Florida Power & Light Company, 6501 S. Ocean Drive, Jensen Beach, FL 34957

FPL

March 15, 2012

L-2012-106
10 CFR 50.90

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

Re: St. Lucie Plant Unit 2
Docket No. 50-389
Renewed Facility Operating License No. NPF-16

Response to Nuclear Performance and Code Review Branch Request for Additional Information Identified During an Audit of Analyses Supporting the Extended Power Uprate License Amendment Request

References:

(1) R. L. Anderson (FPL) to U.S. Nuclear Regulatory Commission (L-2011-021), "License Amendment Request (LAR) for Extended Power Uprate," February 25, 2011, Accession No. ML110730116.

(2) NRC Nuclear Performance and Code Review Branch Audit Conducted at Westinghouse Electric Company Facilities in Rockville, MD, February 22 and 23, 2012.

By letter L-2011-021 dated February 25, 2011 [Reference 1], Florida Power & Light Company (FPL) requested to amend Renewed Facility Operating License No. NPF-16 and revise the St. Lucie Unit 2 Technical Specifications (TS). The proposed amendment will increase the unit's licensed core thermal power level from 2700 megawatts thermal (MWt) to 3020 MWt and revise the Renewed Facility Operating License and TS to support operation at this increased core thermal power level. This represents an approximate increase of 11.85% and is therefore considered an Extended Power Uprate (EPU).

During the course of the NRC audit conducted at the Westinghouse Electric Company facilities in Rockville, MD on February 22 and 23, 2012 [Reference 2], the NRC staff requested additional information related to the EPU analyses for boron precipitation. The attachment to this letter provides the requested information.

This submittal contains no new commitments and no revisions to existing commitments.

This submittal does not alter the significant hazards consideration or environmental assessment previously submitted by FPL letter L-2011-021 [Reference 1].

In accordance with 10 CFR 50.91(b)(1), a copy of this letter is being forwarded to the designated State of Florida official.

A001
NRR

Should you have any questions regarding this submittal, please contact Mr. Christopher Wasik, St. Lucie Extended Power Uprate LAR Project Manager, at 772-467-7138.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge.

Executed on 15-March-2012

Very truly yours,

Richard L. Anderson
Site Vice President
St. Lucie Plant

Attachment

cc: Mr. William Passetti, Florida Department of Health

Response to NRC Nuclear Performance and Code Review Branch Request for Additional Information

The following information is provided by Florida Power & Light Company (FPL) in response to the U. S. Nuclear Regulatory Commission's (NRC) Request for Additional Information (RAI). This information was requested to support the review of the Extended Power Uprate (EPU) License Amendment Request (LAR) for St. Lucie Nuclear Plant Unit 2 that was submitted to the NRC by FPL via letter (L-2011-021) dated February 25, 2011, Accession Number ML110730116.

As part of the NRC's LAR review process, an audit of supporting analyses was conducted at the Westinghouse Electric Company facilities in Rockville, MD on February 22 and 23, 2012. During this audit the NRC staff requested additional information related to the EPU analyses for boron precipitation. Although the Westinghouse audit was predominantly in support of the St. Lucie Unit 2 EPU, the NRC reviewer indicated that the information requested is for both St. Lucie units. The St. Lucie Unit 2 responses to the NRC request are documented below.

Item 1

Document core and sump boric acid concentrations versus time post-LOCA.

Response

Table 1 documents the requested results from the case of 250 gpm HLI begun at 6 hours post-LOCA.

Table 1
St. Lucie Unit 2
250 gpm HLI begun at 6.0 hours post-LOCA

Time, hours	Core Boric Acid Concentration, wt%	Sump Boric Acid Concentration, wt%
0.28	3.70	0.00
1.63	10.57	0.00
2.30	13.26	1.44
3.00	15.70	1.41
3.10	16.03	1.40
3.20	16.36	1.40
3.30	16.69	1.39
3.40	17.01	1.39
3.50	17.33	1.39
3.60	17.65	1.38
3.70	17.96	1.38
3.80	18.27	1.38

