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LTR-NRC-11-13

March 3, 2011

Subject: Westinghouse FULL SPECTRUM LOCA Licensing Update Meeting Slide Presentation
(Non-Proprietary) for March 11, 2011

Enclosed is a copy of the non-proprietary slide presentation for March 11, 2011 meeting titled
"Westinghouse FULL SPECTRUM LOCA Evaluation Model (EM) Overview Structure of Topical
Report (WCAP-16996-P)".

Very truly yours,

A handwritten signature in black ink, appearing to read 'J. A. Gresham'.

J. A. Gresham, Manager
Regulatory Compliance

Enclosure

cc: E. Lenning
A. Mendiola

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**Westinghouse FULL SPECTRUM LOCA Evaluation Model (EM)
Overview Structure of Topical Report (WCAP-16996-P)**

Slide Presentation for March 11, 2011

Westinghouse Non-Proprietary Class 3

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**Westinghouse
FULL SPECTRUM LOCA Evaluation
Model (EM)
Overview Structure of Topical Report
(WCAP-16996-P)**

March 11th, 2011

FULL SPECTRUM LOCA



Meeting Objectives

- Westinghouse/NRC kick-off meeting for the review of FULL SPECTRUM™(1) LOCA (FSLOCA™(1)) Topical Report (WCAP-16996-P)
 - Background and clarification about purpose/scope of the new EM
 - High level review of upgrades relative to previous EMs
 - Overview of Topical Report (TR) content, its structure, and new areas of focus
 - Key assumptions
- Discuss Westinghouse/NRC expectations, timelines, milestones
- Logistics and next steps

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FULL SPECTRUM™ LOCA



Meeting Agenda – 03/11/2011

8:00 – 8:15	Introductions (All)
8:15 – 9:15	FULL SPECTRUM LOCA EM general overview, objectives and development history (Westinghouse)
9:15 – 10:00	WCAP-16996-P: Content, structure and new areas of focus (Westinghouse)
10:00 – 10:15	Break
10:15 – 11:15	Review plan, communication strategy, timeline and key milestones (All)
11:15 – 12:00	Open discussion and next steps (All)
12:00	Adjourn

FSLOCA Background

- EM Development Roadmap

- Development started in January 2005 and was completed in November 2010 upon submittal of the Topical Report to the NRC for review and approval.
- Builds on prior Westinghouse Best-Estimate LOCA Code Technology
- Employs ASTRUM-style uncertainty methodology
 - Uncertainty methodology based on non-parametric order statistics
- Expands code validation to address small and intermediate break sizes
- Addresses current and future SBLOCA analysis issues with older Appendix K methods

FSLOCA Scenario Identification and Partition

- LOCA scenario:
 - *The break size considered includes any break size such that break flow is beyond the capacity of the normal charging pumps up to and including a double ended guillotine rupture with a break flow area two times the pipe area*
- LOCA safety analysis tools historically divided in three main EMs:
 - Small break (SB) – Appendix K methods
 - Intermediate break (IB) – Not analyzed
 - Large break (LB) – Best estimate plus uncertainty
- **A FULL SPECTRUM LOCA integrated PIRT was developed**

FSLOCA Objectives – Relationship to U.S. Regulatory Revisions

- Mitigate impact of expected revisions to ECCS acceptance criteria in 10 CFR 50.46(b)
 - Margin generated with FULL SPECTRUM LOCA can be used to offset lower oxidation limits, potential for double-sided oxidation requirements, etc.
- Methodology readily adaptable to comply with new 10 CFR 50.46(a) (Transition Break Size) rule if such option is considered
- **Given the timing of development and rule making not finalized yet, a choice was made to design the methodology around current regulatory requirements**

FSLOCA Objectives

- Development roadmap consistent with more recent Regulatory Guide (RG 1.203): Evaluation Model Development and Assessment Process (EMDAP)
 - Develop assessment strategy for all high and medium ranked PIRT processes across the break spectrum (SB, IB, LB)
 - Improve or range models as needed based on assessment results
- Similar model and EM performance within the Large Break LOCA window of the break spectrum

