

## PMSTPCOL PEmails

---

**From:** Wunder, George  
**Sent:** Monday, March 07, 2011 12:53 PM  
**To:** STPCOL  
**Subject:** FW: RAI 03.08.04-33  
**Attachments:** 03.08.04-33 (U7-C-STP-NRC-100208).pdf

---

**From:** Price, John E [<mailto:jeprice@STPEGS.COM>]  
**Sent:** Monday, March 07, 2011 12:40 PM  
**To:** Wunder, George  
**Cc:** Head, Scott  
**Subject:** RAI 03.08.04-33

George,

Per your request is an attachment from our letter dated September 15, 2010 (U7-C-STP-NRC-100208) regarding the ACI Code (RAI 03.08.04-33). If you need additional information, please call me at 972-754-8221.

*John E. Price*

*Licensing Engineer - STP Units 3 & 4  
361.972.4748 (site office)  
972.754.8221 (cell)*

**Hearing Identifier:** SouthTexas34Public\_EX  
**Email Number:** 2624

**Mail Envelope Properties** (DAC719623E968245BD52D036961111004C88A33383)

**Subject:** FW: RAI 03.08.04-33  
**Sent Date:** 3/7/2011 12:52:50 PM  
**Received Date:** 3/7/2011 12:52:52 PM  
**From:** Wunder, George

**Created By:** George.Wunder@nrc.gov

**Recipients:**  
"STPCOL" <STP.COL@nrc.gov>  
Tracking Status: None

**Post Office:** HQCLSTR02.nrc.gov

<b>Files</b>	<b>Size</b>	<b>Date &amp; Time</b>
MESSAGE	521	3/7/2011 12:52:52 PM
03.08.04-33 (U7-C-STP-NRC-100208).pdf		77351

**Options**  
**Priority:** Standard  
**Return Notification:** No  
**Reply Requested:** No  
**Sensitivity:** Normal  
**Expiration Date:**  
**Recipients Received:**

**RAI 03.08.04-33****QUESTION:**

1. In FSAR Section 3.8, page 3.8-1, the applicant references the departure STD DEP 1.8-1, "Tier 2\* Codes, Standards, and Regulatory Guide Edition Changes." One of the changes included in this departure updates Tier 2 to refer to the 1997 edition of ACI 349 in place of the 1980 edition of the same building code for concrete structures. In the ABWR design certification (NUREG-1503, page 3-53), the staff had evaluated only the use of 1980 edition of ACI 349. Therefore, the applicant is requested to provide a detailed comparison of the differences between these two editions of the code as they apply to the ABWR standard design, and provide justifications for any differences in order for the staff to evaluate the acceptability of the 1997 edition of ACI 349.
2. FSAR Section 3H.6.4.1 references ANSI/AISC N690 specification for design, fabrication, and erection of site-specific seismic category I steel structures. The applicant did not specify in this section which version of the specification is used. It appears that the applicant uses the 1984 edition of the specification referenced in ABWR DCD Table 1.8-21, which the applicant incorporated by reference. However, according to SRP acceptance criteria 3.8.4.II.5, ANSI/AISC N690-1994 including Supplement 2 (2004) has been accepted by the staff for design, fabrication, and erection of safety-related steel structures. According to the guidance provided in RG 1.206, Section C.I.1.9.2, the applicant should use the current SRP for structures outside the scope of the ABWR DCD, or provide justification for not doing so. Therefore, the applicant is requested to provide a detailed comparison of the differences between the 1984 (or whatever edition is used by the applicant) and the 1994 editions of the specification as they apply to the site-specific seismic category I structures at STP site. Also, provide the justification(s) for any differences in order for the staff to evaluate the acceptability of the 1984 edition of the specification.
3. Furthermore, the staff observed that Table 1.8-21 in FSAR Tier 2, Section 1.8, references ASME Code, Section III, Division 2, Edition 2001 with 2003 addenda, and identifies certain limitations. The ABWR DCD specifies the use of ASME code version 1989. In the ABWR FSER, p. 3-49, the NRC has accepted the 1989 Edition of the ASME Code, Section III, Division 2. Therefore, the applicant is requested to provide a detailed comparison of the differences between these two editions of the code as they apply to the design and analysis of safety-related ABWR standard plant structures, and provide justification(s) for any differences in order for the staff to evaluate the acceptability of the ASME Code, Section III, Division 2 Edition 2001 with 2003 addenda. The applicant is also requested to explain how use of the Edition of the ASME Code proposed by the applicant meets the provisions of NCA-1140, "Use of Code Editions, Addenda, and Cases."

