UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 – 0001

April 5, 2010

MEMORANDUM TO: ACRS Members

FROM: Natalie Mitchell-Funderburk, Secretary ***/RA/***
Advisory Committee Reactor Safeguards

SUBJECT: CERTIFICATION OF THE MINUTES OF THE ACRS SUBCOMMITTEE ON THE AP1000 REACTOR, October 6-7, 2009, ROCKVILLE, MARYLAND

The minutes of the subject meeting, issued on April 5, 2010, have been certified as the official record of the proceedings for that meeting. A copy of the certified minutes is enclosed.

Enclosure: As stated

cc via e mail: ACRS Staff Engineer

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 – 0001

April 5, 2010

MEMORANDUM TO: Said Abdel-Khalik, Chairman
ACRS

FROM: Harold B. Ray, Chairman
ACRSAP1000 Subcommittee

SUBJECT: CERTIFICATION OF THE MINUTES OF THE ACRS SUBCOMMITTEE ON THE AP1000 REACTOR, October 6-7, 2009, ROCKVILLE, MARYLAND

I hereby certify, to the best of my knowledge and belief, that the minutes of the subject meeting held on October 6-7, 2009, are an accurate record of the proceedings.

/RA/ 3/4/2010
Harold B. Ray, Chairman *Date*
ACRS AP1000 Subcommittee

Certified on: March 4, 2010 Issued: April 5, 2010
Certified by: Harold B. Ray

REVISION 17 TO AP1000 DESIGN CONTROL DOCUMENT: SELECTED CHAPTERS

October 6-7, 2009
ROCKVILLE, MARYLAND

INTRODUCTION

The Advisory Committee on Reactor Safeguards (ACRS) Subcommittee on the Westinghouse Electrical Company's AP1000 advanced pressurized water reactor (PWR) design met in Room T-2B3 at the Headquarters of the U.S. Nuclear Regulatory Commission (NRC), located at 11545 Rockville Pike, Rockville, Maryland, on October 6-7 2009. The Subcommittee was briefed by representatives of the Westinghouse Electrical Company (WEC) and NRC's Office of New Reactor Licensing (NRO). The topics included selected chapters of revision 17 (hereafter REV17) of the design control document (or DCD) amendment describing the standard plant design for the AP1000 PWR. As part of the respective review processes, NRC's regulations under 10 CFR Part 52 direct the staff to consult with the ACRS on safety-related issues before any reactor design can be certified or any NRC operating license can be approved.

The staff's SER review was organized based on the various chapters found in NUREG-0800 – NRC's "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition." To this end, the Subcommittee planned to gather information, analyze relevant issues and facts, and formulate proposed positions and actions, as appropriate, for deliberation by the full Committee of the ACRS at a later date. This was the second of scheduled Subcommittee meetings on the proposed amended DCD. The first Subcommittee meeting was held in July 2009.

The Chairman for this ACRS Subcommittee was Mr. Harold Ray. Mr. Michael P. Lee was the cognizant ACRS staff engineer on this topic and served as the Designated Federal Official for this meeting. The entire meeting was open to public attendance. The Subcommittee received no written comments or requests for time to make oral statements from any members of the public concerning the subject of this meeting. This two-day meeting convened at approximately 9:00 am on the first morning and 8:30 am on the second day.

The detailed agenda identifying the presentation topics comprising this meeting can be found in Attachment 1. The presentation materials and sign-in sheets can be found in Attachment 2. Attachment 3 is a Trip Report submitted by ACRS invited consultant Dr. Thomas Kress. Both during and following the scheduled presentations, the speakers responded to specific questions and comments from the ACRS Subcommittee members. The scope of the questions, comments, and answers thereto, and the speaker's responses thereto, have been captured in the verbatim meeting transcript. Nevertheless, as a result of Member questions and comments, and speaker responses (answers) thereto – so-called 'Qs and As', a number of follow-up actions were identified for further discussion at subsequent Subcommittee meetings. These follow-up actions will be tracked by the ACRS staff.

ACRS Subcommittee meeting transcripts can be found at the following NRC Internet website location: *http://www.nrc.gov/ reading-rm/doc-collections/acrs/tr/subcommittee/*.

ATTENDEES

ACRS		
H. Ray, Subcommittee Chairman	S. Banerjee, Member	D. Bley, Member
M. Bonaca, Member	M. Ryan, Member	W. Shack, Member
J. Armijo, Member	T. Kress, Invited ACRS Consultant	M. Lee, ACRS Staff
W. Wang, ACRS Staff		

NRC Staff		
F. Akstulewicz, NRO	D. Jaffe, NRO	P. Pieringer, NRO
P. Buckberg, NRO	R. Jenkins, NRO	N. Ray, NRO
P. Chen, NRO	M. Keefe, NRO	J. Rayan, NRO
O. Chopra, NRO	P. Keillan, NRO	E. Reichelt, NRO
J. Chuang, NRO	J. Lai, ACRS Staff	K. See, NRO
P. Clark, NRO	C-Y Li, NRO	J. Segala, NRO
M. Commar, NRO	T. Le, NRO	T. Scarbrough, NRO
D. Desauhers, NRO	R. Li, NRO	D. Shum, NRO
P. Donnelly, NRO	S. Lu, NRO	T. Spicher, NRO
B. Gleaves, NRO	J. Marble, NRO	B. Thomas, NRO
D. Habib, NRO	J. Martin, NRO	D. Tera, NRO
C. Hair, NRC-Office of the General Counsel	M. McKenna, NRO	J. Walker, NRO
R. Hernandez, NRO	R. McNally, NRO	Y. Wong, NRO
J. Dixon-Herrity, NRO	B. Musico, NRC-Nuclear Security & Incident Response	C. Wu, NRO
J. Honcharik, NRO	C. Ng, NRO	
R. Hsu, NRO	S. Park, NRO	
J. Huang, NRO	P. Patel, NRO	

Others		
A. Aughtman, Southern Nuclear Co.	B. Hermanpour, NuStart	J. O'Hara, Brookhaven National Lab (BNL)
J-P Berger, Électricité de France (EDF International North America)	J. Higgins, BNL	R. Seelman, WEC
R. Cooper, Nuclear News	P. Hunton, WEC	B. Sisk, WEC
E. Cummins, WEC	P. Kotwicki, WEC	T. Spink, TVA
M. Demaglio, WEC	A. Levin, Areva	T. Pilo, Progress Energy
M . Gibson, Progress Energy (NuStart)	D. Lindgren, WEC	J. Reed, WEC
E. Grant, NuStart	M. Melton, WEC	D. Wiseman, WEC
R. Grumbir, NuStart	G. Meyer, WEC	
P. Hastings, NuStart (Duke Energy)	A. Monroe, WEC	
P. Hunton, WEC	M. Subudhi, BNL	

SCHEDULED PRESENTATIONS

The published meeting agenda for this Subcommittee meeting called for the discussion of topics corresponding to three specific chapters in the proposed amended DCD, consistent with the staff's guidance found in the SRP. It was those chapters, listed below, that were discussed at this Subcommittee meeting:

DCD Chapter 3	*Design of Structures, Components, Equipment and Systems (with the exception of Sections 3.7 and 3.8)*
DCD Chapter 8	*Electric Power*
DCD Chapter 18	*Human Factors Engineering*

In general, for each DCD chapter, a standard briefing template was followed that consisted of essentially two elements:

(1) a Westinghouse-led discussion on the proposed REV17 changes (i.e., proposed amendments) to the currently-certified DCD.

(2) an NRC-led discussion concerning the results of the staff's review of the proposed amended DCD, including the discussion of applicable open items bearing on AP1000 DCD standard content.

The briefing materials used in association with the respective DCD chapter presentations can be found at the Attachment 2.

Opening Remarks by the Subcommittee Chair

Subcommittee Chair Ray made the opening remarks. He stated that the purpose of this Subcommittee meeting was two-fold. First, it was to learn more about the nature and scope of the Westinghouse-proposed changes to revision 15 (the current NRC-certified design) of the AP1000 DCD. Second, it was to hear from the NRC staff on the results of their review of the proposed amended DCD. Mr. Ray noted that there were hundreds of textual modifications to the proposed DCD amendment, and he expressed the desire that the discussions (presentations) of the highlighted changes (revisions) would proceed in an efficient way.

Introductory Statements

Ms. McKenna, the NRO Branch Chief responsible for AP1000 DCD amendment review, also made an opening statement. Consistent with the published meeting agenda, Ms. McKenna noted that the scheduled presentations would cover SRP Chapters 8, 18, and most of Chapter 3. The other portions of Chapter 3, specifically those sections pertaining to structural design and the treatment of seismicity (specifically Section 3.7 and 3.8) were still undergoing discussions with WEC and consequently would be covered at some future Subcommittee meeting. Ms. McKenna also noted that the focus of the staff's safety reviews were on those changes introduced by WEC subsequent to the NRC certification of REV15 as well as a review of any potential impacts of those changes on the balance of the AP1000 overall design. She also noted that NRO staff had issued the draft SERs on Chapters 2 ("Site Characteristics and Site Parameters") and 13 ("Conduct of Operations"). Although these chapters had been provided to the Committee, she indicted that the staff do not plan on reviewing this material with the Subcommittee. She commented that the two chapters in question had no significant technical material or safety-related information. Moreover, Ms. McKenna reported that it was the staff's intention to address Chapter 2-related information with the Subcommittee in the context of specific DCD chapters where it is used. Lastly, Ms. McKenna noted that the staff intended to address some of the so-called "follow-up" actions (i.e., questions) that were raised previously by the Subcommittee during the July 2009 meeting.

Mr. Robert Sisk, the WEC AP1000 Licensing Manager spoke next and he introduced the WEC Vice President of Regulatory Affairs and Standardization, Mr. Ed Cummins. Other WEC representatives were introduced during the presentations.

Before the formal presentations commenced, Member Bonaca asked a question concerning the motivation (or driver) behind the REV17 changes to the existing certified AP1000 design. In response, Mr. Sisk noted that there were the following 'drivers':

(1) the closing-out the COL holder items:

(2) the need to address design acceptance criteria (DAC) issues;

(3) refinements/finalization in certain aspects of the design; and

(4) the apparent resolution of NRC staff issues and concerns.

SUBCOMMITTEE FOLLOW-UP ACTIONS

As a result of questioning by Subcommittee Members at the July 2009 meeting, a number of follow-up actions were identified for tracking at future AP1000 Subcommittee meetings. Approximately 27 follow-up actions were identified by the Subcommittee and they can be found in Attachment 2. At the October 2009 meeting, NRC staff, WEC representatives, and the ACRS Members and staff reviewed the status of about 22 of these follow-up actions. As a result of those discussions it was determined that about eight of the follow-up actions could be considered "closed." The status/disposition of all follow-up actions is identified in an italicized type face in Attachment 2. New action items were identified during the October 2009 Subcommittee meeting and their status will be reviewed at the next AP1000 Subcommittee meeting currently scheduled for November 19-20, 2009.

Attachments (4):

1. Detailed Meeting Agenda
2. Presentation Materials and Sign-In Sheets
3. T. Kress Trip Report
4. ACRS AP1000 Subcommittee Action Items

Advisory Committee on Reactor Safeguards

MEETING OF THE SUBCOMMITTEE ON THE WESTINGHOUSE (WEC) AP1000 DESIGN CONTROL DOCUMENT AMENDMENTS (DCDA) AND NRC DRAFT SAFETY EVALUATION REPORT (DSER) WITH OPEN ITEMS (OIs)

OCTOBER 6-7, 2009

MEETING AGENDA

Subommittee Chair: Harold Ray
ACRS Contact: Michael Lee 301/415-6887
mpl@nrc.gov

	AGENDA ITEM/TOPIC	PRESENTER(S)	TIME (approx.)
	October 6, 2009, Room T-2B1		
1	Opening Remarks by the Subcommittee Chair	Harold Ray/ACRS	9:00 am - 9:05 am
2	Introductions and Opening Comments	E. McKenna/NRC E. Cummins/Westinghouse	9:05 am - 9:15 am
3	DCDA Chapter 8	R. Sisk/Westinghouse	9:15am - 9:45am
4	NRC Chapter 8 DSER/OIs	D. Jaffee/NRC O. Chopra/NRC	9:45am - 10:15am
	*** BREAK ***		10:15am - 10:30am
5	DCDA Chapter 18	R. Sisk/Westinghouse	10:30 am - 11:30am
	*** LUNCH ***		11:30 am - 12:30 pm
6	NRC Chapter 18 DSER/OIs	P. Donnelly/NRO P. Pieringer/NRC	12:30 pm - 1:30 pm
7	Summary/Follow-ups from the July 2009 ACRS AP1000 Subcommittee Meeting	E. McKenna/NRC S. Coffin/NRC R. Sisk/Westinghouse	1:30am - 2:30 pm
	*** BREAK ***		2:30 pm - 2:45 pm
8	DCDA Section 3.4	R. Sisk/Westinghouse	2:45 pm - 3:45 pm
9	NRC Section 3.4 DSER/OIs	P. Clark/NRC K. See/NRC C. Li/NRC	
10	Subcommittee Discussion	Harold Ray/ACRS et al.	3:45 pm - 4:00 pm
11	Adjourn		4:00 pm

MEETING AGENDA
(continued)

	AGENDA ITEM/TOPIC	PRESENTER(S)	TIME (approx.)
	October 7, 2009, Room T-2B1		
1	Opening Remarks by the Subcommittee Chair	Harold Ray/ACRS	8:30 am - 8:35 am
2	DCDA Chapter 3 Sections 3.2, 3.6, 3.9.1-3.9.5, 3.10, 3.12	R. Sisk/Westinghouse	8:35am -10:00 am
	*** BREAK ***		10:00 am - 10:15 am
3	NRC Chapter 3 DSER/OIs - Sections 3.2, 3.6, 3.9.1-3.9.5, 3.10, 3.12	Various NRC Staff	10:15 am - 11:45 am
	*** LUNCH ***		11:45 am - 12:45 pm
4	DCDA Chapter 3 Sections 3.3, 3.5.3	R. Sisk/Westinghouse	12:45 pm - 2:00 pm
5	NRC Chapter 3 DSER/OIs - Sections 3.3, 3.5.3	Various NRC Staff	
6	DCDA Chapter 3 Sections 3.6.3, 3.9.6, 3.11	R. Sisk/Westinghouse	2:00 pm - 2:45 pm
	*** BREAK ***		2:45 pm - 3:00 pm
7	NRC Chapter 3 DSER/OIs - Sections 3.6.3, 3.9.6, 3.11	Various NRC Staff	3:00 pm - 3:45 pm
8	Subcommittee Discussion	Harold Ray/ACRS et al.	3:45 pm - 4:15 pm
9	Adjourn		4:15 pm

NOTES:

1. Presentation time should not exceed 50 percent of the total scheduled time. The remaining time is reserved for Subcommittee discussion.

2. 50 copies of the presentation materials are to be provided to the ACRS staff at the time of the meeting.

3. An electronic copy of the presentation materials are to be provided to both the Court Reporter and the ACRS staff.

AP1000 Design Control Document

Amended Design

Chapter 8 – Electric Power

Bob Seelman

Mark DeMaglio

AP1000 Electrical Systems Integration

October 6, 2009

Westinghouse

Chapter 8 - Overview

The AP1000 design does not require Class 1E alternating current (ac) electrical power, except that provided by the Class 1E direct current (dc) batteries and their inverters, to accomplish the plant's safety-related functions.

Major Changes:

- Onsite Power Systems
- Containment Electrical Penetrations
- Reactor Coolant Pump Breakers

Westinghouse

Chapter 8 – Governing NRC Guidance

- ac power systems have no safety function – conformance to GDC, Reg Guides, and Class 1E IEEE Standards generally not required
  - Exceptions are stated in Table 8.1-1

- Class 1E dc power design is based on the GDC, Reg Guides, and IEEE Standards listed in DCD Rev 17, Section 8.1.4.3

Westinghouse

Chapter 8 – Design Changes

NUREG-1793 - Offsite Power System

- Added Fast Bus Transfer (TR79)
  - Added an additional Reserve Auxiliary Transformer
  - Benefits:
    - Will avoid reactor trip due to component failure or spurious actuation of the protective relaying
    - Allow complete bus transfer from Unit Auxiliary Transformers to Reserve Auxiliary Transformers
  - Confirmatory Item

Chapter 8 – Design Changes

NUREG-1793 - Onsite Power System (cont.)

Change in Class 1E dc Distribution

- Change in system voltage of Class 1E dc loads from 125Vdc to 250Vdc
- Tier 1 change
- Benefits:
  - Draw less current to accomplish required power resulting in reduced cable sizes

Westinghouse

Chapter 8 – Design Changes

NUREG-1793 - Onsite Power System (cont.)

Change in Non-Class 1E dc and UPS System

- Added a dc subsystem (EDS5) to serve non-safety related turbine generator motor loads
- Tier 1
- Benefits: An expanded EDS4 subsystem provides greater flexibility to service the Non-Class 1E portion of the dc and UPS system

Westinghouse

Chapter 8 – Design Changes

NUREG-1793 – Containment Electrical Penetrations

- Module Separation Criteria for Cables
  - Deleted the need for module separation criteria for cables of varying voltage service levels
  - Tier 2 change affecting Tier 1
  - Benefit: places electrical penetration conductor modules in penetrations of the same service class

Westinghouse

Chapter 8 – Design Changes

NUREG-1793 – Reactor Coolant Pump Breakers

- Added Isolation Breakers
  - Added input and output isolation breakers to each variable frequency drive (VFD) unit
  - Tier 2 change affecting Tier 1
  - Benefit: provides flexibility to service the VFD unit without taking the RCP offline

Westinghouse

Open Items

Item	Subject	Status
CI-SRP-8.3.1-EEB-02	Fast Bus Transfer	Resolved
OI-SRP8.3.2-EEB-03	Provide load profiles for 24/72 hour batteries	The nominal loads on the batteries are identified in DCD tables 8.3.2-1, 2, 3, 4. Detailed load profiles will be provided with/ as a design input to the calculations fulfilling OI-SRP8.3.2-EEB-05 (below).
OI-SRP8.3.2-EEB-04	Provide a qualification test program for 24/72 hour batteries	APP-DB01-VPH-001, Rev A "AP1000 Test Plan for Safety Related 250 VDC Batteries" was submitted August 20, 2009 for NRC review.

