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To: "'Thomas Alexion'" <TWA@nrc.gov>
Date: 5/8/05 3:16PM
Subject: Waterford 3 Draft Additional Information Regarding Instrument Uncertainty

<<Draft for NRC 5-8-05.pdf>>
Tom,
The information we added as a result of our conference call last week is identified by revision bars in the attached document. Let me know if this addresses Kent's remaining questions.
Thanks,
Bryan

CC: "KALYANAM, N. KALY" <nxk@nrc.gov>

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Technical Specification 3.2.6

Footnote * to Technical Specification 3.2.6 allows the upper limit on Tcold to increase to 559°F for up to 30 minutes following a reactor power cutback in which (1) regulating groups 5 and/or 6 are dropped or (2) regulating groups 5 and/or 6 are dropped and the remaining regulating groups are sequentially inserted. This value is considered an arbitrary value to which uncertainty need not be applied. Footnote * to Technical Specification 3.2.6 was in the Waterford 3 Technical Specifications at the time of initial licensing. There has been no change to that footnote between initial licensing and EPU.

A reactor power cutback is a non-safety system which is initiated in the event of a load rejection, such as a turbine trip or a loss of one of two main feedwater pumps, which exceeds the capacity of the turbine bypass valves. The reactor power cutback system initiates the dropping of one or more preselected CEA groups. This rapid reduction of plant power at a rate which is greater than that provided by the normal high speed CEA insertion, helps to restore the plant to within prescribed operating ranges. Reactor power cutback is not credited in any FSAR Chapter 15 safety analyses.

The reactor power cutback system will also throttle the turbine admission valve (for a loss of a feedwater pump) to rebalance turbine and reactor power. If there is a minor mismatch and core power is greater than turbine demand, cold leg temperature will slowly increase. With a negative MTC, the increasing temperature will cause core power to decrease to match the turbine demand, resulting in a stable power at the reduced level set by the turbine. Since this power is substantially below full power, there is no challenge to thermal margins.

Reactor power cutback will occur in response to a Loss of Load type event, such as those documented in FSAR Section 15.2 including the Loss of External Load and Turbine Trip events. These events, categorized as Decreases in Heat Removal by the Secondary System, are events in which reactor power cutback is utilized to rapidly reduce RCS power to avoid reactor trips which would otherwise result on high pressurizer pressure. The response of Waterford 3 to the limiting FSAR 15.2 Anticipated Operational Occurrence, the Loss of Condenser Vacuum (without credit for reactor power cutback), is documented in the EPU License Amendment Request of letter W3F1-2003-0074 dated November 13, 2003. As can be seen per Figure 2.13.2.1.3-14 the LOCV is an event which does not challenge DNBR margins. As discussed in the PUR and in the Waterford 3 FSAR, the response to a Loss of External Load or a Turbine Trip is bounded by the response to a Loss of Condenser Vacuum. The responses to those events with a reactor power cutback present would also be bounded by the Loss of Condenser Vacuum analysis.

The loss of one feedwater pump is an event which is bounded by the total Loss of Feedwater event (without credit for reactor power cutback) which is documented in FSAR Section 15.2.2.5 and in Section 2.13.2.2.5 of the 3716 MWt Extended Power Uprate License Amendment Request, W3F1-2003-0074. As shown in Figure 2.13.2.2.5-12 of the EPU LAR, this event also does not challenge DNBR, with a relatively constant DNBR prior to reactor trip.

Thus, the resultant core conditions after a reactor power cutback would result in no challenge to thermal margins.

Control system analyses conducted in support of Waterford 3 EPU have modeled the plant response to transients involving reactor power cutback. For example, reactor power cutback would result in a core power of about 50% for an End of Cycle (EOC) Turbine Trip. With no

operator action to drive in additional CEA's, there would be about a 7°F rise in Tcold from a nominal 543°F to about 550°F. This is consistent with the 10°F rise allowed per the footnote to TS 3.2.6.

As stated in Attachment 1 to W3F1-2003-0074, the 3716 MWt Extended Power Uprate License Amendment Request, this value is being revised from 568°F to 559°F for EPU, in conjunction with the change to the Tcold LCO; the LCO is being revised from a range of 541°F to 558°F to a new range of 536°F to 549°F. The revision of this value to 559°F maintains the existing 10°F difference to the maximum T_{cold}.

Waterford 3 was licensed with a Tcold range of 541°F to 558°F, based on a nominal temperature ramp from 545°F at Hot Zero Power (HZP) to 553°F at Hot Full Power (HFP). Under 10CFR50.59, Waterford 3 revised this nominal temperature program to a constant 545°F value in the early 1990's. For power uprate, a 2°F ramp is being adopted, with nominal Tcold ranging from 541°F at HZP to 543°F at HFP. Thus, with the implementation of EPU, there will be a more restrictive differential~~range~~ of 16°F (559°F versus 543°F) between normal Tcold and~~to~~ the footnote value compared to the pre-EPU differential range of 23°F (568°F versus 545°F).

The original 568°F value in Technical Specifications was arbitrarily chosen to be 10°F above the upper limit of the LCO, on the basis that it is reasonable to allow some deviation for a short period of time (30 minutes) to allow recovery and subsequent plant stabilization after the reactor power cutback. This also prevents unnecessary plant entries into Technical Specification ACTION statements. The 10°F offset is unchanged for 3716 MWt Power Uprate.

