FPL

February 28, 2008
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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Florida Power & Light Company
Turkey Point Units 3 and 4
Docket Nos. 50-250 and 50-251

Subject: Supplemental Response to NRC Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors"

References:

(1) Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors," dated September 13, 2004

(2) Letter from J. A. Stall (FPL) to U. S. Nuclear Regulatory Commission "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized Water Reactors," dated March 4, 2005

(3) Letter from E. A. Brown (U. S. Nuclear Regulatory Commission) to J. A. Stall (FPL), "Turkey Point Plant, Units 3 and 4 – Request for Additional Information (RAI) Related to Generic Letter 2004-02, 'Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized Water Reactors,'" dated June 2, 2005

(4) Letter from J. A. Stall (FPL) to U. S. Nuclear Regulatory Commission "Request for Additional Information - Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized Water Reactors," dated July 20, 2005

(5) Letter from J. A. Stall (FPL) to U. S. Nuclear Regulatory Commission "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized Water Reactors – Second Response," dated September 1, 2005

(6) Letter from J. A. Stall (FPL) to U. S. Nuclear Regulatory Commission "Supplement to Response to NRC Generic Letter 2004-02, Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized Water Reactors," dated January 27, 2006

(7) Letter from B. T. Moroney (U. S. Nuclear Regulatory Commission) to J. A. Stall (FPL) "Turkey Point, Units 3 and 4 , Request for Additional Information Re: Response to Generic letter 2004-02, Potential Impact of Debris

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Blockage on Emergency Recirculation During Design-Basis Accidents at Pressurized-Water Reactors," dated February 8, 2006

(8) Letter from C. T. Haney (U. S. Nuclear Regulatory Commission) to Holders of Operating Licensees for Pressurized Water Reactors, "Alternate Approach for Responding to the Nuclear Regulatory Commission Request for Additional Information RE: Generic Letter 2004-02," dated March 28, 2006

(9) Letter from B. T. Moroney (U. S. Nuclear Regulatory Commission) to J. A. Stall (FPL) "Turkey Point Plant, Unit No. 4 – Approval of GSI-191/GL 2004-02 Extension Request," dated April 13, 2006

(10) Letter from C. T. Haney (U. S. Nuclear Regulatory Commission) to Holders of Operating Licenses for Pressurized Water Reactors, "Alternate Approach for Responding to the Nuclear Regulatory Commission Request for Additional Information Letter Regarding Generic Letter 2004-02," dated January 4, 2007

(11) Letter from W. H. Ruland (U. S. Nuclear Regulatory Commission) to A. Pietrangelo (Nuclear Energy Institute), "Content Guide for Generic Letter 2004-02 Supplemental Responses," dated August 15, 2007

(12) Letter from W. H. Ruland (U. S. Nuclear Regulatory Commission) to A. Pietrangelo (Nuclear Energy Institute), "Revised Content Guide for Generic Letter 2004-02 Supplemental Responses," dated November 21, 2007

(13) Letter from W. H. Ruland (U. S. Nuclear Regulatory Commission) to A. Pietrangelo (Nuclear Energy Institute), "Supplemental Licensee Responses to Generic Letter 2004-02, Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors," dated November 30, 2007

(14) Letter from J. A. Stall (FPL) to U. S. Nuclear Regulatory Commission "Request for Extension of Completion Date of the St. Lucie Unit 1, St. Lucie Unit 2 and Turkey Point Unit 3 Generic Letter 2004-02 Actions," dated December 7, 2007

(15) Letter from J. A. Stall (FPL) to U. S. Nuclear Regulatory Commission "Response to Questions Regarding Request for Extension of Completion Date of the St. Lucie Unit 1, St. Lucie Unit 2 and Turkey Point Unit 3 Generic Letter 2004-02 Actions," dated December 20, 2007

(16) Letter from T. H. Boyce (U. S. Nuclear Regulatory Commission) to J. A. Stall (FPL) "St. Lucie Nuclear Plant, Units 1 and 2, and Turkey Point Nuclear Plant, Unit 3 – Generic Letter 2004-02, Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized Water Reactors, Extension Request Evaluation," dated December 28, 2007

The purpose of this submittal is to provide the Florida Power and Light Company (FPL) supplemental response to Generic Letter (GL) 2004-02 (Reference 1) for Turkey Point Units 3 and 4. The U. S. Nuclear Regulatory Commission (NRC) issued Reference 1 to request that addressees perform an evaluation of the emergency core cooling system (ECCS) and containment spray system (CSS) recirculation functions in light of the information provided in the GL and, if appropriate, take additional actions to ensure system functions.

Additionally, the GL requested addressees to provide the NRC with a written response in accordance with 10 CFR 50.54(f). The request was based on identified potential susceptibility of the pressurized water reactor (PWR) recirculation sump screens to debris blockage during design basis accidents requiring recirculation operation of ECCS or CSS and on the potential for additional adverse effects due to debris blockage of flowpaths necessary for ECCS and CSS recirculation and containment drainage.

Reference 2 provides the initial FPL response to the GL. Reference 3 requested additional information regarding the Reference 2 response to the GL for Turkey Point Plant Units 3 and 4. Reference 4 provided the FPL response to Reference 3. Reference 5 provides the second of two responses requested by the GL. In Reference 6 FPL requested a short extension for the completion of the corrective actions required by the GL for Turkey Point Unit 4 until the Unit 4 spring 2008 refueling outage. This request for extension was approved in the Reference 9 evaluation. Reference 7 requested FPL to provide additional information to support the NRC staff's review of Reference 2, as supplemented by References 4 and 5.

Reference 8 provided an alternative approach and timetable that licensees may use to address outstanding requests for additional information (i.e., Reference 7). Reference 10 supplemented Reference 8 with the NRC expectation that all GL 2004-02 responses will be provided no later than December 31, 2007. For those licensees granted extensions to allow installation of certain equipment in spring 2008, the NRC staff expects that the facility response will be appropriately updated with any substantive GL corrective action analytical results or technical detail changes within 90 days of the change or outage completion. As further described in Reference 10, the NRC expects that all licensees will inform the NRC, either in supplemental GL 2004-02 responses or by separate correspondence as appropriate, when all GSI-191 actions are complete.

Reference 11 describes the content to be provided in a licensee's final GL 2004-02 response that the NRC staff believes would be sufficient to support closure of the GL. Reference 12 revised the guidance provided in Reference 11 by incorporating minor changes which were viewed by the NRC as clarifications. However, Reference 12 was issued after major development of this response using the guidance of Reference 11. Therefore, this response was prepared using the guidelines of Reference 11.

Reference 13 authorized all PWR licensees up to two months beyond December 31, 2007 (i.e., to February 29, 2008) to provide the supplemental responses to the NRC.

In Reference 14 FPL requested an extension for completing Turkey Point Unit 3 chemical effects testing and analysis activities until June 30, 2008, and in-vessel and ex-vessel downstream effects evaluations until March 31, 2008. Reference 15 provided FPL's response to NRC questions regarding Reference 14. The request for an extension was approved in the Reference 16 evaluation.

In accordance with References 1, 7, 8, 9, and 11, FPL is providing the necessary supplemental response addressing GL actions at Turkey Point Units 3 and 4 in Attachments 1 and 2, respectively, to this letter.

There are no new regulatory commitments made by FPL in this submittal. Outstanding FPL commitments made in previous correspondence pertaining to the GL are summarized in Attachment 3.

This information is being provided in accordance with 10 CFR 50.54(f).

Please contact Paul Infanger, at (305) 246-6632, if you have any questions regarding this response.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on February 28, 2008.

Sincerely yours,

William Jefferson, Jr.
Site Vice President
Turkey Point Nuclear Plant

Attachments: (3)

cc: NRC Regional Administrator, Region II
USNRC Project Manager, Turkey Point Nuclear Plant
Senior Resident Inspector, USNRC, Turkey Point Nuclear Plant

ATTACHMENT 1

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Topic 1: Overall Compliance

FPL Response

The response to GL 2004-02 that was submitted to the NRC on September 1, 2005 (September 1 response) was based on the information that was available at that time. Subsequent to the September 1 response, all identified corrective actions have been completed (e.g., installation of new sump strainers and removal of fibrous insulation from areas where it could contribute to the strainer debris load and downstream effects). In addition, improvements in programmatic controls have been implemented to ensure that the potential quantity of debris is maintained within the new sump strainer design values.

These corrective actions have created NPSH margin, reduced the size of debris that can pass through the sump strainers, and reduced the maximum quantity of fiber that could be generated and transported to the sump strainers. Walkdowns have confirmed that the only potential choke points that could prevent the design basis volume of water from being available for recirculation are the refueling canal drain covers. Procedural controls have been put in place to ensure that refueling canal drain covers which could cause a potential choke point are removed prior to restart from an outage.

However, a request to delay completion of tests and analyses that depend on the resolution of chemical effects issues or are impacted by the recent revision to WCAP-16406-P, "Evaluation of Downstream Sump Debris Effects in Support of GSI-191," Revision 1, August, 2007 was submitted on December 7, 2007 (FPL to NRC Letter L-2007-155, Request for Extension of Completion Date of the St. Lucie Unit 1, St. Lucie Unit 2 and Turkey Point Unit 3 Generic Letter 2004-02 Actions, December 07, 2007). The extension was approved in a letter dated December 28, 2007 (NRC Letter (T. H. Boyce to J. A. Stall), St. Lucie Nuclear Plant, Units 1 and 2, and Turkey Point Nuclear Plant Unit 3 - Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents At Pressurized-Water Reactors," Extension Request Evaluation (TAC Nos. MC4710, MC4711, and MC4725) December 28, 2007). Therefore, where information related to chemical effects or the results of downstream analysis is incomplete, it will be provided in a follow-on supplemental response in accordance with the schedule provided to the NRC staff in letter L-2007-155.

Additional information to support the staff's evaluation of Turkey Point Unit 3 compliance with the regulatory requirements of GL 2004-02 was requested by the NRC in a "Request for Additional Information" (RAI) dated February 8, 2006 (NRC Letter to FPL (J. A. Stall), Turkey Point Plant, Units 3 and 4, "Request for Additional Information RE: Response to Generic Letter 2004-02, 'Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors'" (TAC Nos. MC4725 and MC4726), February 8, 2006). Each RAI question is addressed in this response. The RAI question (and specific RAI response) is identified by the RAI question number in the following format: [RAI ##], where ## is the RAI question number. As above, where information related to chemical effects or the results of downstream analysis is incomplete it will be provided in a follow-on supplemental response in accordance with the schedule provided to the NRC staff in letter L-2007-155.

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Based on the completed corrective actions and enhanced procedural controls, it is expected that upon completion of the confirmatory tests and analyses, Turkey Point Unit 3 will be demonstrated to be in compliance with the regulatory requirements listed in GL 2004-02.

However, although not expected, the final testing and analysis may result in further re-examination of original assumptions and bases of other calculations or, potentially, additional corrective actions. In the case that additional corrective actions are required, FPL will contact the Commission.

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Topic 2: General Description of and Schedule for Corrective Actions

FPL Response

The corrective actions identified for Turkey Point Unit 3 have been completed. However, as discussed in the response to NRC Topic 1, Overall Compliance, Florida Power & Light requested, and received, a short extension to complete selected confirmatory tests and analyses. The delayed tests and analyses are those that depend on the resolution of chemical effects issues or those that are impacted by the recent revision to WCAP-16406-P, Evaluation of Downstream Sump Debris Effects in Support of GSI-191, Revision 1, August, 2007.

A general description of the actions already taken or planned to be taken is presented below. Additional details are contained in subsequent sections of this response.

The original sump screens have been completely replaced with a strainer system that has a total strainer surface area of approximately 5,543 ft^2. The new system consists of 12 strainer modules with interconnecting piping and is passive (i.e., it does not have any active components or rely on backflushing). The strainer system is described in the response to NRC Topic 3.j, Screen Modification Package.

Three insulation modifications have been completed that reduce the quantities of fibrous and particulate debris that could be transported to the sump strainers. These modifications replaced the insulation on the Pressurizer Surge Line with reflective metal insulation (RMI), replaced the insulation on the Reactor Coolant Pumps with RMI, and removed the insulation from the Pressurizer Relief Tank (PRT).

A walkdown confirmed that the only potential choke points are the fuel transfer canal drain covers at the bottom of the refueling canal. These potential choke points have been removed by updating the closeout procedure to ensure that the drain covers are removed prior to restart.

The downstream effects assessments of the fuel and vessel are ongoing. FPL is participating in the PWR Owners Group (PWROG) program to evaluate downstream effects related to in-vessel long-term cooling using the methodology of WCAP-16793-NP "Evaluation of Long-Term Cooling Considering Particulate, Fibrous and Chemical Debris in the Recirculating Fluid," Rev. 0. Still ongoing is a Turkey Point Unit 3 calculation using plant-specific parameters and WCAP-16793-NP methodology to confirm that chemical plate-out on the fuel is acceptable. It is planned to have this assessment completed in accordance with the schedule provided to the NRC staff in letter L-2007-155.

The downstream effects assessment of components is being revised to incorporate the methodology of WCAP-16406-P, Revision 1, "Evaluation of Downstream Sump Debris Effects in Support of GSI-191," (WCAP-16406-P). It is planned to have this assessment completed in accordance with the schedule provided to the NRC staff in letter L-2007-155.

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Enhancements to programmatic controls have been put in place at Turkey Point Unit 3. Engineering procedures have been revised to provide guidance to design engineers working on plant modifications to take into account the impact of the design on the "containment sump debris generation & transport analysis and/or recirculation functions."

As an enhancement to the existing process for controlling the quantities of piping insulation within the containment, the engineering specification that controls thermal insulation was revised to provide additional guidance for maintaining containment insulation configuration.

New controls have been instituted limiting the permissible quantity of unqualified coatings in the containment building to ensure that the ECCS strainer design requirements, as documented in the Turkey Point Unit 3 debris generation calculation, remain within permissible limits.

Based on the results of the latent and foreign material walkdowns that were performed, it was determined that changes in the Turkey Point Unit 3 housekeeping procedures were not required because of the limited amount of material observed.

Chemical effects testing will be performed by Alion Science and Technology. It is planned to have this testing completed in accordance with the schedule provided to the NRC staff in letter L-2007-155.

At the present time, it is expected that the results of the tests and analyses will not indicate that additional corrective actions are needed to comply with the regulatory requirements of GL 2004-02. Although not expected, the final testing and analyses may result in further re-examination of original assumptions and bases of other calculations or, potentially, additional corrective actions. In the case that additional corrective actions are required, FPL will contact the Commission.

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Topic 3.a: Break Selection

FPL Response

In agreement with the staff's SE of NEI 04-07, the objective of the break selection process was to identify the break size and location which results in debris generation that will maximize the head loss across the containment sump. Breaks were evaluated based on the methodology in Nuclear Energy Institute (NEI) guidance document NEI 04-07, as modified by the staff's SE for NEI 04-07.

The Nuclear Steam Supply System (NSSS) is located between a bioshield wall near the outer wall of containment and a primary shield that surrounds the reactor cavity. The bioshield is a two-piece wall with one wall starting at the floor and extending up, and the other starting at the ceiling and extending down. The two walls are offset so that they do not intersect, which creates an opening between them due to their overlap. This opening can provide a path for jet impingement on piping outside the bioshield by breaks inside the bioshield (or vice versa). An evaluation of potential breaks and potential targets in both the inner annulus and the outer annulus was performed. The evaluation concluded that the effect of this opening is negligible, and that the opening does not affect the selection of the limiting break.

[RAI 33] The following specific break location criteria were considered:

- Breaks in the reactor coolant system with the largest amount of potential debris within the postulated ZOI,
- Large breaks with two or more different types of debris, including breaks with the most variety of debris,
- Breaks in areas with the most direct path to the sump,
- Medium and large breaks with the largest potential particulate debris to insulation ratio by weight, and
- Breaks that generate an amount of fibrous debris that, after transport to the sump strainer, could form a uniform "thin bed."

[RAI 34] All Reactor Coolant System (RCS) piping and attached energized piping was evaluated for potential break locations. Inside the bioshield breaks in the hot legs (29-inch ID), cold legs (27½ -inch ID), crossover legs (31-inch ID), pressurizer surge line (14-inch nominal), and Residual Heat Removal (RHR) recirculation line from the hot leg (14-inch nominal) were considered. Feedwater and main steam piping was not considered for potential break locations because ECCS in recirculation mode is not required for Main Steam or Feedwater line breaks. The other piping lines have smaller diameters (10-inch nominal maximum), which will produce a much smaller quantity of debris.

[RAI 33] Inside the bioshield the break selection process used the discrete approach described in Section 3.3.5.2 of the staff's SE of NEI 04-07. The staff's SE of NEI 04-07 notes that the *concept of equal increments is only a reminder to be systematic and thorough.* As stated in the staff's SE of NEI 04-07, the key difference between many breaks (especially large breaks) will

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

not be the exact location along the pipe, but rather the envelope of containment material targets that is affected. Consistent with this guidance, break locations were selected based on the total debris, mixture of debris, and distance from the sump. Containment symmetry ensures similar results for each break, but each break is also unique in certain aspects, and this was considered in the break selection process. The crossover leg is the largest line (31-inch ID) inside the bioshield and would produce the largest zone of influence (ZOI). A crossover leg break is analyzed in loops B and C in order to maximize the ZOI radius which maximizes the insulation encircled. A cold leg break in loop A is chosen for its proximity to a large amount of calcium silicate (cal-sil) insulation.