Open Items

OI-SRP8.3.2-EEB-05	Provide battery sizing calcs, terminal voltage calcs, short circuit calcs, voltage drop for safety related batteries	Review of these calculations will be available during design review. Expected timeframe is Q1 10

Open Items

OI-SRP8.3.2-EEB-08	Explain how Westinghouse will assure consistency in transfer of design information to the applicant related to voltage regulation, ratings for equipment such as circuit breakers, and assumptions used to determine equipment sizing.	Non-safety design calculations to include plant ETAP analysis will be transmitted to the COLA with plant finalization/ document turnover as a part of a configuration controlled process. These design calculations will include the design inputs, assumptions, methodology, and acceptance criteria used in the development of the sizing basis, settings, lad flow, short circuit and voltage regulation.

Open Items

OI-SRP8.3.2-EEB-09	Explain methodology to ensure that during voltage transients on the AC system the DC system is protected and the battery charger/ inverter trips are coordinated.	The AP1000 recognizes the need for voltage protection of battery chargers and inverters IAW IEEE446. WEC will require suppliers to provide protection that coordinates the input voltage protection of the charger and the inverter.

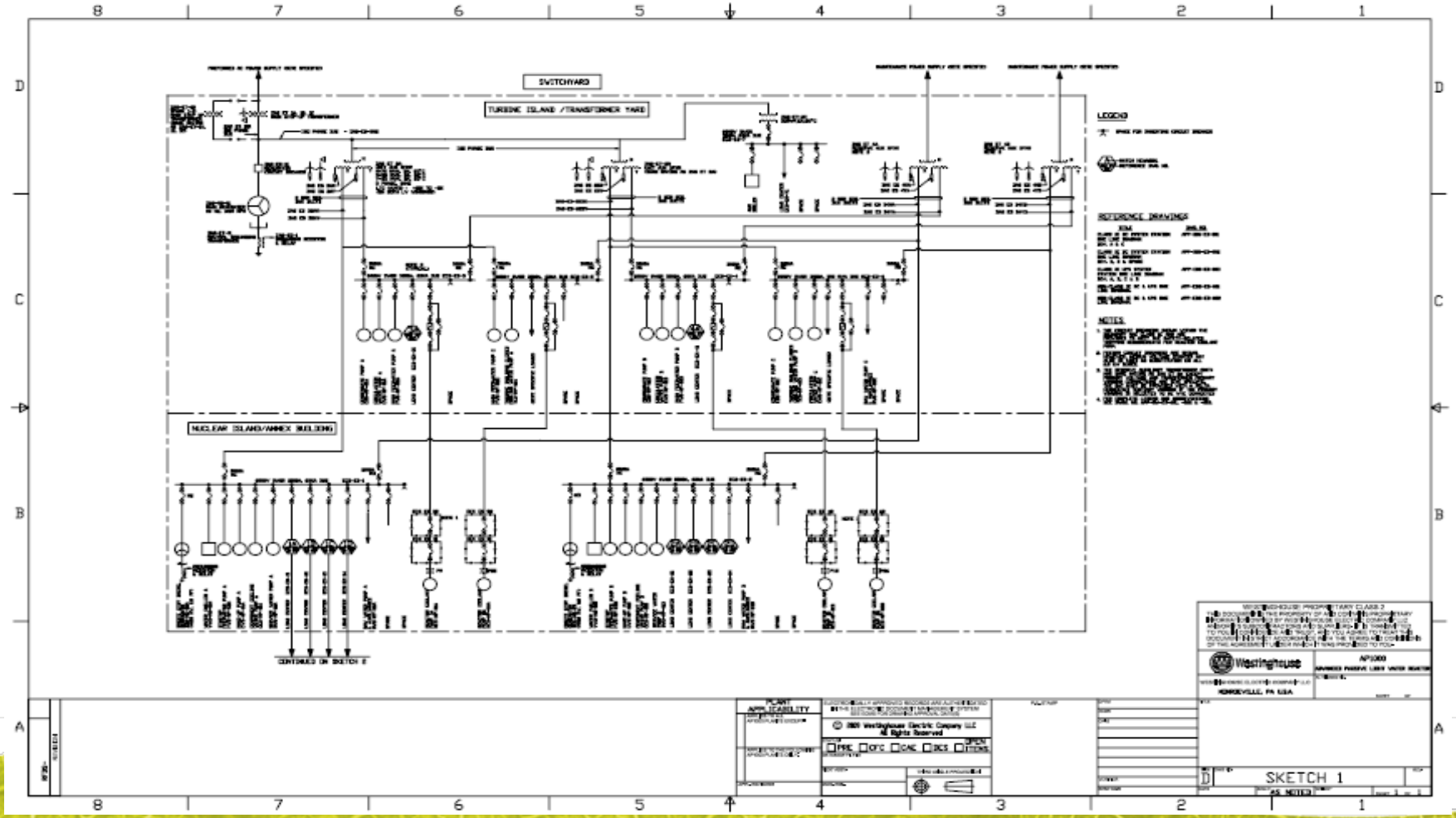
Conclusions

The review of the amended DCD produced:

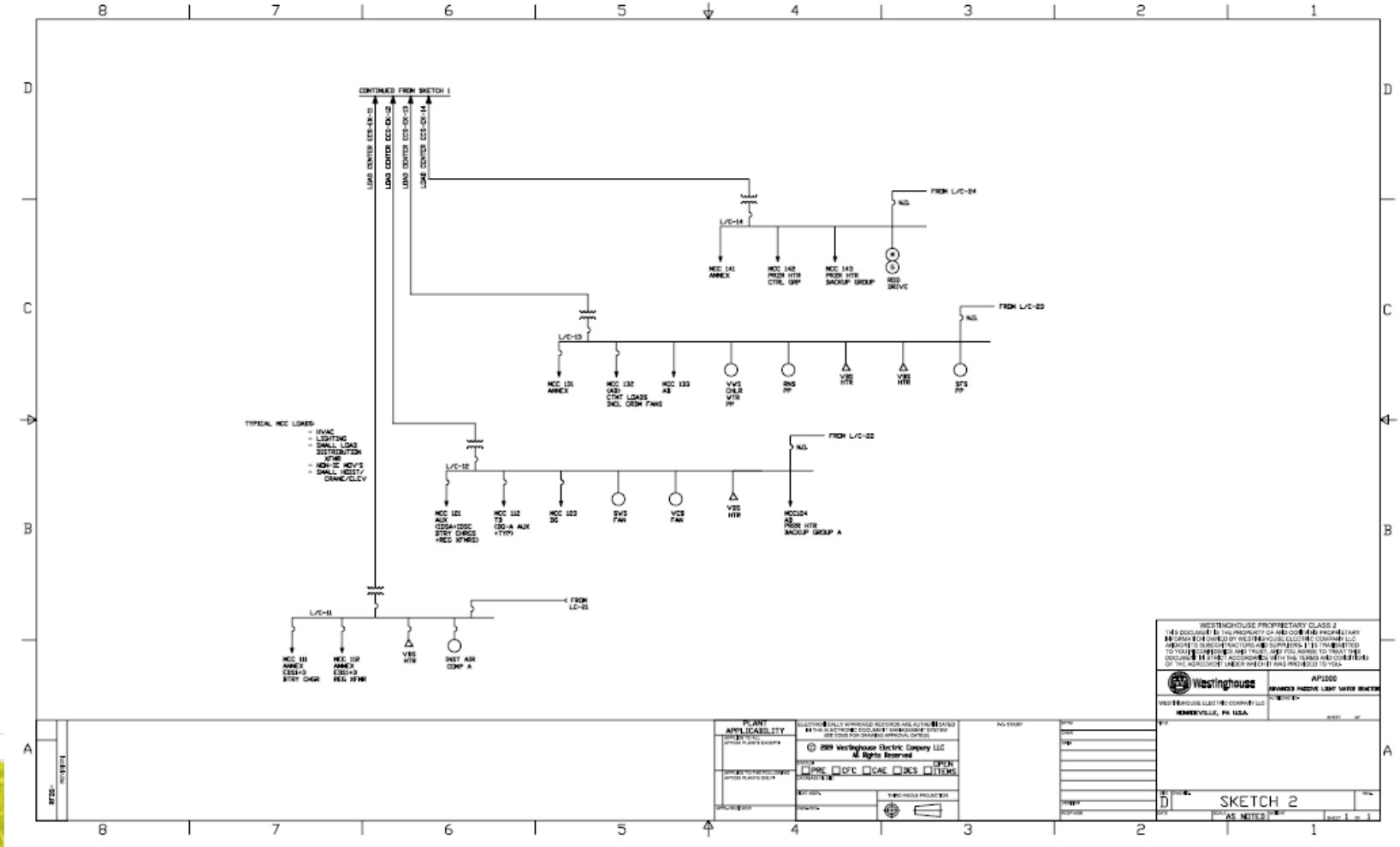
- 11 RAIs / responses
- 5 Open Items
- 2 Confirmatory Items (Resolved)

Westinghouse

Sketch 1


SWITCHYARD
TURBINE ISLAND /TRANSFORMER YARD
NUCLEAR ISLAND/ANNEX BUILDING
LEGEND
REFERENCE DRAWINGS
NOTES
Westinghouse
SKETCH 1

Sketch 2


CONTINUED FROM SKETCH 1
LOAD CENTER ECS-DC-11
LOAD CENTER ECS-DC-12
LOAD CENTER ECS-DC-13
LOAD CENTER ECS-DC-14
FROM L/C-24
L/C-14
MCC 141 ANNEX
MCC 142 PRZR HTR CTRL GRP
MCC 143 PRZR HTR BACKUP GROUP
RCD DRIVE
FROM L/C-23
L/C-13
MCC 131 ANNEX
MCC 132 CASI CTMT LOADS INCL CRDM FANS
MCC 133 AB
VWS OILS WTR PP
RNS PP
VBS HTR
VBS HTR
SFS PP
TYPICAL MCC LOADS:
- HVAC
- LIGHTING
- SMALL LOAD DISTRIBUTION XFMR
- NON-IE MOV'S
- SMALL HOIST/ CRANE/CLEV
FROM L/C-22
L/C-12
MCC 121 AUX CCS&+120DC STBY CHRGS +REG XFMRS
MCC 122 TS CSO-A AUX +TYPO
MCC 123 SC
RVS FAN
VCS FAN
VBS HTR
MCC124 AB PRZR HTR BACKUP GROUP A
FROM LC-25
L/C-11
MCC 111 ANNEX ECS+3 STBY CHGR
MCC 112 ANNEX ECS+3 REG XFMR
VBS HTR
INST AIR COMP A
WESTINGHOUSE PROPRIETARY CLASS 2
Westinghouse
AP1000
ADVANCED PASSIVE LIGHT WATER REACTOR
WESTINGHOUSE ELECTRIC COMPANY LLC
MONROEVILLE, PA U.S.A.
PLANT APPLICABILITY
© 2009 Westinghouse Electric Company LLC
All Rights Reserved
PRE
DFC
CAE
DCS
OPEN ITEMS
THIRD ANGLE PROJECTION
NO STAMP
D
SKETCH 2
AS NOTED
SHEET 1 OF 1

United States Nuclear Regulatory Commission

Protecting People and the Environment

Presentation to the ACRS Subcommittee

Westinghouse AP1000 Design Certification Amendment Application Review

SER/OI Chapter 8

Electric Power Systems

October 6-7, 2009

Staff Review Team

- Technical Staff
  - **Ronaldo Jenkins**, Chief, Electrical Engineering Branch, Division of Engineering (EEB/DE)
  - **Om Chopra**, Sr. Electrical Engineer, Electrical Systems Branch, Division of Engineering (EEB/DE)
- Project Manager
  - **David Jaffe**, AP1000 DCA

Overview of DCA

SRP Section/Application Section		Open Items
		DCA
8.1	Introduction	0
8.2	Offsite Power System	0
8.3.1	AC Onsite Power System	0
8.3.2	DC Power Systems	5
Totals		5

Overview of AP1000 DCA Chapter 8 Electric Power Systems

DCD Section		Summary of Changes to DCA
8.1	Summary Description	- Minor Editorial changes
8.2	Offsite Power System	- Added a reserve auxiliary transformer (Rev.16) - Added unit auxiliary transformer (Rev.16) - Incorporate fast bus transfer scheme to automatically transfer loads from the unit auxiliary transformer to the reserve transformer (Rev.16)
8.3.1	AC Onsite Power Systems	- Revised the nominal power ratings of various pieces of equipment and updated diesel generator load Tables 8.3.1-1 and 2 (Rev.16) - Replaced a diesel-fired auxiliary steam boiler with a electric auxiliary steam boiler (Rev. 16)

Overview of AP1000 DCA Chapter 8 Electric Power Systems

DCD Section		Summary of Changes to DCA
8.3.2	DC Onsite Power Systems	- Changed the system voltage for the operation of Class 1E dc loads from 125 V dc to 250 v dc. (Rev.17)
8.4	8.4.1 Electrical Penetrations 8.4.2 Reactor Coolant pumps	- Revised DCD to include non-Class 1E penetration to be qualified for a harsh environment (Rev.16) - Revised Figure 2.6-1 to add input and output isolation breakers to each RCP pump variable frequency drive (Rev.16)

Technical Topics of Interest, AP1000 DCA

<u>Offsite Power system</u>

- DCA Changes:
  - Added an additional reserve auxiliary transformer and a fast bus transfer scheme to automatically transfer the loads from the unit auxiliary transformer to the reserve auxiliary transformer in the event electrical fault at the main transformer, unit auxiliary transformer or the isophase bus. In the original design there was only one reserve auxiliary transformer

Technical Topics of Interest, AP1000 DCA

Reactor Coolant Pump Breakers

- DCA Change:
  - Since variable speed drives are provided for RCP startup, input and out put isolation breakers are added to each RCP variable frequency drive (VFD) unit to facilitate service to the VFD without RCP being off line

Standby Diesel Generators

- DCA Change:
  - In DCD Rev 16 and 17, Westinghouse revised the nominal sizes of various pieces of equipment and updated the diesel generator loading Tables 8.3.1 and 2

Change in steam Boiler design

- DCA Change:
  - Westinghouse replaced diesel-fired steam boiler with an electric auxiliary steam boiler in order to reduce the size of the boiler. Because of this change, a third unit auxiliary transformer was added to accommodate the electric boiler

Technical Topics of Interest, AP1000 DCA

Operating voltage Change in DC system

- DCA Change:

  The system voltage for the operation of Class1E dc loads was changed from 125 V dc to 250 v dc. As a result of this change the staff has identified the following 5 open items because design information is not yet available from Westinghouse:

  - Load profile for each 24-hour and 72-hour batteries.
  - Test plan to qualify 24-hour and 72-hour long duty cycle batteries.
  - The results of 250 V battery and battery charger sizing calculations, battery terminal voltage calculations, short circuit calculations, and voltage drop calculations.

