Westinghouse

Westinghouse Electric Company
Nuclear Services
P.O. Box 355
Pittsburgh, Pennsylvania 15230-0355
USA

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555-0001

Direct tel: (412) 374-4643
Direct fax: (412) 374-3846
e-mail: greshaja@westinghouse.com

Our ref: LTR-NRC-09-22

Date: April 22, 2009

TRANSMITTAL OF PROPRIETARY INFORMATION

Enclosed is:

1. 1 copy of Presentation Material entitled, "NRC Containment Audit – STP 3&4 COLA" (Proprietary)
2. 1 copy of Presentation Material entitled, "NRC Containment Audit – STP 3&4 COLA" (Non-Proprietary)

Also enclosed is:

1. One (1) copy of the Application for Withholding, AW-09-2556 (non-proprietary) with Proprietary Information Notice.
2. One (1) copy of Westinghouse Electric Company Affidavit (non-proprietary).
3. One (1) copy of Toshiba Corporation Affidavit (non-Proprietary).

This information is being submitted by Westinghouse Electric Company LLC to provide the presentation material that was used for the NRC's Containment Audit of STP 3&4 on March 3, 2009. This material is being provided at the NRC's request and for the NRC's information in support of the STP 3&4 COL Application (Docket Nos. 52-012 and 52-013).

This submittal contains proprietary information of Westinghouse Electric Company, LLC and Toshiba Corporation. In conformance with the requirements of 10 CFR Section 2.390, as amended, of the Commission's regulations, we are enclosing with this submittal an Application for Withholding from Public Disclosure, an affidavit for the Westinghouse sections of the presentation material, and an affidavit for the Toshiba section of the material. The affidavits set forth the bases on which the information identified as proprietary may be withheld from public disclosure by the Commission.

Correspondence with respect to the affidavits or Application for Withholding should reference AW-09-2556 and should be addressed to J. A. Gresham, Manager, Regulatory Compliance and Plant Licensing, Westinghouse Electric Company LLC, P.O. Box 355, Pittsburgh, Pennsylvania 15230-0355.

Very truly yours,

J. A. Gresham

J. A. Gresham, Manager
Regulatory Compliance and Plant Licensing

Enclosures

cc: G. Bacuta (NRC OWFN 12E-1)

D091
NRO

bcc: J. A. Gresham (ECE 4-7A) 1L
R. Bastien, 1L (Nivelles, Belgium)
C. Brinkman, 1L (Westinghouse Electric Co., 12300 Twinbrook Parkway, Suite 330, Rockville, MD 20852)
RCPL Administrative Aide (ECE 4-7A) (letter and affidavit only)
B. F. Maurer (ECE 307C) 1L
K. Aria (Toshiba – Isogo Engineering Center) 1L
S. Head (STPNOC) 1L

Westinghouse Electric Company
Nuclear Services
P.O. Box 355
Pittsburgh, Pennsylvania 15230-0355
USA

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555-0001

Direct tel: (412) 374-4419
Direct fax: (412) 374-6526
e-mail: maurerbf@westinghouse.com

Our ref: AW-09-2556

April 22, 2009

APPLICATION FOR WITHHOLDING PROPRIETARY
INFORMATION FROM PUBLIC DISCLOSURE

Subject: "NRC Containment Audit – STP 3&4 COLA" (Proprietary)

Reference: Letter from J. A. Gresham to Document Control Desk LTR-NRC-09-22, dated April 22, 2009

The proprietary information for which withholding is being requested in the above-referenced report is further identified in Affidavit AW-09-2556 and Affidavit (SSO-2009-000058-P) signed by the owners of the proprietary information, Westinghouse Electric Company LLC and Toshiba Corporation, respectively. The Toshiba Corporation Affidavit provides the basis for the proprietary information contained in the section entitled "Test Data Overview." The Westinghouse Affidavit provides the basis for the proprietary information contained in all other sections of the report. The affidavits, which accompany this letter, set forth the bases on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR Section 2.390 of the Commission's regulations.

Correspondence with respect to the proprietary aspects of the application for withholding or the Westinghouse affidavit should reference this letter, AW-09-2556, and should be addressed to B. F. Maurer, Manager, ABWR Licensing, Westinghouse Electric Company LLC, P.O. Box 355, Pittsburgh, Pennsylvania 15230-0355.

