Nuclear Operating Company

South Texas Project Electric Generating Station 4000 Avenue F – Suite A Bay City, Texas 77414

October 7, 2009
U7-C-STP-NRC-090161

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
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Rockville MD 20852-2738

South Texas Project
Units 3 and 4
Docket Nos. 52-012 and 52-013
Response to Request for Additional Information

Attached are the responses to the NRC staff questions included in Request for Additional Information (RAI) letter number 259 related to Combined License Application (COLA) Part 2, Tier 2, Sections 3.3, 3.4, and 3.5. This submittal completes the response to this RAI letter.

Attachments 1 through 18 address the responses to the RAI questions listed below:

RAI 03.03.02-1	RAI 03.04.02-1
RAI 03.03.02-2	RAI 03.04.02-2
RAI 03.03.02-3	RAI 03.04.02-3
RAI 03.03.02-4	RAI 03.04.02-4
RAI 03.03.02-5	RAI 03.04.02-5
RAI 03.03.02-6	RAI 03.05.03-1
RAI 03.03.02-7	RAI 03.05.03-2
RAI 03.03.02-8	RAI 03.05.03-3
RAI 03.03.02-9	RAI 03.05.03-4

When a change to the COLA is indicated, it will be incorporated in the next routine revision of the COLA following the NRC acceptance of the RAI response.

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NRO

STI 32540278

There are no commitments in this letter.

If you have any questions, please contact me at (361) 972-7136, or Bill Mookhoek at (361) 972-7274.

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

Executed on 10/7/09

Scott Head
Manager, Regulatory Affairs
South Texas Project Units 3 & 4

jep

Attachments:

1. RAI 03.03.02-1
2. RAI 03.03.02-2
3. RAI 03.03.02-3
4. RAI 03.03.02-4
5. RAI 03.03.02-5
6. RAI 03.03.02-6
7. RAI 03.03.02-7
8. RAI 03.03.02-8
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10. RAI 03.04.02-1
11. RAI 03.04.02-2
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13. RAI 03.04.02-4
14. RAI 03.04.02-5
15. RAI 03.05.03-1
16. RAI 03.05.03-2
17. RAI 03.05.03-3
18. RAI 03.05.03-4

cc: w/o attachment except*
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RAI 03.03.02-1

QUESTION:

With respect to the design and analysis of STP 3 and 4 site-specific Seismic Category I structures including the UHS structure, the applicant is requested to discuss in detail (1) the aspects of structural and seismic analysis and design that are not in compliance with the applicable SRP Section 3.7 and 3.8 acceptance criteria, and for each deviation from the SRP acceptance criteria justify the identified deviations, and (2) discuss site-specific analyses performed in order maintain structural integrity of the UHS structure subject to load combinations including the tornado loads.

RESPONSE:

1. Standard Review Plan (SRP) Sections 3.7.1, 3.7.2, 3.8.4 and 3.8.5 are applicable to design and analysis of the site-specific Category I structures. These SRPs were reviewed to determine compliance with the acceptance criteria included in these SRPs. The following paragraphs describe any exceptions taken to these SRPs.

   SRP Section 3.7.1:

   The only exception taken is that the three ground motion time histories are not statistically independent from each other.

   SRP Section 3.7.1 requires that when time histories are used, the three ground motion time histories must be shown to be statistically independent from each other. This deviation is justified, because the maximum representative responses of interest for the Category I structures are obtained by performing separate analyses for each of the three components of earthquake motion, and then combined using the Square Root of Sum of Squares (SRSS) rule. This is in accordance with sub-section 2.2 (1) of Regulatory Guide 1.92, Revision 2.

   SRP Section 3.7.2:

   No exception is taken.

   SRP Section 3.8.4:

   No exception is taken, with the following comments on the applicability of some of the SRP requirements.

   Out of the Regulatory Guides listed in Section II under SRP Acceptance Criteria, only Regulatory Guides 1.142, 1.160, and 1.199 are applicable for the design and analysis of the site-specific Category I structures.

Article 4 'Design and Analysis Procedure'
Item 'I' is not applicable because there is no masonry wall in the site-specific Category I structures.

Article 8, masonry walls requirements are not applicable because there is no masonry wall in the site-specific Category I structures.

<u>SRP Section 3.8.5:</u>

No exception taken.

2. The analysis of the site-specific Category I structures including the effects of the tornado loads is discussed in the response to RAI 03.08.04-11 (see letter U7-C-STP-NRC-090136, dated September 15, 2009).

No COLA change is required as a result of this RAI response.

RAI 03.03.02-2

QUESTION:

With respect to STP UHS structural design to ensure structural integrity against tornado impact effects, discuss in detail, the results of both the local damage and structural response evaluations performed for controlling UHS wall and roof panels.

RESPONSE:

The tornado parameters listed in COLA Part 2, Tier 2, Section 3H.6.4.3.3.1 are used for both local and global evaluations. Also listed in the same section are the parameters used for computation of tornado wind pressure. All these parameters are in accordance with Regulatory Guide 1.76, Revision 1, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants" and NUREG-0800, Revision 3, Standard Review Plan (SRP) Section 3.3.2.

Section 3H.6.4.3.3.1 as enclosed in the response to RAI 03.07.01-3 (see letter U7-C-STP-NRC-090136, dated September 15, 2009) provides global overall damage evaluations performed in accordance with SRP Section 3.5.3. In these evaluations, the tornado loads (i.e. W_t) to be included in combination with other applicable loads are per combination $W_t = W_w + 0.5W_p + W_m$ (where W_w = tornado wind pressure, W_p = tornado differential pressure, and W_m = load due to missile impact).

For any critical missile hit location considered, the structure is analyzed for the resulting equivalent static load due to tornado missile impact in conjunction with tornado wind pressure and 50% of tornado differential pressure. The resulting induced forces and moments from this analysis are combined with the induced forces and moments due to other applicable loads within the load combination to determine the total demand for design of the structural elements.