Technical Topics of Interest, AP1000 DCA

- The results of an analysis of the onsite ac power distribution system for maintaining adequate voltages at the terminal of the Class1E battery chargers, and an analysis to evaluate acceptable rating for dc distribution system equipment

- Lack of sufficient information to conclude that transient overvoltage on the battery chargers have no adverse affects

AP1000 Design Control Document

Amended Design

Chapter 18

Paul J. Hunton – Program Manager

Julie Reed – Human Factors Lead

October 6, 2009

Westinghouse

Chapter 18 Overview

Governing NRC Guidance:

- Human Factors Engineering Program
  - NUREG-0711 “Human Factors Engineering Program Review Model,” U.S NRC, July 1994
  - NUREG-0711, Revision 1, May 2002
- Human System Interface Design Review Guidelines
  - NUREG-0700, Revision 2, May 2002

Westinghouse

Human Factors Engineering Program

Elements Comprising the AP1000 HFE Program

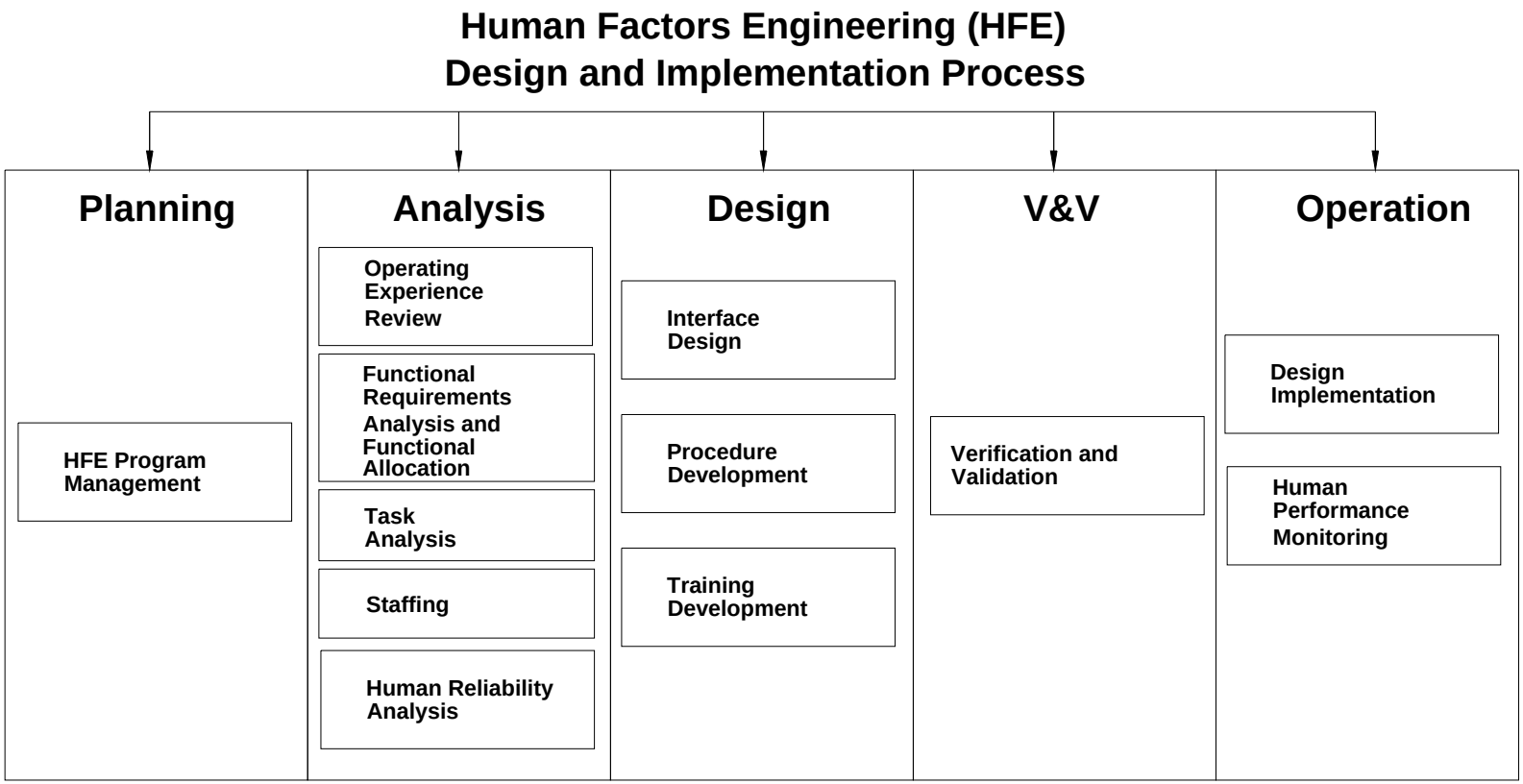
- Program Management
- Operating Experience Review
- Functional Requirements Analysis & Allocation
- Task Analysis
- Staffing
- Integration of Human Reliability Analysis with HFE
- Human System Interface Design
- Procedure Development
- Training Program Development
- Human System Interface Verification and Validation Program
- Inventory (minimum inventory of indications, alarms, and controls)
- Design Implementation
- Human Performance Monitoring

Westinghouse

Efforts Since Design Certification

- Implement outstanding HFE program elements
- Work since DCD Rev 15 is being credited to close
  - COL Information Items
  - Design ITAAC

AP1000 HFE Process (DCD Figure 18.1-1)



Chapter 18 Licensing and DCD Rev. 17

Address Combined Operating License (COL) Information Items

- Provide sufficient information to the NRC to close Chapter 18 COL Information Items

Address Design Inspection, Test, Analysis, and Acceptance Criteria (DAC)

- Provide sufficient information to the NRC to close Tier 1, Table 3.2-1 items 1-4 from DCD Rev. 15

Westinghouse

DCD Rev. 15 Design COL Items

Table 1.8-2 (Sheet 7 of 7) **SUMMARY OF AP1000 STANDARD PLANT COMBINED LICENSE INFORMATION ITEMS**		
Item No.	**Subject**	**Subsection**
18.2-1	Execution of the NRC Approved Human Factors Engineering Program	18.2.6
18.2-2	Design of the Emergency Operations Facility	18.2.6
18.5-1	Task Analysis	18.5.4
18.5-2	Main Control Room	18.5.4
18.7-1	Execution and Documentation of the Human Reliability Analysis/Human Factors Engineering Integration	18.7.1
18.8-1	Execution and Documentation of the Human System Interface Design Implementation Plan	18.8.5
18.9-1	Procedure Development	18.9.1
18.11-1	Verification and Validation of AP1000 Human Factors Engineering Program	18.11.1

Multiple Technical Reports & Design Documents Provided to NRC Staff as Bases to Close COL Information Items

Westinghouse

Chapter 18 COL Information Item Status

COL Item	Subject	Status
18.2-1	HFE Program Execution	Closed: Redundant with Design ITAAC (DAC) • HFE Program Plan (APP-OCS-GBH-001) provided to NRC
18.2-2	Design of the Emergency Operations Facility	Open: NRC Draft SER proposes that this item be revised (per RAI response). NRC open Item OI-SRP18-COLP to track TSC/EOF Task analysis completion (in revised open item): **provided on 9/30/09 – APP-OCS-J0A-001**
18.5-1	Task Analysis	Open: Pending review of: • APP-OCS-GER-031: "The Incorporation of HFE into the Development of AP1000 Plant Procedures" • APP-OCS-GER-041: "The Incorporation of HFE into the Development of the AP1000 Plant Training Programs" **Plan to provide to NRC in December 2009**
18.5-2	Main Control Room Staff Roles/Responsibilities	Closed • APP-GW-GLR-010: "AP1000 Main Control Room Staff Roles and Responsibilities"

Westinghouse

Chapter 18 COL Information Item Status

COL Item	Subject	Status
18.7-1	Execution and Documentation of Human Reliability Analysis/Human Factors Engineering Integration	Closed Addressed by: • WCAP 16555,"AP1000 Identification of Critical Human Actions and Risk Important Tasks" • Operational Sequence Analysis (OSA) 1 & 2
18.8-1	Execution and Documentation of the Human System Interface Design Implementation Plan	Closed: Redundant with Design ITAAC (DAC)
18.9-1	Procedure Development	Open: Closed pending NRC confirmation in CBP audit report: (audit performed 9/15/09)
18.11-1	Verification and Validation of AP1000 Human Factors Engineering Program	Closed: Redundant with Design ITAAC (DAC)

DAC Status (Rev. 15 Table 3.2-1)

DAC Item	Subject	Status
1	Integration of Human Reliability Analysis with Human Factors Engineering Design	Closed (WCAP-16555, OSA 1 & 2)
2	Task Analysis is performed in accordance with the task analysis implementation plan.	Open: Expect to be closed pending staff review of Revision B of APP-OCS-J1R-220 , "AP1000 Operational Sequence Analysis (OSA-2) Summary Report" **(provided 9/30/09)**

DAC Status (Rev. 15 Table 3.2-1)

DAC Item	Subject	Status
3	The HSI design is performed for the OCS in accordance with the HSI design implementation Plan	Open: Outstanding documents provided and await NRC review • APP-OCS-J4V-001, "Control Centers Alarm Presentation System Design Specification" • APP-OCS-J4-002, "Wall Panel Information System Hardware Design Specification"
4	An HFE program verification and validation implementation plan is developed in accordance with the programmatic level description of the AP1000 human factors verification and validation plan	Open: 4 of 5 documents required to close this item have been accepted as satisfactory. The remaining document (APP-OCS-GEH-320, "AP1000 Human Factors Engineering Integrated System Validation Plan") is under revision to address NRC RAIs. **Provide revision: Jan. 2010.**

Westinghouse

Conclusions

- Westinghouse is executing the Human Factors Program Certified in DCD Revision 15.
- COL Information Items
  - 6 of 9 items have been closed.
  - Open Items:
    - Procedure Development item closure awaits NRC documenting results of 9/15/09 audit
    - EOF/TSC item closure awaits NRC review of provided documentation
    - Documentation addressing Task Analysis item on track for December 2009 availability

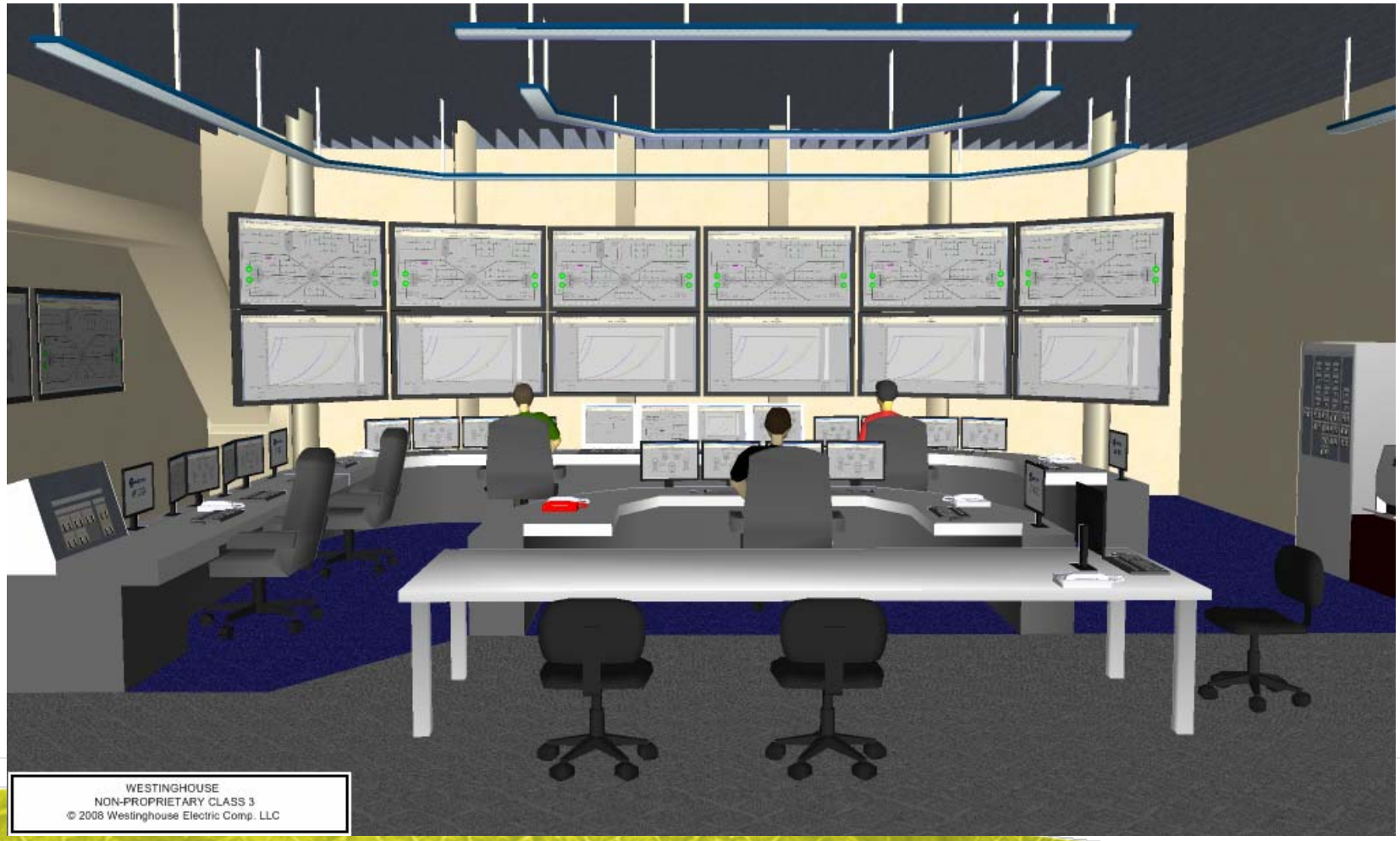
Westinghouse

Conclusions

- DAC Items 1-4 from Tier 1 Table 3.2-1
  - #1 – Closed
  - #2 – Documentation provided for NRC Review
  - #3 – Documentation provided for NRC Review
  - #4 – Resolving NRC RAIs on final remaining document (HFE ISV Plan): Revision expected to be available: January 2010

Westinghouse

Current AP1000 Main Control Room



Westinghouse

United States Nuclear Regulatory Commission

Protecting People and the Environment

Westinghouse AP1000 Design Certification Amendment Application Review

SER/OI Chapter 18

Human Factors Engineering Program

Presentation to the ACRS Subcommittee

October 6-7, 2009

Chapter 18 Review Team

Technical Staff

- **Michael Junge**, Chief, Operator Licensing and Human Performance Branch, Division of Construction Inspection Programs (COLP/DCIP)
- **Paul Pieringer**, Lead Reviewer, COLP/DCIP
- **Molly Keefe**, Reviewer, COLP/DCIP
- **Jacqwan Walker**, Reviewer, COLP/DCIP
- **James Bongarra**, Consultant, COLP/DCIP

Contractor Support

- **Jim Higgins**, Reviewer, Brookhaven National Laboratory
- **John O'Hara**, Reviewer, Brookhaven National Laboratory

Project Manager

- **Patrick Donnelly**, Project Manager, NWE2/DNRL

Objectives

- Verify that the implementation plans and the results summary reports for all Planning and Analysis phase elements from NUREG-0711 are complete.

- Verify that the implementation plans for all NUREG-0711 elements are complete.

- Verify that chapter 18 of the DCD and the associated ITAACs provide reasonable assurance that acceptable HFE practices and guidelines will be incorporated in plant design.

Overview of AP1000 DCA

SRP Section/Application Section		AP1000 Status
18.1	Overview	No Changes
18.2	Human Factors Engineering Program Management	1 Confirmatory Item 1 Open Item Closed COL18.2-1
18.3	Operating Experience Review	No Changes
18.4	Functional Requirements Analysis and Allocation	No Changes
18.5	Task Analysis	2 Open Items Closed COL 18.5-2
18.6	Staffing	No Changes
18.7	Human Reliability Analysis	Closed COL 18.7-1 Closed ITAAC DC-1

Overview of AP1000 DCA

SRP Section/Application Section		AP1000 Status
18.8	Human-System Interface Design	1 Open Item Closed COL 18.8-1
18.9	Procedure Development	1 Open Item
18.10	Training	No Changes
18.11	Verification and Validation	2 Open Items Closed COL 18.11-1
18.12	Minimum Inventory	No Changes
18.13	Design implementation	No Changes
18.14	Human Performance Monitoring	No Changes

Topics of Interest

Section 18.2 – HFE Program Mgmt.

- Added DCD reference to “AP1000 HFE Program Plan” (SER pg 1)
  - Supports existing safety conclusion
- COL 18.2-1 – Implement HFE Program (pgs1-2)
  - Closed based on redundancy to ITAAC
- COL 18.2-2 – EOF (pgs 2-4)
  - Confirmatory Item to revise COL info item: Design responsibilities and EOF location
  - Open item to document task analysis results

Topics of Interest

Section 18.5 – Task Analysis

- Added specific OSA-2 implementation plan (SER pgs 6-7)
  - supports existing safety conclusion
- COL 18.5-1 – Conduct HFE task analysis (pgs 7-14)
  - Open item to provide TA input to training and procedure development
- COL 18.5-2 – Define operator responsibilities (SER pgs 14-15)
  - Closed based on TR-52
- ITAAC DC-2 – Perform a task analysis (pgs15-18)
  - Open item to complete the analysis of 24 maintenance/ testing/ inspection/Surveillance tasks

Topics of Interest

Section 18.7 – Human Reliability Analysis

- COL 18.7-1 – Execute the HRA implementation plan (SER pgs 18 - 22)
  - Closed. Risk-important actions have been identified IAW the implementation plan
- ITAAC DC-1 – Integration of HRA with HFE (pg 22)
  - Closed. Risk important actions have been identified IAW the implementation plan

Topics of Interest

Section 18.8 – Human System Interface design

- COL 18.8-1 – Execute the HSI design implementation plan (SER pg 23)
  - Closed, COL item is redundant to ITAAC DC-3
- AP1000 HSI Design Guidelines (pgs 24-27)
  - Addresses guidance in NUREG-0711
  - Includes NUREG-0700, HSI Design Review Guidelines, plus other HFE source material
- ITAAC DC-3 – Design Development (pgs 4-6)
  - Open item to complete design specifications

Topics of Interest

Section 18.9 – Procedure development

- COL 18.9-1 – Execute the Procedure Implementation Plan (SER pgs 27-30)
  - Writer's guides have been completed IAW the implementation plan.
  - Open item to track resolution of questions associated with loss of computer based procedure system
    - Closed based on September 15-17 audit.
    - Dedicated printer prints each step as it is finished. Hardcopy of procedures will be available in the control room.

Topics of Interest

Section 18.11 – Verification and Validation

- COL18-11-1 – Develop and execute a V&V implementation plan (SER pg 31)
  - Closed. Redundant to ITAAC DC-4 and DC-5
  - W has assumed responsibility for implementation plans
- ITAAC DC-4 – Develop V&V implementation plans (SER pgs 31-42)
  - HFE Design Verification Plan, complete
  - HFE Task Support Verification Plan, compete
  - HFE Discrepancy Resolution Process, complete
  - AP1000 Plant Startup HFE Design Verification Plan, complete
  - Open item to complete HFE Integrated System Validation Plan
  - Open item NRC staff to complete SER documentation of Startup HFE Design Verification Plan

Conclusions

- Following closure of two open item on Task Analysis, Chapter 18 of the Westinghouse DCD will satisfactorily address all implementation plans and results summary reports will be complete for the planning and analysis elements of NUREG-071.
- Chapter 18 of the Westinghouse DCD provides implementation plan information in sufficient detail to provide reasonable assurance that the COL will implement an HFE program that meets applicable regulation and guidance.
- Chapter 18 of the DCD and the associated ITAACs provide reasonable assurance that acceptable HFE practices and guidelines will be incorporated into COL plant design.
- Questions?

