Attachment 3-4

UFSAR Markups (Information Only)

STPEGS UFSAR Page Markups

The changes to the South Texas Project Electric Generating Station (STPEGS) Updated Final Safety Analysis Report (UFSAR) are provided for the staff's information to support the review of the STP licensing application.

3.1.2.4.6.1 Evaluation Against Criterion 35 – The ECCS is provided to cope with any LOCA in the plant design basis. Abundant cooling water is available in an emergency to transfer heat from the core at a rate sufficient to maintain the core in a coolable geometry and to assure that clad metal/water reaction is limited to less than 1 percent. Adequate design provisions are made to assure performance of the required safety functions. ~~even with a single failure~~.

An exemption to GDC 35 has been approved to allow application of the risk-informed analysis instead of the deterministic methods required by GDC 35. The exemption applies to the scope of breaks that generate and transport debris not bounded by STP plant-specific deterministic testing. Details of the conditions for the exemption are included in Appendix 6A.

Details of the capability of the systems are included in Section 6.3. An evaluation of the adequacy of the system functions is included in Chapter 15. Performance evaluations have been conducted in accordance with 10CFR50.46 and 10CFR50 Appendix K.

3.1.2.4.9.1 Evaluation Against Criterion 38 – The CHRS consists of the CSS, the Reactor Containment Fan Cooler (RCFC) Subsystem and the residual heat removal (RHR) heat exchangers. The CHRS acts in conjunction with the Safety Injection System to remove heat from the Containment. The CHRS is designed to accomplish the following functions in the unlikely event of a LOCA: to rapidly condense the steam within the Containment in order to prevent over pressurization during blowdown of the RCS; and to provide long-term continuous heat removal from the Containment.

Initially, the CSS and the high-and low-head safety injection (HHSI and LHSI) pumps take suction from the refueling water storage tank (RWST). During the recirculation phase, the CSS and the HHSI and LHSI pumps take suction from the Containment emergency sumps. The CHRS is divided into three trains. Each train is sized to remove 50 percent of the system design heat load at the start of recirculation. Each train of the CHRS is supplied power from a separate independent Class 1E bus. The redundancy and capability of the Offsite and Emergency Power Systems are presented in the evaluation against Criterion 17. Redundant system trains and emergency diesel power supplies provide assurance that system safety functions can be accomplished.

An exemption to GDC 38 has been approved to allow application of a risk-informed analysis instead of the deterministic methods required by GDC 38, to address the effects of debris. The exemption applies to the scope of breaks that generate and transport debris not bounded by STP plant-specific deterministic testing. Details of the conditions for the exemption are included in Appendix 6A.

For further discussion, see the following sections of the UFSAR:

Residual Heat Removal System	5.4.7
Design for Debris Effects	App. 6A
Containment Systems	6.2
Engineered Safety Features Actuation System	7.3
Onsite Power System	8.3
Accident Analysis	15.0

3.1.2.4.12.1 Evaluation Against Criterion 41 – The CSS is provided to reduce the concentration and quantity of fission products in the Containment atmosphere following a LOCA. Per 10CFR50.44, hydrogen recombiners are no longer required for design basis accidents.

The equilibrium sump pH is maintained by trisodium phosphate (TSP) contained in baskets on the containment floor. The initial CSS water and spilled RCS water dissolves the TSP into the containment sump allowing recirculation of the alkaline fluid. Each unit is equipped with three 50-percent spray trains taking suction from the Containment sump. Each Containment spray train is supplied power from a separate bus. Each bus is connected to both the Offsite and the Standby Power Supply Systems. This assures that for Onsite or for Offsite Electrical Power System failure, their safety function can be accomplished~~, assuming a single failure~~.

An exemption to GDC 41 has been approved to allow application of a risk-informed analysis instead of the deterministic methods required by GDC 41, to address the effects of debris on the CSS function. The exemption applies to the scope of breaks that generate and transport debris not bounded by STP plant-specific deterministic testing. Details of the conditions for the exemption are included in Appendix 6A.

Post-accident combustible gas control is assured by the use of the Supplementary Containment Purge Subsystem.

For further discussion, see the following sections of the UFSAR:

Containment Systems	6.2
Containment Spray System – Iodine Removal	6.5.2
Design for Debris Effects	App. 6A
Containment Hydrogen Sampling System	7.6.5
Containment HVAC System	9.4.5

TABLE 3.12-1
REGULATORY GUIDE MATRIX

ABBREVIATIONS:

A Conform to guide

No.	Regulatory Guide Title	UFSAR Reference	Revision Status On STPEGS	STPEGS Position
1.82	Sumps for Emergency Core Cooling and Containment Spray Systems	6.2.2.1.2 6.2.2.2.3 6.3.4.1	Proposed Rev 1 (5/83)	A See Note 103

NOTES

103 NRC Generic Letter 2004-02 (GL 04-02) "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors," required licensees to evaluate the ECCS and CSS recirculation functions based on the potential susceptibility of sump screens to debris blockage during design basis accidents. Refer to Section 6.2.2.1.2.

