ACI Committee 376

Concrete Structures for Refrigerated Liquefied Gas (RLG) Containment

Agenda

Saturday, March 29, 2008

1:00 PM – 5:00 PM
El Conquistador Resort
Room: Westwood

1. TASK GROUP STATUS AND VOTING PREVIEW
   Chapter 5 – Load Factors
   Review of ballot results

2. EDITORIAL TASK GROUP PREVIEW
   Review of Gap Analysis results and next steps.

3. ADJOURNMENT **5:00 PM**

Steering Committee Meeting
Sunday, March 30, 2008; 7:30 AM – 8:30 PM
Closed Meeting (by invitation only)

Main Committee Meetings

Sunday, March 30, 2008

9:00 AM – 5:00 PM
Hyatt Regency Century, Los Angeles
Room: Encino

&

Monday, March 30, 2008

9:00 AM – 2:00 PM
Hyatt Regency Century, Los Angeles
Room: Penthouse 1906

1. CALL TO ORDER and APPROVAL OF AGENDA *(approx. 10 min.)*

2. INTRODUCTIONS *(approx. 10 min.)*

3. APPROVAL OF MINUTES *(approx. 10 min.)*

Minutes of the Puerto Rico meeting from Fall 2007.

4. ANNOUNCEMENTS *(approx. 20 min.)*

Planning the next full (main) committee meeting in June 2008.

5. TASK GROUP STATUS AND VOTING

Chapter 6 – Analysis and Design
Review of ballot results.

Chapter 10 – Commissioning and Decommissioning Criteria
Review of ballot results and re-balloting sections 10.2.x and 10.3.x.:

Chapter 5 – Load Factors
Review of ballot results, discussion and re-balloting of load factors for Prestressing Loads.

LUNCH BREAK on Sunday March 30, 2008 approx. 12:15 to 12:45 PM.

Brown Bag Lunch Presentation: Jeff Novak, PE and Dipl.-Ing. Gerhard Vitt of Bekaert (www.bekaert.com) on "*Combined Reinforcement - Crack Control in Structures Using Steel Fibers With Rebar.*"

6. EDITORIAL TASK GROUP

Gap Analysis
Review and discussion of results.

Tuesday, April 1, 2008

9:00 AM – 12:00 PM
Hyatt Regency Century, Los Angeles
Room: Penthouse 1915

1. ***TASK GROUP STATUS AND VOTING*** *- Continued*
   Chapter 7 – Detailing
   Review of ballot results and updating.

2. ***EDITORIAL TASK GROUP*** *- Continued*

   Gap Analysis
   Review and discussion of results.

3. **ADJOURNMENT** **12:00 PM**

Wednesday, April 2, 2008

9:00 AM – 5:00 PM
Hyatt Regency Century, Los Angeles
Room: Encino

1. ***TASK GROUP STATUS AND VOTING*** *- Continued*
   Chapter 7 – Detailing
   Review of ballot results and updating.

2. ***EDITORIAL TASK GROUP*** *- Continued*

   Gap Analysis
   Review and discussion of results.

3. **ADJOURNMENT** **5:00 PM**

Thursday, April 3, 2008

9:00 AM – 5:00 PM
Hyatt Regency Century, Los Angeles
Room: Brentwood

1. ***TASK GROUP STATUS AND VOTING*** - *Continued*
   Chapter 7 – Detailing
   Review of ballot results and updating.

2. ***EDITORIAL TASK GROUP*** - *Continued*

   Gap Analysis
   Review and discussion of results.