Backup – Nureg-0711 information

Applicant Submittals - In general, applicants are expected to submit two reports for NRC review:

- An *implementation plan* gives the applicant's proposed methodology for meeting the acceptance criteria of the element. An implementation plan review gives the applicant the opportunity to obtain staff review of and concurrence in the applicant's approach before conducting the activities associated with the element. Such a review is desirable from the staff's perspective because it provides the opportunity to resolve methodological issues and provide input early in the analysis or design process when staff concerns can more easily be addressed than when the effort is completed.

A *results summary report* gives the results of the applicant's efforts related to each element. The NRC staff will use the report as the main source of information for assessing the applicant's efforts using the review criteria contained in this document.

Backup – NUREG-0711 Information

Planning and Analysis	Design	Verification and Validation	Implementation and Operation
HFE Program Management Operating Experience Review Functional Requirements Analysis and Function Allocation Task Analysis Staffing and Qualifications HRA	HSI Design Procedure Development Training Program Development	Human Factors Verification and Validation	Design Implementation Human Performance Monitoring

AP1000 Design Control Document
Tier 2 Chapter 3

Design of Structures, Components, Equipment, and Systems

Donald Lindgren
AP1000 Licensing
October 6 & 7, 2009

Tier 2 Chapter 3

- Chapter Overview
  - General Design Criteria
  - Classification of Structures, Components, and Systems
  - Wind and Tornado Loadings
  - Water Level (Flood) Design
  - Missile Protection

Tier 2 Chapter 3

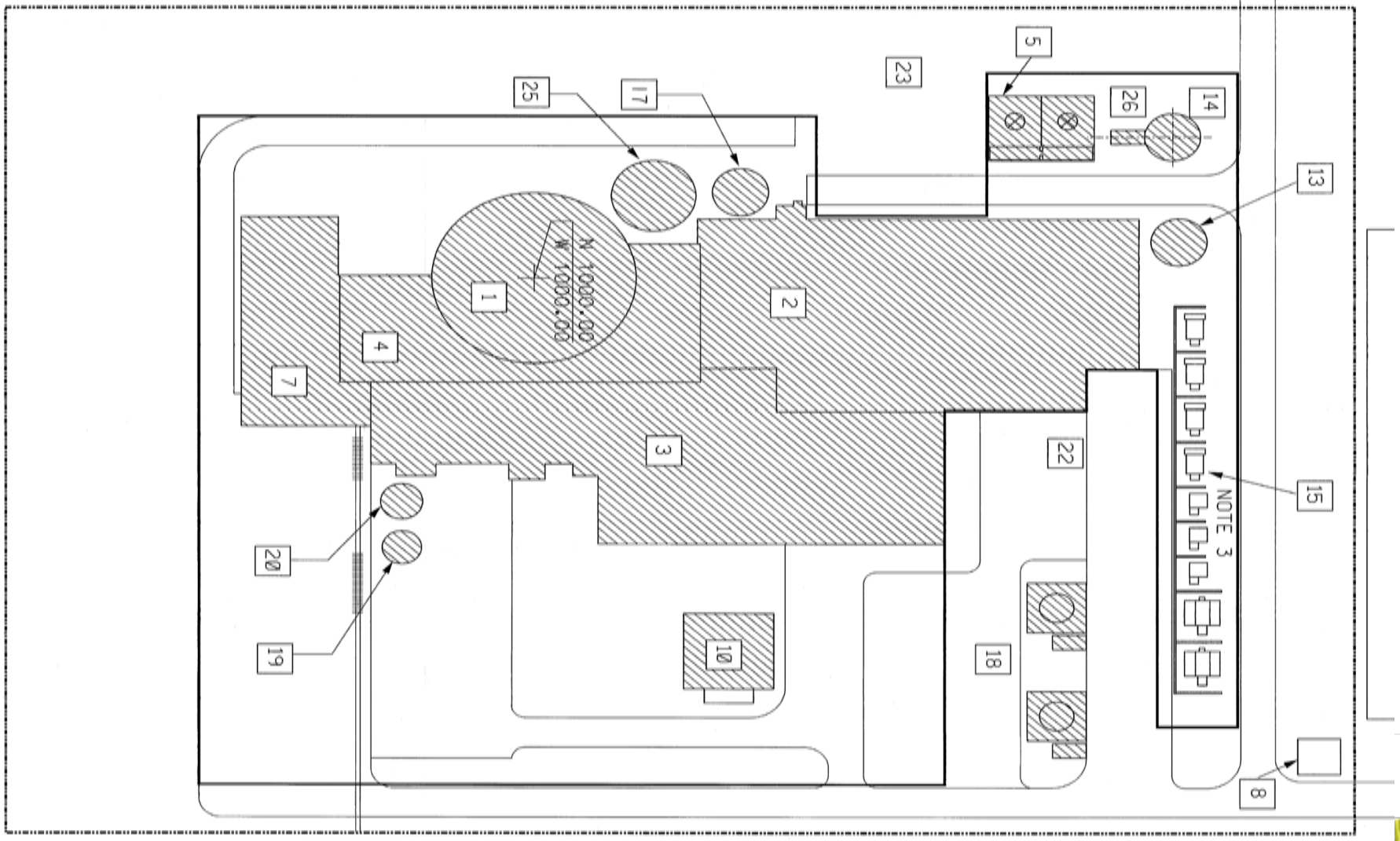
- Chapter Overview (continued)
  - Postulated Pipe Rupture Dynamic Effects
  - Seismic Design- Later
  - Design of Category I Structures - Later
  - Mechanical Systems and Components
  - Seismic and Dynamic Qualification
  - Environmental Qualification

3.1 General Design Criteria - Changes

- Conforming changes due to change in other sections and RAI responses
  - Technical Support Center changed to Control Support Area
    - Support COL application departure
  - Main Control Room Isolation
    - Change to initiation on low pressurizer pressure
  - Spent Fuel Pool
    - Address passive sources of makeup water

Water Level (Flooding)

Site Plan


NOTE 3
N 1000.00
W 1000.00
1
2
3
4
5
7
8
10
13
14
15
17
18
19
20
22
23
25
26

3.4 Water Level (Flood) Design – Changes

- Added parapets to roof
  - Roof is reviewed for probable maximum precipitation
- Additional waterproofing options
  - Waterproofing choice is COL applicant's
- Added watertight doors
- Added three waste monitor tanks
- Change in fire tank volume
  - From 400,000 to 490,000
  - Located next to turbine building

3.4 Water Level (Flood) Design – Site Parameter Change

- Probable Maximum Precipitation was changed from
  - 19.4 in./hr (6.3 in./5 min)

  To
  - 20.7 in./hr [1-hr 1-mi^2 PMP]
- Changes to bound additional sites
- Structural loading on the roofs is the impact on AP1000 design

3.4 Water Level (Flood) Design – Elevation Levels

- Nominal Grade Elevation – 100’
  - Actual grade expected to be a few inches below and slope away to direct surface water away.
- Maximum Water Table Elevation – 98’
  - Based on testing and historic values
- Maximum predicted flood level – 100’
  - Seismic analysis assume water to this elevation
  - No + tolerance on this level
- Access Elevation
  - 100’ at Rail/Truck bay in south end of the Aux Building
  - 100’ at security entrance in Annex Building
  - 107’ through Annex building and Aux Building to Containment access

3.4 Water Level (Flood) Design – Open Items

Item	Subject	Status/Comments
OI-SRP3.4.1-RHEB-01	Analysis of Parapet roof design for Probable Maximum Precipitation	Analysis complete Response in preparation
OI-SRP3.4.1-RHEB-02	Analysis of increase in fire tank volume	Analysis complete Response in preparation
OI-SRP3.4.2-SEB1-01	Hydrodynamic load of tanks in Radwaste Building	Response in preparation

Classification

3.2 Classification of Structures, Components, and Systems - Changes

- Updates to Equipment Classification Table
  - Design Finalization
  - RAI Responses
  - Added Ancillary Diesels
  - Added Fire Protection Equipment
  - Corrected Hydrogen Control Class
  - Control Room Envelope
- Additional updates to table required
  - RAI Responses
  - NRC Audit and review extent of condition

3.2 Classification of Structures, Components, and Systems - Changes

- Structure Seismic Classification
  - Seismic Requirements for NS structures
    - Reference to Section 3.7
  - Changes to Annex Building
    - Portions are seismic Category II
  - Turbine Building First Bay made Category II
    - First bay of turbine building is reinforced concrete structure
- Correct Fire Protection Classifications
  - Include seismic requirement inside containment

3.2 Classification of Structures, Components, and Systems

- Questions were raised during the review about classification of Regulatory Treatment of Non-Safety Systems (RTNSS) and Defense in Depth systems
- Westinghouse has not changed the classification criteria, definitions, and requirements in the DCD Section 3.2
- The AP1000 relies on safety related systems to shut down the plant and mitigate postulated accidents
- RTNSS and defense in depth systems provide investment protection.
- RTNSS and defense in depth systems are not required to support operation of the safety related systems

3.2 Classification of Structures, Components, and Systems

- RTNSS is included in Class D in Section 3.2
- A structure, system or component is classified as Class D when it directly acts to prevent unnecessary actuation of the passive safety systems. Structures, systems and components which support those which directly act to prevent the actuation of passive safety systems are also Class D.
- For Class D structures, systems, and components considered to be risk significant as defined in the reliability assurance program, provisions are made to check for operability, including appropriate testing and inspection, and to repair out-of-service structures, systems, and components.

3.2 Classification of Structures, Components, and Systems

- The NS buildings containing Class D structures, systems, and components, as well as the anchorage of the structures, systems, and components to the building, are designed to the seismic requirements of the Uniform Building Code
- The systems and components are not designed for seismic loads.

3.2 Classification of Structures, Components, and Systems - Open Items

Item	Subject	Status/Comments
OI-SRP3.2.1-EMB2-01	Seismic Requirements for Class D Systems	Need Discussion with NRC Staff
OI-SRP3.2.1-EMB2-02	Seismic Classification for Electrical and other Equipment not in Table 3.2-3	Expect to Provide Classification information for Electrical Equipment
OI-SRP3.2.1-EMB2-03	Augmented QA for SC II SSCs	Need Discussion with NRC Staff
OI-SRP3.2.1-EMB2-06	SSCs Required for continued operation	RAI submitted
OI-SRP3.2.2-EMB2-01	Supplemental Requirements for risk significant RTNSS Systems	Need Discussion with NRC Staff
Correction of Table 3.2-3	From extent of condition	Have not discussed resolution

Piping

3.6 Postulated Pipe Rupture Dynamic Effects - Changes

- Break locations updated due to design finalizations
- Change to BOP valves used for mitigation due to turbine change
- Hot Water Heating system changes to moderate energy
- Main steam pipe material change

3.6 Postulated Pipe Rupture Dynamic Effects - Changes

- Revised COL Information Item for break hazard analysis
  - Added as-designed PRHA
- LBB As-Designed evaluation completed
  - COL Information Item revised - completed during design certification review
- LBB As-Built evaluation COL Information Item deleted
  - Redundant ITAAC

3.6 Postulated Pipe Rupture Dynamic Effects – Open Items

Item	Subject	Status/Comments
OI-SRP3.6.2-EMB2-01	• Evaluation of leakage and through wall cracks, • Complete as-designed pipe break hazards analysis report	• As-Designed PRHA is being prepared • Revised COL information item required to address pipe whip restraint design
OI-SRP3.6.3-CIB1-01	Review as-designed LBB analyses for other-than-hard-rock seismic input	Review expected as part of piping DAC review

3.12 Piping- Open Items

- Prepare for review for Class 1, 2, and 3 risk-significant piping analysis to complete resolution of the piping DAC
  - As-Designed piping analysis for 48 piping packages prepared and provided for NRC review – Delivered February through June 2009
  - Analyses address stress analyses, support designs, and fatigue analysis
  - Some analysis are based on envelop or preliminary values such as valve parameters

3.12 Piping- Open Items

- NRC Staff considers that the piping packages are not complete due to open items and other issues
- NRC Staff considers complete to mean meets ASME Code requirements
- Westinghouse will complete the design packages and perform an extent of condition evaluation to determine areas that require additional analysis.
- Piping design efforts continue to prepare CFC design documents
- Final audit meeting is needed to complete review and response to NRC questions and issues

Mechanical Systems and Components

3.9 Mechanical Systems and Components - Transient Changes - 3.9.1

- Added daily load follow transient
  - 17,800 events
- Reduced number of unit loading and unloading transients
  - 19,800 to 2000 events
- Revised RCP startup and shutdown transient
  - Changes due to variable speed drives
- Increased pressurizer spray and heater cycles for load regulation
  - 19,800 to 750,00 cycles
- Revised RCS depressurization for steam generator
  - Combination of stuck open valve and inadvertent spray

3.9 Mechanical Systems and Components – Open Items

Item	Subject	Status/Comments
OI-SRP3.9.1-EMB1-03	Follow up WESTEMS audit	Need to schedule discussion on these items
OI-SRP3.9.1-EMB1-04	Provide guideline or criteria for developing or benchmarking transfer function stress database	Need to schedule discussion on these items
OI-SRP3.9.1-EMB1-05	Provide technical justification for this option in selecting peak and valley times for the fatigue evaluation	Need to schedule discussion on these items
OI-SRP3.9.1-EMB1-06	Provide benchmark acceptance criteria to validate the computer code calculation (WESTEMS)	Need to schedule discussion on these items
OI-SRP3.9.1-EMB1-07	Provide the configuration control and limitations of WESTEMS for an option to eliminate peak/valley points	Need to schedule discussion on these items

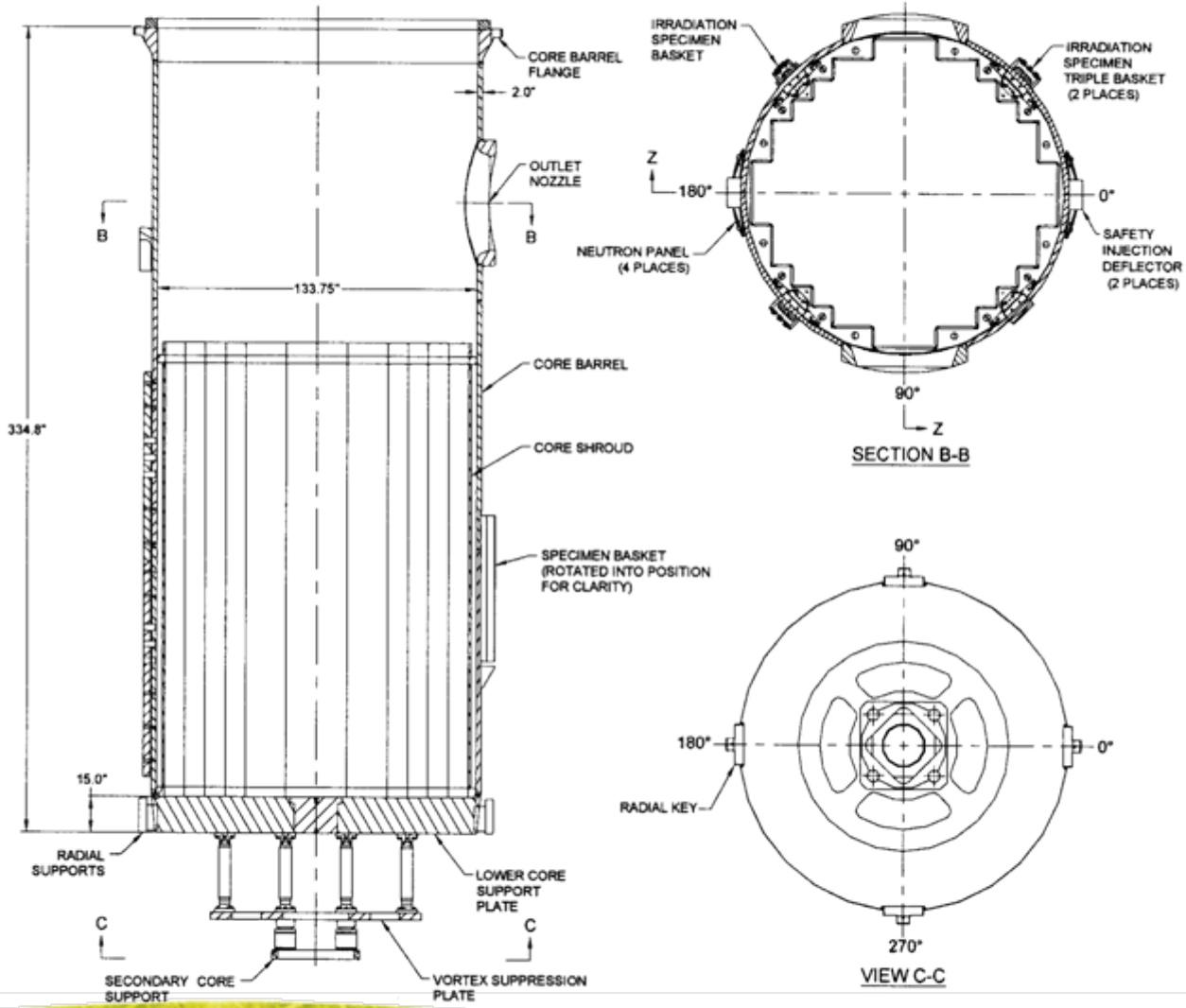
3.9 Mechanical Systems and Components – Changes – 3.9.2 and 3.9.5 Reactor Internal

- Completed action for COL item on reactor internals vibration assessment and predicted response
- Completed evaluation of core support material for COL Information Item
- Revised reactor vessel internals modeling discussion
- Added discussion about gap in reactor internals and pulses from reactor coolant pump
- Revised reactor vessel internals vibration measurement transducer locations