Outside the bioshield a break was considered in an RHR line. The RHR lines are of smaller diameter than the RCS piping. Therefore, inside the bioshield, a break in these lines would be bounded by the reactor coolant loops, and thus need not be analyzed. However, the RHR recirculation line travels outside the bioshield before the second isolation valve. This location was selected in order to include a break outside the bioshield.

The postulated break locations were as follows:

- S1 The Loop B Crossover Leg at the base of the reactor coolant pump (31-inch ID)
- S2 The Loop C Crossover Leg at the low point of the pipe (31-inch ID)
- S3 The Loop A Cold Leg at the base of the reactor coolant pump (27.5-inch ID)
- S5 The RHR line RC-2501R from Loop C Hot Leg outside the bioshield (14-inch nominal)

Break S1 generated the greatest quantity of Calcium Silicate (Cal-sil) debris. Therefore it was selected for the strainer design basis.

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Topic 3.b: Debris Generation/Zone of Influence (ZOI) (excluding coatings)

FPL Response

The debris generation calculations used the methodologies of Regulatory Guide 1.82, Rev. 3, and the staff's SE of NEI 04-07. However, there have been changes in the input to the analyses since the September 1 response.

Debris specific ZOIs were used in the debris generation calculations for calcium-silicate (cal-sil), low density fiber glass (LDFG) and reflective insulation. ZOIs for commonly used insulation were obtained from Table 3-2 and § 3.4.2.2 of the staff's SE of NEI 04-07. Specific insulation ZOIs that were used are: 17D for Nukon (fiber) insulation, 5.45D for Calcium Silicate (cal-sil) insulation, 28.6D for Mirror reflective metal insulation (RMI), and 2.0D for Transco/Darchem RMI. The ZOI for Min-K insulation, 28.6D, was used for Microtherm insulation. This value was selected because Microtherm and Min-K are similar, and Min-K has the largest of ZOI of all the tested insulation materials. All cal-sil, Nukon, and RMI insulation is jacketed.

The updated debris generation calculations make use of two assumptions related to non-coating debris generation.

Assumption 1
Supporting members fabricated from steel shapes (e.g., angles, plates) are installed to provide additional support for insulation on equipment. It is assumed that as a result of the postulated pipe break, these supporting members will be dislodged from the equipment, and may be bent and deformed, but will not become part of the debris that may be transported to the sump.

Assumption 2
In the September 1 response it was noted that an analytical process was used that conservatively overstated the quantity of debris from insulation by 5-15%. That analytical process has been completely replaced and the debris quantity is no longer overstated. Instead, a 10% margin has been added to the cal-sil insulation volume results. In addition, a uniform factor of 1.1 is applied to the ZOI used for calculating piping insulation volumes to account for minor variances such as insulation around valves, irregularities in the as-installed configuration, etc.

The quantities of debris and destruction ZOI are provided in Table 3.b-1 below.

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Table 3.b-1: Destruction ZOI and Limiting Break Comparison

Debris Type	Destruction ZOI	Break S1 (Note 1)	Break S2 (Note 1)	Break S3 (Note 1)	Break S5 (Note 1)
Fiber Insulation (Note 2)	17.0 D	0.00 ft^3	0.00 ft^3	0.00 ft^3	0.00 ft^3
Cal-sil (Note 3)	5.45 D	56.18 ft^3	44.96 ft^3	46.03 ft^3	26.89 ft^3
Microtherm	28.6 D	2.28 ft^3	1.14 ft^3	2.28 ft^3	0.00 ft^3
RMI (mirror)	28.6 D	12023.52 ft^2	7002.33 ft^2	13090.12 ft^2	0.00 ft^2
Insulation Jacketing (Note 4)	28.6 D	2119.91 ft^2	1248.42 ft^2	2241.55 ft^2	209.42 ft^2
Coatings					
Qualified - Steel	4.0 D	1.10 ft^3	1.10 ft^3	1.10 ft^3	0.20 ft^3
Qualified - Concrete	4.0 D	2.90 ft^3	2.90 ft^3	2.90 ft^3	0.20 ft^3
Unqualified -Total	N/A	5.06 ft^3	5.06 ft^3	5.06 ft^3	5.06 ft^3
Latent Debris (15% fiber, 85% particulates)	N/A	77.22 lbm	77.22 lbm	77.22 lbm	77.22 lbm
Miscellaneous Debris					
Labels, Tags, etc	N/A	35.62 ft^2	35.62 ft^2	35.62 ft^2	35.62 ft^2
Glass	N/A	57.57 ft^2	57.57 ft^2	57.57 ft^2	57.57 ft^2
Adhesive	N/A	0.02 ft^3	0.02 ft^3	0.02 ft^3	0.02 ft^3

Notes:

1. Break locations are discussed in the response to NRC Topic 3.a, Break Selection
2. Existing fibrous insulation was removed from areas affected by the limiting breaks by replacing it with RMI on the reactor coolant pumps and pressurizer surge line. Other potential areas exist, but none will deliver enough fiber, along with the latent fiber, to result in a thin bed effect on the strainers. The original worst case of 8.22 ft^3 of fiber for the S1 break will be used in the downstream effects calculations in Topic 3.m, Downstream Effects – Components and Systems.
3. The cal-sil value contains an additional 10% margin.
4. This entry is the total for all jacketing. For each insulation type, the insulation jacketing ZOI is the same as the underlying insulation.

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Topic 3.c: Debris Characteristics

FPL Response

[RAI 35] As discussed in the staff's SE of NEI 04-07, the categories in any size distribution are related to the transport model. For the purposes of determining the strainer debris load and head loss at Turkey Point Unit 3, a single integrated transport model was not used. Instead, each debris type was addressed separately; (i.e., Reflective Metal Insulation (RMI), paint chips, particulates, and fiber). These debris specific transport analyses did not use the size distribution as part of the input. Therefore, detailed size distributions were not required or developed for the determination of the strainer debris load or head loss. The transport analysis for each debris type is discussed in the response to NRC Topic 3.e, Debris Transport.

The bulk densities that were used to ensure that the proper quantities of the surrogate materials were used in the module head loss tests (excluding chemical effects) are provided in Table 3.c-1 below.

Table 3.c-1: Bulk Densities Used For Module Tests

Debris Type	Bulk density
Cal-sil	14.5 lbs/ft^3
Fiber	2.4 lbs/ ft^3
Zinc Filler (surrogate for zinc coatings)	457 lbs/ ft^3
Silicon Carbide (surrogate for coatings)	94 lbs/ ft^3
Microtherm	12 lbs/ft^3

The technical basis for the surface areas of signs, placards, tags, tape, etc is provided in the response to NRC Topic 3.d, Latent Debris.

The specific surface area, S_V, is a parameter that is used in the NUREG/CR-6224 head loss correlation. The head loss across the strainers was determined by testing, not the NUREG/CR-6224 correlation. Therefore, the specific surface area was not calculated or used. The head loss determination is described in the response to NRC Topic 3.f, Head Loss and Vortexing.

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Topic 3.d: Latent Debris

FPL Response

The bases and assumptions related to latent and miscellaneous debris, and the resulting quantities used for analyses and testing, have been updated since the September 1 response. In that response it was noted that the quantity of latent debris was an assumed value in lieu of applied survey results, and that the sacrificial area for miscellaneous debris was independently estimated. Subsequently, walkdowns have been completed in the Turkey Point Unit 3 containment specifically for the purpose of characterizing latent, miscellaneous and foreign debris (e.g., labels, stickers, etc.). The results of the walkdowns are discussed below and summarized in Table 3.b-1 in the response to NRC Topic 3.b, Debris Generation/Zone of Influence (ZOI) (Excluding coatings). These walkdowns utilized the guidance of NEI 02-01 and the staff's SE of NEI 04-07.

The methodology used to estimate the quantity and composition of latent debris in the Unit 3 containment is that of the staff's SE of NEI 04-07, Section 3.5.2. Samples were collected from eight surface types; floors, containment liner, ventilation, cable trays, walls, equipment, piping and grating. For each surface type, a minimum of (4) samples were collected, bagged, and weighed to determine the quantity of debris that was collected. A statistical approach was used to estimate an upper limit of the mean debris loading on each surface. The horizontal and vertical surface areas were conservatively estimated. The total latent debris mass for a surface type is the upper limit of the mean debris loading multiplied by the conservatively estimated area for that surface type, and the total latent debris is the sum of the latent debris for each surface type.

Based on the walkdown data, the quantity of latent debris in the Unit 3 containment is estimated to be 77.22 pounds. The latent debris composition is assumed to be 15% fiber and 85% particulate in agreement with the staff's SE of NEI 04-07.

A walkdown was performed in the Unit 3 containment for the purpose of identifying and measuring the miscellaneous (foreign) debris that constitutes the sacrificial area (e.g., labels, stickers, tape, tags etc). Based on the walkdown data, the total quantity of miscellaneous debris in the Unit 3 containment is estimated to be 93.21 ft^2.

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Topic 3.e: Debris Transport

FPL Response

[RAI 41] In the September 1 response it was noted that debris transport would be analyzed using the computational fluid dynamics (CFD) based methodology outlined in NEI 04-07. Instead, for the purposes of determining the strainer debris load and head loss, each debris type was addressed separately (i.e., Reflective Metal Insulation (RMI), paint chips, particulates, and fiber).

The transport models for RMI and paint chips accounted for the low approach velocities and the fact that the lower edge of the strainer disks is approximately 5 inches above the floor. The velocities required to lift materials over a curb (lift velocity) are provided in NUREG/CR-6808. The lift velocities are 0.3 ft/sec for aluminum RMI, 0.5 ft/sec for paint chips, and 0.84 ft/sec for stainless steel RMI. The velocity under the strainer is approximately 0.1 ft/sec, and the velocity entering the strainer disks is approximately 0.02 ft/sec. These velocities are well below the velocity required to lift paint chips and RMI above a 2-inch curb, and the disks are approximately 5 inches above the floor. Therefore it is concluded that RMI and paint chips will not be transported to the strainer disks.

Although a separate calculation was not done for insulation jacketing, the same logic applies, and it is concluded that insulation jacketing will not be transported to the strainer disks.

For the remainder of the debris load it was assumed that 100% of the latent fiber, latent particulates, cal-sil, microtherm, and coating particulates are transported to the strainer disks.

The quantity of debris that arrives at the strainer modules is provided in Table 3.e-1 below.

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Table 3.e-1: Debris at Sump Strainer Modules for Limiting Case (Break S1)

Constituent (From Table 3.b-1)	Quantity Generated	Quantity at Strainer
Fiber Insulation (Note 1)	0.00 ft^3	0.00 ft^3
Cal-sil	56.18 ft^3	56.18 ft^3
Microtherm	2.28 ft^3	2.28 ft^3
RMI (Mirror)	12023.52 ft^2	0 ft^2
Insulation Jacketing	2119.91 ft^2	0 ft^2
Coatings		
Qualified - Steel	1.10 ft^3	1.10 ft^3
Qualified - Concrete	2.90 ft^3	2.90 ft^3
Unqualified -Total	5.06 ft^3	5.06 ft^3
Latent Debris		
15% Fiber	11.58 lbm	11.58 lbm
85% Particulate	65.64 lbm	65.64 lbm
Total	77.22 lbm	77.22 lbm
Foreign Materials		
Labels, Tags, etc	35.62 ft^2	35.62 ft^2
Glass	57.57 ft^2	57.57 ft^2
Adhesive	0.02 ft^3	0.02 ft^3
Total	93.21 ft^2	93.21 ft^2

Notes:

1. Existing fibrous insulation was removed from areas affected by the limiting breaks by replacing it with RMI on the reactor coolant pumps and pressurizer surge line.

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Topic 3.f: Head Loss and Vortexing

FPL Response

A piping schematic of the ECCS and containment/reactor building spray systems is provided in Figure 3.f-1 below. A description of the strainer system, including the capability to accommodate thin bed effects, is provided in the response to NRC Topic 3.j, Screen Modification Package. However, Turkey Point Unit 3 has very little fibrous debris.

[RAI 37] [RAI 40] The entire distributed strainer system is fully submerged from the initiation of recirculation through the duration of the event. At the minimum Large Break LOCA (LBLOCA) water level, the submergence of the strainer disk (which is the highest opening in the strainer system) is approximately 7.9 inches. At the minimum Small Break LOCA (SBLOCA) water level, the submergence of the strainer disks is approximately 4.1 inches.

The possibility of vortex formation at the strainer modules was evaluated by both tests and analyses. The strainer module tests were conducted at a test submergence that is less than the submergence during recirculation (~ 3½ inches for the test vs. ~7.9 inches for LBLOCA and 4.1 inches for SBLOCA recirculation). No vortexing or air ingestion was observed during the testing. In addition, an evaluation was conducted that doubled the approach velocity (a 100% increase). This evaluation generated an air ingestion factor of ~0.1, which, because it is much less than 1.0, indicates that air ingestion will not occur at the strainer module during operation.

[RAI 40] Vortexing at the sump ECCS/CSS suction inlets is not a concern because the strainers are piped directly to the suction inlets.

No formal analysis has been performed regarding buoyant debris circulating on top of the sump water over the strainer modules. However, it is noted that other than latent fiber, Turkey Point Unit 3 has little or no fibrous debris and is thus effectively immune to issues associated with buoyant fibrous debris. Further, with the highest screens submerged by a good margin, and with no vortexing possible, the potential for floating debris reaching the screens is remote.

[RAI 39] The new strainer system has a surface area of approximately 5,543 ft^2, which can accommodate the maximum debris load, after transport to the strainer, from the bounding break discussed in the response to NRC Topic 3.a, Break Selection.

The total strainer system head loss is made up of two components; the strainer module head loss, and the interconnecting piping head loss. Each of these components was evaluated for two recirculation flow conditions. For the first 24 hours after a LOCA, the maximum flow rate is 2,697 gpm, and after 24 hours (> 24 hrs post-LOCA) the maximum flow rate is 3,750 gpm.

The strainer module head loss, excluding chemical effects, is based on tests that were run specifically for Turkey Point Unit 3 by Continuum Dynamics, Inc (CDI). The tests were performed using a test module with 16 discs. The module tests simulated plant debris loads and strainer approach velocities to validate the design. The module discs were aligned

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

vertically in the same manner as the plant strainer discs. The tests were performed with a submergence of ~3½ inches. The strainer head loss test results were scaled to the full sized strainer system based on velocity, kinematic viscosity, and bed thickness differences. The scaling process assumed that flow through the strainer internals is turbulent due to the abrupt direction changes and abrupt expansions from the strainer discs to plenum.

[RAI 36] The near-field effect was not credited in the design or tests. The steps taken to minimize near-field effects in the tests included placing the flow return near the bottom of the test tank to help suspend debris, and using six (6) motor driven agitators to ensure that all debris remained suspended. Eight (8) agitators were started prior to debris addition to facilitate mixing and prevent settling of debris prior to strainer test pump startup, and the two agitators behind the module were stopped after flow through the module was established. The materials listed in Table 3.f-1 below were used to represent the Turkey Point Unit 3 debris in the test.

The piping head losses are the hydraulic losses associated with flow through the twelve strainer plenums, interconnecting pipe, and discharge piping to the ECCS pump suction inlets. Assumptions, margins, and conservatisms used in establishing the head losses are:

- A maximum temperature of 300°F
- A minimum temperature of 65°F
- A flow rate of 2,697 gpm during the first 24 hours after a LOCA
- A flow rate of 3,750 gpm after the first 24 hours after a LOCA
- For the piping line head loss, the flow was analyzed for both the north and south sumps and the limiting case was used

[RAI 39] The head loss for the strainer system, not considering chemical effects, is provided in Table 3.f-2 below.