Correspondence with respect to the proprietary aspects of the Toshiba affidavit should reference this letter, AW-09-2556, and should be addressed to Mr. Kenji Aria, Senior Manager, System Design & Engineering Department, Power Systems Company, Toshiba Corporation, 8, Shinsugita-Cho, Isogo-Ku, Yokohama, 235-8523, Japan.

Very truly yours,

B. F. Maurer, Manager
ABWR Licensing

G. Bacuta (NRC OWFN 12E-1)

Enclosures

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared B. F. Maurer, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Company LLC (Westinghouse), and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

B. F. Maurer, Manager
ABWR Licensing

Sworn to and subscribed before me
this 22nd day of April, 2009

Sharon L. Markle
Notary Public

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Sharon L. Markle, Notary Public
Monroeville Boro, Allegheny County
My Commission Expires Jan. 29, 2011
Member, Pennsylvania Association of Notaries

(1) I am Manager, ABWR Licensing, in Nuclear Services, Westinghouse Electric Company LLC (Westinghouse), and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rule making proceedings, and am authorized to apply for its withholding on behalf of Westinghouse.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.390 of the Commission's regulations and in conjunction with the Westinghouse "Application for Withholding" accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Westinghouse policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information that is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.390, it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in, "NRC Containment Audit – STP 3&4 COLA" (Proprietary) for submittal to the Commission, being transmitted by Westinghouse letter (LTR-NRC-09-22) and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk. The proprietary information as submitted by Westinghouse is that associated with the NRC audit of the Westinghouse containment analysis methodology as applied to the South Texas Project Units 3 and 4 COL Application.

This information is part of that which will enable Westinghouse to:

(a) Assist the customer in obtaining NRC review of the South Texas Project Units 3 and 4 COL Application.

Further this information has substantial commercial value as follows:

(a) Westinghouse plans to sell the use of this information to its customers for purposes of plant specific ABWR containment analysis for licensing basis applications.

(b) Its use by a competitor would improve their competitive position in the design and licensing of a similar product for ABWR containment analyses.

(c) The information requested to be withheld reveals the distinguishing aspects of a methodology which was developed by Westinghouse.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar calculations and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended.

Further the deponent sayeth not.

Proprietary Information Notice

Transmitted herewith are proprietary and/or non-proprietary versions of documents furnished to the NRC in connection with requests for generic and/or plant-specific review and approval.

In order to conform to the requirements of 10 CFR 2.390 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the affidavit accompanying this transmittal pursuant to 10 CFR 2.390(b)(1).

Copyright Notice

Affidavit for Withholding Confidential and Proprietary Information from Public Disclosure under 10 CFR § 2.390

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of

STP Nuclear Operating Company

Docket Nos.52-012
52-013

South Texas Project
Units 3 and 4

AFFIDAVIT

I, Kenji Arai, being duly sworn, hereby depose and state that I am Senior Manager, System Design & Engineering Department, Nuclear Energy Systems & Services Division, Power Systems Company, Toshiba Corporation; that I am duly authorized by Toshiba Corporation to sign and file with the Nuclear Regulatory Commission the following application for withholding Toshiba Corporation's confidential and proprietary information from public disclosure; that I am familiar with the content thereof; and that the matters set forth therein are true and correct to the best of my knowledge and belief.

In accordance with 10 CFR § 2.390(b)(1)(ii), I hereby state, depose, and apply as follows on behalf of Toshiba Corporation:

(A) Toshiba Corporation seeks to withhold from public disclosure the proprietary information which is appropriately indicated in "Test Data Overview," Revision 1, SSO-2009-000058-P (Proprietary) for submittal to the Commission, being transmitted by Westinghouse Electric Company letter and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk.

(B) The Confidential Information is owned by Toshiba Corporation. In my position as Senior Manager, System Design & Engineering Department, Nuclear Energy Systems & Services Division, Power System Company, Toshiba Corporation, I have been specifically delegated the function of reviewing the Confidential Information and have been authorized to apply for its withholding on behalf of Toshiba Corporation.