3. **ADJOURNMENT** **5:00 PM**

Respectfully submitted,
Neven Krstulovic-Opara
Chairman, ACI 376

cc: D. W. Falconer (*TAC Secretary and Managing Director of Engineering*)
R. Janowiak (*TAC Contact Member*)

CHAPTER 6 – ANALYSIS AND DESIGN

	Approved Sections

Latest Text Reviewed	Vote	Committee Members' COMMENTS	Author	RESPONSE	Notes
A) the existing text of paragraph 6.1.1 be replaced with: **6.1.1 – Required analysis -** The containment structure shall be analyzed as an integrated structure that includes the foundation, wall, roof, contained liquid, liner or portion of the liner that is assumed to act compositely with the concrete structure. The effects of discontinuities shall be considered. Constitutive models, assumed values and details used in the analysis shall be approved by the owner/engineer. B) the following text be added at the end of the commentary paragraph R6.1.1: … The effect of soil stiffness should be included in the analysis as defined in 6.1.2. For load conditions 3.1.15 and 3.1.16, which include severe thermal loading conditions, the structure should be analyzed for the entire transient history up to and including steady state. Both maximum and minimum design ambient temperatures should be used as the initial temperature profiles for the analysis of all loading conditions. For load condition 3.1.15, the temperature for the entire structure, including the roof, should be estimated. The temperature resulting from vapor generation during roll-over and spill events shall be taken into account. The structural model for load conditions 3.1.15 and 3.1.16 should consider the entire temperature time history and be analyzed on the basis of transient inelastic response. Serviceability requirements should be checked both during the transient and steady state temperature profiles. The analysis for these thermal load conditions should take into account the effect of cracking and tension stiffening. Cracking and tension stiffening should be included by appropriate modification of the material stress strain relationship or by the use of finite elements that have the capability of cracking under tension, and crushing under compression as well as the ability to include reinforcing steel.	***Ballot 2/19/08 – 3/20/08*** Approved = 24 App. w. Com.= 2 Abst.= 2 Neg.= 0	"Constitutive Model" should be added to the definition list. R6.1.1 states that constitutive models should be in accordance with European Code EC2. Since EC2 is not a readily available document for most engineers it is suggested that the specific requirements of EC2 be defined in the Chapter 1.	Hoptay	**TG Houston Meeting – 3-18-08:** Brannan, Hjorteset, Ballard, NKO The concrete model cited by EC2 is reasonably widely used and available. The model is a part of various standard F.E. packages such as Adina, ABAQUS, etc. Furthermore, EC2 is believed to be easier to access and obtain than the original papers on which the code model is based. Therefore, the reference to EC2 is maintained. However, the TG advises that the original model references be included in the commentary section where EC2 is referenced. Unanimously agreed by all the TG members present: Brannan, Hjorteset, Ballard, NKO.	Include original references for the model used by the EC2 code. Also include full reference to EC2, including listing it in the reference section.
		It appears that the characteristics demanded of an FEM-Program to fulfill the requiremets of this clause are such that only complex university or research type programs will suit. This may lead to a dangerous situation in that the results are difficult to verify = "black box" syndrome. The use of less complex programs, which, with experience supply sensible and verifiable results, may be considered inapplicable as they would fail to meet a stringent specification contained here. This aspect should be reconsidered.	Douglas		
R6.1.2.1 - The ballot proposes that Mash's negative vote on the ballot from 9/13/2007 to 10/13/2007 is found accepted in principle in part. To address raised issues, the following text is proposed to replace the existing text: **R6.1.2.1 –** Both linear and non-linear analysis may be used in determining seismic forces. In general, linear analysis is used in the case of low seismic regions, while non-linear analysis is used in regions with higher seismicity. When seismic forces are determined using a linear elastic approach, the	***Ballot 2/19/08 – 3/20/08*** Approved = 21 App. w. Com.= 3 Abst.= 4	It should be reviewed whether non-linear methods for the outer concrete tank should be limited to the SSE case. Our experience shows that this makes little sense for the OBE+Operation case.	Douglas	**TG Houston Meeting – 3-18-08:** Brannan, Hjorteset, Ballard, NKO • Mash Comment 1: term "demonstrated explicitly" included • Mash Comment 2: static analysis can be linear or non-linear, depending on the range of material behavior. The following wording was added (e.g., "push-over"). • Wu's comment: included **R6.1.2.1 –** Both linear and non-linear analysis may be used in determining seismic forces. In general, linear analysis is used in the case of low seismic regions <u>and/or OBE case</u>, while non-linear	*Ballard:* I think the discussion of ASCE 4 should be expanded a bit. ASCE 4 discusses selection of material properties, damping, discretization of mass, etc. This
		Include the terms "demonstrated explicitly" Remove "static", as nonlinear is by definition not static	Mash		