Table 3.f-1: Module Test Debris Materials

Debris Type	Material	Density	Manufacturer
Fiber	Transco Thermal Wrap (shredded)	2.4 lb/ft^3	Transco
Cal-Sil	Thermo 12 Gold (pulverized)	14.5 lb/ft^3	Industrial Insulation Group
Inorganic Zinc	Carboline Carbo-Zinc filler	457 lb/ft^3	Carboline
Microtherm	Microtherm (pulverized)	12 lb/ft^3	Microtherm, Inc.
Coating Particulates	Silicon Carbide (~ 10 micron dia)	94 lb/ft^3	Electro Abrasives

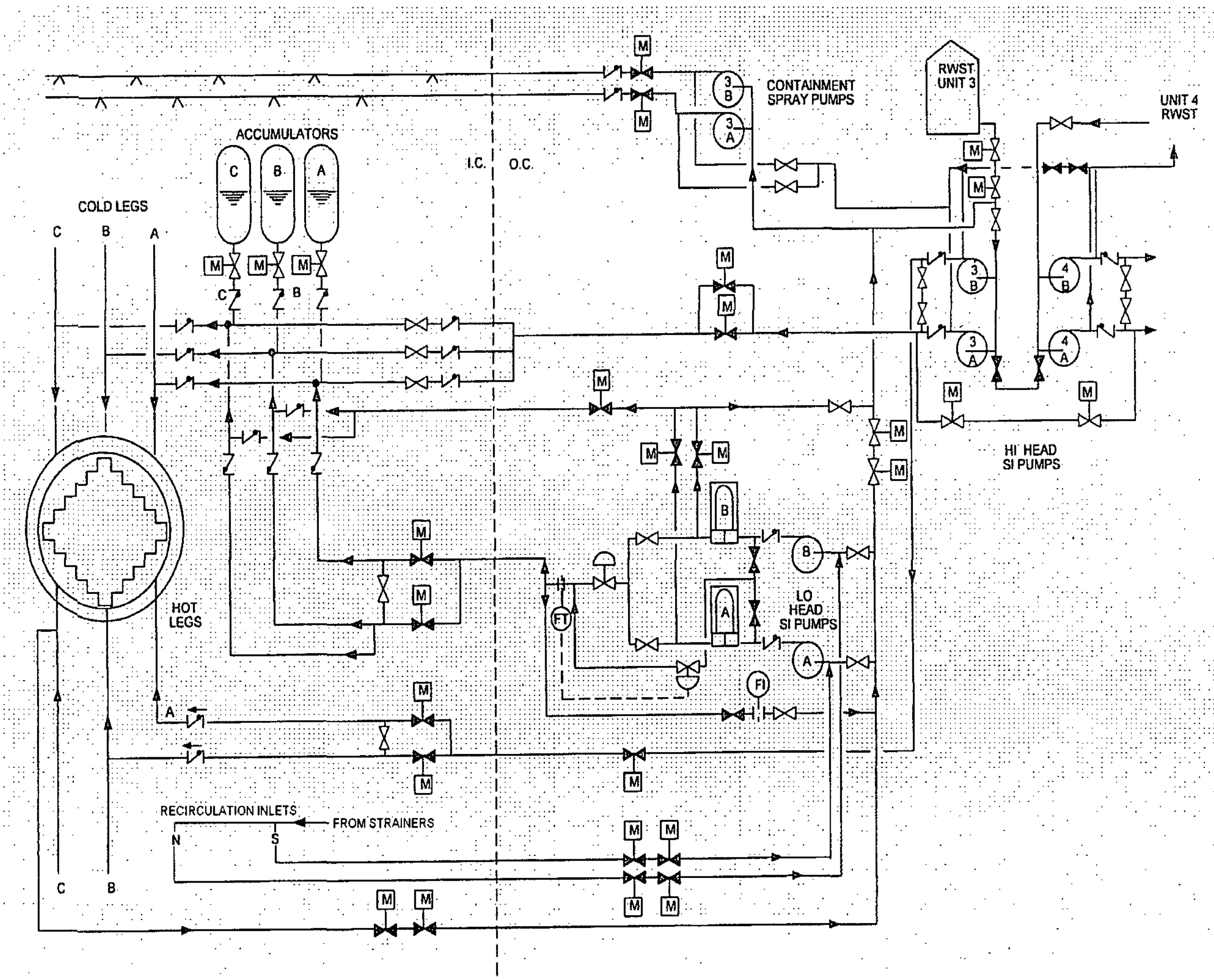
ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Table 3.f-2: Strainer System Head Loss Summary (Excluding Chemical Effects)

Condition	Flow Rate (gpm)	Strainer Head Loss (ft)	Piping Head Loss (ft)	Total Head Loss (ft)
Debris Laden (< 24 hrs)	2,697	0.97	1.18	2.15
Clean (< 24 hrs)	2,697	.08	1.18	1.26
Debris Laden (> 24 hrs)	3,750	1.02	2.28	3.30
Clean (> 24 hrs)	3,750	.09	2.28	2.37

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Figure 3.f-1: ECCS/CSS Piping Schematic



ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Topic 3.g: Net Positive Suction Head Available (NPSH)

FPL Response

Following a large break LOCA (LBLOCA) both trains of the RHR/Low Head Safety Injection (RHR/LHSI) Pumps and High Pressure Safety Injection (HHSI) pumps are automatically started on a safety injection signal (SIS). Both Containment Spray (CS) pumps are automatically started on a containment high pressure signal (CHPS). Recirculation is initiated manually on the refueling water storage tank (RWST) low level alarm, which occurs approximately 30 minutes after the LBLOCA. At the changeover to recirculation both RHR/LHSI pumps are manually stopped and switched over from the RWST to the recirculation sump. One RHR/LHSI pump is then manually restarted. At this point, the CS and HHSI pumps continue to draw water from the RWST although one CS pump is manually stopped. When the RWST level reaches 60,000 gallons the HHSI and CS pumps are manually stopped and aligned to take suction from the RHR/LHSI pumps ("piggyback" mode), and one HHSI pump is restarted.

Following a small break LOCA (SBLOCA) both trains of the RHR/LHSI Pumps and HHSI pumps could automatically start if an SIS is received. Both Containment Spray (CS) pumps could automatically start if a CHPS is received. If the recirculation phase is entered, suction to the safety injection pumps is provided by the RHR/LHSI pumps as in the LBLOCA. For a SBLOCA where the RCS pressure is above the RHR/LHSI shut-off head, the RHR/LHSI pumps will not deliver flow into the RCS during the injection phase. Under these conditions the time to recirculation, which is based on the RWST level, is increased beyond the LBLOCA value of approximately 30 minutes.

The range of SBLOCA breaks includes those that require recirculation from the containment sump as well as those that permit the operators to depressurize the RCS and initiate the shutdown cooling mode of decay heat removal, which does not require suction from the containment sump. Because the SBLOCA produces less debris, the debris load on the sump strainers is less than the design basis debris load. However, for the purpose of evaluating the sump strainer under SBLOCA conditions, it is conservatively assumed that the recirculation flow from the containment sump and the debris load are the same as the LBLOCA, and that the water level is that of the SBLOCA.

The minimum sump water level is 17.35 feet for the LBLOCA and 17.03 feet for the SBLOCA. These water levels account for following volumes:

- Volume Additions
  - None
- Volume Subtractions
  - Empty spray piping
  - Containment spray droplets
  - Steam in the containment atmosphere
  - Condensation film on horizontal and vertical surfaces
  - Reactor vessel (reflood volume)

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

The LBLOCA sump flow rates used to calculate the NPSH margin are 2,697 gpm for the period prior to 24 hrs and 3,750 gpm after 24 hrs, which are the same as those used to determine the strainer system head loss discussed in the response to NRC Topic 3.f, Head Loss and Vortexing. In recirculation mode, the CS and HHSI pumps operate in "piggyback" mode on the RHR/LHSI pumps. Therefore they are already included in the RHR/LHSI pump flow.

The temperature ranges used to calculate the NPSH margin are 65 °F to 300 °F for the period prior to 24 hours, and 65 °F to 170 °F for the period after 24 hrs. The minimum NPSH margin occurs at a temperature of approximately 200 °F.

Under these conditions, the minimum NPSH margin, excluding chemical effects, is approximately 6.1 feet for the LBLOCA and 5.8 ft for the SBLOCA. The key assumptions are listed below.

- Containment accident pressure is consistent with Regulatory Guide 1.1 guidance (i.e., at lower temperatures, when the vapor pressure of water is less than the partial pressure of air, the total containment pressure is set equal to the minimum partial pressure of air and is not increased: at higher temperatures when the vapor pressure of water is greater than the minimum partial pressure of air, the total containment pressure is set equal to the vapor pressure of water.)
- NPSH required ($NPSH_R$) is based on pump test curves
- Strainer head loss, excluding chemical effects, was determined by testing.

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Topic 3.h: Coatings Evaluation

FPL Response

At Turkey Point Unit 3 coatings are classified as qualified/acceptable or unqualified. The qualified/acceptable coating systems used in the Turkey Point Unit 3 containment are listed in Table 3.h-1 below.

Table 3.h-1 Qualified/Acceptable Coatings in the Turkey Point Unit 3 Containment

Substrate	Application	Coating Product	Application Thickness (mils)
Steel	1st Coat	Carboguard 890	6
	2nd Coat	Carboguard 890	6
	1st Coat (Note 1)	Carbozinc 11	4.5
	2nd Coat (Note 1)	Phenoline 305	5
Concrete Floor	1st Coat	Carboguard 2011S	50
	2nd Coat	Carboguard 890	7
	3rd Coat	Carboguard 890	7
	1st Coat (Note 1)	Phenoline 305 Concrete Primer	4.5
	2nd Coat (Note 1)	Phenoline 305	4.5
Concrete Wall	1st Coat	Carboguard 2011S	35
	2nd Coat	Carboguard 890	7
	3rd Coat	Carboguard 890	7
	1st Coat (Note 1)	Phenoline 305 Concrete Primer	4.5
	2nd Coat (Note 1)	Phenoline 305	4.5

Notes:
1. Specified thickness for original coatings. Repaired coatings are thicker, and the debris generation is based on the maximum coating thicknesses of the repair coatings.

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

[RAI 30] For Turkey Point Unit 3, the fiber is that contributed by latent debris, i.e., 11.58 lbm (15% of 77.2 lbm). ElectroCarb black silicon carbide was used as a surrogate for coatings other than inorganic zinc. ElectroCarb has a 10-micron diameter, which is the limiting particle size for head loss per NEI 04-07, and has a density similar to the qualified and unqualified coatings in Table 3-3 of NEI 04-07. As discussed in the response to NRC Topic 3.e, Debris Transport, coating chips will not be transported to the strainer disks. Carboline Carbo-zinc filler was used as the surrogate for inorganic zinc because it is the principal constituent.

Selected features of the treatment of qualified and unqualified coatings in the determination of coating debris that reaches the sump strainers have been updated since the September 1 response. These changes are discussed individually below.

[RAI 29] The qualified coating ZOI in the September 1 response for Turkey Point Unit 3 was 10D. The ZOI for qualified coatings has subsequently been reduced to 4D. The 4D ZOI is based on testing that was completed at the St. Lucie Plant during February of 2006.

A description of the test, the test data, and the evaluation of the test data, were previously provided to the NRC staff for information on July 13, 2006 in FPL Letter L-2006-169 (R. S. Kundalkar (FPL) to M.G. Yoder (NRC), "Reports on FPL Sponsored Coatings Performance Tests Conducted at St. Lucie Nuclear Plant," July 13, 2006). The evaluation of the test results confirms that a 4D ZOI is applicable to the in-containment qualified coating systems at Turkey Point Unit 3. As stated in the test plan, heat and radiation increase coating cross linking, which tends to enhance the coating physical properties. Therefore, since artificial aging, heat, or irradiation to the current plant conditions could enhance the physical properties and reduce the conservatism of the test, the test specimens were not aged, heated, or irradiated.

The coating thicknesses in the September 1 response were assumed to be 3 mils of inorganic zinc primer plus 6 mils of epoxy (or epoxy-phenolic) top coat for qualified coatings, and 3 mils of inorganic zinc (IOZ) for unqualified coatings. Subsequently, the analyses have been updated. The current debris generation model conservatively assumes the maximum thicknesses for each applicable coating system.

The coating area in the ZOI in the September 1 response was assumed to be equal to the surface area of the ZOI. Subsequently, the updated debris generation calculations calculate the quantity of qualified coatings for each break by using the concrete and steel drawings to determine the amount of coating that will be within the ZOI for each break. Coatings that are shielded from the jet by a robust barrier are not included in the total. The calculated volume of qualified steel coating is then increased by 10% to account for small areas of additional items such as piping, pipe/conduit/HVAC/cable tray supports, stiffener plates, ladders, cages, handrails and kick plates.

The estimated quantity of unqualified/failed coatings in the September 1 response was 6 ft^3. With the changes discussed above, the total quantity of unqualified/failed coatings is now 9.06 ft^3.

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Subsequent to the September 1 response, the process for controlling the quantity of degraded qualified coatings in containment has been enhanced to ensure that it does not exceed the sump strainer design basis.

The previous program for controlling in-containment coatings was described in the FPL response to NRC Generic Letter 98-04, "Potential for Degradation of the Emergency Core Cooling System and the Containment Spray System After a Loss-of-Coolant Accident Because of Construction and Protective Coating Deficiencies and Foreign Material in Containment" in letter L-98-272 on November 9, 1998. The letter summarized the program in place at that time for assessing and documenting the condition of qualified/acceptable coatings in the primary containment at Turkey Point Unit 3.

[RAI 25] The current program for controlling the quantity of unqualified/degraded coatings includes two separate inspections by qualified personnel during each refueling outage, and notification of plant management prior to restart if the volume of unqualified/degraded coatings approaches pre-established limits.

The first inspection takes place at the beginning of every refueling outage, when all areas and components from which peeling coatings have the potential for falling into the reactor cavity are inspected by the FPL Coating Supervisor. The second inspection takes place at the end of every refueling outage when the condition of containment coatings is assessed by a team (including the Nuclear Coating Specialist) using guidance from EPRI Technical Report 1003102 ("Guidelines On Nuclear Safety-Related Coatings," Revision 1, (Formerly TR-109937)). Accessible coated areas of the containment and equipment are included in the second inspection. Plant management is notified prior to restart if the volume of unqualified/degraded coatings approaches pre-established limits.

The initial coating inspection process is a visual inspection. The acceptability of visual inspection as the first step in monitoring of Containment Building coatings is validated by EPRI Report No. 1014883, "Plant Support Engineering: Adhesion Testing of Nuclear Coating Service Level 1 Coatings," August 2007. Following identification of degraded coatings, the degraded coatings are repaired per procedure, if possible. For degraded coatings that are not repaired, all areas of coatings determined to have inadequate adhesion are removed, and the Nuclear Coatings Specialist assesses the remaining coating to determine if it is acceptable for use. The assessment is by means of additional nondestructive and destructive examinations as appropriate.

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Topic 3.i: Debris Source Term Refinements

FPL Response

The second debris source term refinement discussed in Section 5.1 of NEI 04-07, "change-out of insulation", was utilized to improve the debris source term. Three (3) insulation modifications were completed that reduced the quantities of fibrous and particulate debris that could be transported to the sump strainers. The first modification replaced the Nukon and cal-sil insulation on the Pressurizer Surge Line with reflective metal insulation (RMI). The second modification replaced the coated blanket insulation on the Reactor Coolant Pumps with RMI. The third modification completely removed the insulation from the Pressurizer Relief Tank (PRT).

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Topic 3.j: Screen Modification Package

FPL Response

The original sump screens have been completely replaced with a single, non-redundant, distributed sump strainer system that consists of twelve (12) modules combined into four (4) assemblies and interconnecting piping, and increases the surface area to approximately 5,543 ft^2. The strainer system uses the General Electric discreet modular stacked disc strainers.

[RAI 32] The new strainer system is completely passive (i.e., it does not have any active components or rely on backflushing).

As in the original design, the new distributed strainer system serves both ECCS suction intakes. The original ECCS intake design has a permanent cross-connection downstream of the containment ECCS sump inlets (outside the containment), which permits either train to draw from both ECCS sump inlets. The new strainer design provides a pathway inside the containment that is parallel to the original cross-connection. Because the original Turkey Point Unit 3 design contained this ECCS cross-connection, the new design is not a departure from the existing design basis. It is consistent with the current design basis, Technical Specifications, and regulatory commitments for Turkey Point Unit 3. The new strainer system is sized for the full debris load and full ECCS flow from the ECCS/CSS systems. Design basis flow is discussed in the response to NRC Topic 3.f: Head Loss and Vortexing. Because a single non-redundant strainer system is used, the system has been designed such that there is no credible passive failure mechanism that could render both ECCS trains inoperable. Active strainer failure mechanisms are not considered because the strainer system is completely passive. The strainer system structural design is discussed in the response to NRC Topic 3.k, Sump Structural Analysis.

The strainer modules consist of a series of vertically oriented rectangular discs, stacked in parallel along a horizontal axis, that have exterior debris capturing surfaces of perforated plate covered with woven wire mesh. The wire mesh decreases the head loss across the strainer plates by breaking up debris beds. Each strainer disc is constructed of two plates and has an open interior to channel disc flow toward the strainer plenum. The discs are mounted on a frame and to the discharge plenum on the side of the disc set which channels disc flow to the interconnecting suction piping. Stainless steel is used as the material of construction.

The quantity of fibrous debris available for transport is not sufficient to produce a 1/8-inch thick debris bed. Nevertheless, the debris plate and the small pitch between disks allow the strainer to mitigate thin bed effects should they occur.

The strainer perforations are nominal 3/32-inch diameter holes. This is an enhancement from FPL's statement in the September 1, 2005 submittal, where the stated expectation was only that the perforation size would be less than 1/8-inch by 1/8-inch square opening (that is, the current opening size is 93.75 mils, while the initial postulated square opening had a diagonal dimension of 176.78 mils.).

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

The modules in each assembly are tied together into larger units by a connected common plenum. The strainer plenums are connected together and to the ECCS suction inlets by the strainer piping.

Fabrication and installation tolerances of all equipment are such that debris larger than 0.1031 inch (110% of nominal opening diameter) cannot bypass the strainer system. Therefore, debris retention capacity of the entire system is at least as good as the strainer modules.

The entire strainer system is designed and situated to be fully submerged at the minimum containment water level during recirculation. During flood-up water would fill the strainer system from the bottom up, forcing air out of the perforated strainer discs, thereby venting the system. Because the discs are below the containment water level prior to the start of recirculation, air will not be sucked in through the perforated discs. Because the strainers vent the system prior to the start of recirculation, no other venting is required.

The capability of the strainer system to accommodate the maximum mechanistically-determined debris volume has been confirmed by a combination of testing and analysis. The volume of debris at the screen is discussed in the response to NRC Topic 3.c, Debris Characteristics. The capability to provide the required NPSH with this debris volume is discussed in the response to NRC Topic 3.g, Net Positive Suction Head (NPSH). The capability to structurally withstand the effects of the maximum debris volume is discussed in the response to NRC Topic 3.k, Sump Structural Analysis.