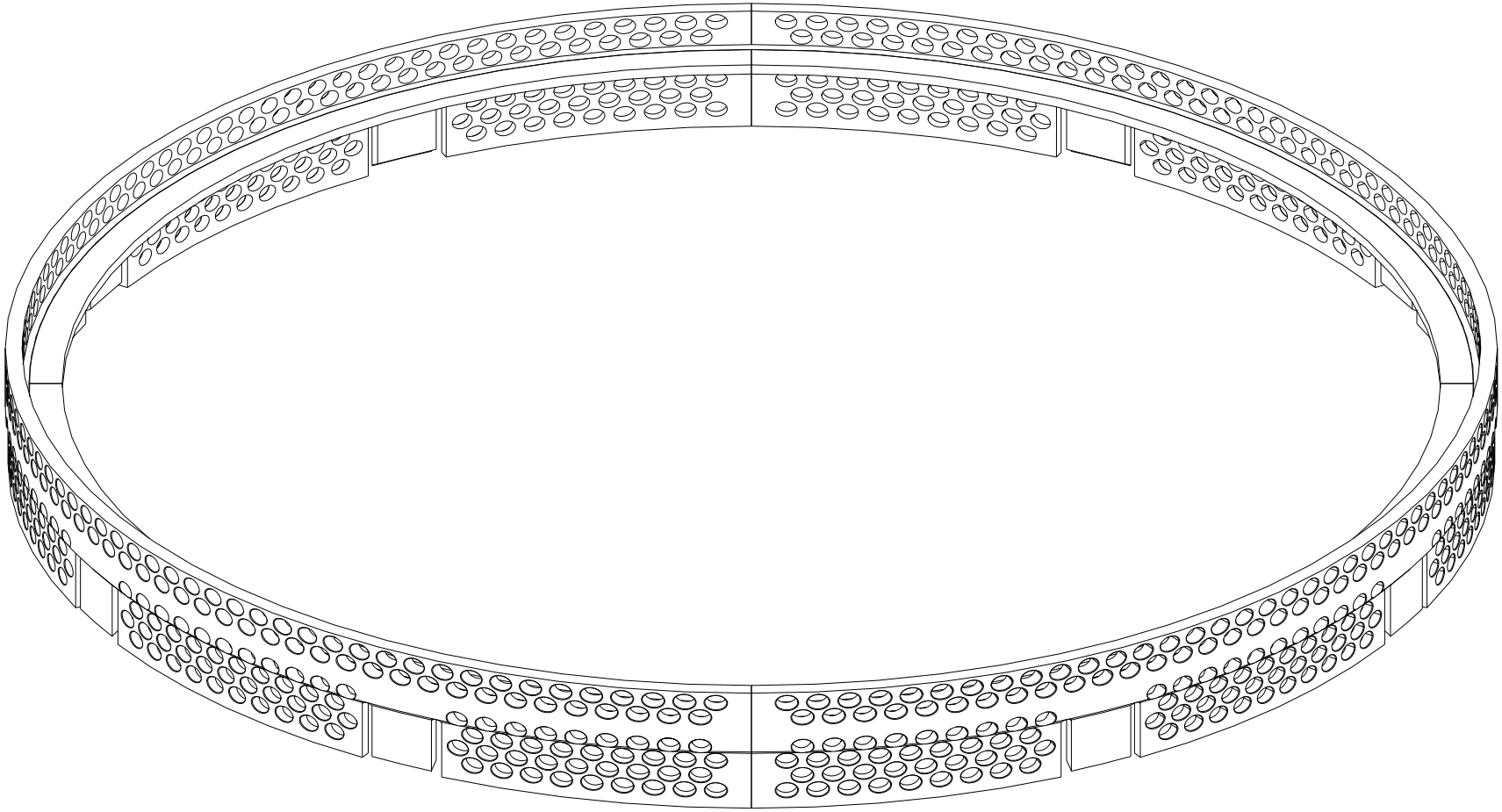
3.9 Mechanical Systems and Components – Changes – 3.9.2 and 3.9.5 Reactor Internal

- Added neutron panels to reactor internals
  - Reduce fluence on reactor vessel
  - Diameter of reactor vessel increased
- Added flow skirt to lower portion of reactor vessel
  - Improves distribution of flow into fuel assemblies
  - Supported by testing

Reactor Internals



Reactor Vessel Flow Skirt



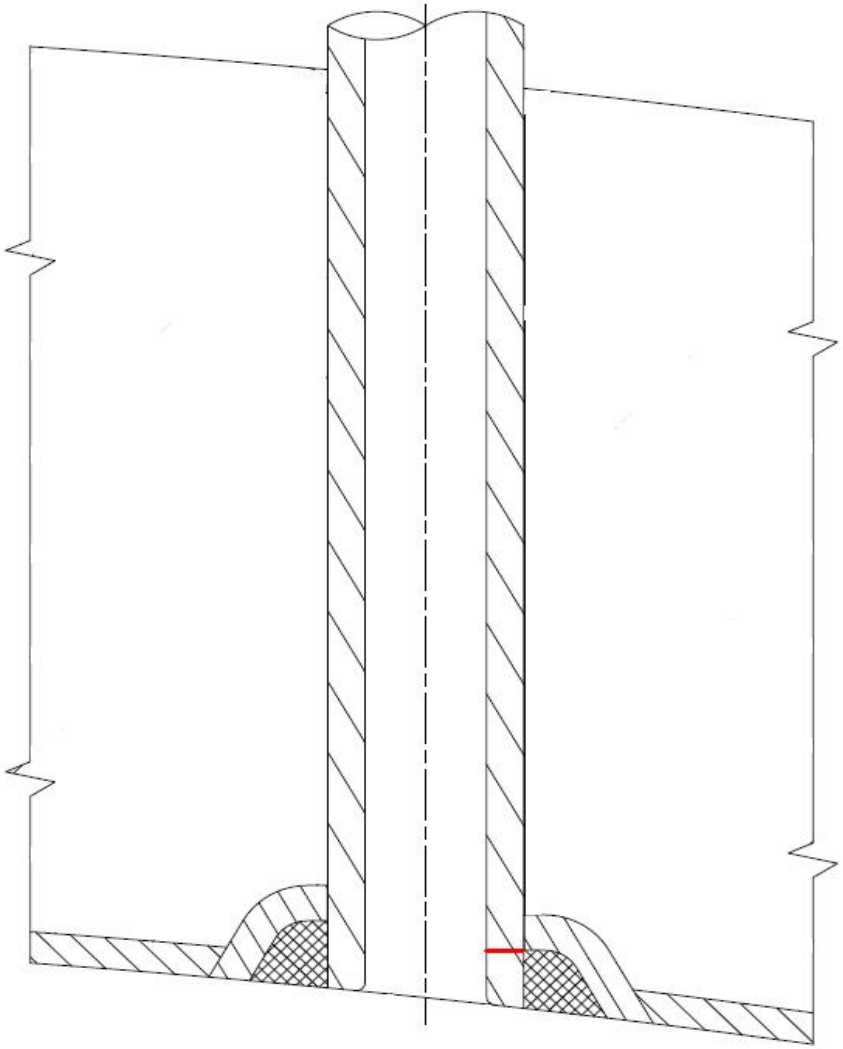
3.9 Mechanical Systems and Components – Changes – 3.9.3 ASME Code Components

- Revised list of piping lines susceptible to thermal stratification, cycling, and striping
- Added table of critical piping design method and criteria for ASME Code Piping to capture info previously in piping DAC
- Added requirement for snubber inspection, testing, repair, and replacement program
- Activity completed to close COL Information Item on design specification and design report review
  - NRC audit of component design specifications and design reports.
- Revised COL Information Item on piping benchmark program
  - No requirement for benchmarking

3.9 Mechanical Systems and Components – Open Items

Item	Subject	Status/Comments
OI-SRP3.9.3-EMB2-05	ASME Code Requirements for reactor vessel J-Groove weld	Westinghouse completed a plastic analysis and sent in a revised RAI response
OI-SRP3.9.3-EMB2-08	Address issues with Containment Recirculation Screens design specifications	• Issues are related to loads on screens • Updated design documents are ready for review

J-Groove Weld



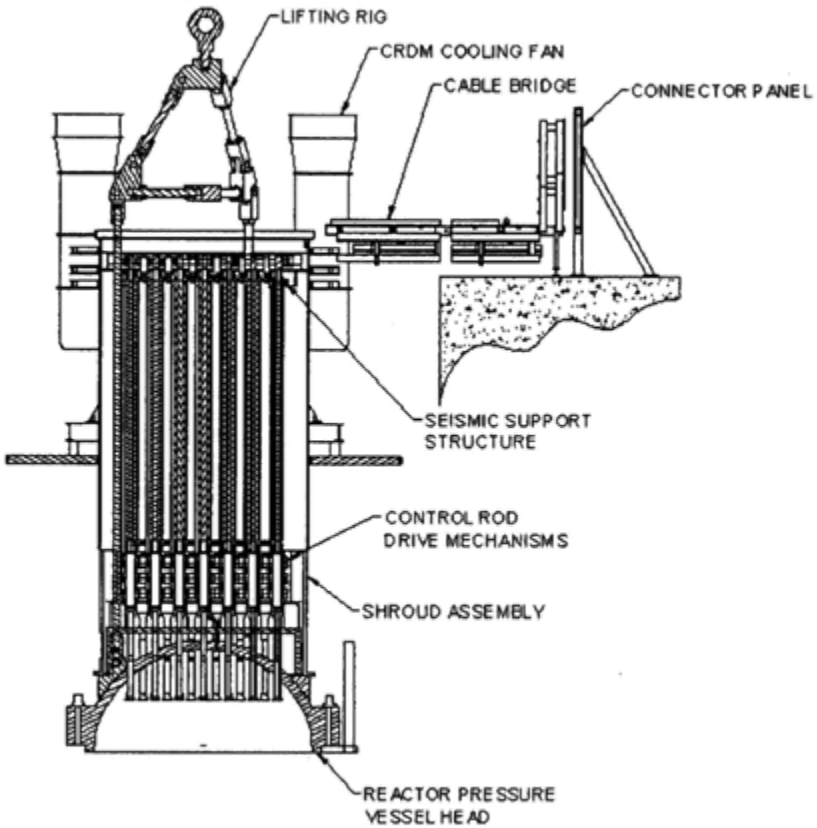
3.9 Mechanical Systems and Components – Changes – 3.9.4 Control Rod Drive System

- Changed material of gray rod assemblies
  - Was 24 stainless steel rodlets
  - Now 12 Ag-In-Cd rodlets and 12 SS rodlets
- Revised description of control rod withdrawal and insertion
- Revised seismic support of CRDM
  - Revised due to integrated head package changes

3.9 Mechanical Systems and Components – Changes – 3.9.7 Integrated Head Package

- The integrated head package decreases time to prepare for refueling
- Design of in-core instrumentation support system (IISS) changed
  - Quick Loc Design
  - Reduced Radiation exposure
  - Highly irradiated instrumentation remains underwater
- Cooling fans are attached to IHP
- Reduced weight of shroud
- Revised seismic support of CRDM rod travel housing
- A cable bridge supports power and instrument cables

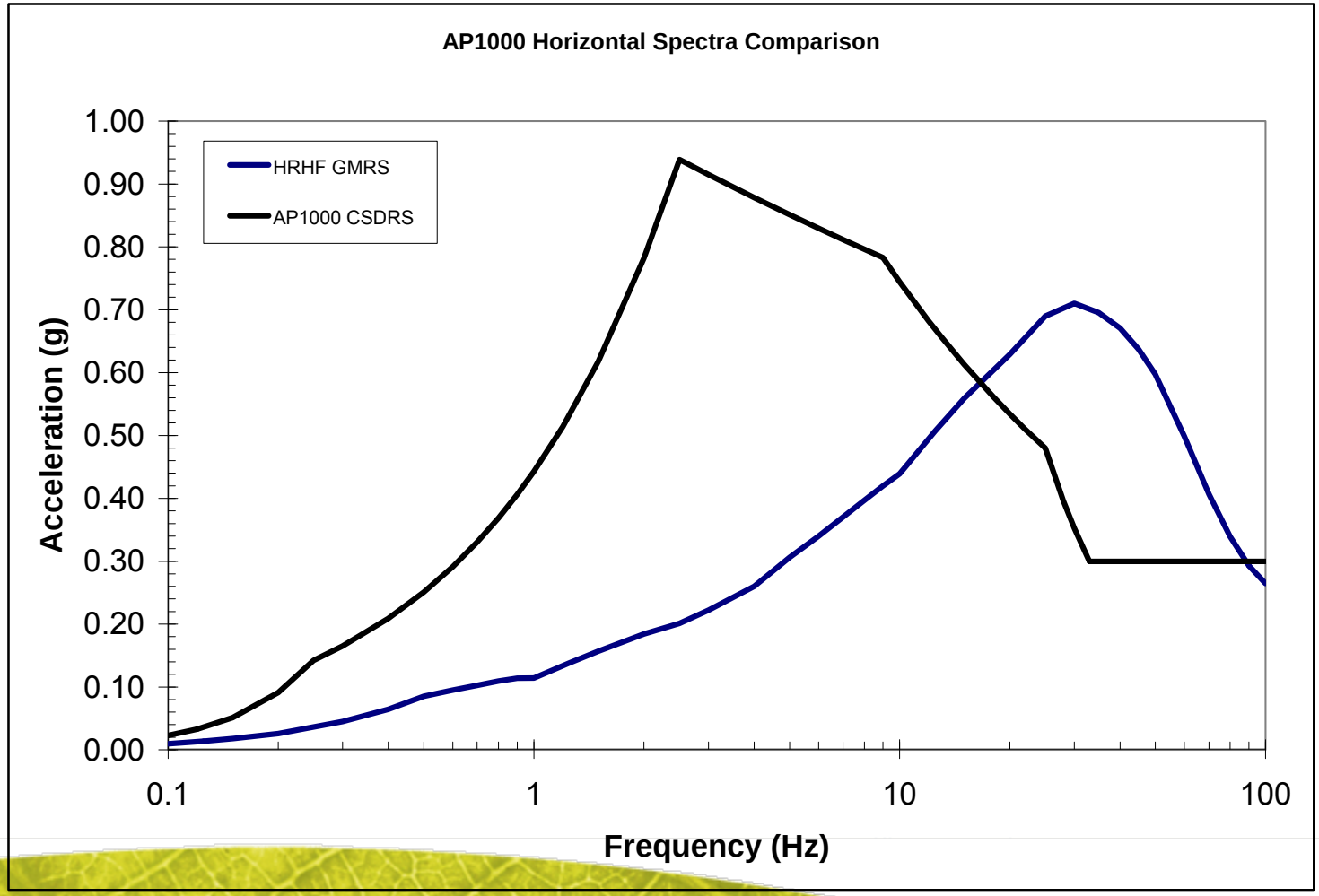
Integrated Head Package



3.10 Seismic and Dynamic Qualification – Changes

- Additional information provided on qualification by analysis
- Deleted option of qualification by experience
- Deleted COL Information Item on qualification by experience
- Additional information to address screening and qualification of equipment for high frequency motions

3.10 Seismic and Dynamic Qualification
Hard Rock High Frequency



Wind, Tornado, and Missiles

3.3 Wind and Tornado Loadings – Changes

- Change height of Shield Building
  - Reduced height of enhanced Shield Building
- Revised COL Information item
  - Additional Information to support Design Certification
  - Previous COL information required addressing interface criteria
  - Updated version provides specific requirements
- Site parameters for Wind Speed and Tornadoes are not changed

3.3.Wind and Tornado Loadings – Open Items

Item	Subject	Status/Comments
OI-SRP3.3.2-SEB1-01	Impact of steel siding missile on the modular wall of the shield building	Response being prepared
OI-SRP3.7.2-SEB1-02	Effect of 3 added radwaste tanks on collapse of Radwaste Building	Response being prepared

3.5 Missile Protection – Changes

- COL Information Item updated requirements
  - Specific requirement for wind interface requirements defined
  - Show that site specific tornado missile sources are considered
    - Building construction and location
    - Other buildings
  - Show that other site missile sources are bounded by tornado missiles
- Conforming changes for changes in other sections

- Missile spectrum is not changed
- Open items are the same as Section 3.3

3.5 Missile Protection – Elevated Automobile

- NRC guidance required evaluation of tornado driven impact of automobile 30 feet above ground level
- Some sites have parking areas above the nominal grade elevation – COL application question
- Westinghouse has evaluated impact of tornado driven automobile at all elevations of the auxiliary building including the roof and the shield building up to the roof.
- These buildings withstand the impact without adverse effects.

3.5 Missile Protection – Neighboring Unit Impact

- AP1000 Design Certification is for a single unit
- Effect of turbine missile on adjacent unit is addressed by COL applicants – Westinghouse has provided the evaluation
- The probability of destructive overspeed condition and missile generation is less than 1×10^{-5} per year
- This probability satisfies the criteria in Regulatory Guide 1.115 for an unfavorably oriented turbine
- AP1000 units located side by side are in an orientation no worse that an unfavorable orientation from Regulatory Guide 1.115
  - Separation of at least 800 feet.