Table 1
St. Lucie Unit 2
250 gpm HLI begun at 6.0 hours post-LOCA

Time, hours	Core Boric Acid Concentration, wt%	Sump Boric Acid Concentration, wt%
3.90	18.58	1.37
4.00	18.89	1.37
4.10	19.19	1.36
4.20	19.49	1.36
4.30	19.79	1.36
4.40	20.09	1.35
4.50	20.38	1.35
4.60	20.68	1.35
4.70	20.97	1.34
4.80	21.26	1.34
4.90	21.54	1.34
5.00	21.83	1.33
5.10	22.11	1.33
5.20	22.39	1.33
5.30	22.67	1.32
5.40	22.95	1.32
5.50	23.23	1.32
5.60	23.50	1.31
5.70	23.77	1.31
5.80	24.04	1.31
5.90	24.31	1.31
6.00	24.58	1.30
6.10	24.84	1.30
6.20	25.07	1.30
6.30	25.28	1.29
6.40	25.48	1.29
6.50	25.65	1.29
6.60	25.80	1.29
6.70	25.92	1.29
6.80	26.03	1.29
6.90	26.12	1.28
7.00	26.19	1.28
7.10	26.24	1.28
7.20	26.27	1.28
7.30	26.28	1.28
7.40	26.28	1.28
7.50	26.26	1.28
7.60	26.22	1.28

Table 1
St. Lucie Unit 2
250 gpm HLI begun at 6.0 hours post-LOCA

Time, hours	Core Boric Acid Concentration, wt%	Sump Boric Acid Concentration, wt%
7.70	26.16	1.28
7.80	26.09	1.28
7.90	26.01	1.29
8.00	25.91	1.29
8.10	25.79	1.29
8.20	25.66	1.29
8.30	25.52	1.29
8.40	25.37	1.29
8.50	25.21	1.29
8.60	25.03	1.30
8.70	24.85	1.30
8.80	24.66	1.30
8.90	24.45	1.30
9.00	24.24	1.31
9.10	24.02	1.31
9.20	23.80	1.31
9.30	23.57	1.31
9.40	23.33	1.32
9.50	23.09	1.32
9.60	22.84	1.32
9.70	22.58	1.33
9.80	22.33	1.33
9.90	22.07	1.33
10.00	21.80	1.33
10.10	21.54	1.34
10.20	21.27	1.34
10.30	21.00	1.34
10.40	20.73	1.35
10.50	20.46	1.35
10.60	20.19	1.35
10.70	19.91	1.36
10.80	19.64	1.36
10.90	19.37	1.36
11.00	19.10	1.37
11.10	18.83	1.37
11.20	18.56	1.37
11.30	18.29	1.38
11.40	18.03	1.38

Table 1
St. Lucie Unit 2
250 gpm HLI begun at 6.0 hours post-LOCA

Time, hours	Core Boric Acid Concentration, wt%	Sump Boric Acid Concentration, wt%
11.50	17.76	1.38
11.60	17.50	1.38
11.70	17.24	1.39
11.80	16.99	1.39
11.90	16.73	1.39
12.00	16.48	1.40
12.10	16.23	1.40
12.20	15.99	1.40
12.30	15.75	1.41
12.40	15.51	1.41
12.50	15.28	1.41
12.60	15.04	1.41
12.70	14.82	1.42
12.80	14.59	1.42
12.90	14.37	1.42
13.00	14.15	1.42
13.10	13.94	1.43
13.20	13.73	1.43
13.30	13.53	1.43
13.40	13.32	1.43
13.50	13.13	1.44
13.60	12.93	1.44
13.70	12.74	1.44
13.80	12.56	1.44
13.90	12.37	1.45
14.00	12.19	1.45
14.10	12.02	1.45
14.20	11.85	1.45
14.30	11.68	1.45
14.40	11.52	1.46
14.50	11.36	1.46
14.60	11.20	1.46
14.70	11.05	1.46
14.80	10.90	1.46
14.90	10.75	1.47
15.00	10.61	1.47
15.10	10.47	1.47
15.20	10.33	1.47

Table 1
St. Lucie Unit 2
250 gpm HLI begun at 6.0 hours post-LOCA

Time, hours	Core Boric Acid Concentration, wt%	Sump Boric Acid Concentration, wt%
15.30	10.20	1.47
15.40	10.07	1.47
15.50	9.94	1.48
15.60	9.82	1.48
15.70	9.70	1.48
15.80	9.58	1.48
15.90	9.47	1.48
16.00	9.36	1.48
16.10	9.25	1.48
16.20	9.14	1.49
16.30	9.04	1.49
16.40	8.94	1.49
16.50	8.84	1.49
16.60	8.74	1.49
16.70	8.65	1.49
16.80	8.56	1.49
16.90	8.47	1.49
17.00	8.38	1.49
17.10	8.30	1.50
17.20	8.22	1.50
17.30	8.14	1.50
17.40	8.06	1.50
17.50	7.98	1.50
17.60	7.91	1.50
17.70	7.84	1.50
17.80	7.77	1.50
17.90	7.70	1.50
18.00	7.63	1.50
18.10	7.57	1.50
18.20	7.51	1.51
18.30	7.44	1.51
18.40	7.38	1.51
18.50	7.33	1.51
18.60	7.27	1.51
18.70	7.21	1.51
18.80	7.16	1.51
18.90	7.11	1.51
19.00	7.05	1.51