Two additional modifications were completed that are not directly related to the requirements of GL 2004-02. The first of these modifications created a cylindrical core bore 15½ feet long with a 16-inch diameter beneath the refueling cavity (also known as the fuel transfer canal) to provide a pathway for the piping that connects the strainer assemblies to the south ECCS sump suction inlet.

The second modification filled the existing ECCS sump suction inlet pits with reinforced concrete. At Turkey Point Unit 3, the ground floor of the containment acts as a sump pool, and the ECCS pumps take suction from this pool via two inlet lines that are set into the containment floor on the 14-foot elevation. The piping from the new strainers is connected directly to the ECCS suction inlet piping. Therefore, the existing ECCS sump pits no longer provide any benefits.

Topic 3.k: Sump Structural Analysis

FPL Response

The previous sump strainer system has been completely replaced by a new strainer system. The new system is passive and does not utilize backflushing. It is described in the response to NRC Topic 3.j, Screen Modification Package. Assurance that strainer system is inspected for adverse gaps or breaches prior to concluding an outage is discussed in the response to NRC Topic 3.p, Foreign Material Control Programs.

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

There are four (4) strainer assemblies in the system. Each assembly consists of multiple strainer units bolted together. There are three (3) major subcomponents: passive strainer assemblies, strainer piping, and pipe supports. The pipe runs that connect the strainer assemblies and ECCS/CSS suction inlets are nominal 14-inch stainless steel, schedule 10S, and utilize flexible bellows connections to allow for thermal expansion. The assemblies are connected to the south ECCS/CSS suction inlet by piping that runs through a cylindrical core bore 15½ feet long with a 16-inch diameter beneath the refueling cavity (also known as the fuel transfer canal). The piping that connects to both the north and south ECCS/CSS suction inlets is embedded in concrete within the sumps so that negligible loads are imposed on the ECCS/CSS suction piping.

The NSSS system is located between a bioshield near the outer wall of containment and a primary shield that surrounds the reactor cavity. The bioshield is a two-piece wall with one wall starting at the floor and extending upwards, and the other starting at the ceiling and extending down. The two walls are offset so that they do not intersect, which creates an opening between them due to their overlap. This opening provides a clear path for jet impingement on piping outside the bioshield by breaks inside the bioshield (or vice versa) in certain instances. An evaluation of potential breaks and potential targets in both the inner annulus and the outer annulus was performed. The evaluation concluded that the effect of the opening is negligible.

The system only operates once the containment is filled with water and the entire system is fully submerged. The system is also designed to vent during containment flood up, and there is no requirement to be leak tight. That is, the strainers and piping are not pressure-retaining vessels, but rather are required to guide the screened water to the pump suction lines while fully submerged. However, the strainers and associated piping have been designed to withstand a crush pressure of 20 psi. The maximum debris only head loss experienced by the strainers is 1.54 psi, which is much less than the design crush strength.

The strainer module structural loads and load combinations are summarized in Tables 3.k-1 and 3.k-2 below. The strainer module structural qualification results are summarized in Table 3.k-3 below. Finite element analyses were performed for all components of the strainer module assembly using the ANSYS program. The strainer modules were designed using ASME Section III, Subsection NC Class 2 (components) and Subsection NF (supports) as a guide. The capability of the strainer perforated plate discs as structural members was calculated using the equivalent plate approach which is contained in the ASME B&PV Code, Section III, Appendix, Article A-8000. For the concurrent events of a LOCA, seismic event, and the strainer modules fully clogged, the strainer discs were designed to ASME Section III Subsection NCA-2142, Level D allowable stresses.

The connecting piping was analyzed using Sargent & Lundy computer program PIPSYSW. The connecting piping was designed and analyzed in accordance with ASME III Subsection NC (Class 2 components). The analyses confirmed that the pipe stresses are below the Code allowable limits.

The piping supports were designed to AISC with allowable stresses based on the AISC manual of Steel Construction, 13th Edition. In all cases the loads were applied in the direction that

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

generated the maximum stress levels, and the analyses confirmed that the supports met the acceptance criteria.

The 16-inch diameter core bore was analyzed for its effect on the structural integrity of the concrete wall that it penetrates. The only affected component is the concrete wall that contains the core bore. The analysis confirmed that the concrete wall with the core bore continues to meet the design basis requirements with margin. Subsequent to drilling the 16-inch diameter concrete core, the penetration was coated to protect the cut ends of steel reinforcement from corrosion.

With regard to trash racks, the design is robust and the trash rack function is incorporated into the design. Separate (distinct) trash racks are not required. This is consistent with the original Turkey Point Unit 3 strainers/sumps, which did not have separate trash racks.

The new strainer system is described in the response to NRC Topic 3.j, Screen Modification Package. Assurance that there are no adverse gaps or breaches that could allow larger debris to bypass the strainer system is discussed in the response to NRC Topic 3.p, Foreign Material Control Programs.

Table 3.k-1: Strainer Structural Loads and Load Combinations

Load	Load Combination
1	$D + L + E_1$
2	$D + L' + E_2$
3	$D + L + T + E_1$
4	$D + L' + T + E_2$
5	$D + L + T + E'_1$
6	$D + L + T_A$
7	$D + L' + T_A + E'_2 + P_{CR}$

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Table 3.k-2: Structural Load Symbols

Symbol	Load Definition
D	Weight of Dry Strainer Assembly
L'	Water Weight + Debris Weight + Hydrodynamic Mass
L	Live Load, 250 Pound Person
T	Normal Operating Thermal Load
T_A	Accident Thermal Load
E_1	Earthquake Load, OBE in air
E_2	Earthquake Load, OBE in water
E'_1	Earthquake Load, SSE in air
E'_2	Earthquake Load, SSE in water
P_{cr}	Differential (Crush) Pressure
S	The Limit, S, is the section strength based on elastic design methods and allowable stresses defined in AISC Specification Part 1, Manual of Steel Construction Allowable Stress Design, 9th Edition, 1989
Sy	ASTM minimum yield strength

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Table 3.k-3: Strainer Structural Load Stress Ratio Results

Load Combination (Note 1)	4	7
Allowable Stress	Sy	Sy or 2.4S (Note 2)
Stress Ratio		
Plenum Support Plate	1.01	1.37
Plenum Support Frame	1.33	1.79
14 inch pipe	1.05	1.4
Pipe run Connection Plate	1.54	2.08
Plenum Side Cover 28 Disks	1.11	1.46
Plenum Flange	4.38	5.92
Foot Top Plate	5.51	6.42
Plenum Inspect Plate	3.49	4.69
Foot Base Plate	15.08	19.59
Foot	1.68	2.18
Plenum Support Block	5.60	7.33
Angle Bracket	1.08	1.22
Plenum Body	2.35	3.15
1" Angle Support Plate	12.55	13.97

Notes:
1. Load combinations 4 and 7 were bounding, and therefore were the only loads that were analyzed.
2. The higher limit is based on ASME Sub-section NF, Appendix F. The higher limit only applies to the disks (all parts).

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Topic 3.I: Upstream Effects

FPL Response

In the September 1 Turkey Point response it was noted that the refueling canal drains required further evaluation to determine if they constituted potential choke points. Subsequent to the September 1 response, a walkdown was conducted in the Turkey Point Unit 3 containment specifically to evaluate ECCS recirculation flow paths. The walkdown utilized the guidance in Nuclear Energy Institute (NEI) Report 02-01, NEI Report 04-07 and the staff's SE of NEI 04-07.

[RAI 38] The information obtained during the walkdown confirmed that the only potential choke points are the fuel transfer canal drain covers at the bottom of the refueling canal. The drain covers are intended to prevent items from falling into the drains during refueling operations. These potential choke points have been removed by updating the containment closeout procedure to ensure that the drain covers are removed prior to restart. The procedure changes are described in the response to NRC Topic 3.p, Foreign Material Control Program.

Other specific NEI and NRC concerns that were addressed in the walkdown are itemized below.

- Choke points will not be created by debris accumulating on access barriers (fences and/or gates).
- Choke points will not be created by debris accumulation in narrow hallways or passages.
- No curbs or ledges were observed within the recirculation flow paths. At the upper elevations, concrete slabs smoothly transition to grating or open space without any contiguous curbs.
- No potential choke points were observed at upper elevations, including floor grates, which would be expected to retain fluid from reaching the containment floor.
- The containment floor was surveyed for choke points formed by equipment, components, and other obstructions. While some debris hold up may occur, it will not prevent water from reaching the sump strainers.

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Topic 3.m: Downstream Effects – Components and Systems

FPL Response

In the September 1 response it was noted that, at that time, the downstream evaluations identified instrumentation and seventeen (17) components that required further evaluation. Subsequently, the strainer opening size has been reduced from an assumed opening of 1/8-inch by 1/8-inch (diagonal dimension of 0.177-inch) to an installed opening of 3/32-inch diameter (0.09375 inch), and the quantity of insulation debris available for transport has been reduced.

The new strainer system is described in the response to NRC Topic 3.j, Screen Modification Package. The insulation changes are described in the response to NRC 3.i, Debris Source Term refinements.

[RAI 31] Component downstream analyses are currently in progress that use the methodologies of WCAP-16406-P Revision 1 (WCAP-16406-P, "Evaluation of Downstream Sump Debris Effects in Support of GSI-191," Revision 1, August 2007). FPL plans on completing the downstream component analyses in accordance with the schedule provided to the NRC staff in letter L-2007-155.

As discussed in the response to NRC Topic 3.e, Debris Transport, detailed debris size distributions were not required or developed for the purposes of determining the debris load at the strainer and the strainer head loss. However, debris size distributions are required for the downstream analyses. As a result, a conservative set of debris characteristics was developed independently of transport considerations. The debris characteristics that are planned to be used in the downstream analyses are provided in Table 3.m-1 below.

No credit is being taken for reducing the amount of debris by sequestration in an inactive volume. Consistent with the guidance in WCAP-16406-P Revision 1, the evaluation considers debris larger than the largest dimension of the sump strainer opening, 3/32 inch (93.75 mils). However, four (4) clarifications of the methodology of WCAP-16406-P are expected to be utilized in the downstream analyses. These clarifications are discussed below.

Clarification 1
In lieu of the guidance provided in WCAP 16406-P (WCAP) regarding particle sizes, the analyses will conservatively define the "smaller" flow clearance as the circular dimension able to pass a 0.125-inch spherical particle. The 0.125-inch diameter sphere exceeds all dimensional attributes except for the length dimensions. However the overall dimension (cross-sectional area) for a 0.125-inch diameter sphere is approximately 160% greater than the guidance provided in the WCAP. Therefore, this is acceptable.

The analyses will also conservatively assume that all fines initially bypass the strainer modules with the exception of unqualified coating and RMI, where particulates ≤ 125 mils are assumed to bypass the strainer modules. This is conservative because the strainer openings are 93.75 mils and the debris retention is 100% for particles ≥ 103.1 mils.

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Clarification 2
The size distributions will be calculated in lieu of the size distributions specified in WCAP-16406-P, Revision 1, for RMI, cal-sil, and latent debris. Microtherm will be assumed to have similar size characteristics as cal-sil. For unqualified coatings, the size/mass distribution of WCAP-16406-P Revision 1 will be used.

Clarification 3
All particulate debris will be assumed to be spherical when calculating settling sizes and associated velocities.

Clarification 4
The time dependent debris decay and depletion model will use the debris decay coefficients of a cold leg break and the reactor lower plenum settling sizes and velocities of a hot leg break. Cold leg recirculation cooling will be assumed for both cases. This model minimizes the debris settling and depletion, which maximizes the debris concentration over the mission time, thus establishing conservative values for the wear analysis.

Table 3.m-1: Debris Characteristics

Debris	Category	Percentage
Latent Fiber	Fines	100%
Particulates		
Cal-sil	Fines	100%
Microtherm	Fines	100%
Qualified Coating	Fines	100%
Unqualified Coating	Fines	100%
Latent Particulate	Fines	100%
RMI	Fines	75%
	Intact	25%

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Topic 3.m: Downstream Effects – Fuel and Vessel

FPL response

FPL is participating in the PWR Owners Group (PWROG) program to evaluate downstream effects related to in-vessel long-term cooling. The results of the PWROG program are documented in WCAP-16793-NP (WCAP-16793-NP, "Evaluation of Long-Term Cooling Considering Particulate, Fibrous and Chemical Debris in Recirculating Fluid," Rev. 0, May, 2007), which was provided to the NRC staff for review in June 2007. The program was performed such that the results apply to the entire fleet of PWRs, regardless of the design (e.g., Westinghouse, CE, or B&W).

The PWROG program demonstrated that the effects of fibrous debris, particulate debris and chemical precipitation would not prevent adequate long-term core cooling flow from being established. In the cases that were evaluated, the fuel clad temperature remained below 800 °F in the recirculation mode. This is well below the acceptance criterion of 2200 °F in 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors." The specific conclusions reached by the PWROG are noted below.

- Adequate flow to remove decay heat will continue to reach the core even with debris from the sump reaching the RCS and core. Test data has demonstrated that any debris that bypasses the screen is not likely to build up an impenetrable blockage at the core inlet. While any debris that collects at the core inlet will provide some resistance to flow, in the extreme case that a large blockage does occur, numerical analyses have demonstrated that core decay heat removal will continue. Per WCAP 16793-NP, Revision 0, no plant specific evaluation is recommended. This conclusion thus applies to Turkey Point Unit 3.

- Decay heat will continue to be removed even with debris collection at the fuel assembly spacer grids. Test data has demonstrated that any debris that bypasses the screen is small and consequently is not likely to collect at the grid locations. Further, any blockage that may form will be limited in length and not be impenetrable to flow. In the extreme case that a large blockage does occur, numerical and first principle analyses have demonstrated that core decay heat removal will continue. Per WCAP 16793-NP, Revision 0, no plant specific evaluation is recommended. This conclusion thus applies to Turkey Point Unit 3.

- Fibrous debris, should it enter the core region, will not tightly adhere to the surface of fuel cladding. Thus, fibrous debris will not form a "blanket" on clad surfaces to restrict heat transfer and cause an increase in clad temperature. Therefore, adherence of fibrous debris to the cladding is not plausible and will not adversely affect core cooling. Per WCAP 16793-NP, Revision 0, no plant specific evaluation is recommended. This conclusion thus applies to Turkey Point Unit 3.

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

- Using an extension of the chemical effects method developed in WCAP-16530-NP to predict chemical deposition of fuel cladding, two sample calculations using large debris loadings of fiberglass and calcium silicate, respectively, were performed. The cases demonstrated that decay heat would be removed and acceptable fuel clad temperatures would be maintained.

WCAP-16530-NP, Revision 0 evaluated the potential for chemical precipitation to form on the cladding surface as summarized in the preceding bullet, which is demonstrated in WCAP-16793, Revision 0, to produce acceptable fuel clad temperature results for two sample cases. As recommended in the WCAP-16793-NP, Revision 0, FPL has decided to perform a plant-specific calculation using plant-specific parameters and the recommended WCAP methodology to confirm that chemical plate-out on the fuel does not result in the prediction of fuel cladding temperatures approaching the 800 °F value. We plan to have this assessment completed in accordance with the schedule provided to the NRC staff in letter L-2007-155. Results of this assessment will be provided in a separate submittal as discussed in the response to NRC Topic 2, General Description of and Schedule for Corrective Actions.

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Topic 3.n: Chemical Effects

FPL Response

As described in Attachment 2 of our December 7, 2007 extension request, a purchase order has been issued for performing a 30-day integrated chemical effects test. As described in Attachment 4 of our December 7, 2007 extension request, the purchase order is with Alion Science and Technology. It is anticipated that the chemical testing and analyses will be completed by June 30, 2008. In the meantime, the new strainer system that was installed during the unit 3 cycle 23 refueling outage increased the strainer surface area to approximately 5,534 ft^2. After accounting for head losses due to debris and temperature dependent effects, the new strainer system provides an NPSH margin of approximately 6.1 ft for the LBLOCA and 5.8 ft for the SBLOCA. Pending resolution of chemical effects issues, this margin is available to accommodate strainer head loss due to chemical effects at the sump strainers. Upon completion of the chemical effects tests, the available NPSH margin will be updated to incorporate the results of the chemical effects tests and analyses.

As discussed in our December 7, 2007, extension request, although the identified corrective actions have been completed, the impact of chemical effects on full implementation of GSI-191 corrective actions will not be fully assessed until June 30, 2008. Therefore, responses to the staff's RAI items related to chemical effects in the NRC RAI dated February 8, 2006 (TAC Nos. MC4725 and MC4726) will be provided at that time as necessary.

[RAI 9] [RAI 15] At the time of the September 1 response, it was planned to change the buffering agent from sodium tetraborate (borax) to tri-sodium phosphate (TSP). Subsequently, in consideration of results from the industry Integrated Chemical Effects Tests (ICET), it has been decided to retain borax as the buffering agent.

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Topic 3.o: Licensing Basis

FPL Response

No changes to the plant licensing basis were required to ensure compliance with the regulatory requirements of GL 04-02. However, the Technical Specification Bases and the ECCS procedures have been updated to incorporate the new strainer design basis. These changes did not affect the plant licensing basis or existing UFSAR analyses. All of the changes were completed in accordance with the requirements of 10 CFR 50.59.