These analyses and design results will be provided in a supplemental response to RAI 03.07.01-13. The supplemental response is currently scheduled by December 31, 2009, in accordance with the schedule provided in Attachment 1 of letter U7-C-STP-NRC-090112 dated August 20, 2009.

No additional COLA change is required for this response.

RAI 03.03.02-3

QUESTION:

The applicant stated that "Tornado missile impact effects on the UHS basin and cooling tower enclosures, and the RSW pump houses are evaluated for the following two conditions:

(a) Local damage in terms of penetration, perforation, and spalling, which is evaluated using the TM 5-855-1 formula (Reference 3H.6-1).

(b) Structural response in terms of deformation limits, strain energy capacity, structural integrity, and structural stability, which is evaluated in accordance with BC-TOP-9A (Reference 3H.6-2).

Provide a discussion of the use of the TM 5-855-1 formula (Reference 3H.6-1) and BC-TOP-9A (Reference 3H.6-2) methods as compared to their corresponding SRP acceptance criteria/methodology, and justify their deviations from the same.

RESPONSE:

For overall damage prediction, see Section 3H.6.4.3.3.1 as enclosed in the response to RAI 03.07.01-3 (see letter U7-C-STP-NRC-090136, dated September 15, 2009).

a. Prediction of local damage in terms of penetration, perforation, and spalling for concrete barriers is performed using the TM 5-855-1 formula to remain consistent with that used in the DCD design for standard plant safety-related structures. This is different from that in Section 1.A of the Acceptance Criteria of Standard Review Plan (SRP) Section 3.5.3, Rev. 3, which specifies using the modified National Defense Research Council (NDRC) formula. In comparison to the NDRC formula, the TM 5-855-1 formula will predict higher penetration but less required thickness to prevent scabbing. However, actual thicknesses provided for the Ultimate Heat Sink Basin, Cooling Tower Enclosures and Reactor Service Water Pump House walls and slabs acting as missile barriers exceed the higher scabbing thickness predicted by the NDRC formula.

b. The reference to BC-TOP-9A was removed in COLA Revision 2. Structural response evaluation is not performed in accordance with BC-TOP-9A. Ductility limits for the concrete barriers are in accordance with the limits specified in Appendix C of ACI 349-97. This is consistent with SRP Section 3.8.4.

No additional COLA change is required as a result of this response.

RAI 03.03.02-4

QUESTION:

Appendix 3H.6.4.3.4.3 Reinforced Concrete Load Combinations lists the following:

$U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7\ R_o$
$U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7W + 1.7\ R_o$
$U = D + F + L + H + To + R_o + W_t$
$U = D + F + L_o + H' + T_o + R_o + E'$
$U = 1.05D + 1.05F + 1.3L + 1.3H + 1.05To + 1.3R_o$
$U = 1.05D + 1.05F + 1.3L + 1.3H + 1.3W + 1.05T_o + 1.3R_o$

Discuss the differences in load factors as well as the load combinations of the above equations compared to their corresponding SRP acceptance criteria/load combinations, and justify the deviations from the SRP acceptance criteria.

The STP applicant states that for the UHS basin, the required strength defined by the above load combinations are multiplied by the following Environmental Durability Factors (S) defined in ACI 350:

Flexural strength .... S = 1.30
Axial tension (including hoop tension)........................ S = 1.65
Excess shear strength carried by shear reinforcement .... S = 1.30

The applicant is requested to discuss any past nuclear facility UHS/intake structures related operating experience that would support the adequacy of the above design practices.

RESPONSE:

Standard Review Plan (SRP) Section 3.8.4 Acceptance Criteria Section II.3, "Loads and Load Combinations," states that all loads and load combinations are to be in accordance with ACI 349 and Regulatory Guide (RG) 1.142. The following load combinations are listed in ACI 349-97:

1. U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7Ro
2. U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7Eo + 1.7Ro
3. U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7W + 1.7Ro
4. U = D + F + L + H + To + Ro + Ess
5. U = D + F + L + H + To + Ro + Wt
6. U = D + F + L + H + Ta + Ra + 1.25Pa
7. U = D + F + L + H + Ta + Ra + 1.15Pa+ 1.0(Yr + Yj + Ym) + 1.15Eo

8. U = D + F + L + H + Ta + Ra + 1.0Pa+ 1.0(Yr + Yj + Ym) + 1.0Ess
9. U = 1.05D + 1.05F + 1.3L + 1.3H + 1.05To + 1.3Ro
10. U = 1.05D + 1.05F + 1.3L + 1.3H + 1.3Eo + 1.05To +1.3Ro
11. U = 1.05D + 1.05F + 1.3L + 1.3H + 1.3W + 1.05To + 1.3Ro

COLA Part 2, Tier 2, Section 3H.6.4.3.4.3 (refer to COLA Revision 3) provides revised load combinations as follows:

1. U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7 Ro
2. U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7W + 1.7 Ro
3. U = D + F + L + H + To + Ro+ Wt
4. U = D + F + Lo + H'+ To + Ro+ E'
5. U = 1.05D + 1.05F + 1.3L + 1.3H+ 1.2To + 1.3Ro
6. U = 1.05D + 1.05F + 1.3L + 1.3H + 1.3W + 1.2To + 1.3Ro
7. U = D + F + L + H + To + Ro + FL
8. U = D + F + L + H + To + Ro + S_E

Table 03.03.02-4A presents the comparison of the ACI 349-97 load combinations with the load combinations included in COLA Part 2, Tier 2, Section 3H.6.4.3.4.3. Based on this comparison, it is concluded that the requirements of ACI 349-97 and Regulatory Guide 1.142 are satisfied. Please note that the COLA load combinations 7 and 8 above, include the site design basis flood, FL, and extreme snow load, S_E. These two load combinations are in addition to those required by ACI 349-97.

The following two load combination changes, as shown in Table 03.03.02-4A, will be added to the COLA.