6.2.2.1.2 Containment Emergency Sump Design Bases:

The Containment emergency sump meets the following design bases:

1. Sufficient capacity and redundancy to satisfy the single-failure criteria. To achieve this, each CSS/ECCS train draws water from a separate Containment emergency sump.

2. Capable of satisfying the flow and net positive suction head (NPSH) requirements of the ECCS and the CSS under the most adverse combination of credible occurrences. This includes minimizing the possibility of vortexing in the sump.

3. Minimizes entry of high-density particles (specific gravity of 1.05 or more) or floating debris into the sump and recirculating lines.

4. Sumps are designed in accordance with RG 1.82, proposed revision 1, May 1983 with consideration of the debris effects addressed by Generic Letter 2004-02, as described in ~~NOC-AE-08002372~~ Appendix 6A.

6.2.2.2.3 Containment Emergency Sump Description:

At the beginning of the recirculation phase, the minimum water level above the Containment floor is adequate to provide the required NPSH for the ECCS and CSS pumps. The sumps are designed to RG 1.82, proposed revision 1, May 1983 and with consideration of the debris effects identified in Generic Letter 2004-02, as described in ~~NOC-AE-08002372~~ Appendix 6A. The sump structures are designed to limit approach flow velocities to less than 0.009 ft/sec permitting high-density particles to settle out on the floor and minimize the possibility of clogging the strainers. The risk-informed methodology applied to evaluate the risk associated with effects of debris shows that the increase in risk associated with debris that would exceed the design limits of the sump structures is very small, in accordance with the acceptance criteria of Regulatory Guide 1.174.

6.3 EMERGENCY CORE COOLING SYSTEM

6.3.1 Design Basis

Insert:

The Licensing Basis for ECCS with regard to effects of debris on emergency sump strainers to the extent that the strainers support the ECCS element of the core cooling function, is a risk-informed analysis that shows there is a high probability that ECCS can perform its design basis functions based on plant-specific prototypical testing using deterministic assumptions that provide safety margin and defense-in-depth and that the risk from breaks that could generate debris that is not bounded by the testing is very small and acceptable in accordance with the criteria of RG 1.174.

The STP Risk over Deterministic (RoverD) methodology was used to evaluate the effects of debris. RoverD relegates break sizes that generate and transport debris that is not bounded by deterministic testing to failure (core damage). It then applies the NUREG 1829 pipe break frequency for the smallest unbounded breaks to determine the increase in core damage frequency. The increase is compared to the criteria in RG 1.174. The analysis shows that the risk from the unbounded breaks is very small, as defined by RG 1.174. An exemption to GDC 35 has been approved to allow application of the risk-informed analysis instead of the deterministic methods required by GDC 35. The exemption applies to the scope of breaks that generate and transport debris not bounded by the deterministic testing.

Details of the design basis for the effects of debris on the function of the emergency sump strainers is provided in UFSAR Appendix 6A.

Insert for UFSAR Ch. 15 after Section 15.6.5.4

15.6.5.5 Risk-Informed Assessment of Debris on ECCS Sump Strainers

The Licensing Basis assessment for ECCS and containment heat removal with regard to effects of debris on emergency sump strainers as described in GL2004-02, is a risk informed analysis that is described in more detail in Appendix 6A. The analysis examines the effects of debris on the strainers that support the CSS and ECCS core cooling and containment heat removal functions. The analysis shows that there is a high probability that the CSS and ECCS can perform their design basis functions based on plant-specific prototypical testing using deterministic assumptions that provide safety margin and defense-in-depth. The analysis also shows that the risk from breaks that could generate debris that is not bounded by the testing is very small and acceptable in accordance with the criteria of RG 1.174.

The STP Risk over Deterministic (RoverD) methodology described in Appendix 6A was used to evaluate the effects of debris. RoverD relegates break sizes that generate and transport debris that is not bounded by plant-specific deterministic testing to failure (core damage). It then applies the NUREG 1829 pipe break frequency for the smallest unbounded breaks to determine the increase in core damage frequency. The increase is compared to the criteria in RG 1.174 and is very small, as defined by RG 1.174. Exemptions to 10CFR50.46(d), GDC 35, GDC 38 and GDC 41 have been approved to allow application of the risk-informed analysis instead of the deterministic methods required by GDCs. The exemptions apply to the scope of breaks that generate and transport debris not bounded by the plant-specific deterministic testing.

As part of the RoverD methodology, STPNOC performed a thermal-hydraulic screening analysis that shows there are no down-stream (e.g., in-core) debris effects on core cooling that result in core damage from a break not bounded by the plant-specific testing. In accordance with accepted practice for assessment of debris effects on long-term cooling, the analysis applied 800°F as the success criteria for PCT. The results of this analysis support the risk-informed methodology by showing that the risk from debris can be quantified by evaluation of debris effects at the strainer.

The risk-informed analysis does not replace the ECCS evaluation methodology in the preceding UFSAR Ch. 15.6 sections, which applies only through the LOCA reflood phase. The Chapter 15.6 ECCS evaluation methodology is not used for the assessment of long-term cooling required by the risk-informed assessment of debris effects.