Mechanical Systems and Components

Component Integrity

3.9 Mechanical Systems and Components – Changes – 3.9.6 Inservice Testing

- Added description of valve operability testing
  - Consistent with JOG Valve Program
- Updated description of valve inservice testing program
- Revised and updated table of valve inservice testing requirements
  - Design finalization
  - RAI responses
- Updated list of active valves
- Revised COL Information Item for valve inservice testing

3.9 Mechanical Systems and Components – Open Items – 3.9.6

Item	Subject	Status/Comments
OI-SRP3.9.6-CIB1-01	Resolve issues from onsite review of design and procurement specifications for pumps, valves, and dynamic restraints	Reviewing DCD tables and other information to determine extent of condition. Need to schedule meeting to discuss resolution.
OI-SRP3.9.6-CIB1-02	Reference to static testing needs to be consistent with the JOG MOV Program, which might require dynamic testing	Preparing response
OI-SRP3.9.6-CIB1-03	Specify the edition of the ASME Standard QME-1 referenced in Section 3.9	Preparing response
OI-SRP3.9.6-CIB1-04	Application of ASME OM Code Case OMN-1 as part of the AP1000 IST Program	Preparing response

3.9 Mechanical Systems and Components – Open Items – 3.9.6

Item	Subject	Status/Comments
OI-SRP3.9.6-CIB1-05	Technical Specifications and Technical Specification Bases need to be revised to be consistent with the ASME OM Code	Need to schedule meeting
OI-SRP3.9.6-CIB1-06	Include Acceptance Criteria for Check Valve and clarify response to RAI-SRP3.9.6-CIB1-12	Preparing response
OI-SRP3.9.6-CIB1-07	Clarify Table 3.9-16 Note 31 be consistent with the JOG MOV periodic verification program	Preparing response
OI-SRP3.9.6-CIB1-08	Clarify the reference to ASME OM Code, Subsection ISTC-3700 to confirm that the exercise test frequency requirements specified in the ASME OM Code will be satisfied	Preparing response Need to schedule meeting

3.9 Mechanical Systems and Components – Open Items – 3.9.6

Item	Subject	Status/Comments
OI-SRP3.9.6-CIB1-09	Address issues about testing for CVS valves	Need to schedule meeting

3.11 Environmental Qualification – Changes

- Clarify that Westinghouse is responsible for most of the equipment qualification
- Revised COL Information Item on qualification
- Update Table 3.11-1 for design finalization efforts

3.11 Environmental Qualification – Open items

Item	Subject	Status/Comments
OI-SRP3.11-CIB1-01	Revise design and procurement specifications to address NRC audit comments on equipment qualification	Need to Schedule review meeting audit with NRC

Questions

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Presentation to the ACRS Subcommittee

Westinghouse AP1000 Design Certification Amendment Application Review

SER/OI Section 3.4 Flood Protection

October 6-7, 2009

Staff Review Team

Technical Review Team

- **Kenneth See**, RHEB
- **Chang-Yang Li**, SBPB
- **Jerry Chuang**, SEB1
- **Milton Valentin,** SEB1

Project Manager

- **David Jaffe**, AP1000 DCD
- **Phyllis Clark**, AP1000 DCD

Overview of DCA

SRP Section/Application Section		Open Items
3.4.1.1	Protection From External Flooding	2
3.4.1.2	Protection From Internal Flooding	0
3.4.2	Analysis Procedures	1

Overview of AP1000 DCD

Section 3.4, Flood Protection

DCD Section		Summary of Changes to DCD
3.4.1.1	Protection From External Flooding	• Design parameter change in section 2.4 potentially affecting roof design • Volume of firewater storage tank increased
3.4.1.2	Protection From Internal Flooding	• Addition of three waste monitor tanks to flooding analysis • Other flow parts/structures change
3.4.2	Analysis Procedures	• Changes related to external flooding events and their impacts on the structural integrity of the safety related buildings

Technical Topics of Interest
3.4.1.1 Protection From External Flooding

Open Items

- Analysis of roof design for maximum precipitation rate.
  - Design parameter changed from 19.4 in/hr to 20.7 in/hr

- Flooding analysis from larger firewater storage tank
  - Tank volume increased from 400,000 gal to 490,000 gal.

Technical Topics of Interest
3.4.1.2 Internal Flooding

- The staff evaluated the following issues:
  - Watertight Doors for Internal Flood Protection
  - Building Elevation Changes
  - Addition of Redundant Class 1E Flood-Up Level Indication Rack
  - Deletion of Potable Water System (PWS) Tank Rupture in DCD
  - Volume of Passive Containment Cooling System (PCS) Water Storage Tank
  - Elimination of Flow Path Through Turbine Building for Flooding Events in the Annex Building – Nonradiologically Controlled Area (NRCA)
  - Addition of Three Waste Monitor Tanks to Flooding Analysis
  - Structural Changes Performed to the Auxiliary Building
- No remaining Open Items for Internal Flooding.

Overview of AP1000 DCA Chapter 3.4.2 – Analysis Procedures

- SRP 3.4.2 deals with the methodology to transform static and dynamic effects of the highest groundwater and flood levels into effective loads applied to seismic category I structures. The methodology is reviewed in section 3.4.2, but implemented in Chapter 3.8 (Chapter 3.4.2 interface with Chapter 3.8)

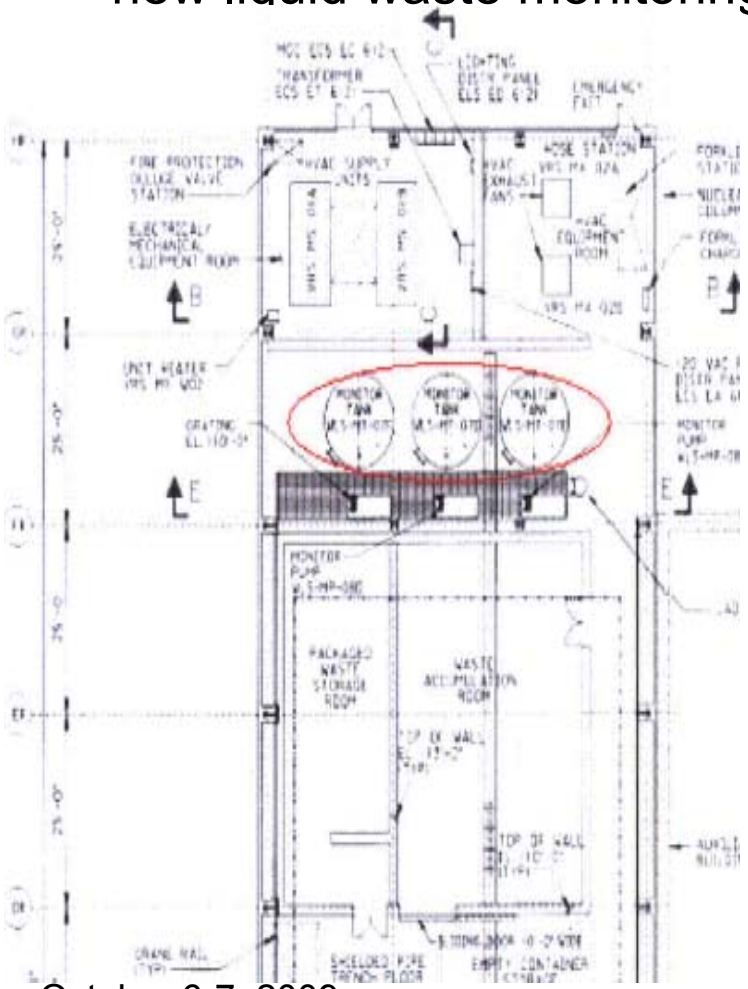
- No changes were presented in latest revision to the AP1000 DC. This section reflects the same information already approved in NUREG-1793 (AP1000 Rev 15).

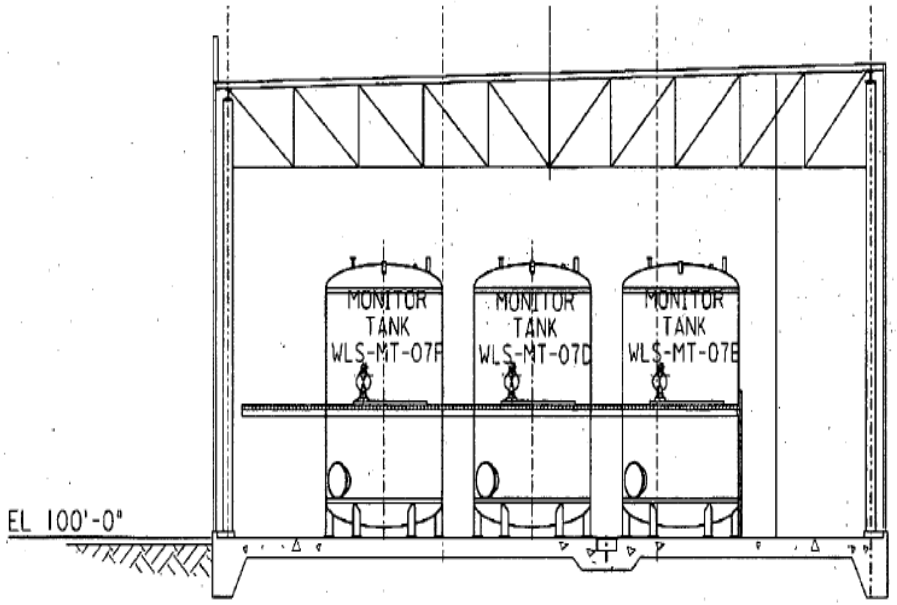
AP1000 Design Values for DCD Chapter 3.4.2

- AP1000 design flood level less than grade level at EL100 ft
- AP1000 design groundwater level 98 ft: 2 ft less than plant elevation of 100 ft

Technical Topics of Interest

- Open Item related to RAI-SRP3.7.2-01-SEB1-02 (TR116)– three new liquid waste monitoring tanks stability





SECTION E-E

Technical Topics of Interest (Cont.)

Safety concern: Radwaste Building is non-seismic, it is not designed to withstand earthquakes, or tornadoes. This building is next to the Nuclear Island.

Consequence of collapse:

- Increase flood level
- Induce hydrodynamic loads on NI structures:
    - Shield Building
    - Auxiliary Building

Technical Topics of Interest, AP1000 DCA

- Open Item related to RAI-SRP3.7.2-01-SEB1-02 – evaluate how the rupture of the three new liquid waste monitoring tanks may affect the flood level and design hydrodynamic loads on the nuclear island structures.

- Westinghouse will provide bounding analysis and COL applicants shall verify site specific conditions are bounded by DCD criteria and bounding analysis results.

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Presentation to the ACRS Subcommittee

Westinghouse AP1000 Design Certification Amendment Application Review

SER/OI Chapter 3
Design of Structures, Components, Equipment and Systems

Engineering Mechanics Branch Topics

October 6 - 7, 2009

Staff Review Team

Technical Review Team

- **R. McNally,** Section 3.2
- **R. Hernandez, R. Li, C. Wu, J. Rajan, T. Spicher, T. Le, P. Sekerak, and J. Strnisha,** Sections 3.6.1, 3.6.2, 3.9.1, 3.9.2, 3.9.3, 3.9.4, and 3.9.5
- **P. Chen, K. Hsu,** Sections 3.10 and 3.12

Project Managers

- **David Jaffe**, AP1000 DCD
- **Phyllis Clark**, AP1000 DCD

Overview of AP1000 DCD

SRP Section/Application Section		Open Items
		DCD
3.2	Equipment Classification	5
3.6	Protection Against the Dynamic Effects Associated with the Postulated Rupture of Piping	2
3.9.1 – 3.9.5	Mechanical Systems and Components	7
3.10	Seismic and Dynamic Qualification of Seismic Category 1 Mechanical and Electrical Equipment	0
3.12	Piping Design	1
Totals		15

Overview of AP1000 DCD

DCD SECTION		SUMMARY OF CHANGES
3.2	Equipment Classification	•Clarification to Subsection 3.2.1.1.1 regarding reference to 10CFR50.34 rather than 10CFR100 • Include notes to clarify the Non-seismic classification of certain structures described in other to Table 3.2-2 • The addition of their components and their seismic classifications to Table 3.2-3
3.6.4.1	Protection Against the Dynamic Effects Associated with the Postulated Rupture of Piping	• Remove Information Item 3.6-1

Overview of AP1000 DCD

DCD SECTION - SUMMARY OF CHANGES (CONT'D)

DCD SECTION		SUMMARY OF CHANGES
3.9.1	Special Topics for Mechanical Components	Editorial, minor technical and clarification changes: • Added daily Load Follow Operations • Redefined reactor coolant pump startup and shutdown cases • Defined loading and unloading operations • WESTEMS Computer Program was not reviewed previously
3.9.2	Dynamic Testing and Analysis of Systems, Components and Equipment	• Reactor internal and analysis changes

Overview of AP1000 DCD

DCD SECTION - SUMMARY OF CHANGES (CONT'D)

DCD SECTION		SUMMARY OF CHANGES
3.9.3	ASME Class 1, 2, and 3 Components and Component Supports, and Core Support Structures	• Deletion of COL Item allowing audit of Design Specifications and Reports
3.9.4	Control Rod Drive System (CRDS)	• Hydrostatic test pressure • Material changes addressed in 3.5.1.2.1.1 and 4.1.1 • Sequence of events
3.9.5	Reactor Pressure Vessel Internals	• Addition of neutron panels • Addition of flow skirt

Overview of AP1000 DCD

DCD SECTION - SUMMARY OF CHANGES (CONT'D)

3.10	Seismic and Dynamic Qualification of Seismic Category 1 Mechanical and Electrical Equipment	• Deletion of all references to Experience-Based Qualification Method for seismic qualification of AP1000 mechanical and electrical equipment • Addition of a new paragraph to address the Certified Seismic Design Response Spectra (CSDRS) exceedance in the high frequency spectrum region at some Central and Eastern United States rock sites • A new reference to Appendix 3I of AP1000 DCD addressing the effect of hard rock high frequency (HRHF) seismic input was added

Overview of AP1000 DCD

DCD SECTION - SUMMARY OF CHANGES (CONT'D)

3.12	Piping Design	• Removal of piping DAC through completion of risk significant piping design reports

Technical Topics of Interest, AP1000 DCA

3.2 Equipment Classification

- Augmented seismic requirements for RTNSS SSCs
- Scope of SSCs
- Augmented QA requirements for Seismic Category II SSCs
- List of SSCs needed for continued operation safety
- Supplemental requirements for nonsafety-related passive SSCs important to safety

Technical Topics of Interest, AP1000 DCA

3.6.1 and 3.6.2 Completion of As-Designed Pipe Break Hazards Analysis Report

• In AP1000 DCD, Revision 17, and two subsequent letters dated June 30, and July 22, 2009, Westinghouse proposed changes to DCD Subsection 3.6.4.1 (COL Information Item 3.6-1) pertaining to the completion of as-designed pipe break hazards analysis report. The analysis was to be completed prior to approval of the amendment and the COL Item was removed.

• Westinghouse stated that it will complete the as-designed pipe break hazards analysis report, with the exception of some pipe whip restraint and jet shield designs, by December 31, 2009 and the completion of the remaining pipe whip restraint and jet shield designs will require a modified COL Information Item to be addressed in the COL application.

• Upon the completion of that report by Westinghouse, the staff will perform an audit (expected in early 2010) to ensure the analysis is performed in accordance with the criteria outlined in DCD Subsections 3.6.1.3.2 and 3.6.2.5 for all the piping systems within the scope of SRPs 3.6.1 and 3.6.2.

• Pending a satisfactory audit of the as-designed pipe break hazards analysis report and a modified COL Information Item or an ITAAC Item that requires the COL applicant to complete the remaining pipe whip and jet shield designs, this issue is identified as OI-SRP3.6.2-EMB2-01.

Technical Topics of Interest, AP1000 DCA

3.9.1 Special Topics for Mechanical Components

- DCA Changes:
  - Daily Load Follow Operations
  - Redefined reactor coolant pump startup and shutdown cases
  - Defined loading and unloading operations
  - WESTEMS Computer Program was not reviewed previously
- Changes are acceptable with the exception of the ongoing review of WESTEMS
- Five Open Items including:
  - Complete package for program to be made available for review
  - Applicant to provide criteria for benchmarking transfer function stress database
  - Technical justification to be provided for use of algebraic summation method used in fatigue evaluation
  - Benchmark acceptance criteria for validation of the computer code calculation were to be provided
  - Applicant to provide configuration control and limitations on the program with regard to eliminating points during calculation

Technical Topics of Interest, AP1000 DCA

3.9.2 Dynamic Testing and Analysis of Systems, Components and Equipment

- DCA Changes:
  - Reactor internal and analysis changes: addition of flow-skirt to the reactor vessel lower head, addition of neutron panels, relocation of radial support keys and tapered periphery on lower core support plate, and reduction of core shroud brace thickness, downcomer excitations and related responses and RCP induced loads.
- Changes are acceptable:
  - Review of changes demonstrate acceptable vibration evaluations of upper and lower internals assemblies that have no impact on the conclusions in the DCD.
- Open Item OI-SRP3.9.2-EMB1-07 has been resolved.

Technical Topics of Interest, AP1000 DCA

<u>3.9.3 ASME Class 1, 2, and 3 Components and Component Supports, and Core Support Structures</u>

- DCA Changes:
  - COL Item allowing audit of Design Specifications and Reports was deleted.
  - Changes are acceptable with the exception of the piping review which is addressed in Section 3.12
- Audit conducted October 13 to 17, 2008, to review AP1000 component Design
- Two Open Items include:
  - Reactor vessel J-groove weld does not meet ASME Code
  - Containment Recirculation screen design was not complete. Engineering drawings, design loads and load combinations, fatigue evaluations, origin and basis for pressure loading, and justification for latent debris mass value and conservatism of flow rate through screen have yet to be addressed.

Technical Topics of Interest, AP1000 DCA

<u>3.10 Seismic and Dynamic Qualification of Mechanical and Electrical Equipment</u>

- DCA Changes:
  - Experience-Based Qualification Method for seismic qualification of AP1000 mechanical and electrical equipment was removed as an alternative
  - Certified Seismic Design Response Spectra (CSDRS) exceedance in the high frequency spectrum region at some Central and Eastern United States rock sites was addressed
  - Appendix 3I of AP1000 DCD addressing the effect of hard rock high frequency (HRHF) seismic input was added
- Changes are acceptable:
  - Review of changes demonstrate no impact on the conclusions in the DCD.
- No Open Items

Technical Topics of Interest, AP1000 DCA

3.12 Piping Design

Resolution of Piping Design Acceptance Criteria (DAC)

– DCD Revision 15 addressed the piping design through inclusion of piping DAC.