- Add a new load combination 9: U = D + F + L+ H + Ta + E'
- Revise the load factor for Hydrostatic load, F, from 1.4 to 1.7. This change is based on the requirement of ACI 350-01, Section 9.2.5.

ACI 350 was not available when the earlier United States nuclear power plants were built during the 1970s and 1980s. However, using the durability factors is conservative for the design of the Ultimate Heat Sink structures.

Table 03.03.02-4A Comparison of ACI 349-97 Load Combinations with STP Units 3 and 4 Load Combinations (see Notes below)	
ACI 349-97 Load Combinations	Comparable STP Units 3 and 4 Load Combinations
U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7Ro	U = 1.4D + 1.7F + 1.7L + 1.7H + 1.7 Ro
U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7Eo + 1.7Ro	Not applicable since OBE* is not part of design basis.
U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7W + 1.7Ro	U = 1.4D + 1.7F + 1.7L + 1.7H + 1.7W + 1.7 Ro
U = D + F + L + H + To + Ro + Ess	U = D + F + Lo + H'+ To + Ro+ E'
U = D + F + L + H + To + Ro + Wt	U = D + F + L + H + To + Ro+ Wt
U = D + F + L + H + Ta + Ra + 1.25Pa	This load combination is bounded by the proposed new load combination No. 9 (see below).
U = D + F + L + H + Ta + Ra + 1.15Pa+ 1.0(Yr + Yj + Ym) + 1.15Eo	Not applicable since OBE is not part of design basis.
U = D + F + L + H + Ta + Ra + 1.0Pa+ 1.0(Yr + Yj + Ym) + 1.0Ess	U = D + F + L + H + Ta + E' (see Note 1)
U = 1.05D + 1.05F + 1.3L + 1.3H + 1.05To + 1.3Ro	U = 1.05D + 1.05F + 1.3L + 1.3H+ 1.2To + 1.3Ro (see Note 2)
U = 1.05D + 1.05F + 1.3L + 1.3H + 1.3Eo + 1.05To +1.3Ro	Not applicable since OBE is not part of design basis.
U = 1.05D + 1.05F + 1.3L + 1.3H + 1.3W + 1.05To + 1.3Ro	U = 1.05D + 1.05F + 1.3L + 1.3H + 1.3W + 1.2To + 1.3Ro (see Note 2)

*OBE – Operating Basis Earthquake

Notes:

1. Since Reactor Service Water piping is not a high energy line, Pa, Ra, Yr, Yj, and Ym loads are not applicable.
2. The load factor for To has been revised from 1.05 to 1.2 based on the guidance in Regulatory Guide 1.142.
3. For the definition of loads in the STP Units 3 and 4 load combinations, refer to COLA Part 2, Tier 2, Section 3H.6.4.3.4.1.

The COLA will be revised as shown below as a result of this RAI response.

3H.6.4.3.3.6 Accident Temperature (Ta)

UHS Basin Water temperature (95°F) during accident condition.

3H.6.4.3.4.1 Notation

T_o = Internal moments and forces caused by temperature distributions
Ta = Accident temperature

3H.6.4.3.4.3 Reinforced Concrete Load Combinations

U = 1.4D + ~~1.4~~1.7F + 1.7L + 1.7H + 1.7R_o

U = 1.4D + ~~1.4~~1.7F+ 1.7L + 1.7H + 1.7W + 1.7 R_o

U = D + F + L + H + Ta + E'

RAI 03.03.02-5

QUESTION:

Radwaste Service Building is now designed as non-Seismic Category I. Please confirm that the design will prevent the collapse of this building on to adjacent seismic Category I buildings and any missiles generated are bounded by the STP 3 and 4 DBT missiles.

RESPONSE:

The Radwaste Building (RWB) is a reinforced concrete structure located about 20 feet west of the Reactor Building (RB). It will be designed in accordance with the requirements of Regulatory Guide (RG) 1.143, Revision 2. Also, since the above grade height of this building exceeds the distance to the RB, to ensure that the integrity of the RB is maintained, the RWB design shall satisfy II/I requirements (i.e. it can not collapse or come in contact with the RB under Safe-Shutdown Earthquake (SSE) and tornado loads). Tornado design parameters will be those defined in DCD for the Standard Plant Seismic Category I structures (i.e. 300 mph tornado). Please note that this exceeds the site-specific tornado for Region II (i.e. 200 mph tornado).

The Radwaste Building is a typical structure found within the power block of nuclear power plants and it does not include any unique design or construction features which may provide a new tornado generated missile spectrum beyond those for typical nuclear power plants. Thus, any tornado generated missile from the Radwaste Building is considered bounded by the STP Units 3 and 4 design basis tornado generated missiles (also see response to RAI 03.05.03-4). The design criteria for Radwaste building is provided in response to RAI 03.08.04-2 (see letter U7-C-STP-NRC-090136, dated September 15, 2009).

No additional COLA change is required as a result of this response.

RAI 03.03.02-6

QUESTION:

Section 3.3.3.4 of the STP 3 and 4 FSAR states that the design criteria for plant structures, systems and components (SSCs) not designed for wind loads are as follows: Such SSCs not designed for wind loads are analyzed using the 1.11 importance factor or are checked to ensure that their mode of failure will not affect the ability of safety-related SSCs to perform their intended safety functions. The applicant is requested to provide more detailed discussion of the approaches and analyses to be used by STP to ensure that site-specific SSCs not designed for tornado loads are analyzed and checked to ensure that their mode of failure will not affect the ability of safety-related SSCs to perform their intended safety functions. Also, discuss the codes and standards (e.g., ASCE-SEI 7-05) that will be used to ensure realization of the expected SSC performance outcome. The discussion should refer to pertinent SRP acceptance criteria or guidance that was relied upon in performing the analyses.

RESPONSE:

Those site-specific Structures, Systems and Components (SSC) which are not designed for tornado loads and are within close proximity of the safety-related SSCs such that their collapse under tornado loading may impact the nearby safety-related SSCs, are evaluated for the site specific tornado loading parameters. This is to ensure that they will not collapse onto the safety-related SSCc under tornado loading. Information regarding tornado loads is provided in the response to RAI 03.03.02-7.