Latest Text Reviewed	Vote	Committee Members' COMMENTS	Author	RESPONSE	Notes
response modification factor should be taken as R=1. A force reduction factor of R > 1 may be used if it can be shown, by means of dynamic or static nonlinear analyses, that the structure meets or exceeds the performance criteria prescribed in this Code. Guidance for selecting material property values used in the analysis is provided in ASCE 4. Selected methods shall be approved by the engineer of record.	Neg.= 0	On the first Paragraph, second and third lines: The seismic level for the site (whether located in low or high seismic region) should not be the basis of selecting linear or nonlinear seismic analysis. As we know that the tank system must be designed to maintain continuous operation during and after OBE event, and thus, the linear elastic approach (R=1) has been commonly applied. Thus, suggest the following: "In general, linear seismic analysis is used for OBE case, while non-linear analysis is used for SSE case."	Wu	analysis is used in regions with higher seismicity and/or SSE case. When seismic forces are determined using a linear elastic approach, the response modification factor should be taken as R=1. A force reduction factor of R > 1 may be used if it can be demonstrated explicitly ~~shown~~, by means of dynamic or static (e.g., "push-over") nonlinear analysis, that the structure meets or exceeds the performance criteria prescribed in this Code. Guidance for selecting modeling methodologies, material properties, and other values used in the analysis is provided in ASCE 4. Selected methods shall be approved by the engineer of record. These are only editorial changes - unanimously agreed by all the TG members present: Brannan, Hjorteset, Ballard, NKO.	document should be used as a guideline for analysis practices that produce reliabable seismic demands for design.

CHAPTER 10 – COMMISSIONING AND DECOMISSIONING CRITERIA

(light blue)	Approved Sections and Approved Sections with resolved Editorial Comments
(light green)	Section Approved with Comments to be resolved
(purple)	Negative Vote

CODE	Vote	Comments	Author	RESPONSE	Notes
The ballot proposes that the paragraph 10.2.x be replaced with the following text: **10.2.x - Anchorage –** Where anchorage is provided that requires tightening of individual anchors, tightening shall be in accordance with procedures defined by the designer. Unless otherwise specified, the following shall be performed: (a) prior to the pneumatic testing of the secondary container, and (b) during the hydrotest, with the primary tank filled at the maximum water level. Anchorages shall be visually inspected prior to and after testing.	***Ballot Results 2/18 – 3/19/08*** Approved = 22 App. w. Com.= 1 Abst.= 4 Neg.= 2	This doesn't tell you what should be performed, only when it should be performed. Seems like something was left out of this clause.	Hoff	**TG Houston Meeting – 3-18-08:** Brannan, Hjorteset, Ballard, NKO • Hoff's and Hoptay's negative votes found persuasive. The negative is addressed by inserting "anchor tightening ~~the following~~", as shown below. • Hanskat's editorial comments: TG believes that word "tightening" better reflects the intent which is to at least tighten the connection vs. prestressing or tensioning it. Ultimately, it is the Designers task to choose tightening or prestressing. Find out whether Hoff and Hoptay agree with the change and whether this addresses their negative. The change is only editorial. Unanimously agreed by all the TG members present: Brannan, Hjorteset, Ballard, NKO. **10.2.x - Anchorage –** Where anchorage is provided that requires tightening of individual anchors, tightening shall be in accordance with procedures defined by the designer. Unless otherwise specified, anchor tightening ~~the following~~ shall be performed: (a~~b~~) during the hydrotest, with the primary tank filled at the maximum water level, and (b~~a~~) prior to the pneumatic testing of the secondary container~~,~~ ~~and~~. Anchorages shall be visually inspected prior to and after testing.	Ballard: I think (b) and (a) should be reversed since the hydro test should be performed first to insure that the inner tank anchorages are tight before the pressure test. Someone might read this paragraph as a do (a) then do (b) direction.
		The paragraph states that " *unless otherwise specified the following shall be performed*" but the following are not actions but points of time during construction. The paragraph needs to be reworded.	Hoptay		
		Is "tightening" the best word? In post-tensioning we typically say "tensioning" or "stressing".	Hanskat		
The ballot proposes that the following text be added to paragraph R10.2.2 **R10.2.2 – (see current R10.2.2)** • ASTM G16 and ASTM G46 may ~~could~~ be used as guidelines for determining which pitting and corrosion testing methodology is appropriate for the examination of pitting and corrosion of the surfaces in question after the hydrotest. The procedure to be used, areas to be tested and the acceptable corrosion and pitting limits should be agreed upon by the Engineer, Owner and Contractor before the hydrotest is performed, subject to the criteria of 10.2.1.	***Ballot Results 2/18 – 3/19/08*** Approved = 23 App. w. Com.=1 Abst.= 4 Neg.= 0	From the titles of each of the ASTM standards listed it is not obvious that guidance is provided in either standard as to which testing methodology is appropriate as indicated in R10.2.2.	Hoptay	**TG Houston Meeting – 3-18-08:** Brannan, Hjorteset, Ballard, NKO ASTM G 46 lists a series of testing methodologies including: • Visual inspection, including metallographic examination • Non-destructive inspections including radiographic, electromagnetic, sonics, and penetrants, • Mass loss, including pit depth measurement (including metallographic, machining, micrometer or depth gage, microscopical), • etc. Text was adjusted as shown below. Furthermore, the text is moved to **R10.2.2*** This is only an editorial change. Unanimously agreed by all the TG members present: Brannan, Hjorteset, Ballard, NKO. **R10.2.2 – (see current R10.2.2)** ~~ASTM G16 and~~ ASTM G46 may ~~could~~ be used as guidelines for determining which pitting ~~and~~	