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TABLE 6.3-1

EMERGENCY CORE COOLING SYSTEM
COMPONENT PARAMETERS

High Head Safety Injection Pumps

Number	3
Design pressure, psig	1,750
Design temperature, °F	300
Design flow rate*, gal/min	800
Design head, ft	2,850
Max. flow rate, gal/min	1,600
Head at max. flow rate, ft	1,000
Differential head at shutoff, ft (max)	3,700
Motor rating, hp	1,000
Required NPSH at max. flow rate, ft (max)	1.1
Available NPSH, ft (From RWST)	41.1
(From RCB Emergency Sump)	7.4
NPSH Margin, ft	6.3
TSHL, ft	3.8

Low Head Safety Injection Pumps

Number	3
Design pressure, psig	495
Design temperature, °F	300
Design flow rate, gal/min	1,900
Design head, ft	560
Max. flow rate, gal/min	2,900
Head at max. flow rate, ft	400
Differential head at shutoff, ft	700
Motor rating, hp	400
Required NPSH, ft (max)	1.5
Available NPSH, ft (From RWST)	40.8
(From RCB Emergency Sump)	7.5
NPSH Margin, ft	6.0
TSHL, ft	3.8

* Includes miniflow

NOTE:

The Available NPSH from RCB excludes the Total Strainer Head Loss.
Total Strainer Head Loss = debris head loss plus clean strainer head loss
NPSH Margin = Available NPSH - Required NPSH
NPSH values from RCB are at the start of recirculation (267°F)
NPSH values are based upon a reference elevation of the center line of the pump suction nozzle rather than the first stage impeller.

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TABLE 6.2.2-4

CSS PUMP NPSH PARAMETERS

Required NPSH at Max Flow Rate, ft (max)	1.4
Available NPSH, ft (from RWST)	41.4
(From RCB Emergency Sump)	7.2

NPSH Margin, ft	5.8
TSHL, ft	3.8

NOTE:

The Available NPSH from RCB excludes the Total Strainer Head Loss.

Total Strainer Head Loss = debris head loss plus clean strainer head loss

NPSH Margin = Available NPSH - Required NPSH

NPSH values from RCB are at the start of recirculation (267°F)

NPSH values are based upon a reference elevation of the center line of the pump suction nozzle rather than the first stage impeller.

NOTE: UFSAR change for Appendix 6A shown below consists entirely of new content, therefore gray highlight is not used.

APPENDIX 6A

Resolution of NRC Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors," Including Application of a Risk-Informed Approach to Potential Impact Of Debris Blockage on Emergency Recirculation During Design Basis Accidents

1.0 Introduction and Summary

NRC Generic Letter 2004-02 (GL 2004-02) required licensees to perform an evaluation of the ECCS and CSS recirculation functions, and the flowpaths necessary to support those functions, based on the potential susceptibility of sump screens to debris blockage during design basis accidents requiring recirculation operation of ECCS or CSS. This Generic Letter resulted from the Generic Safety Issue (GSI) 191, "Assessment of Debris Accumulation on Pressurized-Water Reactor Sump Performance." As a result of the evaluation required by GL 2004-02 and to ensure system function, sump design modifications were implemented (refer to Section 6.2.2.2.3).

The plant licensing basis considers long-term core cooling following a LOCA as identified in 10CFR50.46. Long-term cooling is supported by the ECCS, which includes the Containment Spray (CS), the High Head Safety Injection (HHSI), the Low Head Safety Injection (LHSI), and the Residual Heat Removal (RHR) systems. Of these systems, only the CS, HHSI and LHSI are subject to the effects of LOCA debris because they rely on the containment emergency sumps in the recirculation mode. Debris from non-LOCA events (steam line breaks) is not in the scope of the GL 2004-02 evaluation because those events do not result in ECCS or CS operation in the recirculation mode where debris would become a factor.

GL 2004-02 sump performance evaluation activities included the following:

- Containment walkdowns to identify and quantify sources of debris
- Debris generation and transport analysis
- Calculation of required and available net positive suction head (NPSH) for Emergency Core Cooling and Containment Spray pumps
- ECCS Sump Strainer requirements
- ECCS Sump Strainer structural analyses
- Operations procedures
- Debris effects downstream of the strainers and sumps, including effect on core flow
- Debris effects upstream of the strainers and sumps
- Chemical effects associated with debris
- Plant-specific testing
- Risk-informed evaluation of debris effects not bounded by plant-specific testing

The deterministic evaluation supplemented by a risk-informed evaluation was performed to respond to GL 2004-02. The evaluation provides confidence that the sump design supports long-term core cooling following a design basis loss of coolant accident. The evaluation meets the acceptance guidelines for a very small change as defined in Regulatory Guide 1.174.

The Licensing Basis with regard to effects of debris is that there is a high probability that ECCS and CSS can perform their design basis functions based on successful plant-specific prototypical testing using deterministic NRC-approved assumptions, and that the risk from breaks that could generate debris that is not bounded by the testing is very small and acceptable in accordance with the criteria of RG 1.174.

The use of a risk-informed method, rather than the deterministic methods prescribed in the regulations required exemptions to 10CFR50.46(d), GDC 35, GDC 38, and GDC 41, which have been granted pursuant to 10CFR50.12.