The staff needs the above information to conclude that the applicant used acceptable codes and standards for all seismic category I structures, and any deviations are appropriately addressed.

**RESPONSE:**

1. STD DEP 1.8-1, “Tier 2\* Codes, Standards, and Regulatory Guide Edition Changes,” includes several changes. As noted in the RAI Question, one of the changes included in this departure updates Tier 2 Table 1.8-21 to refer to the 1997 edition of ACI 349 in place of the 1980 edition. In addition, Table 1.8-20 changes the commitment for Regulatory Guide (RG) 1.142, “Safety-Related Concrete Structures for Nuclear Power Plants (Other Than Reactor Vessels and Containments)”, from Revision 1 to Revision 2. Revision 2 of Regulatory Guide 1.142 endorses the 1997 edition of ACI 349.

The use of ACI 349-97 in lieu of ACI 349-80 is consistent with Regulatory Guide 1.142, Rev. 2. RG 1.142, Rev. 2 endorses ACI 349-97 with some additional or alternate requirements as stated in the regulatory positions. In regard to these positions stated in RG 1.142, Rev. 2, STP 3&4 is committed to following the additional requirements in RG 1.142, Rev. 2 as applied to ACI 349-97.

Additional requirements in the DCD regarding safety-related concrete design (e.g. Table 3.8-10) are not affected by this code year change, and will be implemented in design.

A detailed review of the differences between ACI 349-80 and ACI 349-97, as they apply to the design and analysis of safety-related ABWR standard design, has been performed. Generally, revisions provided expanded explanations of the code requirements to eliminate possible misinterpretations or to identify specific instances where the code section applies or does not apply; incorporated provisions based on more current research or experience; or expanded provisions to address new types or methods of construction that were not clearly allowed or disallowed in earlier revisions.

The following is a summary description of the changes that may be both significant as well as applicable to the ABWR standard design, along with associated justifications for accepting the differences.

**Chapter 9** – Strength and Serviceability Requirements, contains changes in Section 9.5 pertaining to calculation of long term deflections. These changes simplify calculation of deflection magnification factors and allow for determining deflection at different time periods. As the design is not expected to be governed by deflection control, these changes will not affect ABWR standard design.

**Chapter 10** – Flexure and Axial Loads, includes changes in Section 10.6 to replace provisions that were determined to be inadequate based on more recent experience, and are, therefore, improvements. Changes in the other sections address more recent construction practices and experience, and will result in no change or more conservative design margins.

**Chapter 11** – Shear and Torsion, includes a large number of changes, most of which are additional provisions or are changes based on more recent research results and experience. None of these changes will reduce design margins for ABWR standard design.

**Chapter 12** – Development and Splices of Reinforcement, includes a large number of changes, most of which are provisions to address epoxy coated rebar (the ABWR does not use epoxy coated rebar) and revised provisions for reinforcement development length. These changes are based on more recent extensive research results and experience and generally result in increased lengths for development.

**Chapter 21** – Special Provisions for Seismic Design, has been added in ACI 349-97 and provides requirements for analysis and design for seismic loading. These provisions are intended to improve the toughness of the structure and to assure that the integrity of the structure is retained even under inelastic deformations due to earthquake events. These provisions are based on more current research and experience, represent the state of the art at the time of the code revision, and therefore its use will result in more robust structures.

**Appendix B** – Steel Embedments, includes changes in ACI 349-97 based on later research. The changes in Appendix B are for the local design of embedment plates and do not affect the design of the major concrete elements. Additionally, the supplemental requirements defined in the Staff Positions in DCD Table 3.8-10 will have a larger impact on the embedment design.

Although Appendix C (Special Provisions for Impulsive and Impactive Effects) has not been revised, the additional requirements defined in Regulatory Guide 1.142, Rev. 2, Positions 10 and 11 will be included.