(C) Consistent with the provisions of 10 CFR § 2.390(a)(4), the basis for proposing that the Confidential Information be withheld is that it constitutes Toshiba Corporation's trade secrets and confidential and proprietary commercial information.

(D) Public disclosure of the Confidential Information is likely to cause substantial harm to

Toshiba Corporation's competitive position by (1) disclosing confidential and proprietary commercial information about the design and operation of ABWR reactors to other parties whose commercial interests may be adverse to those of Toshiba Corporation, and (2) giving such parties access to and use of such information at little or no cost, in contrast to the significant costs incurred by Toshiba Corporation to develop such information.

(E) The Confidential Information which is entirely confidential and proprietary to Toshiba Corporation is indicated in the document using brackets.

Further, on behalf of Toshiba Corporation, I affirm that:

(i) The Confidential Information is confidential and proprietary information of Toshiba Corporation.

(ii) The Confidential Information is information of a type customarily held in confidence by Toshiba Corporation, and there is a rational basis for doing so given the sensitive and valuable nature of the Confidential Information as discussed above in paragraphs (C) and (D).

(iii) The Confidential Information is being transmitted to the NRC in confidence.

(iv) The Confidential Information is not available in public sources.

(v) Public disclosure of the Confidential Document is likely to cause substantial harm to the competitive position of Toshiba Corporation, taking into account the value of the Confidential Information to Toshiba Corporation, the amount of money and effort expended by Toshiba Corporation in developing the Confidential Information, and the ease or difficulty with which the Confidential Information could be properly acquired or duplicated by others.

Apr. 23, 2009

Date

Kenji Arai
Senior Manager
System Design & Engineering Department
Nuclear Energy Systems & Services Division
POWER SYSTEMS COMPANY
TOSHIBA CORPORATION

平成２１年登簿第　48　号

認　　証

嘱託人株式会社東芝部長新井健司は、公証人の面前で、添付書面に署名した。

よって、これを認証する。

平成２１年　4　月　23　日、本公証人役場において

横浜市中区羽衣町2丁目7番10号

横浜地方法務局所属

公　証　人

Notary

KENJI TERANISHI

証　　明

上記署名は、横浜地方法務局所属公証人の署名に相違ないものであり、かつ、その押印は、真実のものであることを証明する。

平成２１年　4　月　23　日

横浜地方法務局長　紺野清幸

APOSTILLE

(Convention de La Haye du 5 octobre 1961)

1. Country：JAPAN

This public document

2. has been signed by KENJI TERANISHI
3. acting in the capacity of Notary of the Yokohama District Legal Affairs Bureau
4. bears the seal/stamp of KENJI TERANISHI, Notary

Certified

5. at Tokyo　　6. APR. 23. 2009
7. by the Ministry of Foreign Affairs
8. 09-№ 300541
9. Seal/stamp：　　10. Signature：

MINISTRY OF FOREIGN AFFAIRS JAPAN

Kazutoyo OYABE

For the Minister for Foreign Affairs

Registered No. **48** of 2009.

Certificate of Acknowledgment of Notary

On this 23rd day of April, 2009, before me, KENJI TERANISHI, a notary in and for YOKOHAMA District Legal Affairs Bureau, personally appeared Kenji ARAI, Senior Manager of TOSHIBA Corporation, with satisfactory evidence of his identification, affixed his signature to the attached document.

Witness, I set my hand and seal.

Notary　　　　　　　　　　　　Notary's seal (Official)

KENJI TERANISHI

Kannai-odori Notary office

2-7-10, Hagoromocho, Naka-ku, Yokohama-city, Japan.

Attached to the Yokohama District Legal Affairs Bureau.