Table 1
St. Lucie Unit 2
250 gpm HLI begun at 6.0 hours post-LOCA

Time, hours	Core Boric Acid Concentration, wt%	Sump Boric Acid Concentration, wt%
19.10	7.00	1.51
19.20	6.96	1.51
19.30	6.91	1.51
19.40	6.86	1.51
19.50	6.82	1.51
19.60	6.77	1.51
19.70	6.73	1.52
19.80	6.69	1.52
19.90	6.64	1.52
20.00	6.60	1.52

Item 2

Provide additional justification for reactor vessel bottom head temperature vs. time following initiation of simultaneous hot and cold leg injection, and explain how this could impact precipitation.

Response

Following a large break LOCA, safety injection is immediately injected into the RCS through the high pressure safety injection (HPSI) and low pressure safety injection (LPSI) pumps and safety injection tanks (SITs) to the cold legs. This pump injection initially comes from the refueling water tank (RWT). The RWT and SITs are at a relatively cold temperature, which leads to an initially subcooled condition for the downcomer. Once the RWT empties, injection switches to recirculation from the containment sump, which is at a hotter temperature than the RWT. After recirculation begins with relatively low HPSI flow, the fluid in the vessel is expected to approach saturation due to heat addition from the vessel walls and an essentially stagnant mass of fluid in the vessel, whose boil-off is replenished by HPSI flow.

The boric acid precipitation analysis does not explicitly calculate the temperature in the reactor vessel bottom head. The analysis assumes saturation conditions, which is conservative, as it maximizes core boil-off.

The time of interest for this response focuses on the timeframe after the latest time to begin simultaneous hot and cold leg injection, specifically, 6-9 hours post-LOCA. Sump water temperature, based on a double-ended break in the discharge leg with a failure of an emergency diesel generator, is on average 185 °F during that time.

For injection from the sump into the RCS, CE plant designs like St. Lucie Unit 2 do not have the sump liquid pass through a heat exchanger before injection. Therefore, liquid is injected into the RCS at the sump liquid temperature.

While this temperature is less than the assumed lower plenum temperature of 212 °F, which is based on saturation conditions of pure water at 14.7 psia, this should not significantly alter the solubility limit in the reactor vessel and the potential for boric acid precipitation. This is because liquid from the sump is only being injected into the reactor vessel at a flow rate of 250 gpm to the hot leg and 273 gpm to the cold leg following the start of simultaneous hot and cold leg injection for St. Lucie Unit 2. Compared to the total mixing volume, which is over an order of magnitude larger in size than the value of gallons entering the mixing volume each minute, this input of colder liquid will not greatly impact the overall liquid temperature in the reactor vessel. Additionally, while the boric acid precipitation analysis models this liquid from the sump being injected directly into the core, in reality, the liquid that will go into the lower plenum will be injected into the cold legs. Therefore, before entering the lower plenum, this liquid also has to travel down the downcomer, where it will mix and heat up. The injected sump water will heat up due to mixing with the hotter liquid in the downcomer and the initial hot temperature and large heat capacity of the walls of the downcomer (MCp = 97,795 BTU/°F). Thus, using an inlet (sump) temperature of 185 °F would have no effect on the boric acid precipitation analysis. In actuality, the temperature will be much higher by the time the liquid enters the lower plenum, and should not have any significant impact on the boric acid solubility limit in the reactor vessel.

Also, while this lower temperature could potentially result in a lower solubility limit at the point of injection and localized boric acid precipitation, this is unlikely and not a major concern for precipitation in the core. As described above, the liquid temperature will increase as it travels down the downcomer to the lower plenum and the core, which will once again raise the solubility limit and dissolve any potential precipitation that had formed.

Item 3

Calculate the depressed elevation of liquid in the outlet plenum when taking into account water in the loop seal, and discuss how this effects the calculation of the mixing volume.