COLA Section 3.3.3.4 will be revised as shown below:

3.3.3.4 Effect of Remainder of Plant Structures, Systems, and Components Not Designed for Tornado Loads

The following site-specific supplement addresses COL License Information Item 3.4.

The design criteria for plant SSCs not designed for tornado loads are as follows: ~~Such plant SSCs not designed for tornado loads are analyzed for the site-specific loadings to ensure that their mode of failure will not affect the ability of safety-related SSCs to perform their intended safety functions.~~ Those plant SSCs not designed for tornado loads and located within close proximity of safety-related SSCs such that their collapse under tornado loading may impact the nearby safety-related SSCs are evaluated for applicable tornado loads to ensure that they will not collapse onto the safety-related SSCs under tornado loading.

RAI 03.03.02-7

QUESTION:

STP Units 3 and 4 COL FSAR Section 3.3.2.2, Determination of Forces on Structures, incorporated by reference the ABWR DCD. In the ABWR DCD design, the conversion of tornado wind velocity into loads on structures and elements followed the methods described in Bechtel Topical Report BC-TOP-3-A, Revision 3 "Tornado and Extreme Wind Design Criteria for Nuclear Power Plants".

The Bechtel Topical Report, BC-TOP -3-A, is not endorsed in Standard Review Plan (SRP) and the conversion of design wind velocity into velocity pressure and design wind pressures in BC-TOP -3-A may be different from the procedures given in ASCE/SEI 7-05, which is approved in the SRP. Please clarify the approach for the design and analysis of STP Units 3 and 4 site-specific structures, including the UHS structure.

RESPONSE:

The tornado loads for site-specific safety-related structures are described in COLA Part 2, Tier 2, Section 3H.6.4.3.3.1. The conversion of tornado wind speed into pressure-induced forces on site-specific structures, including the Ultimate Heat Sink (UHS), follows the procedures described in the ASCE/SEI 7-05 as outlined in Section B of the Acceptance Criteria of Standard Review Plan (SRP) Section 3.3.2, Revision 3 with the following clarifications:

The maximum velocity pressure, q_z, is calculated using Equation 6-15 of ASCE/SEI 7-05 with the maximum wind speed of 200 mph from Table 1 of Regulatory Guide (RG) 1.76, Revision 1 for Region II, which is considered not to vary with height above ground.

$$q_z = 0.00256 K_z K_{zt} K_d V^2 I \ (\text{lb/ft}^2)$$

Where:

K_z = velocity pressure exposure coefficient equal to 0.87 for exposure C
K_{zt} = topographic factor equal to 1.0
K_d = wind directionality factor equal to 1.0
V = maximum wind speed (mi/h)
I = Importance factor equal to 1.15

The internal and external pressure coefficients are taken from Figures 6-5, and 6-6 of ASCE/SEI 7-05, respectively with Gust Factor of 0.85 per Section 6.5.8.1 of ASCE/SEI 7-05.

The following load combinations for the total tornado loads on site-specific structures from Section E of SRP Section 3.3.2, Revision 3 are considered:

$W_t = W_p$	Equation 1 of SRP Section 3.3.2
$W_t = W_w + 0.5W_p + W_m$	Equation 2 of SRP Section 3.3.2

Where:

W_t = total tornado load

W_w = load from tornado wind effect

W_p = load from tornado atmospheric pressure change effect

W_m = load from tornado missile impact effect

COLA Part 2, Tier 2, Section 3.3.2.2 will be revised as shown below:

3.3.2.2 Determination of Forces on Structures

The information in this subsection of the reference ABWR DCD is incorporated by reference with the following standard supplement.

The applied forces and procedure used to determine the tornado loading on the site-specific safety-related structures, including the Ultimate Heat Sink, are described in Appendix 3H.6.

RAI 03.03.02-8

QUESTION:

The applicant is requested to confirm that the design of site-specific category I structures including the UHS structure for load combinations including tornado loads should be in accordance with ASCE 7-05, with exposure coefficients Kz corresponding to exposure D.

RESPONSE:

As discussed in the response to RAI 03.03.02-7, tornado load determination is in accordance with ASCE 7-05. As noted in the response to RAI 03.03.01-8 (see letter U7-C-STP-NRC-090111, dated August 26, 2009), the ABWR DCD Reference 3.3-1, defined Category D as areas that extend inland from the shoreline a distance of 1,500 ft or 10 times the height of the structure, whichever is greater. Category D applied to shorelines exposed to wind flowing over a body of water for a distance of at least a mile across and included hurricane coastline areas.

In ASCE 7-98, the definition for Category D was revised to exclude areas in hurricane prone regions. In ASCE 7-05, further confirmation that Exposure D does not include hurricane prone regions is found in the caption under the Exposure D photo of ASCE 7-05, page 290:

> Exposure D – A building at the shoreline (excluding shorelines in hurricane-prone regions) with wind flowing over open water for a distance of at least 1 mile. Shorelines in Exposure D include inland waterways, the Great Lakes, and coastal areas of California, Oregon, Washington, and Alaska.

Thus, hurricane prone regions are currently defined in ASCE 7-05 Section 6.2 as "The U.S. Atlantic Ocean and Gulf of Mexico coasts where the basic wind speed is greater than 90 mph." The STP Units 3 and 4 site has a basic wind speed (50 yr – 3 second gust) of 125 mph which exceeds the hurricane threshold of 90 mph. Thus, the site falls under the definition of a hurricane prone region and all structures are designed for Exposure Category C.

Exposure Category C applies when the ground surface roughness condition, as defined by surface roughness C, prevails in the upwind direction. Surface Roughness C is defined in ASCE 7-05 Section 6.2 as follows:

> "Surface Roughness C: Open terrain with scattered obstructions having heights generally less than 30 ft (9.1m). This category includes flat open country, grasslands, and all water surfaces in hurricane prone regions".