LTR-NRC-09-22 NP-Attachment

NRC Containment Audit
STP 3&4 COLA

April, 2009

Westinghouse Electric Company LLC
P.O. Box 355
Pittsburgh, PA 15230-0355

NRC Containment Audit
STP 3&4 COLA

March 3, 2009

Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

Westinghouse

NRC Containment Audit for STP 3&4 COLA
Orientation and Overview

Bob Quinn
March 3, 2009
Westinghouse Energy Center, Monroeville, PA

Westinghouse Non-Proprietary Class 3

Westinghouse

Safety Briefing & Facility Orientation

- In case of emergency
- Facility information
  - Restrooms
  - Cafeteria
  - Escort for visitors
- Conference room plan for the week

Introductions

- NRC Staff
  - Stacy Joseph
  - Mike Snodderly
  - Andrzej Drozd
- ERI (NRC Contractor)
  - Fred Moody
  - Michael Zavisca
  - Mohsen Khatib-Rahbar
  - Pravin Sawant
- EPC Team

  (see next slide)

STP 3&4 EPC Team

• Westinghouse	John Kunicky	Global Quality Programs
	Ray Sero	Program Manager ABWR Projects
	Brad Maurer	ABWR Licensing Manager
	Nirmal Jain	ABWR Systems Engineering Mgr
	John Blaisdell	LOCA Analysis & Methods
	Rick Ofstun	Containment Analysis
	Jason Douglass	Containment Analysis
	Tom George*	Modeling & Methods
	Bob Quinn	San Jose Licensing Manager
	Fred Hayes	Principal Licensing Engineer

(continued)

* Nuclear Applications Inc.

STP 3&4 EPC Team *(continued)*

• TANE	Fumihiko Ishibashi	Vice President Licensing
	William McConaghy	Licensing Manager
	Koichi Kondo	Licensing Engineer
	Caroline Schlaseman*	PM Alternate Vendor Inspection
• Toshiba	Hirohide Oikawa	Manager Nuclear Safety Engineering
• STPNOC	Scott Head	STP 3/4 Licensing Manager
	Steve Thomas	STP 3/4 Engineering Manager
	Jim Tomkins	Licensing Engineer
	Aaron Heinrich	Design Engineer, Mechanical
	Steve Frantz**	ABWR Background/Licensing Supt

* MPR Associates
** Morgan, Lewis & Bockius LLP

NRC Containment Audit Plan

- Tuesday March 3 *(8:30A-5:00P)*
  - Overview of licensing history & approach (a.m.)
  - Planning and caucus time (p.m.)
- Wednesday and Thursday March 4-5 *(8:30A-5:00P)*
  - Conduct of Audit
  - Debrief (March 4 p.m.)
- Friday March 6 *(8:30A-12:00P)*
  - EPC Team feedback on debrief items

STP EPC Team Goals and Desired Outcomes

- Provide NRC reviewers with understanding of EPC team ABWR containment analysis capabilities, expertise, and status of containment analyses
- Answer all reviewers questions, and capture those to answer later if information is not available now
- Review of existing containment P/T calculations
- Review of plans for additional P/T calculations
- Review of hydrodynamic loads approach
- Review of containment analysis method and tools
- Everyone understand where we are and what is coming

STP EPC Team Conduct of Audit

- Conference Rooms
  - Provide space for interactive audit activities
  - Provide space for break-outs
- Provide dedicated EPC Team individuals to facilitate NRC auditor needs and requests
- Make technical documents available for review as requested
- Make technical staff available for discussion as needed and requested
- Brief morning meeting and debrief at close of business on March 4 and 5 as appropriate / needed

Presentation Overview

• History of ABWR Containment Licensing	Jim Tomkins
• Overview of Containment Analyses to Date	Bob Quinn
• GOTHIC Experience and Application History	Rick Ofstun
• Primary Containment Benchmarking Results	Jason Douglass
• Westinghouse ABWR methods comparison to NEDO-20533	Tom George
• ABWR Pool Swell Analysis	Tom George
• Test Data	Hirohide Oikawa
• Summary	Bob Quinn

NRC Containment Audit for STP 3&4 COLA

Containment Analysis Licensing History

J. Tomkins – South Texas Project
March 3, 2009
Westinghouse Energy Center, Monroeville, PA

Purpose

Discuss the licensing history of containment P/T response and pool swell dynamic loads issues

Design Control Document (DCD)

- Initial ABWR Part 50 application submitted September 1987
- Application for design certification (Part 52) submitted December 1991
- DCD Rev. 4 submitted March 1997
- ABWR DC issued June 11, 1997
- 34 RAIs on Containment Analysis

DCD (contin.)