The Technical Specification Bases were updated to expand the definition of the recirculation sump inspection requirements to include the entire distributed sump strainer system. This change ensures that the entire system will come under the technical specification requirements for sump inspection and control.

Two (2) of the seven (7) currently allowable ECCS/CSS recirculation pump alignments operate both RHR/LHSI pumps simultaneously. These pumps are redundant, and the other five (5) alignments operate only one of the redundant pumps. The design basis sump strainer flow is consistent with the plant design basis which relies on a single RHR/LHSI pump. Therefore, because the ECCS/CSS alignments that operate two (2) RHR/LHSI pumps simultaneously are not needed to meet design basis requirements and exceed the design flow of the new sump strainers, they have been removed from the emergency operating procedures.

ATTACHMENT 1
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Topic 3.p: Foreign Material Control Programs

FPL Response

Information related to programmatic controls for foreign materials was provided to the NRC in previous submittals. Such information was provided in letter L-2003-201 which responded to NRC Bulletin 2003-01, and most recently in letter L-2005-181 which responded to GL 04-02. In general, the information related to programmatic controls that was supplied in these responses remains applicable. However, since the September 1 response, modifications, tests, and walkdowns have been completed and these have been used to inform and update the programmatic controls that support the new sump strainer system design basis.

The results of the recently completed walkdowns to assess the quantities of latent and miscellaneous debris are discussed in the response to NRC Topic 3.d, Latent Debris. These walkdowns were conducted without any preconditioning or pre-inspections. Consequently, the debris found during the walkdowns is characteristic of approximately 33 years of operation under the existing housekeeping programs. Given the small quantity of latent and miscellaneous debris after 33 years of operation under the current housekeeping program, it is concluded that the current housekeeping program is sufficient to ensure that the new strainer system design bases will not be exceeded.

Currently insulation and materials inside containment are controlled by procedures that require; (a) a review of changes to insulation or other material inside containment that could affect the containment sump debris generation and transport analysis and/or recirculation functions and (b) a review of the effect of a change package for its impact on containment sump debris generation and transport. This guidance is being enhanced by updating the engineering specification that controls insulation configuration with the insulation information that was obtained for the debris generation and transport calculations via walkdowns during outages PT3-19 and PT3-20.

One new procedure has been written for inspection of the new strainer system, and the containment close-out procedure has been updated. The new procedure requires that there are no holes or gaps greater than 3/32 inch (0.09375 inch) in the strainers. The new procedure includes all of the new strainer system components in the final containment closeout inspection.

Note that programmatic controls related to coatings are provided in the response to NRC Topic 3.h, Coatings Evaluation.

END OF ATTACHMENT 1

ATTACHMENT 2

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Topic 1: Overall Compliance

FPL Response

In letter L-2006-028 dated January 27, 2006, Florida Power & Light Company (FPL) requested a short extension to the completion schedule to extend the completion of corrective actions required by Generic Letter 2004-02 for Turkey Point Unit 4 until the spring 2008 outage. In the extension letter request, FPL committed to implement a number of compensatory hardware changes in the fall 2006 refueling outage. The extension request was approved by the NRC in a letter dated April 13, 2006 and the interim compensatory hardware changes were implemented as scheduled.

Information and results provided in this response are based on the in-progress status of calculations and design as of approximately mid-January, 2007. Hence, some information may be from documentation still awaiting final review and approval. As noted elsewhere in this response, final results, information, and RAIs will be provided 3 months following the spring 2008 outage.

Turkey Point Unit 4 received construction permits prior to issuance of the proposed Appendix A to 10 CFR 50 and therefore the current licensing bases include aspects of the 1967 proposed criteria. Although numbered and worded somewhat differently, the 1967 proposed GDC have equivalent versions of the criteria that address the same concepts as the 10 CFR 50, Appendix A GDC.

Additional information to support the Staff's evaluation of Turkey Point Unit 4 compliance with the regulatory requirements of GL 2004-02 was requested by the NRC in a "Request for Additional Information" (RAI) dated February 8, 2006 (NRC Letter to FPL (J. A. Stall), Turkey Point Plant, Units 3 and 4, Request for Additional Information RE: Response to Generic Letter 2004-02, 'Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors'" (TAC Nos. MC4725 and MC4726), February 8, 2006). Each RAI question is addressed in this response if the information is available. The RAI response is identified by the RAI question number in the following format: [RAI ##], where ## is the RAI question number. A number of the RAI responses will be provided in the follow-up supplemental response as discussed in NRC Topic 2, General Description of and Schedule for Corrective Actions.

Based on the planned completion of corrective actions and enhanced procedural controls, it is anticipated that Turkey Point Unit 4 will be in compliance with the regulatory requirements listed in the Applicable Regulatory section of GL 2004-02 prior to startup from the spring 2008 refueling outage (PT4-24) currently scheduled to start March 30, 2008, when all identified permanent hardware modifications are completed.

It is possible that the final testing and analysis may result in further reexamination of original assumptions and bases of other calculations or, potentially require additional outage related modifications. In the case that additional corrective actions are required, FPL will contact the Commission.

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Topic 2: General Description of and Schedule for Corrective Actions

FPL Response

As discussed in the previous section, Florida Power & Light Company (FPL) received a short extension to the completion schedule to extend the completion of corrective actions required by Generic Letter 2004-02 for Turkey Point Unit 4 until the spring 2008 outage. A general description of the actions already taken or planned to be taken are presented below. Additional details are contained in subsequent sections of this supplemental response.

During Turkey Point Unit 4 fall 2006 refueling outage (PT4-23), two interim passive strainer modules were installed to supplement the existing ECCS recirculation sump debris screens in the containment building, adding approximately 462 ft^2 of additional screen area at each of the north and south sumps. The installation of the interim strainer modules exceeded the screen area committed to in the January 27, 2006 letter as a mitigative measure in resolving GSI-191. During the same refueling outage, debris interceptors were installed at the entrances of the biological shield wall, calcium silicate insulation was removed from the pressurizer relief tank (PRT), and modifications were made to existing penetrations in the biological shield wall.

Consistent with our approved extension request, permanent modifications are planned to be implemented during the Turkey Point Unit 4 spring 2008 refueling outage scheduled to begin on March 30, 2008. The preexisting sump screens and interim strainer modules will be replaced with a single strainer system consisting of approximately 3,614 ft^2 of strainer surface area (preliminary). Reactor coolant pump (RCP) insulation is being replaced with reflective metallic insulation (RMI). In addition, the containment spray pump mechanical seals are being modified and their cyclone separators are being removed.

Walkdowns to specifically identify potential choke points (upstream effects) have been completed. The upstream effects assessments confirmed that the only potential choke points are the fuel transfer canal drain covers. As was done for Turkey Point Unit 3, plant procedures will be revised to verify that the drain covers are removed prior entry into mode 4 during startups. These revisions will be made prior to entry into Mode 4 during restart from the spring 2008 refueling outage.

The downstream effects assessments of components are ongoing and are expected to be completed by the schedule provided to the NRC Staff in letter L-2007-155. The methodology of WCAP-16406-P, Revision 1, "Evaluation of Downstream Sump Debris Effects in Support of GSI-191," and the Staff's SE of NEI 04-07 are being used to evaluate the downstream effects of bypass debris on downstream components. As stated above, the containment spray pump mechanical seals will be replaced and the cyclone separators will be removed during the spring 2008 refueling outage.

The downstream effects assessments of the fuel and vessel are ongoing. FPL is participating in the PWR Owners Group (PWROG) program to evaluate downstream effects related to in-vessel long-term cooling using the methodology of WCAP-16793-NP "Evaluation of Long-Term Cooling Considering Particulate, Fibrous and Chemical Debris in the Recirculating Fluid," Rev. 0. Still ongoing is a Turkey Point Unit 4 calculation using plant-specific parameters and WCAP-16793-

NP methodology to confirm that chemical plate-out on the fuel is acceptable. It is planned to have this assessment completed in accordance with the schedule provided to the NRC Staff in letter L-2007-155.

Several enhancements to programmatic controls have been put in place at Turkey Point. Engineering procedures were revised to provide guidance to design engineers working on plant modifications to take into account the impact of the design on the "containment sump debris generation & transport analysis and/or recirculation functions."

New controls have been instituted limiting the permissible quantity of unqualified coatings in the containment building to ensure that the ECCS strainer design requirements, as documented in the Turkey Point Unit 4 debris generation calculation, remain within permissible limits.

As an enhancement to the existing process for controlling the quantities of piping insulation within the containment, the engineering specification that controls thermal insulation was revised to provide additional guidance for maintaining containment insulation configuration.

Based on the latent and foreign material walkdowns performed, and a review of the existing plant procedures, it was determined that changes in the Turkey Point housekeeping procedures were not required because of the limited amount of material observed.

Chemical Effects testing to validate the design of the permanent strainers will begin by the end of March 2008 and be completed during the second quarter of 2008 as discussed in letter L-2007-155, dated December 7, 2007.

As stated in our letter of December 7, 2007, FPL intends to submit a follow-up (updated) supplemental response to Generic Letter 2004-02 within three months following the spring 2008 refueling outage. This follow-up submittal will describe the implemented corrective actions to resolve Generic Letter 2004-02 issues and provide the balance of the requested information not contained in this supplemental response. The follow-up submittal will also address the balance of the RAI responses not contained herein.

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Topic 3.a: Break Selection

FPL Response

In agreement with the staff's SE of NEI 04-07, the objective of the break selection process was to identify the break size and location which results in debris generation that will maximize the head loss across the containment sump. Breaks were evaluated based on the methodology in Nuclear Energy Institute (NEI) guidance document NEI 04-07, as modified by the staff's SE for NEI 04-07.

The Nuclear Steam Supply System (NSSS) is located between a bioshield wall near the outer wall of containment and a primary shield that surrounds the reactor cavity. The bioshield is a two-piece wall with one wall starting at the floor and extending up, and the other starting at the ceiling and extending down. The two walls are offset so that they do not intersect, which creates an opening between them due to their overlap. This opening can provide a path for jet impingement on piping outside the bioshield by breaks inside the bioshield (or vice versa). An evaluation of potential breaks and potential targets in both the inner annulus and the outer annulus was performed. The evaluation concluded that the effect of this opening is negligible and that the opening does not affect the selection of the limiting break.

The following specific break location criteria were considered:

- Breaks in the reactor coolant system with the largest amount of potential debris within the postulated ZOI,
- Large breaks with two or more different types of debris including the breaks with the most variety of debris,
- Breaks in areas with the most direct path to the sump,
- Medium and large breaks with the largest potential particulate debris to insulation ratio by weight, and
- Breaks that generate an amount of fibrous debris that could form a uniform "thin bed."

[RAI 34] All Reactor Coolant System (RCS) piping and attached energized piping was evaluated for potential break locations. Inside the bioshield breaks in the hot legs (29-inch ID), cold legs (27½ -inch ID), crossover legs (31-inch ID), pressurizer surge line (14-inch nominal), and Residual Heat Removal (RHR) recirculation line from the hot leg (14-inch nominal) were considered. Feedwater and main steam piping was not considered for potential break locations because ECCS in recirculation mode is not required for Main Steam or Feedwater line breaks. The other piping lines have smaller diameters (10-inch nominal maximum), which will produce a much smaller quantity of debris.

[RAI 33] Inside the bioshield the break selection process used the discrete approach described in Section 3.3.5.2 of the staff's SE of NEI 04-07. The staff's SE of NEI 04-07 notes that the concept of equal increments is only a reminder to be systematic and thorough. As stated in the staff's SE of NEI 04-07, the key difference between many breaks (especially large breaks) will not be the exact location along the pipe, but rather the envelope of containment material targets that is affected. Consistent with this guidance, break locations were selected based on the total debris, mixture of debris, and distance from the sump. Containment symmetry ensures similar

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

results for each break, but each break is also unique in certain aspects, and this was considered in the break selection process. The crossover leg is the largest line (31-inch ID) inside the bioshield and would produce the largest ZOI. A crossover leg break is analyzed in loops A, B, and C in order to maximize the ZOI radius which maximizes the insulation encircled. The crossover leg of loop C is also near the south sump pit. A hot leg break in loop B is chosen for the large surface area of coatings near it due to the proximity of the pressurizer relief tank and pressurizer surge line. A cold leg break near loop A is chosen for its proximity to several coated walls.

Outside the bioshield a break was considered in an RHR line. The RHR lines are of smaller diameter than the RCS piping. Therefore, inside the bioshield a break in these lines would be bounded by the reactor coolant loops, and thus need not be analyzed. However, the RHR recirculation line travels outside the bioshield before the second isolation valve. This location was selected in order to include a break outside the bioshield.

The postulated break locations were as follows:

- S1 The Loop B Hot Leg at the base of the steam generator (29-inch ID)
- S2 The Loop A Crossover Leg at the base of the steam generator (31-inch ID)
- S3 The Loop A Cold Leg at the base of the reactor coolant pump (27.5-inch ID)
- S4 The Loop B Crossover Leg at the base of the reactor coolant pump (31-inch ID)
- S5 The RHR line from Loop A Hot Leg outside the bioshield wall (14-inch nominal)
- S6 The Loop B crossover Leg at the base of the reactor coolant pump – alternate break (11.19 inch ID)
- S7 The Loop C Crossover Leg at the low point of the pipe (31-inch ID)

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Topic 3.b: Debris Generation/Zone of Influence (ZOI) (excluding coatings)

FPL Response

The debris generation calculations continue to use the methodologies of Regulatory Guide 1.82, Rev. 3, and the staff's SE of NEI 04-07. However, there have been changes in the input to the analyses since the September 1 response. Subsequent to the September 1 response, a new vendor, Sargent & Lundy^{LLC} (S&L), was selected to revise the previously performed debris generation calculations.

Debris specific ZOIs were used in the debris generation calculations for calcium-silicate (cal-sil), low density fiber glass (LDFG) and reflective insulation. ZOIs for commonly used insulation were obtained from Table 3-1 of NEI 04-07 and Table 3-2 of the staff's SE of NEI 04-07. Specific insulation ZOI that were used are: 17 D for Nukon (fiber) insulation, 5.45 D for Calcium Silicate (cal-sil) insulation, 28.6 D for Mirror reflective metal insulation (RMI), and 2.0 D for Transco/Darchem RMI. All cal-sil, Nukon, and RMI insulation is jacketed.

The updated debris generation calculations make use of two assumptions related to non-coating debris generation.

Assumption 1
Supporting members fabricated from steel shapes (e.g., angles, plates) are installed to provide additional support for insulation on equipment. It is assumed that as a result of the postulated pipe break, these supporting members will be dislodged from the equipment, and may be bent and deformed, but will not become part of the debris that may be transported to the sump.

Assumption 2
In the September 1 response, it was noted that an analytical process was used that conservatively overstated the quantity of debris from insulation by 5-15%. This has since been changed to a uniform ZOI factor of 1.1 for insulation debris to account for minor variances such as small variations in the insulation analysis coordinates used for the systematic break selection process, degraded insulation, larger amounts of insulation around valves, etc.

The quantities of debris and destruction ZOI are provided in Table 3.b-1 below:

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Table 3.b-1: Destruction ZOI and Limiting Break Comparison

Debris Type	Destruction ZOI	Break S1(1)	Break S2(1)	Break S3(1)	Break S4(1)
Nukon	17.0 D	599.67 ft^3	644.37 ft^3	589.88 ft^3	618.27 ft^3
Cal-sil	5.45 D	72.02 ft^3	45.86 ft^3	79.85 ft^3	67.61 ft^3
RMI Mirror Darchem/Transco	 28.6 D 2.0 D	 8069.49 ft^2 721.6 ft^2	 3971.58 ft^2 747.5 ft^2	 7878.89 ft^2 3033.08 ft^2	 8716.93 ft^2 1860.33 ft^2
Insulation Jacketing Mirror (2) Darchem/Transco (2)	 28.6 D 2.0 D	 3149.99 ft^2 2386.05 ft^2	 2750.99 ft^2 2415.18 ft^2	 3374.19 ft^2 2602.49 ft^2	 3411.24 ft^2 2607.47 ft^2
Coatings Qualified - Steel Qualified - Concrete Unqualified –Total	 4.0 D 4.0 D N/A	 1.1 ft^3 2.9 ft^3 5.06 ft^3	 1.1 ft^3 2.9 ft^3 5.06 ft^3	 1.1 ft^3 2.9 ft^3 5.06 ft^3	 1.1 ft^3 2.9 ft^3 5.06 ft^3
Latent Debris (15% fiber, 85% particulates)	N/A	154.44 lbm	154.44 lbm	154.44 lbm	154.44 lbm
Miscellaneous Debris Labels, Tags, etc Glass Adhesive	 N/A N/A N/A	 44.5 ft^2 72.0 ft^2 0.03 ft^3	 44.5 ft^2 72.0 ft^2 0.03 ft^3	 44.5 ft^2 72.0 ft^2 0.03 ft^3	 44.5 ft^2 72.0 ft^2 0.03 ft^3

Note: (1) Break locations are discussed in the response to NRC Topic 3.a, Break Selection

Note: (2) The manufacturer of RMI insulation on the piping is unknown, therefore two cases are provided for the piping; one as if the RMI were Mirror and one as if the RMI were Transco or Darchem

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Topic 3.c: Debris Characteristics

FPL Response

The debris sources at Turkey Point Unit 4 include insulation, coatings, latent debris and foreign (miscellaneous) debris that are listed in Table 3.b-1. As discussed in NRC Topic 3.e, Debris Transport, the debris transport analysis is being reassessed because of project changes. The debris characteristics requested to be provided in this section and in RAI 35 will be design inputs to the debris transport calculations that will be used to confirm the required surface area of the replacement strainers. Since the debris transport calculations are being reassessed, the information requested in this section will be provided in a follow-up supplemental response as discussed in NRC Topic 2, General Description of and Schedule for Corrective Actions.