The detailed description of the STP GL 2004-02 closure evaluation is provided in the sections below.

1.1 Deterministic Element

The deterministic element applies STP plant-specific testing performed using accepted guidance to establish an analyzed amount of LOCA debris.

The containment condition assessments included the identification of miscellaneous solid objects such as labels and tags. Qualified tags attached with stainless steel wires were found for much of the equipment. Unqualified items were identified and removed. The total surface area for any remaining debris of this type was determined to be much less than 100 ft^2. Therefore, as suggested by NEI 04-07 Volume 2 [4], this miscellaneous solid object debris source is bounded by the 100 ft^2 that was used in the original STP debris generation and transport analyses that supported the July 2008 strainer head loss test. STP has identified tags and labels which are qualified and which have been shown to not transport to the emergency sump strainers (acceptable labels).

Debris Amounts Used for the Test

The debris amounts that were scaled for the July 2008 test are given in the table below. These values represent the debris amount that gets to the strainers of two operating Trains of strainers (40 modules total).

DEBRIS AMOUNTS FOR JULY 2008 TEST		
Debris Item	**Debris Item**	**Test Surrogate Material**
Fibers		
LDFG / Nukon (30% Fines)	26.91 ft^3	HT Nukon
LDFG / Thermal Wrap (30% Fines)	41.01 ft^3	Knauf ET
LDFG / Nukon Smalls with Fines removed	62.79 ft^3	Nukon
LDFG / Thermal Wrap Smalls with Fines removed	95.69 ft^3	Knauf ET
LDFG / Nukon Larges treat as Fines (erosion)	0.63 ft^3	HT Nukon
LDFG / Thermal Wrap Larges treat as Fines (erosion)	0.96 ft^3	Knauf ET
Latent Fibers - Fines	10.4 ft^3	HT Nukon
Total Fines	79.91 ft^3 191.78 lbm	
Total Smalls	158.48 ft^3 380.35 lbm	
Particulates		
Microtherm	33 lbm	Microtherm powder
Marinite Board	182.7 lbm	Powdered Marinite board *Note: Marinite has since been removed from containment*
Latent particulate, dust, dirt	141.1 lbm	Dirt mix
Total	356.8 lbm	
Coatings		
Zinc	1,368 lbm	Tin Powder
Epoxy (ZOI)	57 lbm	Powder (Acrylic coating)
Polyamide primer	10 lbm	Powder (Acrylic coating)
Alkyds	247 lbm	Powder (Acrylic coating)
Baked enamel	268 lbm	Powder (Acrylic coating)
Epoxy (outside ZOI)	106 lbm	Chips (Acrylic 1/64" to 1/4")
Total powder	1,950 lbm	
Total chips	106 lbm	
Chemical Precipitates		
Sodium Aluminum Silicate	1,432 lbm	WCAP AlOOH
Aluminum Oxyhydroxide	143 lbm	WCAP AlOOH
Calcium Phosphate	359 lbm	WCAP $Ca_3(PO_4)_2$

Marinite (a problematic debris type) was utilized for the July 2008 strainer head loss test. However, note that after the July 2008 testing all Marinite was removed from the STP containment so this debris amount acts as an added margin source term in the STP RoverD evaluation.

The full 30-day chemical precipitate load is assumed to arrive at the strainer at the earliest possible time with no credit for settling or nucleation on containment surfaces. The quantity of precipitate arriving at the strainer surface is expected to be significantly lower than the calculated amounts. In addition, the precipitate is expected to arrive gradually and resultant head loss would be compensated by increased head loss margins.

The sump temperature is from the containment LOCA pressure-temperature analysis which maximizes the sump temperature by using the maximum temperatures for cooling water to the heat exchangers and for the water of the ultimate heat sink and uses very conservative mass and energy release rates from the reactor.

The containment water level was determined using conservative input values for the pool contributions and conservatively accounting for items such as holdup in locations in the containment, filling of empty pipe, water in transit, steam holdup, etc. The minimum sump water level used for the NPSH evaluation was 38 in. which is conservative compared to the maximum calculated water level of 79 in.

Higher-than-expected flow rates are conservatively used for the NPSH evaluation and during strainer head loss testing. Flow rates for the expected LOCA condition would generally be lower than as-tested flow rates and operator actions to further reduce flow would be expected following indications of significant strainer head loss.

For the NPSH evaluation, all of the debris is assumed to be formed into a debris bed on the strainer at the start of recirculation. The debris consists of all of the insulation fiber fines, all of the coating particulates, and all of the chemical precipitates.

The clean strainer head loss calculation utilized classical standard hydraulic head loss equations based on Crane Technical Paper 410 for pipe and fittings that were used to determine the total head loss contributions of the strainer attached pipe and fittings. The individual head loss results from the strainer and the pipe fittings were added together to obtain the head loss for the entire strainer assembly configuration. An increase of 10% for connecting pipe and fitting head loss calculations was adequate to address any non-conservatism inherent in the use of standard head loss correlations. An increase correction of 6% of the clean strainer head loss was used to account for uncertainty.