- Pressure/Temperature response calculated using Mark III methods described in NEDO-20533
- Pool Swell based on Mark II model (NUREG-0808)
- Mark II Pool Swell model assessed against Mark III test data
- Structural impact to be assessed based on NUREG-0479 and NUREG-0978

P/T Response Issues during Certification

- NRC initially unable to conclude models were acceptable (DSER) SECY-91-355
- Had questions generally about the applicability of NEDO-20533 to the ABWR

P/T Response Issues during Certification (contin.)

- NRC Raised Questions Regarding:
  - Modeling of two drywell volumes with one node
  - Modeling of combination of horizontal and vertical vents
  - Air carryover from the drywell volumes to the suppression pool

P/T Response Issues during Certification (contin.)

- GE clarified its modeling in a May 6, 1992 meeting with the NRC
- GE provided additional information in a letter of May 22, 1992 demonstrating the conservatism of its analysis
- GE developed and ran a two-node model resulting in lower pressure results, demonstrating conservatism of one-node model
- NRC concludes " GE's use of NEDO-20533 is acceptable"

Pool Swell Issues during Certification

- Non-uniform pool swell
- Protection of safety related components potentially impacted by pool swell
- Modeling assumptions (use of Mark II model) for calculating pool swell

Pool Swell Issues during Certification (contin.)

- 80 % Correction Factor to account for non-uniform swell
- COL Applicant item to protect drywell-to-wetwell vacuum breakers
- ITAAC for pool swell loads required
- NRC approved pool dynamic loads analysis

COLA Revision 0

- During the preparation of Rev. 0, errors are identified in the DCD P/T response calculations
- GE submits NEDO-33372 on Sept. 4, 2007
- Corrects assumptions in three main areas:
  - Vent modeling
  - Feedwater flow
  - Decay heat
- Added a trip of condensate pumps to ensure feedwater flow assumptions are met

COLA Revision 0

- NEDO-33372 incorporated by reference into Sections 3B, 6.2, and the T. S. in September 2007.
- Results increased peak pressure and pool swell height

COLA Rev 1

- No significant changes made to 3B and 6.2

COLA Rev 2

- GE requested NRC suspend review of NEDO-33372 in the spring of 2008
- Short term containment analysis performed and completed by WEC
- Long term and pool swell analysis ongoing

COLA Rev. 2

- Submitted in September 2008
- Removed reference to NEDO-33372
- Appendix 3B and Section 6.2 markups added WEC P/T short term results where they changed from the DCD
- Figure 3B-13, Schematic of Pool Swell Height, was conservatively modified based on WEC preliminary calculations and engineering judgment

COLA Revision 2(contin.)

- Bulk Pool Swell changed to 8.5 m (from 8.3)
- Froth Height to 11.7 m (from 11.6)
- Changes based on engineering judgment based on short term analysis
- Pool Swell height affects SRV discharge piping, catwalk, drywell/wetwell vacuum breakers
- Final detailed design of affected equipment will reflect these more conservative conditions

NRC Containment Audit for STP 3&4 COLA

Overview of Containment Analyses to Date

Bob Quinn
March 3, 2009
Westinghouse Energy Center, Monroeville, PA

Westinghouse

ABWR Containment Model Comparison

Column	1	2	3	4	5

a,c

NRC Containment Audit for STP 3&4 COLA
GOTHIC Applications History

Rick Ofstun
March 3, 2009
Westinghouse Energy Center, Monroeville, PA

Purpose

- To briefly describe the GOTHIC code, validation, and containment analysis applications

GOTHIC Code Development History

- Originated from the NRC sponsored COBRA code at Battelle Northwest Labs
- Modifications were made to add a non-condensable gas phase, this resulted in the COBRA-NC code
- COBRA-NC was further developed to create GOTHIC

GOTHIC Code

- Developed and maintained by Numerical Applications Incorporated (NAI) for the Electric Power Research Institute (EPRI)
- Intended Applications
  - Containment design analyses
  - Sub-compartment design analyses
  - Auxiliary building analyses
  - General purpose thermal hydraulic analysis

GOTHIC Code

- Solves the conservation equations for multi-dimensional, multi-component, multi-phase flow
  - Phase balance equations are coupled with mechanistic models for mass, energy, and momentum transfer that cover the entire flow regime
  - Models may include up to three primary fields (vapor, liquid, drop) with two secondary fields (mist, liquid component)