CODE	Vote	Comments	Author	RESPONSE	Notes
				corrosion testing methodology is appropriate for the examination of pitting and corrosion of the surfaces in question after the hydrotest. ASTM G 16 may be used for applying statistical analysis to corrosion data. The procedure to be used, areas to be tested and the acceptable corrosion and pitting limits should be agreed upon by the Engineer, Owner and Contractor before the hydrotest is performed, subject to the criteria of 10.2.1.	
The ballot proposes that Hatfield's negative vote is found convincing and that it be introduced as shown below: **10.3.x – Pressure and Vacuum Relief Testing** – Proper functioning of all pressure and vacuum relief valves and devices shall be confirmed by: • Check pressure relief by increasing pressure in the vapor space. • Check vacuum relief by creating a vacuum with a vacuum pump, or alternatively, by partially withdrawing water from the tank. Alternatively, in-situ component testing of relief & vacuum breaker valves with test gas applied to the pressure sensing line and set point of controls calibrated with a dead weight tester.	***Ballot Results 2/18 – 3/19/08*** Approved = 20 App. w. Com.= 2 Abst.= 5 Neg.= 1	Revise last sentence to read: " Alternatively, in-situ component testing of relief and vacuum breaker valves by applying test gas pressure or vacuum to the control valve pressure/vacuum sensing line is permitted. The set point of controls shall be calibrated with a dead weight tester." Add the following sentence: "Monitor the pressure/vacuum in the tank at all times during testing using instruments with alarm settings to guard against pressure/vacuum conditions outside design limits."	Brannan	**TG Houston Meeting – 3-18-08:** Brannan, Hjorteset, Ballard, NKO Changes are more than editorial and the paragraph should be reballoted. Proposed changes unanimously agreed to by all the TG members present: Brannan, Hjorteset, Ballard, NKO. **10.3.x – Pressure and Vacuum Relief Testing** – Proper functioning of all pressure and vacuum relief valves and devices shall be confirmed by: • Increasing pressure in the vapor space to check pressure relief ~~by increasing pressure in the vapor space~~. • Creating a vacuum to check vacuum relief by ~~creating a vacuum with~~ a vacuum pump, or alternatively, by partially withdrawing water from the tank. ~~Alternatively,~~ In-situ component testing of relief and vacuum breaker valves by applying ~~with~~ test gas ~~applied to the~~ pressure or vacuum to the control valve pressure/vacuum sensing line is permitted. The ~~and~~ set point of controls shall be calibrated with a dead weight tester. Proper functioning of the relief valves and associated sensing systems shall be verified before the tank is placed into operation. The pressure/vacuum in the tank shall be monitored at all times during testing using instruments with alarm settings to guard against pressure/vacuum conditions outside design limits. Insert in the Commentary **R10.3.x -** …. Verifying proper functioning of the relief valve system includes, but is not limited to ensuring that the pressure drop in the sensing line does not cause premature reseating of the valves.	
		Editorial suggestion, change the bullet points to read: - Increasing pressure to ... check pressure relief - Creating a vacuum to ... check vacuum relief	Pawski		
		I agree that during normal plant operation that the pressure relief valves are tested as described in the alternate. However, prior to the tank being placed into operation the relief valve sensing system needs to be verified as working properly to insure, for example, that the pressure drop in the sensing line does not cause the valves to reseat prematurely. This is not a new requirement for the testing tank relief valves prior to the tank being placed into service and is a requirement of API 620 for single containment tanks. API 620 Q.9.2.5 states the following," Pressure relief and vacuum relief valves shall be checked by applying the design gas pressure to the outer tank, followed by evacuation of the outer space to the vacuum setting of the relief valve."	Hoptay		