Containment accident pressure is not credited for available NPSH. For a sump temperature of 212°F and higher, the NPSH available considered that the containment pressure was equal to the vapor pressure. For sump temperatures lower than 212°F, the containment pressure was taken as 14.7 psia.

The STP strainer was structurally qualified for the maximum debris loading for two temperature cases:

Case 1 267°F (start of recirculation) for differential pressure of 2.47 psi (5.71 ft)
Case 2 128°F (30 days post-LOCA) for differential pressure of 4.0 psi (9.35 ft)

The debris loading is the same for both cases.

The strainer is conservatively relegated to failure in the RoverD approach when the structural qualification limit as determined from the Code allowable stress value is exceeded.

The chemical effects testing that has been conducted has shown that chemical precipitation does not tend to occur in solution in the STP post-LOCA environment. In cases where precipitation does occur, the current test results suggest that the precipitates that actually form in solution have different morphology from the surrogate precipitates and are likely to have less impact on total head loss.

Realistic analysis of the LOCA response show that the postulated scenarios for core blockage are not expected. Thermal-hydraulic engineering evaluations of core flow blockage scenarios were conducted to understand safety margin in these scenarios. In these evaluations, assessments of extreme conditions of core blockage are included. In these analyses, it was shown that with complete blockage of the core inlet and all bypass paths, only medium and large break cold leg LOCA would result in core damage. In addition, detailed modeling of the core and reactor vessel showed that only one fuel assembly flow passage needs to remain clear to prevent fuel overheating. The analyses included locating the open fuel assembly either at the core center or at an extreme periphery location. Multi-dimensional vessel and core simulations at the time of recirculation show that the core inflow is highly asymmetric indicating that it would be likely that several fuel assemblies would not be blocked by debris that might penetrate the ECCS sump screens.

1.2 Risk Informed Element – RoverD Summary

The approach used to close GL 2004-02 includes a deterministic element and a risk-informed element (risk over deterministic, or RoverD). The effects of debris that is bounded by the plant-specific testing are deterministically mitigated in accordance with NRC-accepted methodology for resolution of GL 2004-02. Section 1.1 above describes the deterministic evaluation.

The risk-informed element then identifies LOCA break sizes may produce more than the deterministically tested amount of fine fiber debris. Breaks that may generate and transport fine fiber debris in excess of the tested amount are conservatively assumed to go to core damage. The break frequency for the smallest break size (i.e., highest frequency) that can generate and transport an amount of fine fiber debris that exceeds the amount that was tested establishes the upper limit for the ΔCDF in the risk-informed evaluation. The geometric mean pipe break frequency from NUREG 1829 is used to evaluate the ΔCDF.

The risk-informed element also evaluates the in-vessel effects to confirm that there are no failures from in-vessel effects for the scope of LOCAs that are satisfactorily addressed in the deterministic element.

1.2.1 RoverD risk quantification process summary

RoverD involves the following steps to assess the risk associated with the effects of LOCA debris:

1. Perform a plant-specific test that has some margin to failure following accepted protocols (deterministic element of RoverD)

   - Note the amount of fine tested (191.78 lbm) as well as the configuration (two ECCS trains). The plant configuration is important to ensure whether the test bounds other plant states. Fine fiber is used because it is the transportable form of the low-density fiberglass (LDFG) debris created in the break scenario
   - Note that the test results must be applied to strainer performance criteria to ensure they are met using deterministic analysis requirements (e.g., vortexing, structural margin, flashing, etc.)

2. In-vessel performance criteria (core cooling, including fiber effects, boric acid precipitation) must be met under the conditions tested

   - A thermal-hydraulic analysis is performed for hot leg breaks to evaluate peak clad temperature with the core and core bypass completely blocked at the time ECCS recirculation is initiated.
   - For cold leg breaks, a mass balance is performed to assure that debris accumulation in the core is less than 15g/fuel assembly for all deterministic scenarios.
   - For boric acid precipitation, the evaluation shows that hot leg switchover timing is appropriate with debris effects considered.

3. Itemize all break locations, break sizes, and amount of LDFG fines in the sump (including erosion and latent fiber)

4. Compare the amount of fiber fines in each break scenario to the tested amount

   - If the amount is equal to or less than the tested amount, categorize the scenario 'deterministic'.
   - If the amount exceeds the tested amount, categorize the scenario 'risk- informed'

5. Evaluate the risk contribution (including in-vessel) of scenarios in the risk-informed category against the Regulatory Guide 1.174 quantitative criteria for {CDF, ΔCDF}, {LERF, ΔLERF}

   - Assign change in core damage frequency to the geometric mean frequency from NUREG 1829 for the smallest size break that can generate and transport fine fiber debris in excess of what was tested.