Further confirmation that Exposure Category C applies to the STP Units 3 and 4 site is found in the following paragraph taken from Standard Review Plan Section 3.3.1 Acceptance Criteria 3.B:

> "For each wind direction considered, the upwind exposure category should be based on ground surface roughness that is determined from natural topography, vegetation, and constructed facilities. Surface roughness C is defined as open terrain with scattered obstructions having heights generally less than 30 ft. This category includes flat open country, grasslands, and all water surfaces in hurricane prone regions. Because most nuclear plants are located in relatively open country, Kz values in Table 6-3 should be selected from the Exposure C column. The definition of Exposure C is provided in ASCE/SEI 7-05, Section 6.5.6.3."

No COLA change is required for this response.

RAI 03.03.02-9

QUESTION:

In STP Units 3 and 4 COL FSAR Applicant has committed to use IBC 2006, which is also adopted by the State of Texas, and not IBC 2003 as referenced in Section 3.3.4 of FSAR. Applicant shall revise and amend section 3.3.4 (and other sections if applicable) to reflect the incorporation of IBC 2006 as one of the codes the plant has been designed for.

RESPONSE:

COLA Part 2, Tier 2, Section 1.8 and Table 1.8-21, "Industrial Codes and Standards Applicable to ABWR," refer to Industrial Building Code (IBC) 2006. As discussed in the response to RAI 03.03.01-1 (see letter U7-C-STP-NRC-090111, dated August 26, 2009), COLA Part 2, Tier 2, Section 3.3.4 was revised to change the reference to the IBC 2003 to IBC 2006.

No additional COLA change is required as a result of this RAI response.

RAI 03.04.02-1

QUESTION:

The STP applicant incorporated ABWR DCD, Section 3.4.2, Revision 4, by reference with departures including STP DEP T1 5.0-1. The departure introduces a new set of site-specific loads including hydrodynamic loads not accounted for within the certified scope of ABWR DCD. Discuss the site specific flood (maximum flood level is 1478.3 cm above MSL) design issues including how the lateral hydrodynamic pressure on the structures due to the design flood water level, as well as ground and soil pressures, are calculated. Also, to the extent IBC 2006, which references ASCE 7-05, is adopted at STP Units 3 and 4, justify its application for the flood design of STP SSCs.

RESPONSE:

As provided in COLA Part 2, Tier 2, Section 3H.2.4.2.3, the design basis flood level was revised to 182.9 cm (6 ft) above grade. The nominal plant grade is at elevation 34 ft.

The following is based on the Main Cooling Reservoir (MCR) embankment breach analysis results provided in COLA Part 2, Tier 2, Section 2.4.

- Maximum calculated water level near the safety-related structures is at elevation 38.8 ft Design flood level is conservatively established at elevation 40 ft.
- Maximum water velocity is 4.72 ft/sec.
- Maximum hydrodynamic force is 44 pounds per square foot of the projected submerged area. This hydrodynamic load is in accordance with Section 5.4.3 of ASCE 7-05 using a conservative drag coefficient of 2.0.

This revised design basis flood level will impact the following:

- Design of exterior walls of the Reactor Building (RB) and Control Building (CB), both above and below grade
- Flotation safety factor of the RB and CB
- Flood protection of the RB and CB against external flooding
- The hydrostatic head for design of seals at seismic gaps and penetrations
- Design of non-safety-related Structures, Systems and Components (SSCs) to withstand the design basis flood in order not to impair safety functions of the adjacent safety-related SSCs

The impact on the design of exterior walls of the RB and CB and the impact on flotation safety factor of the RB and CB is provided in the response to RAI 03.08.01-4 (see letter U7-C-STP-NRC-090136 dated September 15, 2009).

The impact on flood protection of the RB and CB against external flooding is provided in the response to RAI 03.04.02-2. The impact on the design of seals at seismic gaps and penetrations is provided in the response to RAI 03.04.02-5.

The impact on the design of non-safety-related SSCs to withstand the design basis flood in order not to impair the safety functions of the adjacent safety-related SSCs is provided in the response to RAI 03.04.02-4.

Flood protection, design and stability safety factors of the site-specific safety-related SSCs are based on the revised design basis flood level.

No additional COLA change is required for this response.

AI 03.04.02-2

QUESTION:

The applicant stated that "STP 3 & 4 safety-related SSCs are designed for or protected from this flooding event by watertight doors to prevent the entry of water into the Reactor Buildings and Control Buildings in case of a flood. Exterior doors located below the maximum flood elevation on the 12300 floor of the Reactor Building and Control Building are revised to be watertight doors. The Ultimate Heat Sink storage basin and the RSW pump houses are water-tight below the flood level." Discuss a more quantitative performance based definition of a "watertight door," and applicable codes and standards used for the design. Also list STP 3 and 4 site-specific Seismic Category I structures that include watertight doors and penetrations, and discuss how their water tightness is ensured. Provide detailed ITAAC table for STP 3 & 4 safety-related site-specific SSCs including the Ultimate Heat Sink (UHS) structure.

RESPONSE:

The locations and design requirements for watertight doors are provided in the response to RAI 03.08.01-3 (see letter U7-C-STP-NRC-090136, dated September 15, 2009).

Watertight doors will be individually engineered assemblies designed by the supplier to satisfy the design basis performance requirements for external flooding. Watertight doors will allow only slight seepage during an external flooding event in accordance with criteria for Type 2 closures in U. S. Army Corps of Engineers (COE) EP 1165-2-314, "Flood-Proofing Regulations," 1992. This criterion will be met under hydrostatic loading of 12 inches of water above the design basis flood elevation.

There are no exterior access openings or above grade penetrations below the design flood level in the site-specific Category I structures, including the Ultimate Heat Sink (UHS) Basin and the Reactor Service Water (RSW) Pump House. The response to RAI 03.04.02-3 provides an ITAAC for the below grade penetration seals to be provided with flood protection features.