CHAPTER V – LOAD FACTORS

	Approved Sections
	Section Approved with Comments
	Negative Vote

Table 5.1 – Primary Concrete Tank

Latest Text Reviewed	Vote	Committee Members' COMMENTS	Author	RESPONSE	Notes
General Comment on referencing ACI 318 instead of ACI 350	***Ballot Results 2/17 – 3/18/08*** Approved = 20 App. w. Com.= 1 Abst.= 6 Neg.= 1	I note the references to ACI 318. Should we also reference ACI 350 because we have adopted ACI 350 because ACI 376 is more appropriately covered by ACI 350?	Brannan	**TG Houston Meeting – 3-18-08:** Brannan, Hjorteset, Ballard, NKO All the load factors with references to ACI 318 are the same as the corresponding load factors in ACI 350. Therefore, all references to ACI 318 will be replaced with references to ACI 350. To contact Hanskat – regarding his negative. This is only an editorial change. Unanimously agreed by all the TG members present: Brannan, Hjorteset, Ballard, NKO.	
		(N) In general for liquid-containment shouldn't we be referencing ACI 350 instead of ACI 318? I assume this is ACI 318-05, not 318-08.	Hanskat		
General		In general we are referring to ACI-350 and not ACI-318. However, for loads it might be appropriate to refer to ASCE 7 "Minimum Design Loads for Buildings and Other Structures" in lieu of ACI-318 or ACI-350 as ACI load factors are based on ASCE 7 load factors.	Hjorteset		
		Need to develop separate Tables showing the load factors applied for the uplift case, instead of combining with Table 5.1 & 5.2 (e.g. 0.9 for dead loads).	Wu	**TG Houston Meeting – 3-18-08:** Brannan, Hjorteset, Ballard, NKO In the TG's opinion it is more efficient to avoid multiple load tables, and to list both factors in the same table. Unanimously agreed by all the TG members present: Brannan, Hjorteset, Ballard, NKO.	
2) Prestressing Loads – I to X	***Ballot Results 2/17 – 3/18/08*** Approved = 18 App. w. Com.= 2 Abst.= 6 Neg.= 2	On "prestressing loads", a) suggest that the load factor of 1.2 should be used (per ACI 318), instead of 1.15. b) The load factor "(1.0)" should be considered in the case of uplift case, and not for the case that the prestressing load is accurately defined.	Wu	**TG Houston Meeting – 3-18-08:** Brannan, Hjorteset, Ballard, NKO At the beginning of this chapter define that load factors specified in this chapter should be used in conjunction with strength reduction factors defined in ACI 350. For Strut-and-Tie models use 0.75, as per ACI 318. Prestressing Loads say: A load factor of 1.0 should be used for all prestressing loads except in the case of the anchorage zones. For post-tensioned anchorage zone design, a load factor of 1.2 shall be applied to the maximum prestressing steel jacking force, as per ACI 350. Commentary: The load factor of 1.2 applied to the maximum tendon jacking force results in a	
		I am concerned about prestressing load factors listed in Table 5.1. ACI-318/350 and ASCE 7 do not list load factors for prestressing loads. For bridge design load factors for prestressing loads are sometimes given, however, the load factors used are only for "Forces and moments transferred from members containing post-tensioning steel to other members upon application of the post-tensioning force" or for secondary effects. (For primary post-tensioning effects, load factors have no meaning). For bridge design, the load factors for secondary effects are typically 1.0 for all load combinations. The 1.2 load factor referenced to ACI 318 paragraph 9.2.5 is for local anchorage zone design and not for global design. A load factor of 1.2 on maximum initial stressing load for post-tensioned anchor design should be	Hjorteset		

