet temperature is used in the limiting cases. Events to consider in this category include:

1.0 Decreased Heat Removal Events

1.1 Moderate frequency events

- Loss of external load
- Turbine trip
- Loss of condenser vacuum (LOCV)
- Loss of Normal AC power

1.2 Infrequent events

- Loss of external load with concurrent single failure of an active component
- Turbine trip with concurrent single failure of an active component
- Loss of condenser vacuum with concurrent single failure of an active component
- Loss of Normal AC power with concurrent single failure of an active component

The most limiting case among these decreased heat removal events is the LOCV in terms of peak RCS as well as SG pressure. A LOCV may occur due to failure of the circulating water system to supply cooling water, failure of the main condenser evacuation system to remove noncondensible gases, or excessive leakage of air through a turbine gland packing. LOCV causes both the turbine and the feedwater pumps to trip, and disables the turbine bypass valves. Closure of the turbine stop valves and coastdown of the main feedwater pumps cause the primary and secondary temperatures and pressure to increase rapidly. A reactor trip will occur on high pressurizer pressure.

The peak pressure is limited by the reactor trip, the pressurizer safety valves, and the main steam safety valves (MSSVs). The maximum core inlet temperature was used in the limiting case for the peak SG pressure calculation in order to maximize the initial SG pressure. The temperature reduction, hence, will not affect the peak SG pressure calculation.

The minimum core inlet temperature was chosen for the limiting case for the peak RCS pressure calculation in order to minimize the initial steam generator pressure. A lower steam generator pressure delays the opening of MSSVs and increases the peak RCS pressure. Therefore, the LOCV event is being reanalyzed for Cycle 8 to quantify the impact of the 3°F reduction on the minimum core inlet temperature. The preliminary results indicate that peak RCS pressure indeed increases from previously reported value of 2719 psia to 2728 psia due to the temperature reduction. However, the peak RCS pressure remains less than 2750 psia, the 110% of the design pressure.

2.0 Decreased Reactor Coolant Flow Events

2.1 Moderate frequency and infrequent event

- Partial loss of forced reactor coolant flow
- Total loss of forced reactor coolant flow

2.2 Limiting fault events

- Single reactor coolant pump shaft seizure/sheared shaft
- Single reactor coolant pump shaft seizure/sheared shaft with a stuck open secondary safety valve

A partial loss of forced reactor coolant flow can be caused by loss of power to one pump or the loss of power to one pump bus and a total loss of flow can be caused by loss of power to all pumps. Certain COLSS constants are determined based on the more limiting event of the total loss of forced reactor coolant flow as a function of ASI. With proper constants, COLSS will assist operators to preserve enough thermal margin so that violation of SAFDL will be averted during the event. When COLSS is out of service, appropriate margins are preserved by the COLSS Out of Service Limit lines of Technical Specification 3.2.4.

A single reactor coolant pump shaft seizure/sheared shaft can be caused by the mechanical failure of the pump shaft. Following the shearing or seizing of the shaft, the core flow rate rapidly decreases to the value that would occur with only three pumps operating.

As the core flow rate decreases during the transients, the coolant heats up quickly and voids may be generated at the top portion of the core. The power in that region decreases due to the negative reactivity feedback from voids. The minimum core inlet temperature was used in the limiting case to maximize the subcooling of the coolant, which resulted a minimum reactivity feedback during the transient. The total loss of forced reactor coolant flow and the single pump shaft seizure/sheared shaft were analyzed for Waterford 3 Cycle 4. Both the total loss of forced reactor coolant flow and the single pump shaft seizure/sheared shaft were previously analyzed with

a core inlet temperature of 535°F which is 4°F below the current minimum cold leg temperature allowed by Technical Specification. Therefore, a reduction of 3°F on the minimum cold leg temperature in the current Technical Specification is bounded by the previously documented conclusions and results.

3.0 Reactivity Anomaly Events

3.1 Moderate frequency events

- Part length CEA drop
- Single CEA withdrawal

3.2 Limiting fault event

- CEA ejection

Several CEA deviation events, such as a single CEA withdrawal, a part length CEA drop, and a CEA ejection, may not cause any reactor trip with a weak CEA. The power increases slowly due the reactivity insertion from both the CEA and the moderator feedback with a positive MTC. Such slow transients rely on the opening of MSSVs to limit the power increase by re-balancing the primary power and the secondary heat removal. A final steady state will be rendered with MSSVs open and close frequently to regulate the heat removal.

The minimum core inlet temperature was used in the limiting cases to minimize the initial steam generator pressure. This delays the opening of MSSVs and allows the core power to rise higher before the steady state is reached. These events have to be reanalyzed in order to quantify the impact of the temperature reduction.

These CEA deviation events supply input to the calculation of monitoring and protection system setpoints. They have been reanalyzed with the 3°F temperature reduction to support the COLSS and CPCS analyses.

Conclusions

The impact of 3°F reduction on the minimum cold leg temperature on both the directly visible non-LOCA DBEs documented in UFSAR and the set of transients performed to provide COLSS and CPCS limits and setpoints were evaluated. The impact is negligible for all the transients considered, except the following events:

- Loss of condenser vacuum
- Part length CEA drop
- Single CEA withdrawal within CEAE/CPC deadband
- CEA ejection

The LOCV event was reanalyzed explicitly for Waterford 3 Cycle 8 and the results indicate that the peak RCS pressure increases to 2728 psia, which remains less than 110% of the design pressure. The listed reactivity anomaly events have been reanalyzed to provide input to the COLSS and CPCS analyses.

Analyses of the COLSS and CPCS setpoints in support of Cycle 8 address the effects of the 3°F reduction on the minimum cold leg temperature including the margin and setpoint requirements resulting from transient analyses.