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From: Habib, Donald
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Request for Additional Information 116

Issue Date: 03/06/2014
Application Title: Levy County, Units 1 and 2 - Dockets 52-029 and 52-030
Operating Company: Duke Energy Florida
Docket No. 52-029 and 52-030
Review Section: 06.03 - Emergency Core Cooling System
RAI Tracking No. 7439

QUESTIONS

06.03-1
Levy submittal dated February 7, 2014, states that "Containment Response Analysis for the Long Term PRHR Operation," APP-PXS-M3C-071, Revision 1, was used to quantify condensate losses associated with the following thermodynamic phenomena during containment recirculation:

- Losses due to condensation on passive heat sinks
- Mass of steam which remains in the containment free volume
- Losses due to containment leakage

The submittal also states that APP-PXS-M3C-071 analyzed the following input and boundary conditions:

- Heat Input to the PRHR HX
- PCS flow, PCS water temperature, PCS water coverage
- Containment vessel heat transfer rates
- PCS actuation time
- IRWST water level, water temperature
- Containment initial pressure, temperature, relative humidity
- Mass of the heat sinks inside the containment

However, the submittal itself does not describe how each of the above phenomena was modeled and what values were used for the input and boundary conditions. For the staff to make a safety determination on PRHR heat exchanger with respect to General Design Criteria 34 of 10 CFR Part 50, Appendix A, please provide the following regarding APP-PXS-M3C-071 as response to this RAI:

a. Complete listing of important phenomena modeled. For example, the effect of steaming from reactor vessel bottom head by condensate accumulated in the reactor vessel cavity was credited but not noted in the submittal.
b. Description of phenomena and methodology used to analyze the phenomena.
c. Values of input and boundary conditions and justification of the values used. Important assumptions used and their justification.
d. Results of the calculations.

06.03-2
Levy submittal dated February 7, 2014, states that "Condensate Return to IRWST for Long Term PRHR Operation," APP-PXS-M3C-072, Revision 1, was used to characterize the transient condensate return rate from the containment shell given inputs from APP-PXS-M3C-071, including:

- Containment pressure and temperature
- Losses to pressurize the atmosphere, as condensation on passive heat sinks, and to containment leakage

The calculation also incorporated test data from “AP1000 Condensate Return Test Report,” TR-SEE-III-12-01, to determine the losses over attachments to the containment shell. These inputs are used to determine the effects from the following phenomena:

- Dripping/“Rain out” from the inside surface of the upper dome of the containment
- Dripping from the inside surface of the upper dome due to misalignment of the containment plates
- Obstacle induced dripping from the shell, both along the containment dome and the sidewalls
- Water entrainment from the IRWST

While the submittal itself provides a summary of the test procedure and results, it does not state how each of the above phenomena was modeled and used to calculate the total condensate losses. For the staff to make a safety determination on PRHR heat exchanger with respect to General Design Criteria 34 of 10 CFR Part 50, Appendix A, please provide the following regarding APP-PXS-M3C-072 as response to this RAI:

a. Complete listing of important phenomena modeled.
b. Description of phenomena and methodology used to analyze the phenomena. For example, describe the method by which losses over attachment plates are derived from the testing.
c. Important assumptions used and their justification.
d. The resultant losses used in the final analyses, broken down by mechanism.

06.03-3
In the APP-PXS-M3C-072, Revision 1, calculation (“Condensate Return to IRWST for Long Term PRHR Operation”), the transient behavior of the condensate is analyzed. Condensation on most of the heat sinks is directly analyzed in WGOTHIC, while condensation on other surfaces like the operating deck floor and non-fixed equipment has been incorporated into a horizontal film holdup volume assumed proportional to the cross sectional area of containment multiplied by a factor (one for Best Estimate and another for Design Basis cases) used for margin (Section 5.3, p. 128).

a. Justify the factor used in each analysis calculated.
b. The thickness of the film on these surfaces is based on the capillary radius of a droplet of water, which is the minimum thickness of the film. Explain how such a treatment is conservative.

06.03-4
Documents APP-PXS-M3C-020 ("PRHR HX Sizing/Performance calculation"), Revision 3 and APP-SSAR-GSC-536 ("AP1000 Safe Shutdown Temperature Evaluation"), Revision 2, reference two types of calculations, Best Estimate (BE) and Design Basis (DBA). In general, DBA cases are defined by more conservative or bounding sets of input parameters with one notable exception: the DBA cases set the initial temperature inside containment and of the IRWST at 85 ºF, rather than the design basis minimum or maximum temperatures. NRC staff review of the revision 0 of the "AP1000 Safe Shutdown Temperature Evaluation" showed that the initial temperature of the IRWST has a significant impact on the timeline of the initial stages of the transient, while NRC interactions with Westinghouse staff indicated the effects of a lower heat sink temperature outweigh those from the increase in IRWST temperature. Justify the use of 85 ºF as the conservative containment temperature for the DBA analyses.