The COLA revision proposed with the response to RAI 03.08.01-3 (see letter U7-C-STP-NRC-090136, dated September 15, 2009) will be revised as shown below:

3.8.6.4 Identification of Seismic Category I Structures

In addition to the above structures, watertight doors are required on the Reactor and Control Buildings to protect the buildings from the external design basis flood. These watertight doors are considered site-specific Seismic Category I components.

The watertight doors for the Reactor Building to be utilized for protection against external flooding consist of the five exterior doors and the exterior Large Equipment Access Building door shown in COLA Part 2 Tier 1 Figure 2.15.10j. The watertight doors for the Control Building to be utilized for protection against external flooding consist of the exterior equipment access door and an access door between the Control Building and the Service Building shown in DCD Tier 1 Figure 2.15.12g and an additional access door between the Control Building and Radwaste Building Access Corridor.

Since the function of these watertight doors is to protect safety-related SSCs in the event of a Probable Maximum Flood (PMF), they are considered safety-related and designed as Seismic Category I for the site-specific loading.

Exterior openings of the Reactor Building and Control Building which could make safety related SSCs vulnerable to tornado missiles are protected by separate barriers or doors designed to resist tornado missiles. The exterior watertight doors are designed for the wind, tornado wind and pressure drop discussed in Section 3.3 as applicable.

The watertight doors are seated such that the force of the water helps maintain the watertight seal. The watertight doors are designed to be leak tight. Watertight doors will be individually engineered assemblies designed by the supplier to satisfy the design basis performance requirements for external flooding. Watertight doors will allow only slight seepage during an external flooding event in accordance with criteria for Type 2 closures in U. S. Army Corps of Engineers (COE) EP 1165-2-314, "Flood-Proofing Regulations", 1992. This criterion will be met under hydrostatic loading of 12 inches of water above the design basis flood elevation.

The door openings which provide access for maintenance are normally closed and are not used for normal access to and from the Reactor Building and the Control Building. The door openings between the Control Building and the Service Building and between the Control Building and Radwaste Building Access Corridor provide access and egress from the Control Building. The flood resistant doors in these openings are normally open and closed only upon indication of an imminent flood. Separate access doors which function as fire doors are normally closed, but are compliant with the requirements of NFPA 101 for egress. The operation of the watertight doors ~~are~~ is controlled by station procedures.

RAI 03.04.02-3

QUESTION:

Section 3.4.1.1.1 "Flood Protection from External Sources" of the ABWR DCD/Tier2, Revision 4, states that seismic Category I structures are protected from flooding by ensuring that tunnels below grade do not penetrate exterior walls and that the COL applicant will review the use of penetration seals below grade and develop procedures as necessary to protect the plant against the effects of seal failure. The Applicant shall confirm and specify the details of this design requirement by providing the corresponding ITAAC items. For STP 3 and 4 site-specific structures including the UHS, provide ITAAC tables with discussion of the ITTAC contents to demonstrate that seismic Category I structures are protected from flooding by ensuring that tunnels below grade do not penetrate exterior walls and that the integrity of penetration seals below grade is maintained.

RESPONSE:

COLA Part 9, Table 3.0-5 will be revised as shown below to add a new Item 9 on the flood protection features of the Reactor Service Water (RSW) Piping Tunnel and RSW Pump House. The Ultimate Heat Sink (UHS) Basin is not connected to the RSW Piping Tunnel and therefore this ITAAC is not required for the UHS Basin.

Table 3.0-5 Reactor Service Water (RSW)

9. The RSW Piping Tunnel and RSW Pump House are protected against external floods by having: a. External walls below flood level that are equal to or greater than 0.6 m thick to prevent groundwater seepage. b. Tunnels below grade not penetrating exterior walls of the RSW Pump House and Control Building. c. Penetration seals with flood protection features.	9. Inspection of the as-built structure will be conducted.	9. a. External walls below flood level are equal to or greater than 0.6 m thick to prevent groundwater seepage. b. Tunnels below grade do not penetrate exterior walls of the RSW Pump House and Control Building. c. The penetration seals are provided with flood protection features.

RAI 03.04.02-4

QUESTION:

COL Information item 3.7, Flood Protection Requirements for Other Structures, requires that a COL applicant should also provide procedures to design non-safety related SSC to withstand the effects of design basis flood (DBF) in order not to impair adjacent safety related SSCs from performing their safety functions (a II/I structural interaction concern resulting from a DBF induced non-safety related structural failure). Discuss how STP 3 and 4 applicant is addressing this COL information item.

RESPONSE:

The Design Basis Flood (DBF) for safety-related Structures, Systems, and Components (SSCs) is a breach of the Main Cooling Reservoir (MCR) resulting in a flood elevation of 40.0 ft MSL (COLA Part 2, Tier 2, Table 2.0-2) and maximum water velocity of 4.72 ft/sec (COLA Part 2, Tier 2, Section 2.4S.4.2.2.4.1). This DBF is also considered for the purpose of assessing the potential effects of the failure of non-safety-related SSCs on safety-related SSCs.

Non-safety-related SSCs that are located in the close vicinity (i.e., within one building height) of safety-related SSCs and located such that they could collapse onto safety-related SSC will be designed for DBF loads. The maximum water velocity from the DBF produces a hydrodynamic load of 44 psf in addition to hydrostatic forces. The hydrodynamic and static water loads are added together to yield the total force on the structure from the water flow. Above grade non-safety-related buildings that are within a distance of one building height and designed for the DBF include the Service Building, Control Building Annex, Radwaste Building, and Turbine Building.

Other non-safety-related SSCs, i.e. those separated by more than one building height, do not pose a threat to safety-related SSCs because of the separation distance. These structures include, for example, the Water Storage Tanks / Prover Tanks and the Fire Water Storage Tanks. Although a catastrophic failure of non-safety-related SSCs could result in floodwater borne debris, the potential II/I structural interaction due to such debris is enveloped by other design loads applied in the design of safety-related SSCs. Safety-related SSCs are designed for the flood loads resulting from the DBF, seismic loads, and the potential for tornado generated missiles. As noted above, the maximum water velocity resulting from the DBF is 4.72 ft/sec. At such velocity, floodwater borne debris with kinetic energy capable of damaging safety-related SSCs is not credible.