– DCD Revision 17, Westinghouse proposed removal of piping DAC through completion of risk significant piping design reports (COL Item for design specifications and reports would be removed). This is currently listed as an open item in the SER.

– Staff reviewed the piping design completed to date during an audit conducted August 30 thru September 18, 2009. Examples were identified where the packages were incomplete in demonstrating ASME code requirements were met and thus additional work is needed in these cases.

Technical Topics of Interest, AP1000 DCA

3.12 Piping Design (Con't)

Hard Rock High frequency (HRHF) Seismic Input

- TR-115 piping stress result comparison has demonstrated that AP1000 CSDRS could be used to HRHF GMRS seismic input of DCD Figures 3I.1-1 & 3I.1-2.
- Any other HRHF GMRS exceeds the spectra of Figures 3I.1-1& 3I.1-2 has to demonstrate following the methodology and screening criteria stated in DCD.

United States Nuclear Regulatory Commission

Protecting People and the Environment

Presentation to ACRS Subcommittee

Westinghouse AP1000 Design Certification Amendment Application Review

SER Chapter 3.3
Wind and Tornado

SER Chapter 3.5.3
Barrier Design

October 6-7, 2009

Staff Review Team

- Technical Staff
  - Brian Thomas, Chief, Structural Engineering Branch 1 (SEB1), Division of Engineering
  - Tze-Jer (Jerry) Chuang, SEB1 Senior Structural Engineer
  - Milton Valentin, SEB1 Structural Engineer

- Project Managers
  - Phyllis Clark, AP1000 DCA
  - David Jaffe, AP1000 DCA

Chapter 3.3 Wind and Tornado Overview of DCA

SRP Section/Application Section		Open Item
		AP1000 DCA
3.3.1	Wind Loadings	0
3.3.2	Tornado Loadings	2

Overview of AP1000 DCA Chapter 3.3 – Wind and Tornado

- SRP 3.3.1 Wind Loads: wind speeds, recurrence intervals, gust factors, and the procedure to transform design wind speed into an equivalent pressure applied to structures. (As per ASCE 7, Section 6)
- SRP 3.3.2 Tornado Loads: tornado wind speed (including translational and rotational) atm pressure drops, spectrum of tornado-generated missiles, and the procedure to transform tornado parameters into effective loads on structures. (As per ASCE 7, Section 6 and RG 1.76)

Overview of AP1000 DCA Chapter 3.3 – Wind and Tornado (cont.)

- Section 3.3.1 Wind Loadings:
  - Design basis wind speed of 145 mph (3 second gust, ASCE 7-95)
- Section 3.3.2 Tornado Loadings:
  - Tornado wind speed: 300 mph
  - Atmospheric pressure drop: 2.0 psi
  - Rate of pressure change: 1.2 psi/sec
  - Radius of max rotational wind from center: 150 ft

Overview of AP1000 DCA Chapter 3.3 – Wind and Tornado (cont.)

- Structural changes made by Westinghouse were acceptable:
  - 5 ft roof rise reduction at air baffle reduces total wind loads
  - Reduction also reduces risk of being hit by foreign objects

- Westinghouse submitted TR 05 on *Site Interface Criteria for Wind and Tornado*, to address the following COL Information items:
  - COL 3.3-1: COL will ensure that wind or tornado induce failure of structures will not compromise AP1000 safety related structures (3.3.2).
  - COL 3.5-1: Evaluation of external events that may produce missiles more energetic than those postulated for the AP1000 design to demonstrate AP1000 Design can handle the specific hazard (3.3.2 interface with 3.5).

AP1000 DCD, Rev 17 includes TR05 in FSAR 3.3.3 “Combined License Information”

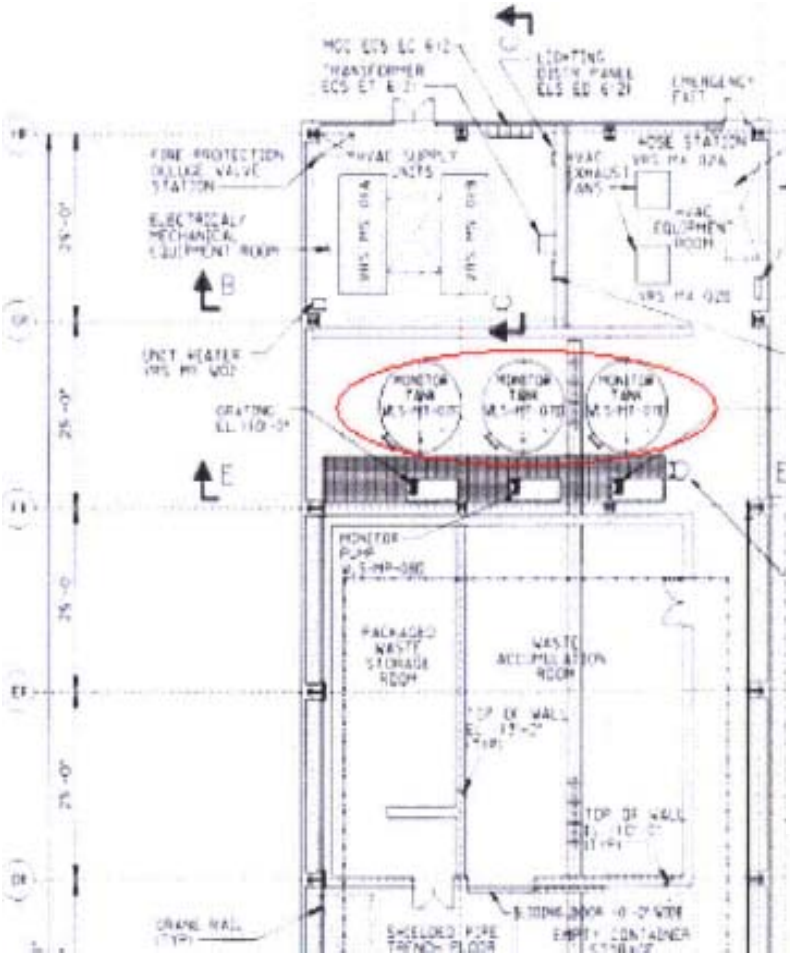
Technical Topics of Interest, AP1000 DCA

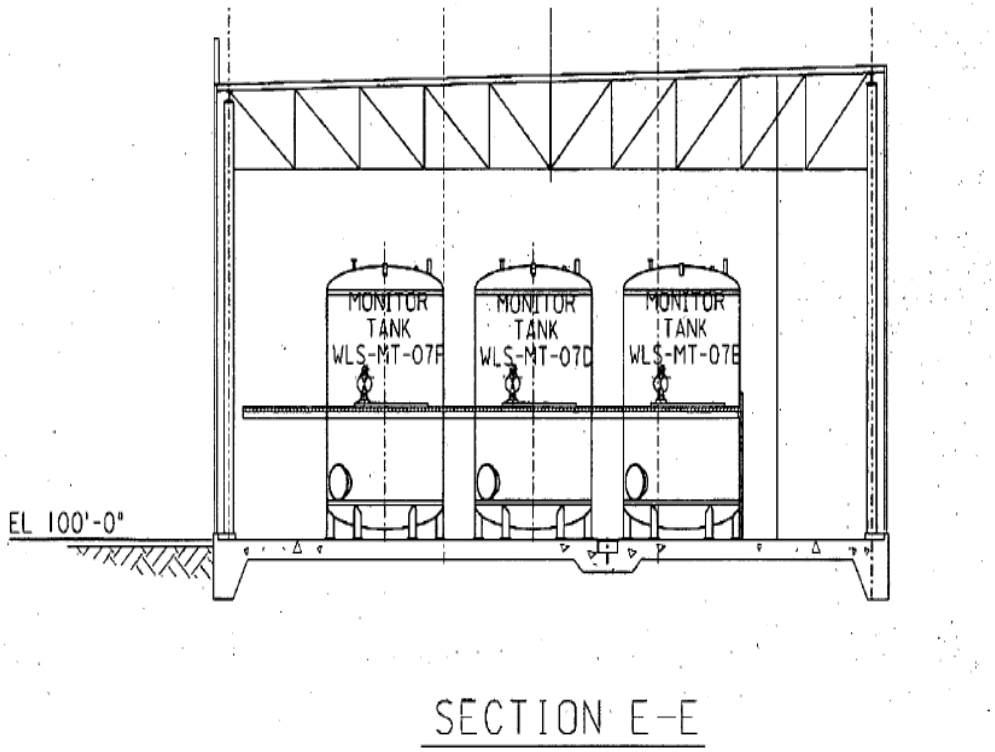
- Open item related to RAI-SRP3.3.2-SEB1-01 – metallic siding of turbine and annex buildings to be evaluated as a potential wind-borne missile against seismic category I structures.

- Westinghouse should evaluate and present results for the above RAI, COL applicants shall verify site specific conditions are bounded by:
  - AP1000 DCD Sections 3.3 and 3.5
  - metallic siding wind-borne missile evaluation

Technical Topics of Interest, AP1000 DCA (cont.)

•Open Item related to RAI-SRP3.7.2-01-SEB1-02 (TR116) on Non Seismic Category building such as radwaste building





Technical Topics of Interest, AP1000 DCA (cont.)

- **Safety concern:** Radwaste Building is non-seismic, it is not designed to withstand earthquakes, or tornadoes. This building is next to the Nuclear Island.

- **Consequence of collapse**:
- Produces wind-borne siding missiles
- Induces hydrodynamic loads on NI structures:
  - Shield Building
  - Auxiliary Building

Chapter 3.5.3
Overview of DCA

SRP Section/Application Section		Open Item
		AP1000 DCA
3.5.3	Barrier Design	1

Overview of AP1000 DCA Chapter 3.5.3 – Barrier Design

- SRP 3.5.3 treats the prediction of ***local*** damage and ***overall*** response of steel and concrete barriers due to wind-borne missiles, or externally generated missiles, or from secondary missiles by spalling and scabbing, and the adequacy of missile parameters used by the applicants for barrier design.

- No changes were presented in latest revision to the AP1000 DCD, section remains as approved in NUREG-1793 (AP1000 DCD Rev 15).

Technical Topics of Interest, AP1000 DCA

- Open Item related to RAI-SRP3.3.2-SEB1-01 requests an analysis to show the effect of impact by the high energy metallic wind-borne siding missiles would not compromise the safety of AP1000 nuclear island structures.

- Westinghouse should provide analysis and COL applicants shall verify site specific conditions are bounded by DCD.

Conclusion

- AP1000 DCA in Sections 3.3.1, 3.3.2, and 3.5.3 are acceptable pending resolution of the following open items:

- Open Items:
  - 3.3.1 Wind Loadings: NO open items
  - 3.3.2 Tornado Loadings: 2 open items
  - 3.5.3 Barrier Design: 1 open item

Presentation to the ACRS Subcommittee

Westinghouse AP1000 Design Certification Amendment Application Review

SER Section 3.6.3
Leak-Before-Break

October 6 - 7, 2009

AP1000 SER Section 3.6.3

- Technical Staff
  - Eric Reichelt, CIB1
- Project Managers
  - David Jaffe, NRO
  - Phyllis Clark, NRO

3.6 – Protection Against the Dynamic Effects Associated with the Postulated Rupture of Piping

<u>3.6.3 Leak-Before-Break Evaluation Procedures</u>

- Revision 16 revised COL Information Items 3.6-2 and 3.6-3 to address as-designed LBB analyses.
- The NRC staff performed an audit of the as-designed LBB analyses and found the methodology and calculations to be adequate.
- Revision 17 changed Main Steam Line (MSL) material from ASME SA-333 Grade 6 to ASME SA-335 Grade 11.
- LBB analysis for this material remains bounding for the AP1000 DCD.
- No Open Items

United States Nuclear Regulatory Commission

Protecting People and the Environment

AP1000 Design Certification Amendment Application Review

SER Section 3.9.6

Functional Design, Qualification, and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints

October 6-7, 2009

AP1000 SER Section 3.9.6

- Technical Staff
  - David Terao, Chief, CIB1
  - Thomas Scarbrough, Reviewer, CIB1
  - Om Chopra, Support, EEB
- Project Managers
  - David Jaffe
  - Phyllis Clark

Section 3.9.6 Overview

- AP1000 DCD includes provisions for functional design, qualification, and inservice testing (IST) of pumps, valves, and dynamic restraints
- NUREG-1793 concluded AP1000 DCD acceptable for design certification
- Bellefonte FSAR incorporates by reference AP1000 DCD for full description of IST operational program
- Westinghouse revising AP1000 DCD to address IST issues common to all COL applicants
- NRC conducted audit of Westinghouse design and procurement specifications in October 2008
- 9 open items in SER Section 3.9.6

Introduction

- AP1000 DCD includes provisions for functional design, qualification, and inservice testing (IST) of pumps, valves, and dynamic restraints.
- AP1000 DCD specifies COL Information Items that COL applicants will develop IST program in conformance with Section 3.9.6 and snubber operability program per Section 3.9.3
- Bellefonte COL application incorporates by reference AP1000 DCD provisions to help fully describe the functional design, qualification, and IST programs for pumps, valves, and dynamic restraints.

NRC Review

- In NUREG-1793, NRC found AP1000 DCD provisions for functional design, qualification, and IST programs for pumps, valves, and dynamic restraints to be acceptable for AP1000 Design Certification.
- At March 2008 public meeting, Westinghouse stated that it would revise AP1000 DCD to address IST issues common to all COL applicants.
- NRC staff is reviewing AP1000 DCD Revision 17 provisions for functional design, qualification, and IST programs for pumps, valves, and dynamic restraints that support COL applications.

Functional Design and Qualification

- AP1000 DCD provides high-level provisions for functional design and qualification of pumps, valves, and dynamic restraints (no safety-related pumps in AP1000 design).
- In October 2008, NRC performed on-site review of design and procurement specifications for pumps, valves, and dynamic restraints at Westinghouse Monroeville, PA, office.
- Memorandum dated November 6, 2008, summarized NRC on-site review with follow-up items identified as open item in SER (ML083110154).

IST Program

- In RAIs, NRC staff requested that Westinghouse clarify several provisions in AP1000 DCD that have been incorporated by reference in Bellefonte FSAR.
- In response, Westinghouse modified AP1000 DCD in Revision 17 to include additional IST provisions.
- Bellefonte FSAR and AP1000 DCD combined provisions are intended to fully describe the IST operational program per Commission paper SECY-05-0197.

AP1000 DCD IST Changes

- Section 3.9.6 revised to reference ASME OM Code rather than ASME Boiler & Pressure Vessel Code.
- Testing provisions for power-operated valves (POVs) revised to reference Joint Owners Group (JOG) program on Motor-Operated Valve (MOV) periodic verification, and to address POV functional margin and risk ranking.
- Provisions for check valve testing revised to address ASME OM Code.
- IST Table 3.9-16 and applicable notes updated.
- New Section 3.9.3.4.4 addresses inservice examination and testing of snubbers per ASME OM Code, Subsection ISTD.

Section 3.9.6 Open Items
OI-SRP-3.9.6-CIB1-

1. Resolution of audit follow-up items
2. Consistency of POV periodic testing with JOG program
3. Need for QME-1-2007 reference in Section 3.9
4. Use of ASME OM Code Case OMN-1
5. Consistency of technical specifications with OM Code
6. Provisions for check valve test acceptance criteria
7. Specification that POV programs incorporate attributes in Regulatory Issue Summary 2000-03
8. Clarification of reference to OM Code for exercise testing
9. Clarification of planned changes to IST table notes

Section 3.9.6 Remaining Review

- Address audit follow-up items with Westinghouse
- Resolve open items in AP1000 SER
- Confirm AP1000 DCD consistent with Bellefonte FSAR to support full description of functional design, qualification, and IST programs for pumps, valves, and dynamic restraints in support of COL applications

United States Nuclear Regulatory Commission

Protecting People and the Environment

AP1000 Design Certification Amendment Application Review

SER Section 3.11

Environmental Qualification of Mechanical and Electrical Equipment

October 6 - 7, 2009

AP1000 SER Section 3.11

- Project Managers
  - David Jaffe
  - Phyllis Clark

- Technical Staff
  - Ronaldo Jenkins, Chief, EEB
  - David Terao, Chief, CIB1
  - Om Chopra, Reviewer, EEB
  - Thomas Scarbrough, Reviewer, CIB2

Section 3.11 Overview

- AP1000 DCD includes provisions for environmental qualification (EQ) of mechanical and electrical equipment
- NUREG-1793 concluded AP1000 DCD acceptable for design certification
- Bellefonte FSAR incorporates by reference AP1000 DCD for full description of EQ operational program
- Westinghouse changes to AP1000 DCD EQ provisions do not impact NUREG-1793
- NRC conducted audit of Westinghouse design and procurement specifications in October 2008
- 1 open item in SER Section 3.11

Introduction

- AP1000 DCD includes provisions for environmental qualification (EQ) of mechanical and electrical equipment.
- AP1000 DCD specifies COL Information Item for equipment qualification file.
- Bellefonte COL application incorporates by reference AP1000 DCD provisions to help fully describe the EQ operational program.