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Topic 3.d: Latent Debris

FPL Response

The bases and assumptions related to latent and miscellaneous debris, and the resulting quantities used for analyses and testing, have been updated since the September 1 response. In that response it was noted that the quantity of latent debris was an assumed value in lieu of applied survey results, and that the sacrificial area for miscellaneous debris was independently estimated to be 50 ft^2. Subsequently, walkdowns have been completed in the Turkey Point Unit 3 containment specifically for the purpose of characterizing latent, miscellaneous and foreign debris (e.g., labels, stickers, etc.). These walkdowns utilized the guidance of NEI 02-01, Rev. 1, "Condition Assessment Guidelines: Debris Sources Inside PWR Containments" and the Staff's SE of NEI 04-07. This methodology, the results and the justification for basing Turkey Point Unit 4 latent and miscellaneous debris on Turkey Point Unit 3 data is discussed below.

The methodology used to estimate the quantity and composition of latent debris in the Unit 3 containment is that of the staff's SE of NEI 04-07, Section 3.5.2. Samples were collected from eight surface types; floors, containment liner, ventilation, cable trays, walls, equipment, piping and grating. For each surface type, a minimum of (4) samples were collected, bagged and weighed to determine the quantity of debris that was collected. A statistical approach was used to estimate an upper limit of the mean debris loading on each surface. The horizontal and vertical surface areas were conservatively estimated. The total latent debris mass for a surface type is the upper limit of the mean debris loading multiplied by the conservatively estimated area for that surface type, and the total latent debris is the sum of the latent debris for each surface type.

Turkey Point Units 3 and 4 are of similar design. The internal containment horizontal and vertical surface areas are similar. Procedures for containment closeout and the plant organizations which perform those procedures are the same for both units. For these reasons, the latent and foreign debris surveyed, measured, and calculated for the Turkey Point Unit 3 containment were used as the basis for estimating the quantity of this debris in the Turkey Point Unit 4 containment.

Based on the Turkey Point Unit 3 containment walkdown data, the quantity of latent debris in the Unit 3 containment is estimated to be 77.22 pounds. The latent debris composition is assumed to be 15% fiber and 85% particulate in agreement with the staff's SE of NEI 04-07. However, in order to ensure the differences are bounded, the Turkey Point Unit 3 quantity is doubled to 154.44 pounds (100% margin) for Turkey Point Unit 4. Latent debris quantities and distributions are provided in Table 3.b-1 above.

A walkdown was performed in the Turkey Point Unit 3 containment for the purpose of identifying and measuring the miscellaneous (foreign) debris that constitutes the sacrificial area (e.g., labels, stickers, tape, tags etc). Based on the Turkey Point Unit 3 walkdown data, the total quantity of miscellaneous debris in the Unit 3 containment is estimated to be 93.21 ft^2. However, to account for differences, the quantity of miscellaneous debris that was determined in the Turkey Point Unit 3 walkdown was increased to 116.5 ft^2 (25% margin) for Turkey Point Unit 4. The miscellaneous debris quantities and distribution are provided in Table 3.b-1 above.

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Topic 3.e: Debris Transport

FPL Response

In the Turkey Point September 1 response it was noted that debris transport was analyzed using the computational fluid dynamics (CFD) based methodology outlined in NEI 04-07. Alden Research Laboratory (Alden) prepared a Turkey Point Unit 4 debris transport study to determine the quantities of insulation, by debris type and size, that may be transported to the containment sump during the recirculation phase of a loss-of-coolant-accident (LOCA). This study was performed prior to both the selection of Performance Contracting, Inc. (PCI) as the replacement sump strainer vendor and the installation of the debris interceptors now located at the entrances to the biological shield wall. Consequently, the CFD model and debris transport calculation are being revised. The results of these revisions, including a response to RAI 41, will be provided in a follow-up supplemental response as discussed in NRC Topic 2, General Description of and Schedule for Corrective Actions.

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Topic 3.f: Head Loss and Vortexing

FPL Response

The permanent Turkey Point Unit 4 replacement strainers will not be installed until refueling outage PT4-24 (spring 2008). The strainer design is not finalized at this time as discussed in NRC Topic 3.j, Screen Modification Package. The information provided in this section is therefore preliminary. It is anticipated that final information concerning head loss and vortexing will be provided in a follow-up supplemental response as discussed in NRC Topic 2, General Description of and Schedule for Corrective Actions. At that time, responses to [RAIs 36, 37, 39 and 40] will be provided.

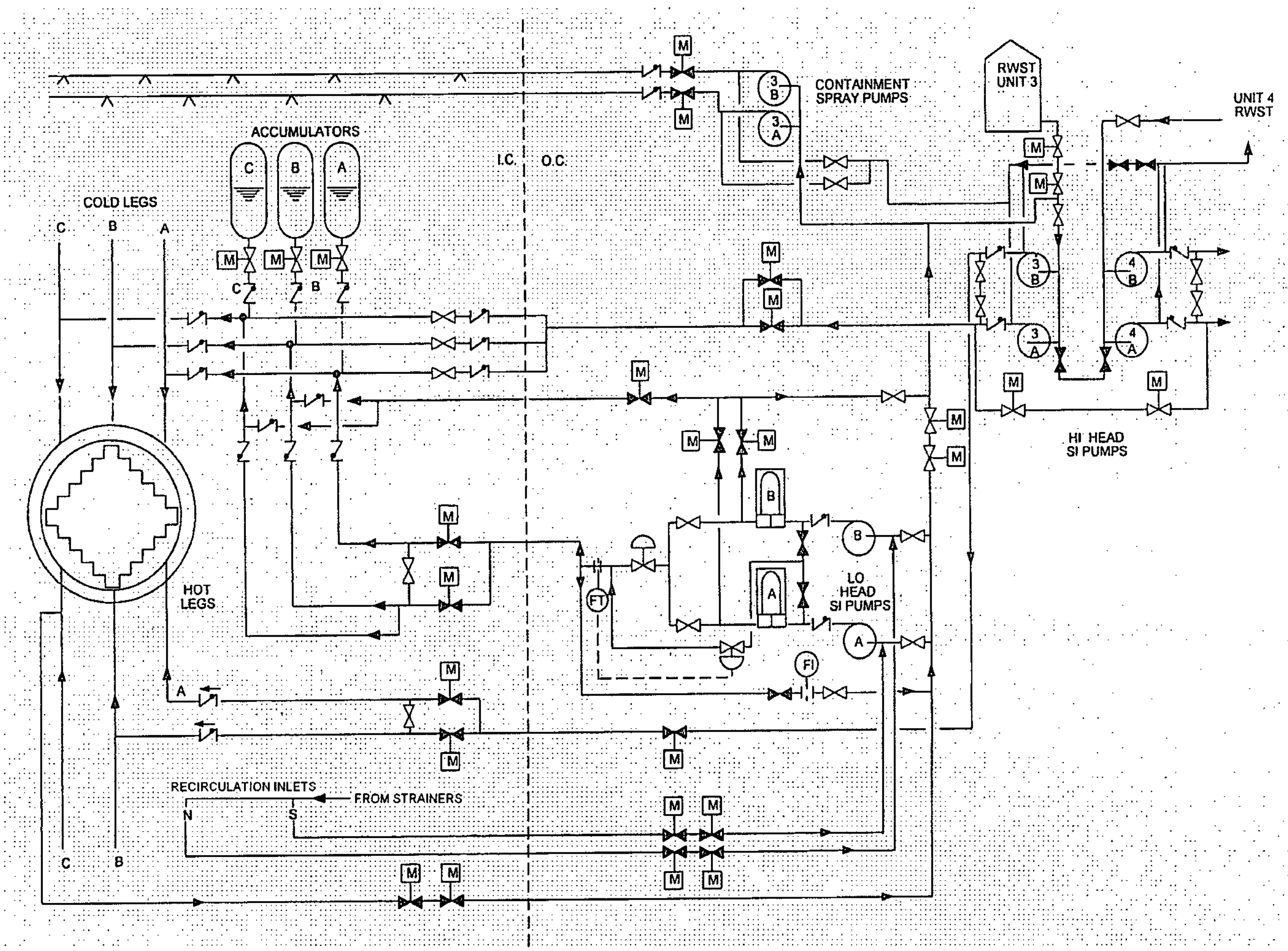
A piping schematic of the ECCS and containment/reactor building spray systems is provided in Figure 3.f-1 below. A description of the preliminary design of the strainer system is provided in the response to NRC Topic 3.j, Screen Modification Package. The information required in this section is not yet available because the strainer design has not been finalized and head loss testing for the strainer has not yet been performed.

The strainers are being designed to be fully submerged by three inches with the containment water level at its minimum post-LOCA value of 3.01 ft during recirculation. The strainer design specification requires that there is sufficient submergence margin per Appendix A of Regulatory Guide 1.82, Revision 3. The final design will confirm these margins.

Strainer head loss testing is to be performed in accordance with the schedule provided to the NRC Staff in letter L-2007-155. This test will be a large flume integrated debris and chemical test utilizing WCAP-16530-NP, Rev. 0, "Evaluation of Post-Accident Chemical Effects in Containment Sump Fluids to Support GSI-191."

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Figure 3.f-1: ECCS/CSS Piping Schematic



(This unit 3 figure is typical of unit 4 as well)

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Topic 3.g: Net Positive Suction Head Available (NPSH)

FPL Response

The replacement strainers will not be installed until Turkey Point Unit 4 refueling outage PT4-24 (spring 2008). The information provided below is based on the preliminary design of the replacement strainers as discussed in NRC Topic 3.j, Screen Modification Package, and will be updated with a follow-up supplemental response as discussed in NRC Topic 2, General Description of and schedule for Corrective Actions.

Following a large break LOCA (LBLOCA) both trains of the RHR/Low Head Safety Injection (RHR/LHSI) Pumps and High Pressure Safety Injection (HHSI) pumps are automatically started on a safety injection signal. Both Containment Spray (CS) pumps are automatically started on a containment high pressure signal. Recirculation is initiated manually on the refueling water storage tank (RWST) low level alarm (155,000 gal), which occurs at approximately 30 minutes after the LBLOCA. At the changeover to recirculation both RHR/LHSI pumps are manually stopped and switched over from the RWST to the recirculation sump. One RHR/LHSI pump is then manually restarted. At this point, the CS and HHSI pumps continue to draw water from the RWST although one CS pump is manually stopped. When the RWST level reaches 60,000 gallons the HHSI and CS pumps are manually stopped and aligned to take suction from the RHR/LHSI pumps ("piggyback" mode), and one HHSI pump is restarted.

The sequence for establishing recirculation following a small break LOCA is similar to that for a LBLOCA, and suction to the HHSI pumps is again provided by an RHR/LHSI pump. The minimum sump level of 3.01 ft is based on a SBLOCA. In the SBLOCA scenario, no reactor coolant system fluid is credited for sump level.

The minimum sump water level is elevation 17.01 feet, which occurs at the RWST low level signal. This minimum sump level does not account for the water volume that will be displaced from the installation of the new sump strainers. In addition, based on lessons learned from published NRC Generic Letter 2004-02 audits, the post-LOCA water level calculation for Turkey Point Unit 4 is being revised to account for applicable issues raised by the Staff. Any water level changes will be provided in the follow-up supplemental response as discussed in NRC Topic 2, General Description of and Schedule for Corrective Actions.

For the first 24 hrs of recirculation, the design recirculation flow rate is 2,697 gpm at 300 °F. After 24 hours the recirculation flow rate is 3,750 gpm at 170 °F. In recirculation mode, the CS and HHSI pumps operate in "piggyback" mode on the RHR/LHSI pumps. Therefore they are already included in the RHR/LHSI pump flow.

The estimated LBLOCA NPSH margin for the preliminary strainer design, without accounting for chemical effects is summarized in Table 3.g-1 below. The strainer system head loss allowance is the value that the strainer design specification states that the strainer vendor must meet with the strainer fully loaded with debris, but not including chemical effects. The head loss margin

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

value is the head loss available to account for chemical effects. These values will be validated and revised as necessary based on the planned prototypical testing described in NRC Topic 3.f, Head Loss and Vortexing.

Table 3.g-1: Recirculation NPSH Margin (Excluding Chemical Effects)

RHR/LHSI Flow Rate	Flow Rate (gpm)	NPSH Margin (ft)	Strainer System Head Loss Allowance (ft)
Debris Laden (< 24 hrs)	2,697	8.2	3.6
Debris Laden (> 24 hrs)	3,750	11.1	5.0

Note: Approximately 55% of the NPSH margin has been reserved to account for chemical effects.

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Topic 3.h: Coatings Evaluation

FPL Response

At Turkey Point Unit 4, coatings are classified as qualified/acceptable, or unqualified. The qualified/acceptable coating systems used in the Turkey Point Unit 4 containment are listed in Table 3.h-1 below.

Table 3.h-1 Qualified/Acceptable Coatings in the Turkey Point Unit 4 Containment

Substrate	Application	Coating Product	Application Thickness (mils)
Steel	1st Coat	Carboguard 890	6
	2nd Coat	Carboguard 890	6
	1st Coat (Note 1)	Carbozinc 11	4.5
	2nd Coat (Note 1)	Phenoline 305	5
Concrete Floor	1st Coat	Carboguard 2011S	50
	2nd Coat	Carboguard 890	7
	3rd Coat	Carboguard 890	7
	1st Coat (Note 1)	Phenoline 305 Concrete Primer	4.5
	2nd Coat (Note 1)	Phenoline 305	4.5
Concrete Wall	1st Coat	Carboguard 2011S	35
	2nd Coat	Carboguard 890	7
	3rd Coat	Carboguard 890	7
	1st Coat (Note 1)	Phenoline 305 Concrete Primer	4.5
	2nd Coat (Note 1)	Phenoline 305	4.5

Note 1: Specified thickness of original coatings. Repaired coatings are thicker, and the debris generation is based on the application coating thicknesses of the repair coatings

Selected features of the treatment of qualified and unqualified coatings in the determination of coating debris that reaches the sump strainers have been updated since the September 1 response. These changes are discussed individually below.

[RAI 30] Coatings debris characteristics will be responded to in the follow-up supplemental response, as discussed in NRC Topic 2, General Description of and Schedule for Corrective Actions.

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

[RAI 29] The qualified coating ZOI in the September 1 response for Turkey Point Unit 4 was 10D. The ZOI for qualified coatings has subsequently been reduced to 4D. The 4D ZOI is based on testing that was completed at the St. Lucie Plant during February of 2006. A description of the test, the test data, and the evaluation of the test data were previously provided to the NRC Staff for information on July 13, 2006 in letter L-2006-169 (R. S. Kundalkar (FPL) to M.G. Yoder (NRC), "Reports on FPL Sponsored Coatings Performance Tests Conducted at St. Lucie Nuclear Plant"). The evaluation of the test results confirms that a 4D ZOI is applicable to the in-containment qualified coating systems at Turkey Point Unit 4. As stated in the test plan, heat and radiation increase coating cross linking, which tends to enhance the coating physical properties. Therefore, since artificial aging, heat or irradiation to the current plant conditions could enhance the physical properties and reduce the conservatism of the test, the test specimens were not aged, heated or irradiated.

The coating thicknesses in the September 1 response were assumed to be 3 mils of inorganic zinc primer plus 6 mils of epoxy (or epoxy-phenolic) top coat for qualified coatings and 3 mils of inorganic zinc (IOZ) for unqualified coatings. Subsequently the analyses have been updated, and now conservatively assume the maximum thicknesses for each applicable coating system.

The coating area in the ZOI in the September 1 response was assumed to be equal to the surface area of the ZOI. Subsequently, the updated debris generation calculations calculate the quantity of qualified coatings for each break by using the concrete and steel drawings to determine the amount of coating that will be within the ZOI for each break. Coatings that are shielded from the jet by a robust barrier are not included in the total. The calculated volume of qualified steel coating is then increased by 10% to account for small areas of additional items such as piping, pipe/conduit/HVAC/cable tray supports, stiffener plates, ladders, cages, handrails, and kick plates.

The quantity of unqualified/failed coatings in the September 1 response was 6 ft^3. Subsequently, with the changes discussed above, the total quantity of unqualified/failed coatings is now 9.06 ft^3.

Since the September 1 response the process for controlling the quantity of degraded qualified coatings in containment has been enhanced to ensure that the quantity of degraded qualified coatings does not exceed the design basis.

The previous program for controlling in-containment coatings was described in the FPL response to NRC Generic Letter 98-04, "Potential for Degradation of the Emergency Core Cooling System and the Containment Spray System After a Loss-of-Coolant Accident Because of Construction and Protective Coating Deficiencies and Foreign Material in Containment" in letter L-98-272 on November 9, 1998. The letter summarized the program in place at that time for assessing and documenting the condition of qualified/acceptable coatings in primary containment at Turkey Point Units 3 and 4.

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

[RAI 25] The current program for controlling the quantity of unqualified/degraded coatings includes two separate inspections by qualified personnel during each refueling outage, and notification of plant management prior to restart if the volume of unqualified/degraded coatings approaches pre-established limits.