Operators select the appropriate CEA group(s) to drop during a reactor power cutback. The selection ensures that the reactor power following cutback will be less than the capacity of the turbine bypass valves of about 65%. Because a reactor power cutback is a plant transient of short duration, no additional accident or transient is postulated to occur simultaneously during the 30 minute time period of the TS 3.2.6 footnote where T_{cold} may be above the explicitly analyzed range. Also, due to the reduced power, there is significantly less energy and latent heat in the reactor core after the cutback.

The Core Protection Calculator (CPC) system initiates automatic protective action to assure that the specified acceptable fuel design limits on DNBR and LPD are not exceeded. The Low DNBR and High LPD trips provided by CPC are discussed in FSAR Section 7.2.

The CPC Wide Range Tcold band extends from 495°F to 580°F, as documented in Bases Section 2.0 of Waterford 3 Technical Specifications. CPC will produce conservative calculations of DNBR and LPD for Tcold values within the Wide Range band, and would be capable of fulfilling their function of initiating a reactor trip when needed. As stated in Technical Specification Bases, the DNBR algorithm used in CPC is valid within these Wide Range limits and operation outside of these limits will result in CPC initiating an Auxiliary trip for the parameter being out of range. Thus the CPCs would continue to adequately protect the core during the temporary 30 minute Tcold excursion to 559°F following the reactor power cutback which is well within the CPC Wide Range upper limit of 580°F (i.e., 21°F below the upper limit). Note that pre-EPU Technical Specifications allowed a temporary 30 minute Tcold excursion to 568°F (i.e., 12°F below the upper limit) following a reactor power cutback.

Many Chapter 15 analyses are conducted assuming initial conditions corresponding to Power Operating Limits, that is, assuming that there is no initial excess margin preserved. For such analyses, there is little impact associated with any specific initial condition, and the initiation of

an analysis in the slightly extended indicated temperature range of 549°F to 559°F associated with the footnote to TS 3.2.6 would have no appreciable effect. While some analyses assume a high bias for the initial Tcold, this is generally done to maximize the core initial energy for the transient; however, the thermal margin gains associated with the lower core power after a reactor power cutback would dominate any small impact due to an initial core temperature which is a couple of degrees higher. Thus, engineering judgment leads to the conclusion, based on the operation of the CPCs, increased thermal margins, and conservatisms in the analysis, that a Tcold up to 558°F for 30 minutes following a reactor power cutback is acceptable.

Further, since the plant would have already experienced a Chapter 15 event initiator (e.g., a Loss of Load or a partial Loss of Feedwater Flow) prior to the reactor power cutback, it is not necessary or credible to postulate another event happening during the limited period of time (30 minutes) that the TS 3.2.6 footnote would be applicable after a reactor power cutback.

Because the 559°F value for the TS 3.2.6 footnote approved via Amendment 199 is not based on a specific analysis but is intended as a reasonable allowance for the potential Tcold temperature swing following a reactor power cutback, there is no need to address instrument uncertainty with respect to this parameter. This parameter is considered a Category D item.

Power Level for OPERABILITY of ADV Automatic Actuation
Technical Specification 3.7.1.7

New Technical Specification 3.7.1.7 is being added due to EPU to specify OPERABILITY requirements for the Atmospheric Dump Valves. This TS is being added since the EPU Small Break LOCA Emergency Core Cooling System (ECCS) analysis credits one Atmospheric Dump Valve for the purpose of secondary pressure control; the ADV's were previously credited only for cooldown to shutdown cooling entry conditions and for their containment isolation function.

The small break LOCA analyses assume a maximum ADV setpoint of 1040 psia. This value is specified in the footnote to TS 3.7.1.7 and explicitly accounts for the instrument uncertainty offset from the nominal setpoint of 1007 psia.

The footnote to the LCO also documents that the ADV automatic actuation channels are not required to be operable when the reactor has been at less than or equal to 70% Rated Thermal Power for greater than 6 hours (following long-term operation at EPU Rated Thermal Power of 3716 MWt). The value of 70% is specified based on reasonable engineering judgment as a power level below which automatic actuation of the ADV's is not required. To verify the acceptability of this arbitrary value, a calculation was performed to demonstrate that the decay heat load associated with operation for 6 hours at 70% Rated Thermal Power is such that the ADV's need not be credited to demonstrate acceptable ECCS performance. The ADV's are not credited in the Waterford 3 Cycle 13 pre-uprate Small Break LOCA ECCS analyses, which leads to the conclusion that long-term operation at power levels of 3441 MWt (92.6% of EPU Rated Thermal Power) is acceptable without crediting ADV's in the SBLOCA analysis. The 6 hour time frame supports the Bases for ACTIONs a and b of new TS 3.7.1.7, which calls for exiting TS applicability within 6 hours after reducing power to less than or equal to 70% of Rated Thermal Power.

Margin exists in the decay heat analysis between the pre-uprate power where ADV's are not required (e.g., long term operation at 3441 MWt) and the decay heat corresponding to operation at 70% of uprated thermal power for 6 hours or less. The decay heat for a reactor trip after operation for six hours at 70% of uprated thermal power after long-term operation at 3716 MWt is around 10% below that from long-term operation at 3441 MWt. A strict analytical approach would result in a curve of increasing Reactor Thermal Power as a function of time, that is, the reactor power could be slowly increased up to approximately 92.6% in order for this decay heat logic to be maintained. In consideration of this margin and the fact that the decay heat load associated with 70% power operation will decrease with longer times, it is not considered necessary to apply any explicit offset to account for power measurement uncertainty to the 70% value specified in Technical Specifications.

Based upon this reasoning, Entergy considers this to be an arbitrary value to which uncertainty need not be applied and therefore a Category D parameter. If explicit analysis were performed this value could be raised to a value closer to 92.6%.