No COLA change is required as a result of this RAI response.

RAI 03.04.02-5

QUESTION:

Given the fact that the site design basis flood level is increased from that specified in the DCD and the certified design site parameter for site flooding is changed from 30.5 cm below grade to 442.0 cm above grade (1036.3 cm above mean sea level (MSL)) in order to adequately design for the site design basis flood that would result from a postulated failure of the main cooling reservoir, indicate if there are any piping, access openings or tunnels which penetrate the exterior walls of in scope Seismic Category I structures below grade elevation, whose design and analysis against design basis flood effects might be affected. If applicable, discuss how the design and analysis of these items were adjusted to account for the elevated design basis flood level. Also, address the same question for the site-specific UHS structure.

RESPONSE:

There are seals which protect the exterior penetrations and external seismic gaps between the Category I structures, below grade. These seals will be designed to take into account the increase in hydrostatic head due to the design basis flood, which has been revised to 182.9 cm above grade (see COLA Part 2, Tier 2, Section 3H.2.4.2.3). The tunnels do not penetrate walls of the Category I structures. A conceptual detail of the interface between the tunnels and Category I structures is described in the response to RAI 03.08.04-15 (see letter U7-C-STP-NRC-090160, dated October 5, 2009). The site-specific structures, including the Ultimate Heat Sink (UHS) Basin and Reactor Service Water (RSW) Pump House, do not have any access openings below design basis flood level. Piping and other penetrations to these structures are located inside the tunnels and, therefore, are protected against flooding.

No additional COLA change is required as a result of this response.

RAI 03.05.03-1

QUESTION:

Appendix 3H.6.1 Objective and Scope states that "The objective of this appendix is to describe the structural analysis and design of the STP 3 & 4 site-specific seismic Category I structures that are identified below and shown in Figures 1.2-32 through 1.2-37." Provide the following additional information:

(1) With respect to Appendix 3H.6.4 Structural Design Criteria, provide a detailed comparative discussion of the STP proposed structural design criteria with their corresponding structural design and acceptance criteria of SRP Sections 3.5.3 and 3.8.4. For each Identified deviation from the applicable acceptance criteria of SRP Sections 3.5.3 and 3.8.4, discuss the basis for the deviation and demonstrate its equivalency to or consistency with the applicable SRP acceptance criteria.

(2) With respect to Appendix 3H.6.5 Seismic Analysis, provide a detailed comparative discussion of the STP proposed seismic analysis methodology and criteria with their corresponding seismic design and analysis acceptance criteria of SRP Sections 3.7. For each Identified deviation from the applicable acceptance criteria of SRP Sections 3.7, discuss the basis for the deviation and demonstrate its equivalency to or consistency with the applicable SRP acceptance criteria.

(3) With respect to Appendix 3H.6.6 Structural Analysis and Design Summary, discuss the STP rationale for asserting or concluding that applicable acceptance criteria of SRP Sections 3.5.3, 3.7.2 and 3.8.4 are fully complied with for the below listed sections:

3H.6.6.1 Analytical Models
3H.6.6.2.1 UHS Basin, UHS Cooling Tower Enclosure, and RSW Pump House
3H.6.6.2.2 RSW Piping Tunnels
3H.6.6.3 Structural Design
3H.6.6.4 Foundations, and
3H.6.6.5 Stability Evaluations.

RESPONSE:

COLA Part 2, Tier 2, Section 3H.6 provides a detailed description of the analysis and design of site-specific structures. The following outlines a summary of compliance with Standard Review Plan (SRP) sections cited in the RAI.

1) The STP structural design criteria meet the requirements of SRP Sections 3.5.3 and 3.8.4 because:

- The tornado loads are per Regulatory Guide (RG) 1.76, Revision 1, for Region II
- Calculation of tornado wind effects are in accordance with SRP Section 3.3.2
- Combined tornado load effects are in accordance with SRP Section 3.3.2

- Tornado evaluations include local and overall damage predictions
- Local damage predictions for steel barriers are in compliance with SRP Section 3.5.3 using the Ballistic Research Laboratory (BRL) formula (see response to RAI 03.03.02-3)
- Local damage predictions for concrete barriers are performed using TM 5.855-1 as described in the response to RAI 03.03.02-3
- Overall damage predictions meet the ductility limits of Appendix C of ACI 349-97 for concrete barriers and ANSI/AISC N690 – 1994 including Supplement No. 2 for steel barriers
- Loads meet or exceed those specified in ASCE 7-05
- Load combinations are in compliance with the requirements of ACI 349-97 (as supplemented by RG 1.142) and ANSI/AISC N690-1994 for concrete and steel components, respectively
- Design and acceptance criteria for concrete components are in accordance with ACI 349-97
- The Ultimate Heat Sink Basin exterior walls and basemat also satisfy the environmental durability factors in accordance with ACI 350
- Design and acceptance criteria for steel components are in accordance with ANSI/AISC N690-1994 including Supplement No. 2

2) Detailed information showing compliance with the requirement of SRP Section 3.7 is provided in the response to RAI 03.03.02-1.

3) See Items 1 and 2 of this response.

No additional COLA change is required for this response.

RAI 03.05.03-2

QUESTION:

STP 3 and 4 applicant is requested to provide the following additional information related to COL License Information Item 3.9:

1. More detailed discussion of design procedures pertaining to local damage prediction for concrete structures in Section 3H.6. As applicable, provide the corresponding information for local damage prediction of steel structures, or confirm that no steel structures are used as barriers for STP site-specific Seismic Category I Structures.

2. Confirm that the same design bases adopted for the UHS are also applied to the tunnel structures connecting the UHS pump house with the Control Building.