Small and intermediate breaks
eliminated as a design constraint

FSLOCA EM Development Approach

- WCOBRA/TRAC Legacy and Westinghouse Code of Choice
- FSLOCA methodology builds on prior Westinghouse realistic LOCA technology.
- Continue evolution of WCOBRA/TRAC
- Desire to be able to use currently available WCOBRA/TRAC inputs without significant changes
 - Both test simulations and plant models
 - Noding or LBLOCA performance

WCOBRA/TRAC Development History

Year	Development Activity
1983	Obtained COBRA/TRAC (NUREG/CR-3046) for UPI plant applications
1988	SER on SECY-UPI method (Interim BE method/SECY-83-472)
1988	RG 1.157 "Best Estimate Calculation of ECCS Performance"
1989	CSAU (NUREG/CR-5249)
1989-1993	Improvements and Error corrections to COBRA/TRAC and Development of <u>W</u> COBRA/TRAC through > 100 SET/IET test simulations
1993	Submittal of Code Qualification Documents (CQD) to USNRC
1996	SER by USNRC for the BELOCA methodology (1996 CQD Method)
1998	SER for DVI Plant (AP600)
1999	SER for UPI-BELOCA
2004	AP1000 ^{®(2)} Design Control Document, SER for ASTRUM
2005-2010	Development of <u>W</u> COBRA/TRAC-TF2 and FSLOCA Methodology

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FULL SPECTRUM LOCA



WCOBRA/TRAC Code Upgrades for FSLOCA Creation of WCOBRA/TRAC-TF2

- New requirements for the 3D vessel module (COBRA)
 - Addition of non-condensable transport capability
- New requirements for the 1D loop module (TRAC)
 - Coupling with TRAC-PF1(which now replaces TRAC-PD2)
- Upgrades to several models in both 1D and 3D modules.
Improvements include, but are not limited to:
 - A new horizontal flow regimes map
 - Safety injection condensation and non-condensable condensation suppression models
 - Enhancement to the core heat transfer package

WCOBRA/TRAC-TF2 Assessment Plan

- Focus on SBLOCA and IBLOCA phenomena
- Assessment of new models and confirmation of functionality of existing models
- LBLOCA SETs and IETs
 - Revalidation against previous LBLOCA tests included in currently approved EM
 - Confirm LBLOCA application/compatibility
- SBLOCA SETs
 - This will include assessments of new/revised models, e.g.,
 - COSI condensation model
 - Low Reynolds number heat transfer

Small and Intermediate Break LOCA - IETs

Small Break Process	Test	Comments
Break Flow, Entrainment at Break – Off Take	LOFT L3 Series ROSA: <u>10%</u> CL (side), <u>5%</u> CL (side), <u>2.5%</u> CL (side), <u>2.5%</u> CL (top), <u>2.5%</u> CL (bottom), <u>0.5%</u> CL (side)	Single and two-phase critical break flow measurements available. Orientation effect.
Mixture Level	ROSA: 10% CL, 5% CL, 2.5% CL, and 0.5% CL, Semiscale 7-10D (run in SET mode)	Range of break sizes. Vessel inventories and system wide mass distributions.
Steam Generator Hydraulics	ROSA NC LOFT L3 series	Provides information on system wide phase separation, primary-secondary heat transfer.
Loop Seal Clearance	ROSA: 10% CL, 5% CL, 2.5% CL, 0.5% CL, and additional 5% CL with higher Core Bypass	Provides information on loop seal clearance phenomena.
Fuel Rod Models	LOFT (4 tests)	Nuclear rods. Clad heatup & PCTs.
IBLOCAs	LOFT L5-1/L8-2	A 14 in. (356 mm) ACC line break

Statistical Approach Development

- Utilize Lessons Learned from ASTRUM implementation
- Main Objective: Generate a sufficiently large sample to allow a stable and robust estimator of the 95/95 PCT and MLO