Response

This calculation is performed here for St. Lucie Unit 1 only, but the discussion also applies to St. Lucie Unit 2. The reactor coolant system (RCS) geometry and pressure drops used to calculate the hydrostatic head in the outlet plenum for St. Lucie Unit 2 are similar to St. Lucie Unit 1. Thus, performing these calculations for St. Lucie Unit 2 would produce similar values and the same overall conclusion as it does for St. Lucie Unit 1, and it is justified to document once for both units.

For St. Lucie Unit 1, the justification of the selection of the top of the mixing volume is documented in LR Section 2.8.5.6.3.5.2 of Attachment 5 to the EPU LAR. Portions of this section are repeated here, with the following changes to satisfy responding to Action Item #3:

1) The hydrostatic head due to water in the loop seal is subtracted from calculated hydrostatic head of the downcomer.
2) The density of saturated liquid in the core and outlet plenum is no longer assumed to be that of pure water, but instead of a saturated boric acid solution.

The method used to justify the top of the mixing volume at the top of the hot legs is to show that the hydrostatic head of the liquid in the mixing volume used in this analysis is less than the Inner Vessel (IV) hydrostatic head, where the IV hydrostatic head equals the hydrostatic head in the downcomer minus the head associated with the core-to-break steam flow pressure drop and the head associated with the hydrostatic head of water in the loop seal. This calculation is performed at 1 hour post-LOCA. The following equation describes the calculation:

$$\Delta P_{MV} < \Delta P_{IV} = \Delta P_{DC} - \Delta P_{STM} - \Delta P_{LS} \text{ (at 1 hour)}$$

The available ΔP can be used to calculate the top of the available mixing volume. If it is greater than the assumed height used (i.e., from the top of the active core to the top of the Core Support Barrel (CSB) nozzles), then this selection is valid.

The density of liquid used to calculate the liquid level in the core and outlet plenum is based on a saturated boric acid solution. This is conservative, as this solution is denser than pure water, and thus will decrease the amount of hydrostatic head available to support the static head of liquid in the outlet plenum.

As stated above, the RCS is broken into four major regions over which the pressure drops are determined:

1) hydrostatic head of the downcomer, ΔP_{DC}
2) hydrostatic head of the loop seal, ΔP_{LS}
3) the core-to-break steam flow pressure drop, ΔP_{STM}
4) hydrostatic head of the IV, ΔP_{IV}

The hydrostatic head is equal to the height of liquid divided by the specific volume, v, (and multiplied/divided by the appropriate conversion factors), given as follows:

$$\Delta P\text{, psi} = (\text{Height of Liquid, ft}) / v\text{, ft}^3/\text{lbm} / 144 \text{ in.}^2/\text{ft}^2 * g/g_c$$

The enthalpies and specific volumes of saturated steam and liquid for pure water at 14.7 psia are as follows:

- enthalpy of saturated steam = 1150.28 Btu/lbm
- enthalpy of saturated liquid = 180.18 Btu/lbm
- specific volume of saturated steam = 26.7952 ft^3/lbm
- specific volume of saturated liquid = 0.016714 ft^3/lbm

The density of a saturated boric acid solution in water is 1.016 g/cm^3, which converts to a specific volume of 0.015765 ft^3/lbm.

Hydrostatic Head of the Downcomer, ΔP_{DC}

This value is unchanged from what is documented in LR Section 2.8.5.6.3.5.2. The hydrostatic head of the downcomer from the bottom elevation of the active core to the bottom elevation of the reactor coolant pump (RCP) discharge legs remains 6.53 psi.

Hydrostatic Head of the Loop Seal, ΔP_{LS}

Using the geometric information in LR Table 2.8.5.6.3-10, the height of the loop seal (from top of cross-over leg to bottom of discharge leg) is 3.5 ft for St. Lucie Unit 1. The static head associated with the height of liquid in the cold leg above the loop seal inlet to the reactor coolant pump is offset by the added static head for the downcomer from this liquid. The hydrostatic head, ignoring the head of steam in the downflow side of the loop seal, associated with this level of liquid in the loop seal is calculated as follows:

$$\Delta P_{LS} = 3.5 \text{ ft} / 0.016714 \text{ ft}^3/\text{lbm} / 144 \text{ in.}^2/\text{ft}^2 * g/g_c = 1.454 \text{ psi}$$

Core-to-break steam flow pressure drop, ΔP_{STM}

This value is unchanged from what is documented in LR Section 2.8.5.6.3.5.2. The core-to-steam flow pressure drop remains 0.593 psi at 1 hour post-LOCA.