- Check {CDF,ΔCDF} against the quantitative requirement of Regulatory Guide 1.174, Region III
- Check {LERF,ΔLERF} against the quantitative requirement of Regulatory Guide 1.174, Region III
- Verify other requirements (for example, safety margin, defense in depth) of Regulatory Guide 1.174 are met

6. If all requirements are met for the risk-informed category, the performance is acceptable

1.2.2 Reactor containment building debris generation and transport

Debris Generation

A break size and location define a scenario from which is derived the amount of fiber fines that arrive in the ECCS sumps. Locations of plant equipment and structures and potential target fiber insulation are identified from a CAD model. A 17D ZOI at each RCS weld location is used to quantify the amount of fine fiber generated. Each scenario specific break is numerically represented by either a spherical ZOI for double-ended guillotine breaks or by a hemispherical ZOI for partial breaks. The computer evaluation varied the orientation of the break location around the circumference of the weld locations to assure that the maximum debris generation was attained. Credit was taken for shielding by concrete walls.

Debris Transport

A transport logic tree is used to quantify the amount of fiber transported to the containment pool. The transport fractions are representative of a break in the Steam Generator compartment, which bound transport fractions that would represent other possible break locations in the RCB.

In addition to the fiber fines from the ZOI, fines are also created from erosion of large and small pieces of insulation not otherwise destroyed in the ZOI. Finally, a fraction of latent debris is assumed to be fine fiber and it is also transported to the containment pool with the eroded fiber fines.

Fiber collection in the ECCS for assessment of in-vessel effects

For cold-leg breaks, a mass balance is performed for the LDFG that includes the ECCS and CSS flow to the RCS, the pool, and the strainer. The core is modeled as the final "sink" for the LDFG mass. If the mass is less than 15 grams of fiber fines per fuel assembly, the evaluation is considered to be a success. STP's evaluation of both the deterministic and risk-informed scope of breaks identified no cold-leg breaks that resulted in more than 15g/fuel assembly.

1.2.3 LOCA frequencies and results

Determination of Core Damage Frequency

Forty-five weld locations were identified on the pressurizer surge line and RCS main loop piping where a sufficient amount of fiber debris can be generated and transported to the sump to exceed

the amount of fine fiber debris in the STP plant-specific testing described in Section 1.1. To provide break size perspective, that scope is generally described as breaks larger than approximately 12.8" ID in those locations. The frequency evaluation includes a beyond design basis case for single train operation.

Weld locations in the risk-informed category

No.	Location
1	16-RC-1412-NSS-8
2	29-RC-1101-NSS-RSG-1A-IN-SE
3	29-RC-1101-NSS-5.1
4	29-RC-1201-NSS-5.1
5	29-RC-1201-RSG-1B-IN-SE
6	29-RC-1301-RSG-1C-IN-SE
7	29-RC-1301-NSS-5.1
8	29-RC-1401-NSS-RSG-1D-IN-SE
9	29-RC-1401-NSS-4.1
10	29-RC-1101-NSS-4
11	29-RC-1301-NSS-4
12	29-RC-1201-NSS-4
13	29-RC-1401-NSS-3
14	31-RC-1102-NSS-2
15	31-RC-1202-NSS-RSG-1B-ON-SE
16	31-RC-1102-NSS-RSG-1A-ON-SE
17	31-RC-1202-NSS-2
18	31-RC-1202-NSS-3
19	31-RC-1302-NSS-2
20	31-RC-1202-NSS-1.1
21	31-RC-1102-NSS-3
22	31-RC-1302-NSS-1.1
23	31-RC-1302-NSS-RSG-1C-ON-SE
24	31-RC-1202-NSS-4
25	31-RC-1302-NSS-3
26	31-RC-1102-NSS-1.1
27	31-RC-1402-NSS-RSG-1D-ON-SE
28	31-RC-1102-NSS-4
29	31-RC-1402-NSS-1.1
30	31-RC-1402-NSS-2
31	31-RC-1302-NSS-4
32	31-RC-1402-NSS-3
33	31-RC-1202-NSS-8
34	27.5-RC-1103-NSS-1

No.	Location
35	31-RC-1102-NSS-8
36	27.5-RC-1203-NSS-1
37	31-RC-1402-NSS-4
38	31-RC-1302-NSS-8
39	27.5-RC-1303-NSS-1
40	31-RC-1202-NSS-9
41	31-RC-1102-NSS-9
42	27.5-RC-1403-NSS-1
43	31-RC-1402-NSS-8
44	31-RC-1302-NSS-9
45	31-RC-1402-NSS-9

A continuum break model is used that evaluates the frequency using the geometric mean aggregation of NUREG 1829 elicited values gives a ΔCDF frequency less than 1.0E-06/yr. The corresponding ΔLERF is less than 1.0E-07/yr.

The risk-informed evaluation meets the RG 1.174 guidance with respect to defense in depth in that the following aspects of the facility design and operation are unaffected:

- Functional requirements and the design configuration of systems
- Existing plant barriers to the release of fission products
- Design provisions for redundancy, diversity, and independence
- Plant's response to transients or other initiating events
- Preventive and mitigative capabilities of plant design features

The Emergency Operating Procedure (EOP) framework has guidance for monitoring for the loss of emergency sump recirculation capabilities and actions to be taken if this condition occurs. Actions are summarized below:

(1) Reducing flow through the strainer(s) by stopping pumps,
(2) Monitoring for proper pump operation, core exit thermocouples, and reactor water level indication,
(3) Refilling the RWST for injection flow,
(4) Using injection flow from alternate sources, and
(5) Transferring to combined hot leg/cold leg injection flow paths.