The first inspection takes place at the beginning of every refueling outage when all areas and components from which peeling coatings have the potential for falling into the reactor cavity are inspected by the FPL Coating Supervisor. The second inspection takes place at the end of every refueling outage when the condition of containment coatings is assessed by a team (including the Nuclear Coating Specialist) using guidance from EPRI Technical Report 1003102 ("Guidelines On Nuclear Safety-Related Coatings," Revision 1, (Formerly TR-109937)). All accessible coated areas of the containment and equipment are included in the second inspection. Plant management is notified prior to restart if the volume of unqualified/degraded coatings approaches pre-established limits.

The initial coating inspection process is a visual inspection. The acceptability of visual inspection as the first step in monitoring of Containment Building coatings is validated by EPRI Report No. 1014883, "Plant Support Engineering: Adhesion Testing of Nuclear Coating Service Level 1 Coatings," August 2007. Following identification of degraded coatings, the degraded coatings are repaired per procedure, if possible. For degraded coatings that are not repaired, areas of coatings determined to have inadequate adhesion are removed, and the Nuclear Coatings Specialist assesses the remaining coating to determine if it is acceptable for use. The assessment is by means of additional nondestructive and destructive examinations, as appropriate.

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Topic 3.i: Debris Source Term Refinements

FPL Response

The second debris source term refinement discussed in Section 5.1 of NEI 04-07, "Change-out of Insulation," was utilized to improve the debris source terms and is summarized below:

During refueling outage PT4-23 (fall 2006), the calcium silicate insulation on the pressurizer relief tank was removed as committed to in Attachment 1 of letter L-2006-028, dated January 27, 2006.

It is our intent to replace the existing thermal insulation on the reactor coolant pumps with reflective metallic insulation to reduce the quantity of insulation debris. This insulation replacement is scheduled for refueling outage PT4-24 (spring 2008).

A discussion of the insulation changes are summarized in the response to NRC Topic 2, General Description of and Schedule for Corrective Actions.

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Topic 3.j: Screen Modification Package

FPL Response

The design of the Turkey Point Unit 4 permanent replacement containment sump strainers is ongoing with installation scheduled for refueling outage PT4-24 (spring 2008) as committed to in our GL 2004-02 extension request of January 27, 2006 which was approved by the NRC Staff in letter dated April 13, 2006. The preliminary strainer design is discussed below. The updated information describing the installed strainer will be provided in a follow-up supplemental response according to the schedule discussed in NRC Topic 2, General Description of and Schedule for Corrective Actions.

During Turkey Point Unit 4 refueling outage PT4-23 (fall 2006), two passive strainer modules were installed to supplement the existing ECCS recirculation sump debris screens in the containment building, adding approximately 462 ft^2 of additional screen area at each of the north and south sumps. The interim strainer modules consist of a series of vertically oriented passive disk sets stacked on a horizontal axis. Piping is routed from the discharge of each strainer module to its respective sump. The installation of the interim strainer modules exceeded screen area committed to in the January 27, 2006 letter as a mitigative measure in resolving GSI-191. During the same refueling outage, debris interceptors were installed and selected calcium silicate insulation was removed from the containment.

The original Turkey Point Unit 4 sump screens and interim strainers discussed above will be completely removed and replaced with the strainer system described below during the spring 2008 refueling outage (PT4-24).

The replacement strainers will be a Performance Contracting, Inc (PCI) Sure-Flow® suction strainer assemblies design. The preliminary replacement PCI design consists of three (3) strainer module assemblies designated as A, B, and C. Each of the three (3) strainer assemblies consist of five (5) modules. Each module has thirteen (13) disks. All disks have a 48 inch width, 30 inch height, and a nominal one-half (1/2) inch thickness. Each disk is separated by a screened 1-inch gap resulting in twelve (12) gaps for each module. Each strainer assembly has a total of 1,204.6 ft^2 of strainer surface area. The strainers have the same components except for varied core tube hole patterns.

Strainer assembly A will connect directly through piping to a common plenum box over the south sump. Strainer assemblies B and C merge together and connect through an 18-inch diameter "lateral T" and piping to the same common plenum box over the south sump. The strainer system and interconnecting piping is located on the 14 foot elevation of the containment building.

The A, B, and C horizontally oriented strainer assemblies have a total strainer area of approximately 3,614 ft^2. The proposed layout of the replacement strainer system is shown in 3.j-1. A typical strainer assembly is illustrated in Figure 3.j-2. Figure 3.j-1 and 3.j-2 illustrate the preliminary design of proposed strainer layout in the containment and a strainer assembly respectively. [RAI 32] The strainer design is completely passive (i.e., they do not have any active components or rely on backflushing). In addition, there are no plans to incorporate any other active approaches.

As in the original screen design, the new distributed strainer system serves both ECCS suction intakes. The original ECCS intake design has a permanent cross-connection downstream of the containment ECCS sump inlets (outside the containment), which permits either train to draw from both ECCS sump inlets. The new strainer design provides a pathway inside the containment that is parallel to the original cross-connection. Because the original Turkey Point Unit 4 design contained this ECCS cross-connection, the new design is not a departure from the existing design basis. It is consistent with the current design basis, Technical Specifications, and regulatory commitments for Turkey Point Unit 4. The new strainer system will be sized for the full debris load and full ECCS flow from the ECCS/CSS systems (design basis flow is discussed in the response to NRC Topic 3.f, Head Loss and Vortexing. Because a single non-redundant strainer system is used, the system will be designed such that there is no credible passive failure mechanism that could render both ECCS trains inoperable. Active strainer failure mechanisms are not considered because the strainer system is completely passive. The strainer system structural design is discussed in the response to NRC Topic 3.k, Sump Structural Analysis.

The strainer assemblies are composed of individual disks formed by a perforated plate, bolted together in horizontal stacks with intermediate stiffener support plates and a core tube for the flow of water to the sumps via the interconnecting piping. The strainer perforations will be nominal 3/32-inch diameter holes. This is an enhancement from FPL's statement in the September 1, 2005 response, where the stated expectation was only that the perforation size would be less than 1/8-inch by 1/8-inch. The strainer system is being designed for retention of 100% of particles larger than 0.103 inches. The entire strainer system is designed and situated to be fully submerged at the minimum containment water level during recirculation.

The capability of the strainer system to accommodate the maximum mechanistically determined debris volume will be confirmed by a combination of testing and analysis. The volume of debris at the screen is discussed in the response to NRC Topic 3.c, Debris Characteristics. The capability to provide the required NPSH with this debris volume is discussed in the response to NRC Topic 3.g, Net Positive Suction Head (NPSH). The capability to structurally withstand the effects of the maximum debris volume is discussed in the response to NRC Topic 3.k, Sump Structural Analysis. The information required to be included in three above referenced sections is not yet available and will be provided in a follow-up supplemental response as discussed in NRC Topic 2, Generic Description of and Schedule for Corrective Actions.

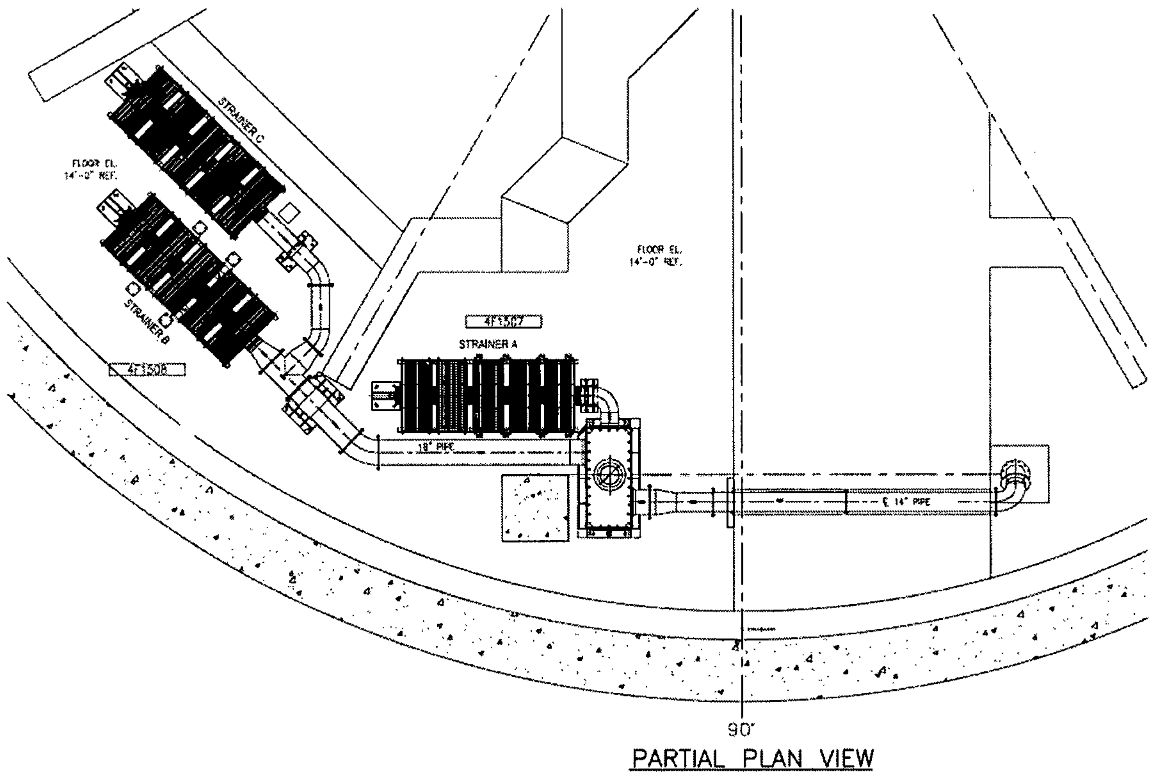
The debris interceptors were installed in five separate locations that limit debris transport from inside to the outside of the containment biowall during the previous refueling outage. Figure 3.j-3 illustrates the arrangement to the debris interceptors in the Turkey Point Unit 4 containment. The debris interceptors including anchors and fasteners are composed of stainless steel. They have a maximum height of 33.5 inches which is less than the minimum containment post-LOCA water level. The debris interceptors function by filtering debris having a size large enough to be retained by the debris interceptor screens. The roof panel increases the amount of debris retained by the debris interceptor system by limiting movement of debris over the top with the fluid. Movement of debris over the top of the debris interceptor is inhibited due to the volumes of low flow velocities and stagnation created by the roof where debris would settle out. Recirculation fluid will flow through the holes in the interceptors and over the top of the roof of the interceptors. Debris may bypass these interceptors if it is smaller than the interceptor hole size, light enough to float, or has a large enough effective flow area such that the flowing fluid can drag it over the top of the interceptor roof. Debris that bypasses the debris interceptors will be filtered by the replacement strainers. The debris interceptor function was not included in the plant design basis during the interim modification. Inclusion of the debris interceptor function into the plant design basis will be assessed in the final strainer design package.

An additional modification necessitated by the sump strainer modification will create a cylindrical core bore approximately 15½ feet long beneath the refueling cavity (also known as the fuel transfer canal) to provide a pathway for the piping that connects the strainer assemblies to the south ECCS sump suction inlet. This core bore is located between the north and south ECCS recirculation sump inlets in Figure 3.j-1. The core bore will be implemented during the spring 2008 refueling outage when the replacement strainers are scheduled to be installed.

Any additional modifications such as reroute of piping and other components, relocation of supports, addition of whip restraints, etc. of significance that may result from the final strainer design and installation will be provided in a follow-up submittal as discussed in NRC Topic 2, General Description of and Schedule for Corrective Actions.

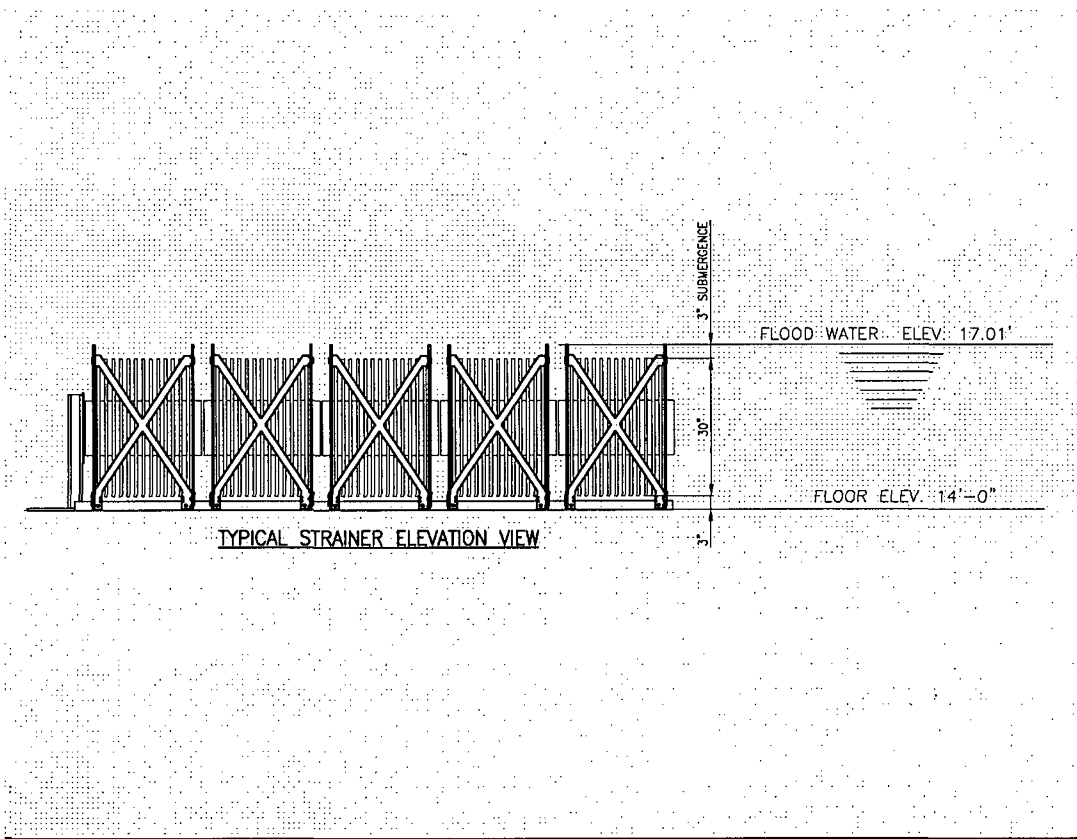
ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Figure 3.j-1: Turkey Point Unit 4 Sump Strainer System (Preliminary Design)



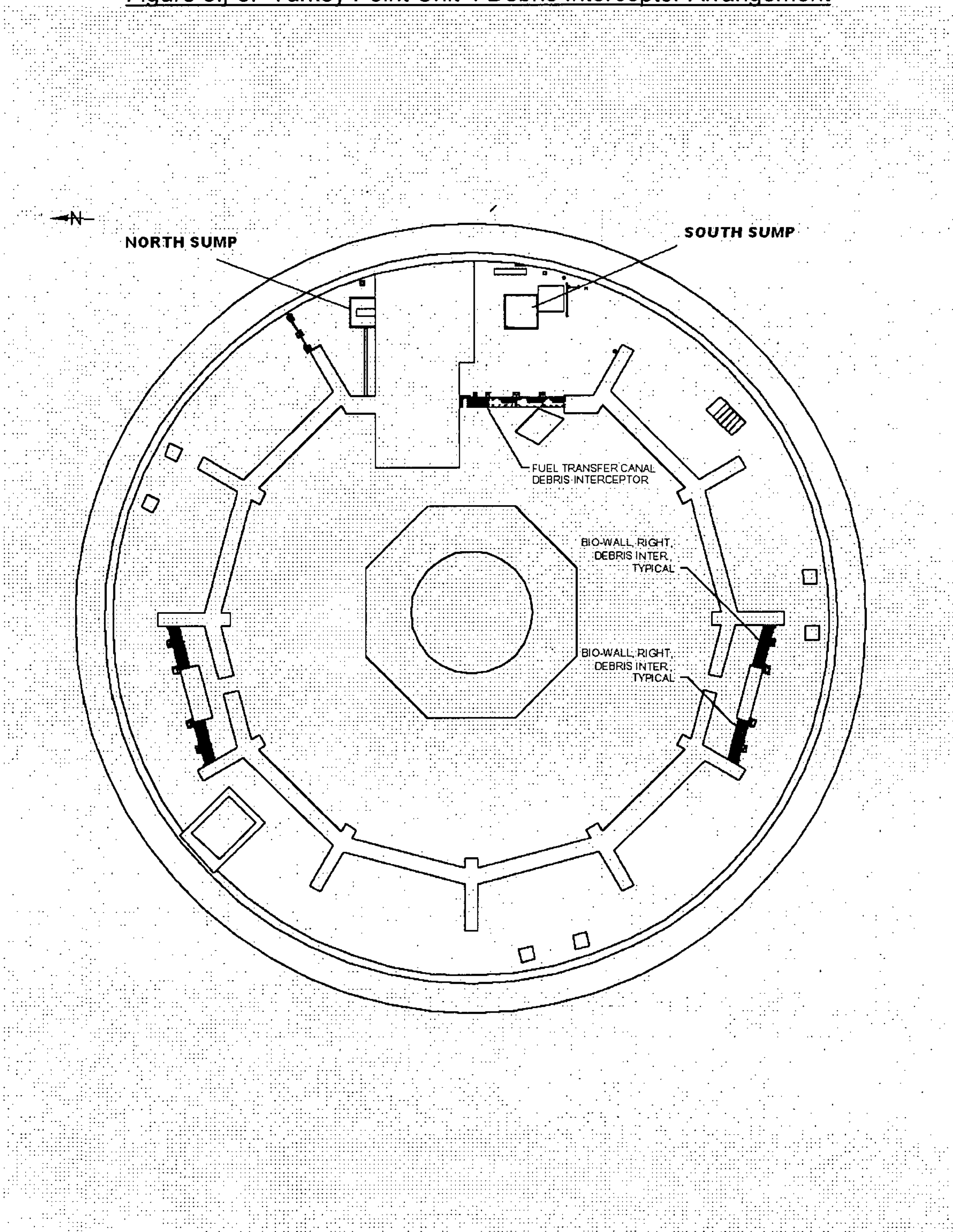
ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Figure 3.j-2: Turkey Point Unit 4 Strainer Assembly (Typical)



ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Figure 3.j-3: Turkey Point Unit 4 Debris Interceptor Arrangement



ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Topic 3.k: Sump Structural Analysis

FPL Response

As previously discussed in our response to NRC Topic 2, General Description of and Schedule for Corrective Actions, the design of the replacement sump strainers scheduled for installation during refueling outage PT4-24 (spring 2008) has not yet been finalized. Therefore, details concerning the final structural design are not available.