Hydrostatic Head of the Inner Vessel, ΔP_{IV}

The hydrostatic head of the mixing volume is made up of two parts; the hydrostatic head of the core, ΔP_{CORE}, and the outlet plenum, ΔP_{OP}, the latter of which is ultimately being solved for.

Hydrostatic Head of the Core, ΔP_{CORE}

The head of the collapsed liquid in the core is dependent upon the liquid volume, which in turn is dependent on the void fraction of the core, and thus is time dependent. The liquid volume in the core at 1 hour post-LOCA is determined to be 160.43 ft^3 and the core flow area is 54.00 ft^2. As documented above, the specific volume of saturated boric acid solution is 0.015765 ft^3/lbm. Based on these data, the core hydrostatic pressure drop, ΔP_{core} is:

$$\Delta P_{core} = (160.43 \text{ ft}^3 / 54.00 \text{ ft}^2) / 0.015765 \text{ ft}^3/\text{lbm} / 144 \text{ in.}^2/\text{ft}^2 * g/g_c = 1.31 \text{ psi}$$

Hydrostatic Head of the Outlet Plenum, ΔP_{OP}

The ΔP available to support the inner vessel liquid volume (i.e., the core and outlet plenum portion of the mixing volume) is the difference between the downcomer hydrostatic ΔP and the steam flow ΔP.

From this relationship, the hydrostatic head of the outlet plenum can be calculated as follows:

$$\Delta P_{IV} = \Delta P_{DC} - \Delta P_{STM} - \Delta P_{LS}$$

$$\Delta P_{OP} + \Delta P_{CORE} = \Delta P_{DC} - \Delta P_{STM} - \Delta P_{LS}$$

$$\Delta P_{OP} = \Delta P_{DC} - \Delta P_{STM} - \Delta P_{LS} - \Delta P_{CORE}$$

$$\Delta P_{OP} = 6.53 - 0.593 - 1.454 - 1.31$$

$$\Delta P_{OP} = 3.173 \text{ psi}$$

This equation gives the amount of hydrostatic head available to support the static head of the outlet plenum. In other words, the static head of the outlet plenum that yields this ΔP_{OP} is the height necessary to balance the system effects. It needs to be shown this height, which represents the collapsed height of the outlet plenum, is greater than the height used in the calculation of the mixing volume, i.e., the distance from the top of the active core to the top of the hot legs. Thus,

$$\Delta P_{MV} < \Delta P_{IV}$$

In other words, it needs to be shown that the hydrostatic ΔP of the selected mixing volume is less than the actual hydrostatic ΔP of the inner vessel. Restated, this relationship is:

$$(\Delta P_{OP\_MV} + \Delta P_{CORE\_MV}) < (\Delta P_{OP\_ACTUAL} + \Delta P_{CORE\_ACTUAL})$$

where ΔP_{CORE_MV} equals ΔP_{CORE_ACTUAL} since the liquid core volume used in determining ΔP_{CORE_ACTUAL} follows the same methodology used in calculating the liquid core volume for the mixing volume (Note: the liquid volume of the core for the mixing volume was calculated at a time of 6 hours, though this sample calculation is performed at 1 hour. This is conservative, as an earlier time corresponds to a higher steam flow rate and hence pressure drop through the system).

The static head of the outlet plenum at 1 hour post-LOCA can be solved as follows:

$$H_{OP}, \text{ft} = \Delta P_{OP}, \text{psi} * v, \text{ft}^3/\text{lbm} * 144 \text{ in.}^2/\text{ft}^2 * g/g_c$$

$$H_{OP}, \text{ft} = 3.173 \text{ psi} * 0.015765 \text{ ft}^3/\text{lbm} * 144 \text{ in.}^2/\text{ft}^2 * g/g_c = 7.20 \text{ ft}$$

Since this height was derived from the pressure drop, it represents the collapsed height of the outlet plenum that can be supported. It can be converted to a froth height since the void fraction of the outlet plenum and volume is known. The outlet plenum void fraction of 0.4621. When this void fraction is applied to the calculated collapsed height of liquid in the outlet plenum, the froth height is calculated as follows:

$$H_{froth}, \text{ft} = H_{OP} / (1 - \text{Void Fraction})$$

$$H_{froth}, \text{ft} = 7.20 \text{ ft} / (1 - 0.4621) = 13.39 \text{ ft}$$

It can be seen that when crediting voiding in the outlet plenum, the available height of two-phase liquid (13.39 ft) is much greater than the actual height of the outlet plenum region currently credited in the mixing volume calculation (7.60 ft). Thus, this calculation justifies the selection of the top of the CSB nozzles as the top elevation of the mixing volume and there should be no change to the mixing volume used in the St. Lucie Unit 1 boric acid precipitation analysis for EPU.