The evaluation demonstrates sufficient safety margin, as summarized below.

- The testing accounted for 440 lbm of Marinite insulation that was subsequently removed from containment and provides margin for evaluation of fiber or particulate debris
- Large bore piping PWSCC susceptible welds (nozzle welds) have been replaced or otherwise mitigated with the exception of the Reactor Vessel nozzle welds.

- The debris generation analysis does not take credit for shielding within the ZOI by equipment (e.g. steam generators, reactor coolant pumps) and large piping.
- Instantaneous failure of 100% of the unqualified coatings inside containment as particulates is a very conservative assumption.
- Chemical effects were conservatively tested although no chemical effects were observed in other plant specific testing.
  - The full 30-day chemical precipitate load is assumed to arrive at the strainer at the earliest possible time with no credit for settling or nucleation on containment surfaces. The effect of the precipitate is reduced at the realistic arrival time because of the lower decay heat load and containment pool temperature.
  - Based on other plant-specific testing, the quantity of precipitate arriving at the strainer surface is expected to be significantly lower than the calculated amounts.
  - The precipitate is expected to arrive gradually and resultant head loss would be compensated by increased head loss margins.
- The available NPSH is conservatively determined.
  - The sump temperature is maximized from the containment LOCA pressure-temperature analysis
  - The containment pool water level assumption is conservatively low
  - No credit is given for containment accident pressure

Thermal-hydraulic evaluations show that there is safety margin to in-vessel debris effects. Adequate cooling with in-vessel effects is established by conservative sensitivity studies of small, medium, and large breaks in the cold leg and hot leg following recirculation initiation. These cases assumed that not only is the core completely blocked, but the bypass is also completely blocked, even though there are no major blockage opportunities in the core bypass region. Even when medium and large cold leg break scenarios are investigated with open bypass (conservatively ignoring the LOCA holes in the baffle walls), such cases go to success.

1.4 Exemptions to Regulations

In support of the South Texas Project (STP) risk-informed approach to addressing GSI-191 and response to GL 2004-02, STP was granted exemptions under 10CFR50.12 from certain requirements in 10CFR50.46 and 10CFR50 Appendix A General Design Criteria (GDC).

The specific exemptions pertain to requirements for deterministic analysis of Emergency Core Cooling System (ECCS) and Containment Spray System (CSS) system functions for core cooling, and containment heat removal and atmosphere cleanup following a postulated loss of cooling accident (LOCA), and affect the following requirements:

- 10CFR50.46(d) – the governing requirement in 10CFR50.46 to establish GDC 35 as the technical design basis for ECCS analysis.
- GDC 35, Emergency Core Cooling

- GDC 38, Containment Heat Removal
- GDC 41, Containment Atmosphere Cleanup

The exemptions allow use of the risk-informed methodology described in this appendix to account for the probabilities and uncertainties associated with mitigation of the effects of debris following postulated LOCAs instead of using the deterministic analyses required by the regulation or GDC.

The scope of the exemptions applies for all debris effects addressed in the risk-informed element of the RoverD methodology described in this appendix, which is associated with LOCA break sizes and locations that potentially generate fine fiber debris that exceeds the quantity bounded by plant-specific testing described in Section 1.1 of this appendix. That scope is generally described as breaks larger than approximately 12.8" ID in locations where a sufficient amount of fiber debris can be generated and transported to the sump to exceed the amount of fine fiber debris in the plant-specific testing described in Section 1.1.

The key elements of each of the exemption requests are:

1. It applies only to the effects of debris as described in UFSAR Appendix 6A.
2. It applies only for LOCA breaks that can generate and transport fiber debris that is not bounded by STP plant-specific testing.
3. It applies to any LOCA break that can generate and transport fiber debris that is not bounded by STP plant-specific testing, provided that the ΔCDF and ΔLERF associated with the break size remains in Region III of RG 1.174.

UFSAR Sections 3.1.2.4.6.1, 3.1.2.4.9.1 and 3.1.2.4.12.1 provide additional information on STP's compliance with GDC 35, 38, and 41, respectively.

1.5 Technical Specifications

The TS for ECCS and for CSS were revised to add an action statement specific to debris effects. The operability requirement for the LCO is based on the quantity of debris in the STP debris analysis and would involve evaluation of the quantity, nature and transportability of the debris in question to determine if it is within the STP debris analysis. Operability determinations do not involve application of probabilistic risk. The required completion time is based on the very low risk from the effects of debris, as demonstrated in the RoverD evaluation.

Additional information is provided in the Technical Specification Bases for the ECCS and CSS.

Attachment 4

List of Commitments

List of Commitments

The following table identifies the actions to which STP Nuclear Operating Company (STPNOC) has committed. Statements in the submittal with the exception of those in the table below are provided for information purposes and are not considered regulatory commitments.