FSLOCA Pilot Plant Projects

- Two Pilot Plants have been contracted:
 - Beaver Valley Unit 1
 - V. C. Summer
- Scoping calculations and/or plant-specific analysis have been included in the FSLOCA Topical Report submitted to the NRC
- Final FSLOCA plant analyses will be delivered to each customer after final approval of methodology

FSLOCA EM Purpose - Power Plant Class/Designs Covered

- The FSLOCA EM is intended to be applicable to all PWR fuel designs with Zirconium alloy cladding
 - Code models, their assessment, and conclusions on model biases and uncertainties are aimed to be generic and applicable to the same class of plants covered by the ASTRUM EM.
- However, when modeling aspects are specific to a particular PWR design, choice was made to focus attention on the Westinghouse 3-loop PWR with cold leg ECCS injection.
 - **The demonstration plant analysis and scoping studies are limited to such a design.**

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FSLOCA Topical Report

Westinghouse Proprietary Class 2

WCAP-16996-P
Revision 0

November 2010

**Realistic LOCA Evaluation
Methodology Applied to the
Full Spectrum of Break Sizes
(FULL SPECTRUM LOCA
Methodology)**

**Volume I
WCOBRA/TRAC-TF2 Models
and Correlations**

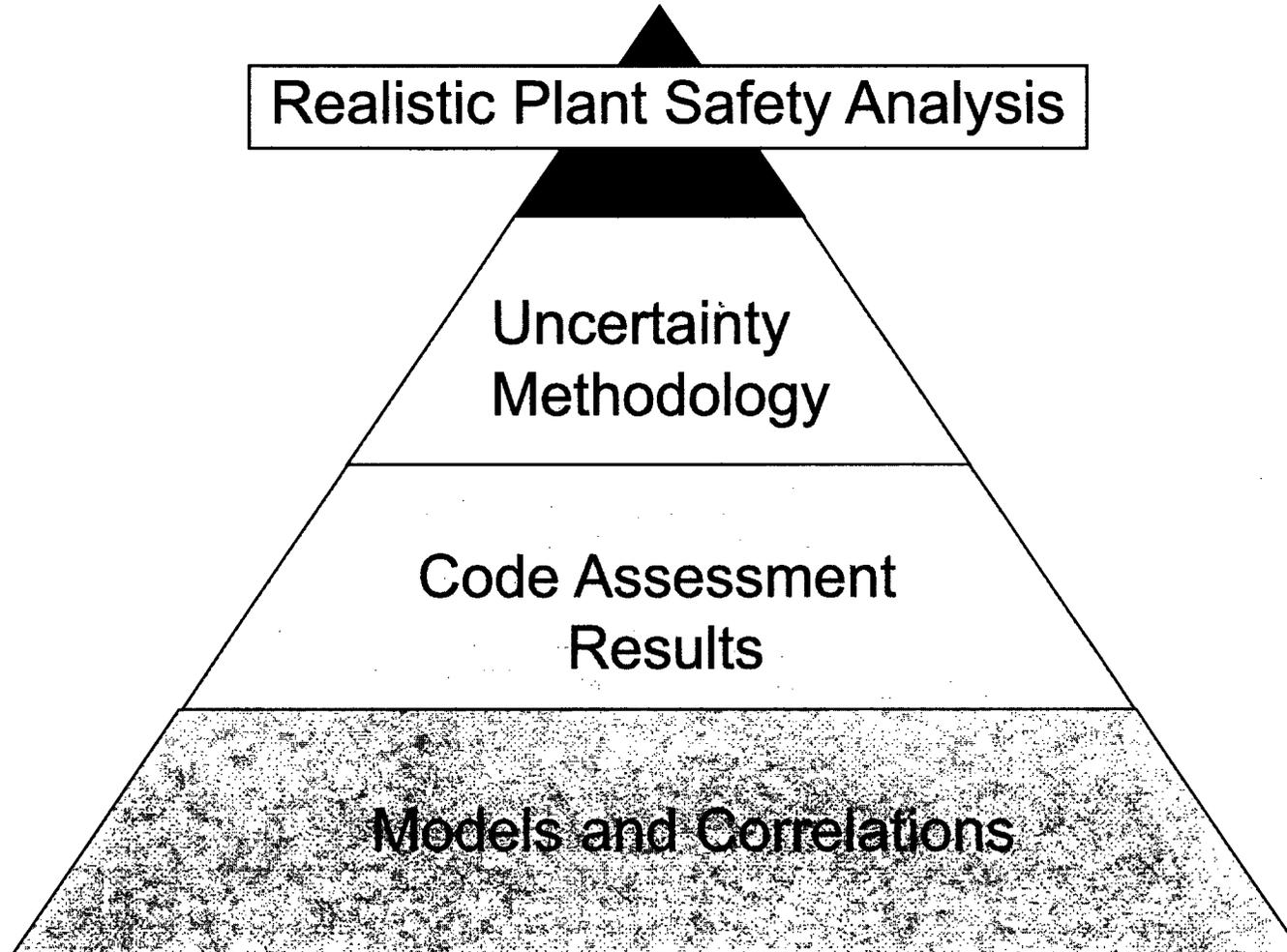
- **WCAP-16996-P**
 - **Vol. 1:** Models and Correlations
 - **Vol. 2:** Code Assessment Results
 - **Vol. 3:** Uncertainty Methodology and Demonstration Plant Analyses
- A comprehensive Topical Report (~3800 pages) which will supersede previous documentation