NRC Review

- In NUREG-1793, NRC found AP1000 DCD provisions for EQ program for mechanical and electrical equipment to be acceptable for AP1000 Design Certification.
- NRC staff is reviewing AP1000 DCD provisions that support the description of the EQ program for COL applications.
- In October 2008, NRC performed on-site review of EQ program at Westinghouse Monroeville, PA, office with follow-up items specified in memorandum dated November 6, 2008, to be resolved with Section 3.9.6 (ML083110154)

AP1000 DCD EQ Changes

- Section 3.11.5 revised to specify that Westinghouse will act as agent during EQ phases with COL holder defining process and procedures for EQ files
- EQ Table 3.11-1 and applicable notes updated
- EQ scope expanded in Section 3D.2 to include Seismic Category II equipment
- RG 1.97 referenced for plant instrumentation
- Section 3D.6.3 revised to specify that qualification by operating experience not employed in AP1000 EQ program
- Section 3D.5.5.1 revised to address NUREG-1465 and RG 1.183 on accident source terms

Section 3.11 Remaining Items

- AP1000 DCD changes for EQ provisions do not impact NUREG-1793 on AP1000 Design Certification
- Address audit follow-up items with Westinghouse in SER Open Item OI-SRP-3.11-CIB1-01 together with Section 3.9.6 open item
- Confirm AP1000 DCD consistent with Bellefonte FSAR to support full description of EQ program

Consultant's Report on the Oct. 6 – 7, 2009 AP1000 Subcommittee Meeting

T. S. Kress
Oct. 9, 2009

Background

This subcommittee meeting was to review the staff's SER and changes from REV. 15 to REV. 17 of selected parts of Chapters 3, 8, and 18 of the applicant's DCD. My comments that were provided at the meeting are more-or-less reproduced here.

Comments

1. The staff and the applicant representatives did a good job of outlining the changes and the respective viewpoints. It was particularly helpful that they discussed the "why" of the changes.

2. There seemed to be a consensus among the subcommittee members that ACRS needs a more efficient and effective way to review such items in the future—perhaps focusing on the more significant items grouped into discipline areas. ACRS should develop guidelines on how to review SERs in the future.

3. A significant design change was the inclusion of a "flow skirt" at the core entrance in an attempt to provide more uniform flow through the fuel channels. Experience in operating plants, CFD code calculations, and a 1/7 scale test model are touted to assure that the flow skirt will accomplish its intended purpose without any unanticipated consequences. However, I recommend that the ACRS examine for potential ECCS effects on Chapter 15 results. For example, making given total flow more uniform means that flow can be re-distributed from hotter channels to cooler ones. This could influence some Appendix K results.

4. In an earlier meeting, I questioned whether enough was known about zinc injection to have assurance that it doesn't have unanticipated negative effects on severe accidents and on DNBR related to Appendix K (zinc does significantly plate out on the fuel cladding.) For AP1000, there appears to be sufficient margin for this not to be of concern especially in light of the positive effects of zinc injection on reducing worker exposure.

5. The required AP1000 fatigue analyses have utilized the unreviewed WESTEMS code. As there were a significant number of open items related to the use of the WESTEMS code, ACRS should review it to assure themselves that the very important fatigue determinations are done correctly and that the open items are appropriately closed.

6. Westinghouse presented their new electronic overspeed protection which appears to be appropriately redundant and diverse. However, I recommend that there be

some off-line testing of the sensor itself at full overspeed conditions. If there is a weakness in the system, it would appear to me to be at the sensor location.

7. It was somewhat surprising to hear that the reactor coolant pump (RCP) inertia had to be increased in order for the original assumed flow coastdown curve to still be applicable. The original inertia was found to be insufficient to overcome the pump and the loop friction and still provide the flow coastdown curve. How was this error missed in the original DCD/SER and is there a lesson to be learned on ACRS reviews?

8. There appeared to be a difference of opinion between the applicant and the staff with respect to what should be the regulatory treatment of non-safety systems (RTNSS). In my opinion, the selection of SSCs needs to include criteria on whether they are needed to meet both Chapter 15 DBAs and defined risk targets. As some of the identified RTNSS have been found to be risk significant, these should be reclassified as safety significant. In particular, if the system is needed to meet a significant portion of a 10^{-6}/yr LRF.

9. With respect to GSI-191, I am of the opinion that the downstream effects will be the significant item for AP1000. In particular, since the post-LOCA strategy of flooding the exterior of the vessel will likely reach to the level of the LOCA break location. The acceptance of AP1000 with respect to GSI-191 will require demonstrating two things; (1) at the COL stage that there is insufficient latent fibrous debris to cause blockage of the flow skirt, and (2) that the transport of such debris to the break location is limited.

10. I did not think the resolution of the striping issue was completely satisfactory. ACRS should review the screening criteria for selecting potential striping locations.

11. The resolution of the potential effects of a hard-rock seismic frequency spectrum was to show that the vulnerability of safety components to such a spectrum was accommodated by the original assumed non-hard-rock spectrum. In general, the high frequency end of the spectrums tend to mostly affect small electric and electronic components. ACRS should review how these types of components were evaluated for vulnerability at the hard-rock spectrum.

ACRS AP1000 Subcommittee Action Items

No.	MTG	ACTION ITEM	CONTEXT	AREA	LEAD(s)	COMMENTS / ACTION / DISPOSITION
July 23–24, 2009 Subcommittee Meeting						
1	JULY09	NRC's Generic Safety Issue resolution process. How has it been addressed since Rev. 15? (example GSI-191)	Chapter 1	DCD	DNRL	Staff to provide additional presentation in future meeting on this topic.
2	JULY09	Non-condensible gases and how they can affect flow from the in-containment refueling water storage tank (IRWST). Westinghouse proposed presentation at future meeting.	Chapter 1	DCD	WEC	Westinghouse to provide additional discussion at future Subcommittee meeting on how non-condensable gas issue is addressed in DCD/Chapter 15 when that chapter is presented to the Subcommittee. *Staff currently reviewing this issue in the context of NRC generic letter 2008-01.*
3	JULY09	Resistance-Temperature Detector (RTD) Relocation. Are the RTDs located at the upper half of the hot leg or at top? Also, does location impact on the dead-band for rod control?	Chapter 5	DCD	WEC	*WEC noted that the wide-range RTD was located at the upper half of the hot leg. The narrow range RTD is located downstream of the pressurized surge line. The location of either has no impact on dead-band for rod control.* *CLOSED*
4	JULY09 OCT09	Reactor Coolant Pump Flywheel Design. Subcommittee had many questions. For example, what is change in inertia (between Rev. 15 and 17); is there a change in the departure from nucleate boiling ratio (or DNBR); is there a missile concern for external heat exchanger? Also questions about materials used in fabrication	Chapter 5	DCD	DNRL	*Staff currently reviewing this issue. Subcommittee to be briefed on results of staff review at later date.*
5	JULY09	Pressurizer. Does the change in the pressurizer shape affect "chugging" behavior with the Automatic Depressurization System discharge? What is the effect on level control set points?	Chapter 5	DCD	WEC	*Westinghouse to provide presentation at a future ACRS Subcommittee meeting.*
6	JULY09 OCT09	Flow skirt. This item is a new design detail for Rev. 17. Subcommittee had many questions. For example, what is ratio of peak/average and minimum/average bundle flows with the flow skirt. Questions also pertain to the 1/7th-scale tests in Japan, including scaling methodology, the Computational Fluid Dynamics (CFD) Method used, Reynolds number.	Chapter 4, Chapter 5	DCD	W/ DNRL/ NEW2	*Westinghouse to provide additional detail on flow skirt design and performance at future ACRS Subcommittee meeting. DNRL to provide background documents on flow skirt to ACRS in advance of any future briefing.*

ACRS AP1000 Subcommittee Action Items

No.	MTG	ACTION ITEM	CONTEXT	AREA	LEAD(s)	COMMENTS / ACTION / DISPOSITION
7	JULY09	Zinc Injection. Subcommittee seeks additional information on operating experience (re: application to 14 foot core). Is there exothermic reaction; how much zinc coats on fuel.	Chapter 5 Chapter 19	DCD	WEC	*DNRL to provide documents to Subcommittee in advance of future briefing on this topic.*
8	JULY09	Pressure/Temperature Limits Report Process. Need to clarify how this is captured in Technical Specification. Other examples include treatment in RCOLA.	Chapter 5	DCD	DNRL	*Staff discussed how this issue is treated generically in design process. Additional discussion may take place in context of RCOLA review.* *CLOSED (for purposes of DCD review)*
9	JULY09	Turbine Over-speed Protection. Subcommittee seeks additional information on topic and has several questions. For example, what is the proposed testing interval for the turbine system (and also see Item 12 below).	Chapter 10	DCD	WEC/ DMRL	*Westinghouse agreed to revise DCD to correct mischaracterization about speed control independence. Open questions on intercept valve test frequency and method of testing for over-speed persist and to be addressed at a future Subcommittee meeting.*
10	JULY09	Elbow Taps for Reactor Coolant System (RCS) Flow Measurement. Need further information, discuss uniformity of flow. Provide ACRS background information for Westinghouse change for monitoring RCS flow to reflect an alternate testing method to the precision heat balance. The alternate testing method includes using elbow taps. OI-SRP-16-CTSB-25.	Chapter 16	DCD	DNRL/ NWE2	*Issue still undergoing Westinghouse review. DNRL to provide relevant WEC submittals once they are available.*
11	JULY09	Aircraft Impact Assessment Inspection Results. Subcommittee seeks briefing.	Chapter 19	DCD	DNRL	*Topic associated w/ the re-design/structural performance of the reactor containment building. Issue tied into structural redesign of containment building as well as Chapters 3.7 & 3.8.*
12	JULY09	Turbine missile generation for Dual Unit Sites. ACRS would like more information about assumptions in analysis. Issue to be discussed during Chapter 3 review where missile generation from one unit impacts on a second unit is discussed. Also missile hazards analysis for existing units on the site should be addressed in presentation to ACRS	Chapter 10	DCD	TVA/DNRL/ NWE1	*At the October 09 Subcommittee meeting, staff described their analysis in detail and reported that they found the hazards analysis results for an unfavorable orientation to be the same as for a favorable orientation.* *CLOSED*
13	JULY09	TVA Legacy Computer Code Flood Routing (Hydrology) Issue and quality assurance pedigree of that code. Staff to provide inspection report and public meeting accession numbers.	Chapter 19	RCOLA	DNRL	*Staff to provide additional information to ACRS. Initial action complete based on information provided to Mike Lee in a 7/28 email from Joe Sebrosky* *Discussion topic to be deferred to RCOLA review/briefing at a later date.*

ACRS AP1000 Subcommittee Action Items

No.	MTG	ACTION ITEM	CONTEXT	AREA	LEAD(s)	COMMENTS / ACTION / DISPOSITION
14	JULY09	Subcommittee concerned about the apparent ad-hoc basis of the staff 's re view of de sign changes to det ermine if a particular desig n change imp acts other areas of th e DCD/FSAR.	Chapter 5 Chapter 10	DCD	DNRL	*Addressed earlier Subcommittee concern by focusing on "design changes" not just DCD changes at Oct09 and subsequent meetings.* *CLOSED*
15	JULY09	Subcommittee would like a better understan ding of how GSI-199 (eastern Tennessee seismic zone) issue affect s seismic design margin for the AP1000 Revision 17 design	Chapter 19	DCD/ RCOLA	DNRL/ NWE1	Staff to address this question in the context of the Chapters 3.7 and 3.8 discussions on seismicity and structural design.
16	JULY09	Does the recent flood at French NPS shed any in sights into the treatment of flooding as a design basis event viz PRA?	Chapter 19	RCOLA	DNRL/ NWE1	Staff to address this question in the conte xt of the RCOLA discussions. *Discussion topic to be deferred to RCOLA review/briefing at a later date.*
17	JULY09	INITIAL TEST PROGRAM. DCD makes refe rence to many different types (or classe s) of t ests – e.g., initial start-up tests, 3 plant tests, and IITAC. Testing condu cted to support Rev 15 and 17 design certifications whereas some testing performed to d emonstrate "as-built" – i.e. the initial test program. There is also testing t hat is done thro ughout the service life of the plant. Th rough the course of the presentations, it is not always clear which testing program class is being discussed.	Chapter 14	DCD/ RCOLA	WEC/DNRL	*Westinghouse agreed to improve future presentations to differentiate between the different types of tests being discussed.* *CLOSED*
18	JULY09	Ambiguity concerning the meaning of "radiation significant" in Chapters 11 and 12. Relate s to Ju ly 22, 2 009, ACRS letter on NEI-0 8-08. Gene ric to all COLs – closed wit h respect to AP1000 SC.	Chapter 12	DCD/ RCOLA	EDO	*Discussion topic to be deferred to RCOLA review/briefing at a later date.*
19	JULY09	Subcommittee had questions con cerning digita l instrumentation and control (DI &C) failure rate s and how they were addre ssed in the PRA. Committee understands that the Rev17 PRA was DI&C neutral. That is to say th is aspect of the reactor design had no effe ct on PRA outcomes.	Chapter 7 Chapter 19	DCD	WEC	*WEC to provide additional information regarding how digital I&C failure rates were treated in the Rev17 PRA. Subcommittee also interested in understanding were improvement/modifications made to the AP1000 design as a result of PRA? If so what were they and why were they made?*

ACRS AP1000 Subcommittee Action Items

No.	MTG	ACTION ITEM	CONTEXT	AREA	LEAD(s)	COMMENTS / ACTION / DISPOSITION
20	JULY09	LONG-TERM COOLING: Staff Requirements Memorandum (SRM) dated M ay 8, 2008, dire cted the ACRS to examine this issue for each reactor design center	Chapter 15	DCD/ RCOLA	ACRS	Standing direction from Commission. Subcommittee to deliberate on each design center approach to address SRM. *Subcommittee needs to deliberate on how it intends to address this Commission-requested action.*
21	JULY09	GSI-191: Sump Pump Blockag e. Subcommitt ee needs to understand AP1000 design approach to addressing concern	Commission Chapter 6	DCD	WEC/DNRL	Review consistent w/ Committee oversight of generic issue resolution process *WEC offered to present closed-session discussion of their approach to addressing GSI-191 at the Nov09 meeting.* *Also need to tie into separate GSI Subcommittee (Powers)*
22	JULY09	GSI-199: Updated PSHA Estimates.	Commission	DCD	WEC/DNRL	Although East Carolina Seismic Source Zone might be accounted for as part of design, basic question remains as to what absolute seismic margin is for standardized design. Review consistent w/ Committee oversight of generic issue resolution process *Also need to tie into WEC discussion of Chapters 3.7 & 3.8 in 2010 as well as separate GSI Subcommittee (Powers).*
Note: Items 23 through 27 are general observations about the presentations						
23	JULY09	Subcommittee expressed concerned about workload and schedule when performing a parallel review of both the DCD and RCOLA. What can be d one to improve efficien cy of ACRS' review. Suggested that alternatives can be explored like thermal hyd raulic issues being discussed f or all design centers during one set of ACRS meetings)	Summary Discussion	DCD/ RCOLA	ACRS	*Issue addressed by September 09 ACRS agreement to bifurcate DCD and RCOLA reviews* *CLOSED*
24	JULY09	In several DCD areas, the Co mmittee sought figures or other visual aids to better understand design changes (flow skirt, flywheel), and a functional block diagram on turbine controls. The Committee will be looking for these types of documentation improvements in future DCD chapters.	As appropriate	DCD/ RCOLA	WEC/TVA/ DNRL	*Commitment to address request at a future Subcommittee meeting.* *CLOSED*
25	JULY09	Subcommittee was not particu larly interested in process (non technical or safety issues), such as handling of COL holder items. For future meetin gs, suggest not presenting such items unless there is a compelling reason/need.	Summary Discussion	DCD/ RCOLA	WEC/TVA/ DNRL	*Request addressed by staff at Oct meeting.* *CLOSED*

ACRS AP1000 Subcommittee Action Items

No.	MTG	ACTION ITEM	CONTEXT	AREA	LEAD(s)	COMMENTS / ACTION / DISPOSITION
26	JULY09	Subcommittee interested in understanding how NRC staff ensures that impacts of design changes are considered/evaluated overall, such as: could something about COL impact upon the 'incorporated by reference' or IBR usage, and are all effects of a particular design change evaluated. (relates to item 14 above)	Summary Discussion	DCD/ RCOLA	DNRL	*CLOSED (consistent with Item 14, above)*
27	JULY09	Subcommittee expressed some confusion about RCOL transition process from Bellefonte to Vogtle.	Summary Discussion	RCOLA	NWE1	*Staff to provide additional discussion in future ACRS meeting on RCOLA*
		October 6-7, 2009 Subcommittee Meeting				
28	OCT09	Additional DCD changes may be forthcoming in response to NRC staff RAIs, the resolution of open items, GSI-191, and other staff reviews. It would be useful to better understand what and where any additional changes are and their 'significance.'	Summary Discussion	DCD	DNRL	Staff to provide additional discussion in future ACRS meeting on how changes are being tracked.
29	OCT09	ESTIMATION OF DOSES TO WORKERS: Committee would like to see reports/analyses that describe how these calculations were performed.	Chapter 18	DCD	WEC	
30	OCT09	WEC recommendation that Subcommittee re-visit Cranberry, PA simulator now that Chapter 18 HFE has been presented	Chapter 18	DCD	ACRS	Concern relates to no. 19, above. Subcommittee to deliberate on WEC recommendation
31	OCT09	Human Factors Engineering Task Analysis Reports: Subcommittee would like to see reports/analyses	Chapter 18	DCD	WEC	Currently scheduled for submittal to NRC in Dec09
32	OCT09	Pressure Temperature Curves: Subcommittee would like to see technical reports supporting DCD that were used to derive these curves	Chapter 3	DCD	WEC	
33	OCT09	Sensor Testing: ACRS will defer this review to a later date	Chapter 3	DCD	ACRS	Work with DNRL and WEC on briefing sensor testing at a future Subcommittee meeting,
34	OCT09	What are the specific acceptance criteria for Tier I DAC?	Chapter 3 Chapter 8	DCD	DNRL	
35	OCT09	J-GROOVE WELD ISSUE: Subcommittee is interested in tracking this	Chapter 3	DCD	WEC/DNRL	Follow-up w/ Subcommittee at an appropriate time