Commitment	Tracking Numbers	Scheduled Completion Date
The document changes required to implement the LAR (approved UFSAR Change Notice, TS, and TS Bases) will be done within 90 days of NRC approval.	CR 11-4249-9 (UFSAR CN) CR 11-4249-10 (TS/TSB)	90 days following approval of LAR

Attachment 5

Definitions and Acronyms

Definitions and Acronyms

ANS American Nuclear Society
ARL Alden Research Laboratory
ASME American Society of Mechanical Engineers
BA Boric Acid
BAP Boric Acid Precipitation
BC Branch Connection
BEP Best Efficiency Point
B-F Bimetallic Welds
B-J Single Metal Welds
BWR Boiling Water Reactor
CAD Computer Aided Design
CASA Containment Accident Stochastic Analysis, also a short name for the CASA Grande computer program that uses the analysis methodology
CCDF Complementary Cumulative Distribution Function or Conditional Core Damage Frequency
CCW Component Cooling Water
CDF Core Damage Frequency
CET Core Exit Thermocouple(s)
CHLE Corrosion/Head Loss Experiments
CHRS Containment Heat Removal System
CLB Cold Leg Break or Current Licensing Basis
CRMP Configuration Risk Management Program
CS Containment Spray
CSHL Clean Strainer Head Loss
CSS Containment Spray System (same as CS)
CVCS Chemical Volume Control System
DBA Design Basis Accident
DBD Design Basis Document
D&C Design and Construction Defects
DEGB Double Ended Guillotine Break
DID Defense in Depth
DM Degradation Mechanism
ECC Emergency Core Cooling (same as ECCS)
ECCS Emergency Core Cooling System
ECWS Essential Cooling Water System (also ECW)
EOF Emergency Operations Facility
EOP Emergency Operating Procedure(s)
EPRI Electric Power Research Institute
EQ Equipment Qualification
ESF Engineered Safety Feature
FA Fuel Assembly(s)
FHB Fuel Handling Building
GDC General Design Criterion(ia)
GL Generic Letter
GSI Generic Safety Issue
HHSI High Head Safety Injection (ECCS Subsystem)
HLB Hot Leg Break
HTVL High Temperature Vertical Loop
HLSO Hot Leg Switchover
HVAC Heating, Ventilation & Air Conditioning
ID Inside Diameter
IGSCC Intergranular Stress Corrosion Cracking
ISI In-Service Inspection
IOZ Inorganic Zinc
LAR License Amendment Request
LBB Leak Before Break
LBLOCA Large Break Loss of Coolant Accident
LLOCA Large Break Loss of Coolant Accident
LCO Limiting Condition for Operation
LDFG Low Density Fiberglass
LERF Large Early Release Frequency
LHS Latin Hypercube Sampling
LHSI Low Head Safety Injection (ECCS Subsystem)
LOCA Loss of Coolant Accident
LOOP/LOSP Loss of Off Site Power
MAAP Modular Accident Analysis Program
MAB/MEAB Mechanical Auxiliary Building or Mechanical Electrical Auxiliary Building
MBLOCA Medium Break Loss of Coolant Accident
MLOCA Medium Break Loss of Coolant Accident

Definitions and Acronyms

NIST National Institute of Standards and Technology
NLHS Non-uniform Latin Hypercube Sampling
NPSH Net Positive Suction Head, (NPSHA – available, NPSHR – required)
NRC Nuclear Regulatory Commission
NSSS Nuclear Steam Supply System
OBE Operating Basis Earthquake
OD Outer Diameter
PCI Performance Contracting, Inc.
PCT Peak Clad Temperature
PDF Probability Density Function
PRA Probabilistic Risk Assessment
PWR Pressurized Water Reactor
PWROG Pressurized Water Reactor Owner's Group
PWSCC Primary Water Stress Corrosion Cracking
QDPS Qualified Display Processing System
RAI Request for Additional Information
RCB Reactor Containment Building
RCFC Reactor Containment Fan Cooler
RCS Reactor Coolant System
RG Regulatory Guide
RHR Residual Heat Removal
RI-ISI Risk-Informed In-Service Inspection
RMI Reflective Metal Insulation
RMTS Risk Managed Technical Specifications
RVWL(S) Reactor Vessel Water Level (System)
RWST Refueling Water Storage Tank
SBLOCA Small Break Loss of Coolant Accident
SLOCA Small Break Loss of Coolant Accident
SC Stress Corrosion
SI/SIS Safety Injection, Safety Injection System (same as ECCS)
SIR Safety Injection and Recirculation
SR Surveillance Requirement
SRM Staff Requirements Memorandum
SSE Safe Shutdown Earthquake
STP South Texas Project
STPEGS South Texas Project Electric Generating Station
STPNOC STP Nuclear Operating Company
TAMU Texas A&M University
TF Thermal Fatigue
TGSCC Transgranular Stress Corrosion Cracking
TS Technical Specification(s)
TSB Technical Specification Bases
TSC Technical Support Center
TSP Trisodium Phosphate
UFSAR Updated Final Safety Analysis Report
UNM University of New Mexico
USI Unresolved Safety Issue
UT University of Texas (Austin)
V&V Verification and Validation
VF Vibration Fatigue
WCAP Westinghouse Commercial Atomic Power
ZOI Zone of Influence