Latest Text Reviewed	Vote	Committee Members' COMMENTS	Author	RESPONSE	Notes
		maintained because a single tendon may by accident be severely overstressed. However, a load factor of 1.2 for global effects might be high (conservative) when the load factors are applied to load effects from initial stressing loads or even final stressing loads (including seating loss). It would be prudent to look further into the magnitude of load factors for post-tensioning and what post-tensioning loads should be used as an upper and lower bound. For example, upper bound might be initial post-tensioning including tendon friction, anchor seating and elastic shortening of concrete. While a lower bound includes losses due to creep, shrinkage, and relaxation.		design load of about 113 percent of the specified prestressing steel yield strength, but not more than 96 percent of the nominal ultimate strength of the prestressing steel. This compares well with the maximum attainable jacking force, which is limited by the anchor efficiency factor. Unanimously agreed by all the TG members present: Brannan, Hjorteset, Ballard, NKO. Hjorteset to further pursue the issue and contact Hoptay	
		(N) In 2) it states: "1.15 - usually used for PSC". "Usually" is not mandatory language..	Hanskat		
		Proposed 1.15 factor for prestressing loads other than the anchorage zone. Before any of the proposed load factors can be approved, the strength reduction factors need to be defined and approved. Both factors need to form a consistent philosophy of design.	Hoptay		
7) Construction – Operation Loads	***Ballot Results 2/17 – 3/18/08*** Approved = 21 App. w. Com.= 1 Abst.= 6 Neg.= 0	(E) In item 7) change CONSTRUCTION-OPERATION to CONSTRUCTION AND OPERATION	Hanskat	Change introduced.	
15) Environmental Loads	***Ballot Results 2/17 – 3/18/08*** Approved = 21 App. w. Com.= 1 Abst.= 6 Neg.= 0	• In section 15 on Wind there is no factor under any of the abnormal loading conditions but there is 1.0 in the notes. This is inconsistent with the presentations in the other sections. Please clarify. • One of the notes in Section 19 refers to the tank's response if it is on piles and seems to imply that a different response will occur if the tank is on a shallow foundation. Please clarify.	Allen	**TG Houston Meeting – 3-18-08:** Brannan, Allen, Ballard, NKO Factor of 1.0 removed from the commentary To address the second comment, introduce the following change: "Explosion and impact loads generally have little of no effect on the primary tank of a double wall tank. However, ~~if the tank is on piles~~ the response of the entire structure may induce forces in the primary container." This is only an editorial change. Unanimously agreed by all the TG members present: Brannan, Allen, Ballard, NKO.	