2. STPNOC will comply with the guidance provided in RG 1.206, Section C.I.1.9.2 and use Standard Review Plan (SRP) Section 3.8.4, Revision 2 for structures outside the scope of the ABWR DCD. According to SRP acceptance criteria 3.8.4.II.5, ANSI/AISC N690-1994 including Supplement 2 (2004) has been accepted by the staff for design, fabrication, and erection of safety-related steel structures. The mark-up for COLA Part 2, Tier 2, Table 1.8-21a is provided at the end of this response.
3. STD DEP 1.8-1, “Tier 2\* Codes, Standards, and Regulatory Guide Edition Changes,” includes several changes. As noted in the RAI Question, Table 1.8-21 references ASME Code, Section III, Division 2, Edition 2001 with 2003 Addenda. In addition, Table 1.8-20 changes the commitment for Regulatory Guide 1.136, “Design Limits, Load Combinations, Materials, Construction, and Testing of Concrete Containments”, from Revision 2 to Revision 3. Revision 3 of Regulatory Guide 1.136 endorses ASME Code, Section III, Division 2, Edition 2001 with 2003 Addenda.

Additional requirements in the DCD regarding containment design (e.g. Table 3.8-2) are not affected by this code year change, and will be implemented in design.

A detailed review of the differences between the 1989 edition and the 2001 edition with 2003 addenda of the ASME Code, Section III, Division 2, as they apply to the design and analysis of safety-related ABWR containment structure, has been performed. Below is a

summary of the significant Code changes along with the justifications for the Code differences as required to evaluate the acceptability of the 2001 Edition with 2003 Addenda. Note that no changes were identified to the load categories and load combinations in Sections CC-3220 and CC-3230.

**Section CC-3421.8**, “Brackets and Corbels”, was substantially revised to incorporate the concept of shear-friction for the design of steel reinforcement (Similar to ACI 318). This change has no impact, as there are no brackets or corbels required for the ABWR containment design.

**Section CC-3424**, “Shear Friction”, was added to provide details of the shear-friction design method (Similar to ACI 318), which is to be applied where it is appropriate to consider shear transfer across a given plane such as a potential crack, an interface between dissimilar materials, or an interface between two concretes cast at different times. This is a code enhancement, since such guidance was not available in the 1989 Edition.

In **Section CC-3431.3**, “Shear, Torsion, and Bearing”, the following changes were made:

- The concrete stress service load allowable for radial shear at sections subjected to membrane tension is now 50% of the factored allowable in CC-3421.4.1(c), except that it need not be reduced below the value of  $0.5 \sqrt{f_c}$ . Previously, the allowable was the same as that used for the factored load allowable, except that the term  $Nu/Ag$  was to be multiplied by 2. This change results in a more conservative design.
- The service load allowable for peripheral shear at sections subjected to membrane tension remains unchanged at 50% of the factored allowable in CC-3421.6(b), except that a provision has been added that it need not be reduced below the value of  $0.5 \sqrt{f_c}$ . This is a very minor relaxation. It will have no significant impact on the design since the service load condition is not expected to control for peripheral shear.
- Service load requirements for design of reinforcement for brackets and corbels were modified based on shear-friction design. This change has no impact, as there are no brackets or corbels required for the ABWR containment design.

**Section CC-3531**, “Reinforcing Steel Requirements – General”, the sentence “For service loads, the requirements are the same, except that the computed moments shall be multiplied by 2.0 and substituted for  $M_u$  in the equations” in Paragraph (b) of the 1989 Edition was deleted. This is a code correction as reinforcing steel splice and development requirements apply to both factored loads and service loads. This change has no design impact.

**Section CC-3532**, “Reinforcing Steel Splicing”, Paragraph (d) “Butt Splices may be welded or mechanical and shall develop a tensile strength of at least 125% of the specified minimum yield strength of the bar” in the 1989 Edition was deleted. This is a code evolution. This change will have no design impact as developing a minimum of 125% of the bar yield strength in the butt splice is covered in Table CC-4333-1.

**Section CC-3532.1.2**, "Development Length", was revised to clarify that Paragraph (h) applies to all main reinforcement that is terminated in a tension zone. This is standard practice and has no impact.