06.03-5
Condensate losses over attachments to the containment wall are based on testing reported in TR-SEEE-III-12-01. Tests were done over different attachment plate types at varying flow rates at both room temperature and heated conditions. Because conditions inside containment following a postulated transient analyzed in APP PXS M3C-072 ("Condensate Return to IRWST for Long Term PRHR Operation"), Revision 1, result in rather higher temperatures than those observed in the tests, the losses over attachments to the containment wall were extrapolated from the test results. Provide a justification for the validity of the extrapolation and explain the impact of the calculated condensate loss rates on the return of water to the IRWST.

06.03-6
The calculated values used for the long-term transient return rate of condensate to the IRWST in the APP-SSAR-GSC-536, "AP1000 Safe Shutdown Temperature Evaluation," Revision 2 and APP-PXS-M3C-020, "PRHR Sizing/Performance," Revision 3 calculations differ. Justify the discrepancy and explain the nature of the transient return rates used in the APP-PXS-M3C-020 calculation.

06.03-7
Section 4.0 of the Levy submittal dated February 7, 2014, describes 55 feet tall test facility used to quantify various loss mechanisms along the length of the containment wall. Provide cross sectional dimensions to the test sections.

06.03-8
Figure 4 of the Levy submittal, dated February 7, 2014, provides an illustration of a downspout screen which is different from the one provided in Figure 4 of an earlier version of the submittal dated April 18, 2013. Explain.

06.03-9
Figure 9 of the Levy submittal dated February 7, 2014, provides an illustration of inter-relationships of four calculations.

a. Explain this figure describing how information flows from one calculation to the other for design basis and best estimate calculations.

b. Explain how information flow loops are addressed. For example, APP-PXS-M3C-071 feeds containment pressure and temperature to SSAR-GSC-536, which feeds back bounding PRHR HX heat transfer and reactor vessel downcomer temperature to APP-PXS-M3C-071, creating a loop.

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Issue Date: 03/06/2014
Application Title: Levy County, Units 1 and 2 - Dockets 52-029 and 52-030
Operating Company: Duke Energy Florida
Docket No. 52-029 and 52-030
Review Section: 15.02.06 - Loss of Non-Emergency AC Power to the Station Auxiliaries
RAI Tracking No. 7440

QUESTIONS

15.02.06-1
In DCD Section 6.3.7.7 it is stated "If the plant does not need actuation of the automatic depressurization system based on having stable pressurizer level, full core makeup tanks, and high and stable in-containment refueling water storage tank levels, the operators are directed to de-energize all loads on the 24-hour batteries (blocking ADS actuation)." NRC staff seeks clarification on the IRWST level required for actuation (in order to protect the spargers), particularly between 24 hours and 72 hours.

a. What is the minimum IRWST level required for ADS actuation?
b. In the event that operators de-energize all loads on the 24-hour batteries, what are the criteria for operators to actuate ADS?

15.02.06-2
In DCD Section 6.3.1.1 it is stated that for postulated non-LOCA events, "The passive residual heat removal heat exchanger, in conjunction with the passive containment cooling system, is designed to remove decay heat for an indefinite time in a closed-loop mode of operation. The passive residual heat removal heat exchanger is designed to cool the reactor coolant system to 420 F in 36 hours, with or without reactor coolant pumps operating". DCD Section 6.3.4 states "The passive core cooling system can maintain safe shutdown conditions for 72 hours after an event without operator action and without both nonsafety-related onsite and offsite power." Previous approval of Chapter 15 analyses in the DCD were based on the assumption that the PRHR-HX would operate indefinitely. Therefore, the calculation could be terminated once the acceptance criteria for the design basis event were initially met. The current submittal has revealed that the assumption of indefinite operation in not valid. In order to provide safe closure of the Chapter 15 events, staff needs to verify that the acceptance criteria for these events will continue to be satisfied. The staff requests the following addition information:

a. Provide an explanation as to why loss of normal feedwater coincident with loss of ac power is the limiting event from the standpoint of PRHR-HX performance.
b. Extend the calculation time for the limiting event to 72 hours. In addition to the plots already presented in the DCD include plots for (1) IRWST level as a function of time, (2) condensate return fraction as a function of time, and (3) containment pressure as a function of time.

15.02.06-3
In DCD Section 6.3.4 it is stated that the only post-72 hour action required is "a potential need for containment inventory makeup. The need for makeup is directly related to the leakrate from

the containment. With the maximum allowable containment leakreate, makeup to containment is not needed for about one month." In APP-PXS-M3C-020, case CD2, the IRWST level has decreased to the midpoint of the PRHR-HX on a time frame much less than a month. Staff is requesting clarification on post-72 hour action for non-LOCA events.

a. In the event that ADS actuation has been blocked and the RCS has been maintained at safe-shutdown for 72 hours, but the IRWST level is significantly reduced, what are the post 72-hour actions?