Ballard, Thomas A	Load factors for product pressure are high considering that the probability of the fill level exceeding the maximum design level is limited by the freeboard and that reliability of the design is pretty high. However, if the load factor of 1.4(D + F) is the only load combination where 1.4F is applied, then this should not control the design since a 1.2 factor on hydrotest (1.25*F) will control the design. Load factors for dead loads when combined with Spill and Spill+SSEalt should be 1.0. The table implies that dead load is not combined with spill or spill+SSEalt, which is not the case. Load factors for OBE or SSE should be 1.0 with different performance limits set for OBE and SSE. For a two-level earthquake design, the probability of failure is implicit in the earthquake return period and all other factors should be based on best estimate. If additional factors are introduced for probability that the loads exceed their best estimated value or probability that the design does not perform as expected, then the probability of failure is skewed to the more conservative side.
Godejord, Arnstein	See pdf file) 2 – IV: Load factor less than 1.0 should be considered. Less prestressing than intended may lead to leakage 2 – VII: Load factor other than 1.0 seems unreasonable 3 – VII: Load factor other than 1.0 seems unreasonable 17 – VII: The load factor for OBE should be 1.0. Load factor of 1.3 is to strict.

Table 5.2 – Secondary Concrete Tank

Latest Text Reviewed	Vote	Committee Members' COMMENTS	Author	RESPONSE	Notes
General Comment on referencing ACI 318 instead of ACI 350	***Ballot Results 2/17 – 3/18/08*** Approved = 20 App. w. Com.= 1 Abst.= 6 Neg.= 1	I note the references to ACI 318. Should we also reference ACI 350 because we have adopted ACI 350 because ACI 376 is more appropriately covered by ACI 350?	Brannan	**TG Houston Meeting – 3-18-08:** Brannan, Hjorteset, Ballard, NKO All the load factors with references to ACI 318 are the same as the corresponding load factors in ACI 350. Therefore, all references to ACI 318 will be replaced with references to ACI 350. To contact Hanskat – withdrawing his negative? This is only an editorial change. Unanimously agreed by all the TG members present: Brannan, Hjorteset, Ballard, NKO.	
		(N) In general for liquid-containment shouldn't we be referencing ACI 350 instead of ACI 318? I assume this is ACI 318-05, not 318-08.	Hanskat		
General		In general we are referring to ACI-350 and not ACI-318. However, for loads it might be appropriate to refer to ASCE 7 "Minimum Design Loads for Buildings and Other Structures" in lieu of ACI-318 or ACI-350 as ACI load factors are based on ASCE 7 load factors.	Hjorteset		
		Need to develop separate Tables showing the load factors applied for the uplift case, instead of combining with Table 5.1 & 5.2 (e.g. 0.9 for dead loads).	Wu	**TG Houston Meeting – 3-18-08:** Brannan, Hjorteset, Ballard, NKO In the TG's opinion it is more efficient to avoid multiple load tables, and to list both factors in the same table. Unanimously agreed by all the TG members present: Brannan, Hjorteset, Ballard, NKO.	
E-2) Prestressing Loads – I to X	***Ballot Results 2/17 – 3/18/08*** Approved = 18 App. w. Com.= 2 Abst.= 6 Neg.= 2	On "prestressing loads", a) suggest that the load factor of 1.2 should be used (per ACI 318), instead of 1.15. b) The load factor "(1.0)" should be considered in the case of uplift case, and not for the case that the prestressing load is accurately defined.	Wu	**TG Houston Meeting – 3-18-08:** Brannan, Hjorteset, Ballard, NKO At the beginning of this chapter define that load factors specified in this chapter should be used in conjunction with strength reduction factors defined in ACI 350. For Strut-and-Tie models use 0.75, as per ACI 318. Prestressing Loads say: A load factor of 1.0 should be used for all prestressing loads except in the case of the anchorage zones. For post-tensioned anchorage zone design, a load factor of 1.2 shall be applied to the maximum prestressing steel jacking force, as per ACI 350. Commentary: The load factor of 1.2 applied to the maximum tendon jacking force results in a design load of about 113 percent of the specified prestressing steel yield strength, but not more than 96 percent of the nominal ultimate strength of the prestressing steel. This compares well with the maximum attainable jacking force, which is limited by the anchor efficiency factor. Unanimously agreed by all the TG members present: Brannan, Hjorteset, Ballard, NKO.	
		I am concerned about prestressing load factors listed in Table 5.1. ACI-318/350 and ASCE 7 do not list load factors for prestressing loads. For bridge design load factors for prestressing loads are sometimes given, however, the load factors used are only for "Forces and moments transferred from members containing post-tensioning steel to other members upon application of the post-tensioning force" or for secondary effects. (For primary post-tensioning effects, load factors have no meaning). For bridge design, the load factors for secondary effects are typically 1.0 for all load combinations. The 1.2 load factor referenced to ACI 318 paragraph 9.2.5 is for local anchorage zone design and not for global design. A load factor of 1.2 on maximum initial stressing load for post-tensioned anchor design should be maintained because a single tendon may by accident be severely overstressed. However, a load factor of 1.2 for global effects might be high (conservative) when the load factors are applied to load effects from initial stressing loads or even final stressing loads (including seating loss). It would be prudent to look further into the magnitude of load factors for post-tensioning and what post-tensioning loads should be used as an upper and lower bound. For example, upper bound might be initial post-tensioning including tendon friction, anchor seating and elastic shortening of concrete. While a lower bound includes losses due to creep, shrinkage, and relaxation.	Hjorteset		