Rationale for Self-Standing TR

- A large portion of model description for vessel component is duplicated from the previous TR since physical models are essentially unchanged
- However, the nature of changes to the EM (Slides 10 & 12), T&H Systems code and uncertainty treatment, warrants a self standing TR
- Consistent with the criteria in LIC-109, "Acceptance Review Procedures," and for the efficient use of the TR going forward, this TR contains as complete and detail information as practical on the proposed EM with references to publically available sources and to previously approved TR

Building Blocks of FSLOCA Evaluation Model Consistent with EMDAP



Bottom-Up / Top-Down Review (1/2)

- Sections 1 and 2 – EMDAP process and the definition of the EM functional requirements
- Section 32 – Methodology summary and compliance with 10 CFR 50.46 rule and regulatory guidance:
 - Particularly **Table 32-1** offers a summary of assessment results and uncertainty treatment for all High PIRT ranked phenomena → adequacy decision
 - Table 32-1 is a good roadmap to navigate through the rest of the documentation

Bottom-Up / Top-Down Review (2/2)

- Volume 1 (Sections 3 through 11) provides a Bottom-Up review of the EM
- Volume 2 provides the Top-Down review of the EM
 - Assessment against SETs, IETs and compensating errors analysis

Volumes 1 and 2 are aimed to demonstrate the adequacy of the code (WCOBRA/TRAC-TF2)