Item 4

Look at all St. Lucie Unit 1 and Unit 2 RAIs related to boron precipitation analyses and ensure that all RAIs are responded to for each unit.

Response

All RAIs for Unit 1 have already been answered for Unit 2.

Item 5

Provide additional justification for SDC single failure capability.

Response

As described in UFSAR Section 9.3.4, the SDC system consists of two independent trains available to provide SDC; therefore, the system is not vulnerable to a single failure.

Item 6

Identify conservative analysis assumptions used in the boric acid precipitation analysis.

Response

The following list documents the notable conservative analysis assumptions from the boric acid precipitation analysis:

- Containment Pressure is assumed to be 14.7 psia in the analysis, when in actuality, the pressure would be, at a minimum, 20 psia. Assuming a conservatively low pressure reduces the boric acid solubility limit quite significantly. If a containment pressure of 20 psia was credited, the solubility limit would increase to approximately 32 wt%.

- 20% uncertainty (in the form of a 1.2 multiplier) is added to the calculation of decay heat for all times post-LOCA.

- There are several conservatisms in the calculation of the mixing volume, including:

    - The steam flow rate is maximized by assuming that saturated water enters the mixing volume.
    - A locked rotor k-factor is used to maximize the steam flow pressure drop.

- Frictional losses in the loop pressure drop calculation were increased by roughly 60%.
- Frictional pressure drops include 10% uncertainty, and geometric pressure drops include 10% uncertainty inside the reactor vessel and 20% uncertainty outside the reactor vessel.
- Crediting only 50% of the lower plenum volume in the mixing volume is conservative based on the results of the Mitsubishi Heavy Industries' BACCHUS mixing tests, which showed that the entire lower plenum contributed to mixing.
- The calculated active core volume based on core area and height used in the mixing volume calculation is smaller than the cited liquid volume in the core (PSL-ENG-SEMS-08-029, Revision 15, page 38), which leads to a smaller mixing volume.
- Justification for the selection of the top of the mixing volume height calculations were performed at 1 hour post-LOCA, while the mixing volume calculation was done at 6 hours post-LOCA. This is conservative, as an earlier time translates to a higher steam flow rate, which equals a higher pressure drop through the system, and ultimately, a lower outlet plenum pressure drop (and height), leaving less available margin in the calculation of the top of the mixing volume.
- Credit was not taken for a 2-phase liquid in calculating the height of liquid in the outlet plenum (i.e., a collapsed liquid height, not a froth height, was used).

- The charging pumps are assumed to inject into 2 intact RCP discharge legs, as opposed to injecting into 1 intact leg and 1 broken leg.

- No credit is taken for subcooling of injection flow, which maximizes core boil-off, and thus, maximizes the boric acid concentration in the core.

- Steam exiting the core is assumed to not contain any boric acid, thus maximizing the concentration in the core.

- Entrainment of liquid from the core during the initial injection phase was neglected. The entrainment removes large amounts of liquid in the early time period following reflood of the core, which minimizes the boric acid build-up during this period.

- Minimum HPSI, LPSI, and containment spray pump flow rates were modeled in the boric acid precipitation calculation in order to maximize the duration of injection flow from the RWT.

- A worst single failure of the loss of an emergency diesel generator is assumed.

- Maximum tank volumes are used for the boric acid makeup tanks (BAMTs), RWT, and SITs, to maximize the boric acid concentration.

- Minimum tank temperatures are used for the BAMTs, RWT, and SITs, to calculate the minimum specific volume, which will maximize the actual tank volumes.

- Maximum boric acid concentrations are used throughout the analysis for the BAMTs, RWT, SITs, and RCS, including a minimum of 100 ppm uncertainty.

- Minimum number of HPSI, LPSI and containment spray pumps is used in order to maximize the duration of injection flow from the RWT.

- At least an hour margin is maintained between the latest time to initiate switchover to simultaneous hot and cold side injection and the time when the boric acid solubility limit will be reached with no HLI.