The replacement strainers will be designed and fabricated as Seismic Category I, Nuclear Safety-Related components. All equipment required for the sump strainer system to perform its intended safety functions will be required to meet Category I Seismic Criteria. The design will ensure that the strainers will be capable of withstanding the full force of full debris loading, in conjunction with all design basis conditions, without collapse or structural damage assuming a maximum differential pressure of 14 psid at the maximum flow rate applied across the strainer assembly. This will ensure that the strainers remain operational under all pump operating conditions. The strainer system will be designed such that pipe whip, jet impingement, and missiles generated by postulated high energy line breaks do not affect the strainer system.

The information contained in the section will be updated in a follow-up supplemental response as discussed in the FPL response to NRC Topic 2, General Description and Schedule for Corrective Action.

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Topic 3.I: Upstream Effects

FPL Response

In the September 1 response it was noted that the refueling canal drains required further evaluation to determine if they constituted potential choke points. Subsequent to the September 1 submittal, a walkdown was conducted in the Turkey Point Unit 4 containment specifically to evaluate ECCS recirculation flow paths. The walkdown utilized the guidance in Nuclear Energy Institute (NEI) Report 02-01, NEI Report 04-07 and the staff's SE of NEI 04-07.

[RAI 38] The information obtained during the walkdown confirmed that the only potential choke points are the fuel transfer canal drain covers at the bottom of the refueling canal. The drain covers are intended to prevent items from falling into the drains during refueling operations. These potential choke points will be eliminated by permanently revising plant procedures to ensure that the drain covers are removed, and verified removed, prior to entry into Mode 4 during startups. These revisions will be made prior to entry into Mode 4 during restart from PT4-24 (spring 2008 outage).

Other specific NEI and NRC concerns that were addressed in the walkdown are itemized below:

- Choke points will not be created by debris accumulating on access barriers (fences and/or gates).
- Choke points will not be created by debris accumulation in narrow hallways or passages.
- No curbs or ledges were observed within the recirculation flow paths. At the upper elevations, concrete slabs smoothly transition to grating or open space without any contiguous curbs.
- No potential chokepoints were observed at upper elevations, including floor grates, which would be expected to retain fluid from reaching the containment floor.
- The containment floor was surveyed for chokepoints formed by equipment, components and other obstructions. While some debris hold up may occur, it will not prevent water from reaching the sump strainers.

During refueling outage PT4-23 (fall 2006), subsequent to the choke point walkdown, debris interceptors were installed in the containment to limit the quantity of debris that could reach the sump strainers and screens. The debris interceptors were installed in five separate locations that limit debris transport from the inside to the outside of the biowall. The debris interceptors are designed to have an open flow channel above them, even at the minimum sump pool levels. This assures that water is not prevented from reaching the sumps and therefore, no choke points are created by installation of the debris interceptors regardless of debris accumulation.

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Topic 3.m: Downstream Effects – Components and Systems

FPL Response

The downstream effects assessments of components and systems are ongoing and are scheduled to be completed by the schedule provided to the NRC Staff in letter L-2007-155.

[RAI 31] The methodologies of Topical Report WCAP-16406-P Revision 1, "Evaluation of Downstream Sump Debris Effects in Support of GSI-191," (WCAP) is being used to evaluate the downstream effects of bypass debris (debris that passes through the strainer) on the downstream components. The WCAP provides a consistent approach to the evaluation of downstream impact of sump debris on the performance of ECCS and CSS following a loss of coolant accident.

In the September 1 response it was noted that, at that time, the downstream evaluations identified instrumentation and seventeen (17) components that required further evaluation. Subsequently, the strainer opening size has been decreased from an assumed opening of 1/8-inch by 1/8-inch (diagonal dimension of 0.177-inch) to a specified value of 3/32-inch diameter (0.09375-inch). These 17 components are being reassessed using the smaller strainer opening and the revised WCAP methodology.

The containment spray (CS) pump seals and cyclone separators are being replaced with a seal system that does not use cyclone separators or rely on CS pumped water for flushing and cooling the mechanical seals. This modification is planned to be installed during refueling outage PT4-24 (spring 2008).

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Topic 3.m: Downstream Effects – Fuel and Vessel

FPL Response
FPL is participating in the PWR Owners Group (PWROG) program to evaluate downstream effects related to in-vessel long-term cooling. The results of the PWROG program are documented in WCAP16793-NP (WCAP-16793-NP "Evaluation of Long-Term Cooling Considering Particulate, Fibrous and Chemical Debris in the Recirculating Fluid," Rev. 0, May, 2007) which was provided to the NRC Staff for review on June 4, 2007. The program was performed such that the results apply to the entire fleet of PWRs, regardless of the design (e.g., Westinghouse, CE or B&W).

The PWROG program demonstrated that the effects of fibrous debris, particulate debris, and chemical precipitation would not prevent adequate long-term core cooling flow from being established. In the cases that were evaluated, the fuel clad temperature remained below 800 °F in the recirculation mode. This is well below the acceptance criterion of 2200 °F in 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors." The specific conclusions reached by the PWROG are noted below.

- Adequate flow to remove decay heat will continue to reach the core even with debris from the sump reaching the RCS and core. Test data has demonstrated that any debris that bypasses the screen is not likely to build up an impenetrable blockage at the core inlet. While any debris that collects at the core inlet will provide some resistance to flow, in the extreme case that a large blockage does occur, numerical analyses have demonstrated that core decay heat removal will continue.

- Decay heat will continue to be removed even with debris collection at the fuel assembly spacer grids. Test data has demonstrated that any debris that bypasses the screen is small and consequently is not likely to collect at the grid locations. Further, any blockage that may form will be limited in length and not be impenetrable to flow. In the extreme case that a large blockage does occur, numerical and first principle analyses have demonstrated that core decay heat removal will continue.

- Fibrous debris, should it enter the core region, will not tightly adhere to the surface of fuel cladding. Thus, fibrous debris will not form a "blanket" on clad surfaces to restrict heat transfer and cause an increase in clad temperature. Therefore, adherence of fibrous debris to the cladding is not plausible and will not adversely affect core cooling.

WCAP 16793-NP Rev. 0 concluded that the calculations, summarized in the bullets above, for fiber debris are applicable to all PWRs, hence they are applicable to Turkey Point Unit 4.

Using an extension of the chemical effects method developed in WCAP-16530-NP to predict chemical deposition of fuel cladding, two sample calculations using large debris loadings of fiberglass and calcium silicate, respectively, were performed and are reported in WCAP-16793-NP, Rev. 0, Appendix E. The cases demonstrate that decay heat would be removed and acceptable fuel clad temperatures would be maintained. However, FPL has decided to perform a plant-specific calculation using Turkey Point Unit 4 parameters and the recommended WCAP methodology to confirm that chemical plate-out on the fuel does not result in the prediction of fuel cladding temperatures approaching the 800 °F value. It is planned that this assessment be completed by March 31, 2008 and the results reported to the NRC in a follow-up supplemental submittal as discussed in NRC Topic 2, General Description of and Schedule for Corrective Actions.

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Topic 3.n: Chemical Effects

FPL Response

The permanent replacement strainers are scheduled to be installed during refueling outage PT4-24 (spring 2008) in accordance with the GL 2004-02/GSI-191 extension requested in the letter L-2006-028 dated January 27, 2006 and approved by the NRC on April 13, 2006.

Chemical Effects testing to validate the design of the permanent strainers will begin by the end of March 2008 and be completed during the second quarter of 2008 as discussed in letter L-2007-155 dated December 7, 2007. Because the chemical effects testing (integrated debris and chemicals) has not yet been completed, the information provided in this section is preliminary and specific responses to the requests for additional information (RAIs) requested by the NRC Staff on February 8, 2006 related to sump chemistry and chemical effects are not included in this supplemental response. It is our intent to provide the NRC staff with a follow-up supplemental submittal which will address both the results of the integrated chemical effects testing and responses to the related RAIs in a schedule discussed in NRC Topic 2, General Description of and Schedule for Corrective Actions.

[RAI 15] At the time of the September 1 response, it was planned to change the buffering agent from sodium tetraborate (borax) to tri-sodium phosphate (TSP). Subsequently, in consideration of results from the industry Integrated Chemical Effects Tests (ICET), FPL notified the NRC in L-2006-028, dated January 27, 2006, that this buffer change will not be implemented.

The responses to the RAIs related to chemical affects will be provided in the follow-up supplemental response. The RAI responses to be provided later include [RAI 2] through [RAI 13].

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Topic 3.o: Licensing Basis

FPL Response

Changes to the licensing basis will be implemented in accordance with the requirements of 10CFR50.59. The Updated Final Safety Analysis Report (UFSAR) will be updated, consistent with the requirements of 10 CFR 50.71(e), to reflect the modifications and other changes made to resolve GL 2004-02/GSI-191. FPL does not anticipate that any license amendments will be requested as a result of the implementation of the GL 2004-02 modifications. However, similarly to what was done for Turkey Point Unit 3, it is anticipated that the Turkey Point Unit 4 technical specification bases and the ECCS procedures may be updated to incorporate the new strainer design basis. It is not anticipated that these changes will affect the plant licensing basis or existing UFSAR analyses. This section will be updated in a follow-up supplemental submittal as discussed in NRC Topic 2, General Description of and Schedule for Corrective Actions,

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Topic 3.p: Foreign Material Control Programs

FPL Response

Information related to programmatic controls for foreign materials was provided to the NRC in previous submittals. Such information was provided in letter L-2003-201 dated August 8, 2003 which responded to Bulletin 2003-01 and, most recently, in the September 1 response to GL 2004-02. In general, the information related to programmatic controls that was supplied in these responses remains applicable. However, since the September 1 response, assessments and walkdowns have been completed, and these are being used to inform and update the programmatic controls that will support the new sump strainer system design basis following the replacement strainer installation scheduled for spring 2008.

To maintain the required configuration of the containment recirculation function that supports the inputs and assumptions utilized to perform the mechanistic evaluation of this function, Turkey Point Unit 4 has implemented (or will implement prior to startup from refueling outage PT4-24 (spring 2008) programmatic and process controls as described below.

FPL has implemented a number of actions to enhance containment cleanliness as documented in the response to Bulletin 2003-01. Detailed containment cleanliness procedures exist for unit restart readiness and for containment entry at power. These procedures incorporate the industry guidance of Nuclear Energy Institute (NEI) 02-01, Revision 1 to minimize miscellaneous debris sources within the containment. The requirements to assure that the containment is free of loose debris and fibrous material, and that items not approved for storage in the containment are removed, are specifically addressed. Detailed containment sump inspections are performed at the end of each outage. Plant procedures also require that the Plant General Manager and the Site Vice President perform a detailed walkdown of the containment prior to entry into Mode 4 at the end of each refueling outage to ensure plant readiness.

The results of the recently completed walkdowns performed at Turkey Point Unit 3 (which is representative of Turkey Point Unit 4) to assess the quantities of latent and miscellaneous (foreign) debris are discussed in the response to NRC Topic 3.d, Latent Debris. These walkdowns were conducted without any preconditioning or pre-inspections. Consequently, the debris found during the walkdowns is characteristic of approximately 34 years of operation under the existing housekeeping programs. Given the small quantity of latent and miscellaneous debris after approximately 34 years of operation under the current housekeeping program, it is concluded that the current housekeeping program is sufficient to ensure that the new strainer system design bases will not be exceeded.

Programmatic controls of containment coatings are described in NRC Topic 3.h, Coatings Evaluation.

The process for controlling insulation and other materials inside containment was strengthened prior to December 31, 2007. This included updating engineering procedures to require; (a) a review of changes to insulation or other material inside containment that could affect the containment sump debris generation and transport analysis and/or recirculation functions and

ATTACHMENT 2
Turkey Point Unit 4
GL 2004-02 Supplemental Response

(b) a review of the effect of a design change package for its impact on containment sump debris generation and transport. In addition, the thermal insulation engineering specification which provides general guidance on insulation control was revised to require that material changes within the containment be reviewed for affect on post-accident PWR sump blockage issue (GSI-191) assumptions and evaluation. These procedural controls are sufficient to ensure that the new strainer design basis will not be exceeded. However, subsequent to these procedure and specification updates it was determined that it would be advantageous to provide additional guidance for maintaining the containment insulation configuration in the insulation engineering specification. The insulation engineering specification was enhanced to require that insulation modifications for new piping be addressed in an approved engineering document. This engineering document will evaluate the type and amount of insulation added/removed to the containment and the change/addition will be reconciled via a calculation revision to contain accurate inventory of potential debris. The revision also requires that repairs to damaged or missing insulation will be performed in accordance with the insulation engineering specification to track insulation configuration. Insulation changes that are not like-for-like will be reconciled against the containment insulation volume calculation. This additional guidance employs the insulation information that was obtained for the debris generation calculations by Turkey Point systems and design engineers via walkdown during outage PT4-20. The guidance in the insulation specification supplements the procedural guidance that was already in place.

As was done as part of the implementation of the already installed Turkey Point Unit 3 replacement strainers, the engineering design package process will ensure that procedures such as containment closeout inspection and containment recirculation sump strainer inspection are reviewed and updated (or replaced) as necessary based on the requirements of the final strainer design.

END OF ATTACHMENT 2

ATTACHMENT 3
Turkey Point Unit 3
GL 2004-02 Supplemental Response

Summary of Turkey Point Unit 3 Commitments

Description of Commitment	Due Date	Origin of Commitment
Complete In-vessel and ex-vessel downstream effects evaluations	March 31, 2008	FPL letter L-2007-155 dated 12/7/07 and L-2007-194 dated 12/20/07. Accepted by NRC in letter dated 12/28/07
Complete chemical effects testing, analysis and documentation	June 30, 2008	FPL letter L-2007-155 dated 12/7/07 and L-2007-194 dated 12/20/07. Accepted by NRC in letter dated 12/28/07
Submit an updated supplemental response to NRC	June 30, 2008	FPL letter L-2007-194 dated 12/20/07. Accepted by NRC in letter dated 12/28/07.
Inform the NRC either in supplemental GL 2004-02 response to NRC or by separate correspondence when all GSI-191 actions are complete	Upon GSI-191 actions completion	NRC letter from C.T. Haney to Holders of Operating Licenses for PWRs dated 1/4/2007

ATTACHMENT 3
Turkey Point Unit 4
GL 2004-02 Supplemental Response

Summary of Turkey Point Unit 4 Commitments

Description of Commitment	Due Date	Origin of Commitment
Compliance with the Regulatory requirements of GL 2004-02 including corrective actions that may emerge after September 1, 2005.	Startup from Refueling Outage PTN4-24 (Spring 2008)	FPL letter L-2006-028, dated January 27, 2006. As approved by NRC in letter dated April 13, 2006
New Sump Strainers installed prior to Unit 4 startup from refueling outage PTN4-23 (fall-2007)	Startup from Refueling Outage PTN4-24 (Spring 2008)	FPL letter L-2006-028, dated January 27, 2006. As approved by NRC in letter dated April 13, 2006
Fully disposition the potential chokepoint in the refueling canal drains prior to Unit 4 startup form refueling outage PT4-23	Startup from Refueling Outage PTN4-24 (Spring 2008) prior to Mode 4 entry	FPL letter L-2006-028, dated January 27, 2006. As approved by NRC in letter dated April 13, 2006
Completion schedule to extend the completion of the corrective actions required by Generic Letter 2004-02 until Spring 2008 outage	Startup from Refueling Outage PTN4-24 (Spring 2008)	FPL letter L-2006-028, dated January 27, 2006. As approved by NRC in letter dated April 13, 2006
Commitment to submit an updated supplemental response	Within 3 months following the Spring 2008 Outage	FPL letter L-2007-155 dated December 7, 2007, accepted by NRC in letter dated December 28, 2007.
Inform the NRC either in supplemental GL 2004-02 response to NRC or by separate correspondence when all GSI-191 actions are complete	Upon GSI-191 actions completion	NRC letter from C.T. Haney to Holders of Operating Licenses for PWRs dated 1/4/2007