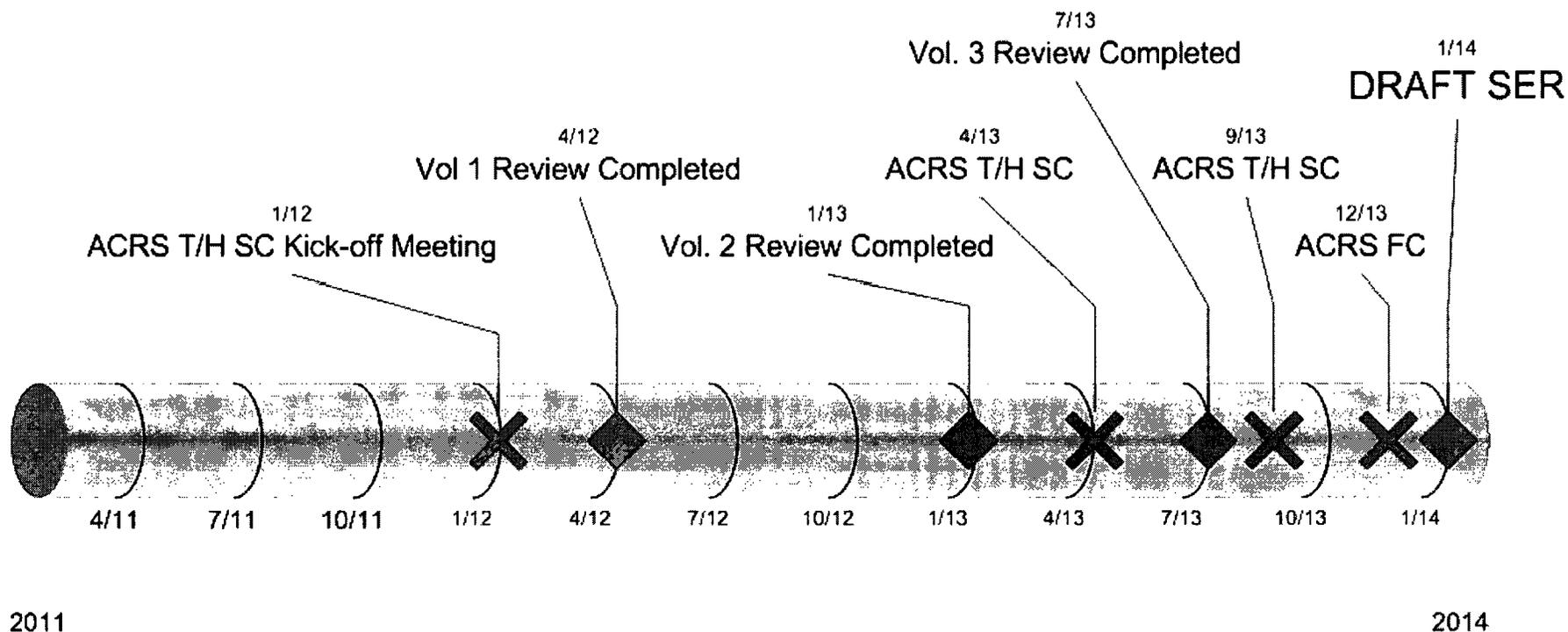
- Volume 3 presents the uncertainty methodology with demonstration plant analysis

Licensing Strategy and Westinghouse/NRC Staff Interactions So Far

- Have held four meetings with the NRC so far to introduce and discuss licensing concept, and provide periodical technical updates on development program
- Topical Report was submitted to the NRC on November 24th, 2010
- NRC in the process of accepting Topical Report for review
- Expected review time 2 to 3 years
 - NRC resource constraints appear to be an issue
- A kick-off Meeting with ACRS within the first year is desired
 - Two T/H subcommittee and one final full committee meeting expected
- Westinghouse committed to open, frequent dialogue with NRC during review

Possible Timeline and Milestones

- Assume a 3-year review time



2011

2014

Areas Where Westinghouse Can Help (1/2)

- Build off Lesson Learned from ASTRUM licensing:
 - Encourage frequent and informal communication such as:
 - Clarification of question
 - Confirmation of understanding
 - Suggest or agree on approach for response
 - Goal is to minimize formal iterations/additional paperwork during RAI process → decrease overall turnaround time, possibly avoid formal RAIs
- Arrangements may be made to have support available at the Westinghouse Rockville office to:
 - Assist with development of input models
 - Address other training needs



Areas Where Westinghouse Can Help (2/2)

- Westinghouse committed to provide NRC with additional support material that may facilitate NRC review
- Example: A roadmap to address the DELTA from previous EM structured as follows:

Roadmap to previous documentation

Section No.	Content	New Material	Legacy of NRC approved documentation	Comments
1	In an nutshell the purpose of the section	What's new (important) from the past	List legacy topical sections (CQD or other) Key RAIs

Next Steps/Open Discussion

- Next Steps:
 - Westinghouse proposes a follow-on closed technical meeting
 - Schedule?
 - Timeline for issuance of NRC acceptance letter
- Review of Action Items
- Other Items??

THANK YOU!