**Section CC-3532.2.3**, "Development Length for Bars in Compression", a provision was added to allow reduction of development length if the bar is not fully stressed. This is a standard provision in concrete codes, including ACI 318 and ACI 349, and has no impact.

**Section CC-3533.2**, "Development of reinforcement for Service Loads", in the 1989 Edition was deleted. This is a code correction as reinforcing steel development length requirement applies to both factored loads and service loads. This change has no design impact.

**Section CC-3535**, "Concrete Crack Control", has been modified to require minimum reinforcement of 0.0020  $A_g$  in the containment shell. Previously, 0.0012  $A_g$  was required for shrinkage and temperature, but a larger value of 0.0021  $A_g$  was required in areas subject to membrane tension. This change is conservative for areas away from membrane tension and similar for areas subjected to membrane tension. As the ABWR is a non-prestressed containment, the minimum reinforcing is not expected to govern in the containment shell. Regardless, this will not affect design margins.

**Section CC-3570**, "Containment External Anchors", is a new section that was added to address loads, displacements, analysis methods, design allowables and other design requirements associated with anchors, embedments and other attachments acting at the external surface of the Containment. This is a code improvement.

In **Section CC-3730** (Liner Anchors), **Section CC-3740** (Penetration Assemblies) and **Section CC-3750** (Brackets and Attachments), new paragraphs were added to require that anchorage forces acting on the containment shell shall be established in the Design Specification. This has no design impact.

In **Sections CC-3740** (Penetration Assemblies) and **CC-3750** (Brackets and Attachments), the requirement to reduce the allowable stress in the thru-thickness direction has been replaced with additional steel plate examination requirements to verify that steel plates meet lamination requirements in CC-4500. The additional steel plate examination provides additional assurance that the material is free of laminations.

**Sections CC-3841(i)** and **CC-3842.9** were added to include Category J welded joints to the list of permissible types of liner welded joints. Category J joints are those liner joints that connect the liner plate to a steel embedment that is continuous through the liner. This is a code improvement.

The following is in response to the request for an explanation of how use of the newer Edition of the ASME Code proposed by the applicant meets the provisions of NCA-1140, "Use of Code Editions, Addenda, and Cases."

The proposed change meets the provisions of Paragraphs NCA-1140 (a)(1) and (a)(2), which read as follows:

**“NCA-1140 USE OF CODE EDITIONS, ADDENDA, AND CASES**

- (a) (1) Under the rules of this Section, the Owner or his designee shall establish the Code Edition and Addenda to be included in the Design Specifications. All items of a nuclear power plant may be constructed to a single Code Edition and Addenda, or each item may be constructed to individually specified Code Editions and Addenda.
- (2) In no case shall the Code Edition and Addenda dates established in the Design Specifications be earlier than:
- (a) 3 years prior to the date that the nuclear power plant construction permit application is docketed; or
  - (b) the latest edition and addenda endorsed by the regulatory authority having jurisdiction at the plant site at the time the construction permit application is docketed.”

This change meets Article NCA-1140(a)(2)(b) because the applicant is proposing to use the 2001 Edition with 2003 Addenda of the ASME Section III, Division 2, Code, which is the latest edition and addenda endorsed by the NRC in Regulatory Guide 1.136, “Design Limits, Loading Combinations, Materials, Construction, and Testing of Concrete Containments”, Revision 3.

As a result of this RAI response, COLA Table 1.8-21a will be revised as follows:

**Table 1.8-21a Codes and Standards for Site-Specific Systems**

Code or Standard Number	Year	Title
<b>American Concrete Institute (ACI)</b>		
349	1997	Code Requirements for Nuclear Safety-Related Concrete Structures
350	2001	Code Requirements for Environmental Engineering Concrete Structures, and Commentary (ACI 350R-01)
350.1	2001	Tightness Testing of Environmental Engineering Concrete Structures, and Commentary (ACI 350.1R-01)
<b>American Institute of Steel Construction (AISC)</b>		
N690 <sup>†</sup>	1994*	Specifications for the Design, Fabrication and Erection of Steel Safety-Related Structures for Nuclear Facilities * (including Supplement 2)
<b>American Nuclear Society (ANS)</b>		
2.8	1992	Determining Design Basis Flooding at Power Reactor Sites
3.11	2005	Determining Meteorological Information at Nuclear Facilities