Latest Text Reviewed	Vote	Committee Members' COMMENTS	Author	RESPONSE	Notes
		(N) In 2) it states: "1.15 - usually used for PSC". "Usually" is not mandatory language..	Hanskat	Hjorteset to further pursue the issue and contact Hoptay	
		The proposed load factor reduction from 1.2 to 1.0 for the OBE load is not consistent with the NFPA 59A (B.2)statement that the OBE is designed in accordance with conventional engineering procedures and criteria. Also it is not consistent to have the same load factor as the SSE event which is the limit state check.	Hoptay		
E-7) Construction – Operation Loads	***Ballot Results 2/17 – 3/18/08*** Approved = 21 App. w. Com.= 1 Abst.= 6 Neg.= 0	(E) In item 7) change CONSTRUCTION-OPERATION to CONSTRUCTION AND OPERATION	Hanskat	Change introduced.	
E-15) Environmental Loads - Wind		E-15 environmental wind loads are 1.6 without directionality factor and 1.3 with directionality factor per ACI 318. This is correct, but ASCE 7 commentary says that there is another criterion to satisfy in order to use 1.3, and that is the site has to be outside hurricane region. For most import facilities this would require the 1.6 factor and not the 1.3.	Pawski	**TG Houston Meeting – 3-18-08:** Brannan, Allen, Ballard, NKO In the TG's opinion ACI 350 should be followed. Ballard to review the issue further and update the Editorial TG accordingly. Unanimously agreed by all the TG members present: Brannan, Allen, Ballard, NKO.	
E-18) Seismic Loads - SSE E-19) Explosion and Impact E-20) Fire	***Ballot Results 2/17 – 3/18/08*** Approved = 21 App. w. Com.= 1 Abst.= 6 Neg.= 0	Agree with all proposed load factors with the exception of "abnormal" combination 18 - SSE; 19 Explosion & Impact; 20 Fire where a load factor of 1.0 is specified. A load factor of 1.05 would be recommendable. See EN 14620-3 Table 1 and BS 7777 Part 3 Table A.3 and given the load factors proposed for the inner tank in Table 5.1. Alternatively, but less transparent and satisfactory, values may be specified for flux, explosion etc.	Douglas		

Ballard, Thomas A	Load factors for product pressure are high considering that the probability of the fill level exceeding the maximum design level is limited by the freeboard and that reliability of the design is pretty high. However, if the load factor of 1.4(D + F) is the only load combination where 1.4F is applied, then this should not control the design since a 1.2 factor on hydrotest (1.25*F) will control the design. Load factors for dead loads when combined with Spill and Spill+SSEalt should be 1.0. The table implies that dead load is not combined with spill or spill+SSEalt, which is not the case. Load factors for OBE or SSE should be 1.0 with different performance limits set for OBE and SSE. For a two-level earthquake design, the probability of failure is implicit in the earthquake return period and all other factors should be based on best estimate. If additional factors are introduced for probability that the loads exceed their best estimated value or probability that the design does not perform as expected, then the probability of failure is skewed to the more conservative side.
Godejord, Arnstein	Load factor less than 1.0 for prestressing loads should be considered Load factor for earthquake OBE should be set to 1.0