3. Discuss pertinent ITAAC requirements for STP Site-Specific Seismic Category I Structures with respect to tornado missile protection and barrier design. Also provide ITAAC tables applicable to the UHS and tunnel structures connecting the UHS pump house with the Control Building.

RESPONSE:

1) Local damage prediction for concrete and steel barriers is performed as follows:

Concrete Barriers:

The local damage prediction for concrete barriers is performed using the TM 5-855-1 formula as described in response to RAI 03.03.02-3.

Steel Barriers:

The local damage prediction for steel barriers is performed using the Ballistic Research Laboratory (BRL) formula. This is consistent with the Acceptance Criteria of Standard Review Plan (SRP) Section 3.5.3, Revision 3, under item 1.B.

Steel barriers are used on top of the Ultimate Heat Sink (UHS) fan enclosure to shield the fans from tornado missiles striking from above the enclosures. The bottoms of the UHS fan enclosures are shielded from tornado generated missiles by the concrete walls of the UHS Basin and the fan enclosure walls.

2) The Reactor Service Water (RSW) Piping Tunnels are also designed for tornado generated missiles. Although all of the RSW piping tunnels with the exception of the access shafts are buried, conservatively no credit is taken for the soil above the tunnels for shielding against tornado generated missiles. Thus, the same design basis adopted for the UHS are also applied to the RSW Piping Tunnels.

3) The ITAACs, including requirements for tornado missiles, for the UHS and the RSW Piping Tunnels were provided in response to RAIs 14.03.02-3, and 14.03.02-5, respectively (see letter U7-C-STP-NRC-090150, dated September 21, 2009).

COLA Part 2, Tier 2, Sections 3H.6.4.3.3.1 and 3H.6.6.6 will be revised as shown below as a result of this RAI response.

3H.6.4.3.3.1 Tornado Loads (Wt)

(3) Tornado Missile Impact (Wm)

Buried RSW piping tunnels do not require the consideration of tornado missile impact. All other structures are evaluated for the effects of missile impact.

Tornado missile impact effects on the UHS basin and cooling tower enclosures, RSW pump houses, and RSW tunnels including access shafts are evaluated for the following two conditions:

(a) For concrete barriers, Llocal damage in terms of penetration, perforation, and spalling, which is evaluated using the TM 5-855-1 formula (Reference 3H.6-1). For steel barriers, local damage prediction is performed using the Ballistic Research Laboratory (BRL) formula (Reference 3H.6-2).

3H.6.6.6 References

3H.6-2 C. R. Russell, "Reactor Safeguards," published by MacMillian, New York, 1962.

RAI 03.05.03-3

QUESTION:

With respect to Section 3.5.4.4, STP states, "...Such plant SSCs are analyzed for the design basis tornado missile to ensure that their failure will not affect the ability of safety-related SSCs from performing their intended safety functions." The applicant is requested to discuss in more detail as to how the STP design will ensure that their failure will not affect the ability of safety-related SSCs from performing their intended safety functions."

RESPONSE:

Those site-specific Structures, Systems and Components (SSCs) which are not designed for tornado loads and are within close proximity of the safety-related SSCs such that their collapse under tornado loading may impact the nearby safety-related SSCs, are evaluated for the site specific tornado loading parameters. This is to ensure that they will not collapse onto the safety-related SSCc under tornado loading. Information regarding tornado loads is provided in the response to RAI 03.03.02-7. This tornado loading includes tornado generated missiles.

No additional COLA change is required as a result of this response.

RAI 03.05.03-4

QUESTION:

With respect to Section 3.5.4.7, Failure of Structures, Systems, and Components Outside ABWR Standard Plant Scope, provide a more quantitatively based justification for STP applicant's assertion that potential missiles or debris resulting from failure of structure or from items blown off, when subjected to winds of tornado intensity, would not generate missiles more severe than the design basis tornado missiles defined in Subsection 3.5.1.4.

RESPONSE:

The ABWR non-tornado resistant structures are similar to those found in typical nuclear power plants within the United States. These structures do not use any unique design or construction features which may introduce new or more airborne capable missiles. Therefore, the impacts of missiles which may be blown off or generated from collapse of these structures are considered to be bounded by the impact of NRC missile spectrum considered for the design of safety-related structures, systems, and components.

Please note the following excerpts from Revision 1 of Regulatory Guide 1.76:

"Tornado-Generated Missile Characteristics

To ensure the safety of nuclear power ....

Protection from a spectrum of missiles (ranging from a massive missile that deforms on impact to a rigid penetrating missile) provides assurance that the necessary structures, systems, and components will be available to mitigate the potential effects of a tornado on plant safety. Given that the design-basis tornado wind speed has a very low frequency, to be credible, the representative missiles must be common items around the plant site and must have a reasonable probability of becoming airborne within the tornado wind field."

"Design-Basis Tornado Missile Spectrum

In accordance with 10 CFR 50.34, ... The selected design-basis missiles for nuclear power plants include at least (1) a massive high-kinetic-energy missile that deforms on impact, (2) a rigid missile that tests penetration resistance, and (3) a small rigid missile of a size sufficient to pass through any opening in protective barriers. The NRC staff considers a 6-inch (15.24-centimeter) Schedule 40 steel pipe and an automobile to be acceptable as the penetrating and massive missiles, respectively, for use in the design of nuclear power plants. Automobiles are common objects near the plant site, and ample evidence supports their potential to be lifted in a tornado wind field. Schedule 40 pipe is also common around plant sites. However, such pipe is intended to represent a rigid component of a larger missile (e.g., building debris or an automobile) that may be lifted in the tornado wind field. Thus, the staff used the maximum speed calculated for the automobile missile for the penetrating missile as well, rather than the speed calculated for a pipe. To test the configuration of openings in the protective barriers, the missile spectrum also includes a 1-inch (2.54-centimeter) solid steel sphere as a small rigid missile. ...."

No COLA change is required as a result of this RAI response.