GOTHIC Code

- Energy exchange to/from solid structures modeled with thermal conductors
  - One dimensional conduction equation
  - Multiple material layers per conductor
  - Multiple conductors per volume
- Components are used to model
  - Pumps/Fans
  - Valves/Doors
  - Heat Exchangers
  - Heaters/Coolers
  - Spray Nozzles

GOTHIC Code Validation

- Validation testing is performed for each code release
- Code results are compared with
  - Analytical solutions
  - Small scale test data
  - Large scale test data
- Qualification report provided with the code

GOTHIC Code Validation

- Analytical Solutions
  - Committee on the Safety of Nuclear Installations (CSNI) numerical benchmark
  - Standard analytical problems
    - Buoyancy driven flow
    - Constant flow gas injection
    - Liquid piston
    - 1-D transient conduction
  - Component tests (pumps, valves, nozzles, heat exchangers, fans, etc.)

GOTHIC Code Validation

- Small Scale Tests
  - Battelle-Frankfurt Model Containment Tests
    - Differential pressure, peak pressure, gas mixing
  - Hanford Engineering Development Laboratory Tests
    - Gas mixing
  - Light Water Reactor Aerosol Containment Experiments
  - ISP 47
    - TOSQAN (multi-dimensional condensation)
    - MISTRA (multi-dimensional condensation)

GOTHIC Code Validation

- Large Scale Tests
  - Marviken Full Scale Boiling Water Reactor (BWR) Containment
    - Blowdown to suppression pool
  - Carolina Virginia Tube Reactor (CVTR)
    - Blowdown to large dry containment w/spray
  - Heisdampfreaktor (HDR)
    - Multi-compartment steam/gas mixing
  - NUPEC Tests (ISP-35)
    - Multi-compartment steam/gas mixing

Westinghouse Containment Analysis Applications

- Westinghouse developed WGOTHIC containment models for the passive containment design
  - Modified the GOTHIC 4.0 code to incorporate film flow and mechanistic heat/mass transfer models for condensation and evaporation
  - Separate effects tests for condensation and evaporation heat and mass transfer under free and forced convection conditions.
  - Built 1-D and 3-D WGOTHIC models of the large scale test (LST) facility for integral tests
  - Built 1-D AP600 and AP1000 containment evaluation models and performed the SAR analyses
  - Received SER for this methodology

Westinghouse Containment Analysis Applications

- Westinghouse has developed and benchmarked several plant specific GOTHIC containment models for the large dry containment design
- Westinghouse has developed a new LOCA mass and energy release and containment response methodology
- Westinghouse and NAI have developed and benchmarked GOTHIC BWR Mark I, II, and III containment models

Current Licensing Applications

- Several plants have approval to use GOTHIC for their containment design analyses
  - –Catawba, McGuire (ice condenser containments)
  - –Kewaunee, Prairie Island, Ginna, Farley, Fort Calhoun, Calvert Cliffs, Diablo Canyon, Callaway, Wolf Creek, Comanche Peak (large dry)
  - –North Anna, Surry (sub-atmospheric)
- Westinghouse has approval to use WGOTHIC for the AP600 and AP1000 design analyses
- Westinghouse has approval to use GOTHIC for the BWR Mark I containment design analyses
- Some plants have approval to use GOTHIC for their sub-compartment design analyses
  - –Farley, Waterford
  - –River Bend

BWR Mark III Licensing Applications

- GOTHIC containment analyses for Grand Gulf (ML022490416) and Clinton (ML031290397)
  - Change Technical Specifications to permit draining the reactor cavity portion of the upper containment pool in MODE 3 with reactor pressure less than 235 psi
  - Analyzed large and small LOCA events with bypass leakage

Future Licensing Applications

- Westinghouse is developing GOTHIC ABWR containment design analysis capability
  - Scheduled to submit WCAP-16608 Appendix D in June 2009
- Westinghouse is developing GOTHIC ABWR pool swell analysis capability (for input to hydrodynamic load calculations)
  - Scheduled to submit LTR in December 2009
- Westinghouse is developing GOTHIC sub-compartment design analysis capability to replace TMD
  - Scheduled to submit WCAP-16608 Appendix E in December 2009

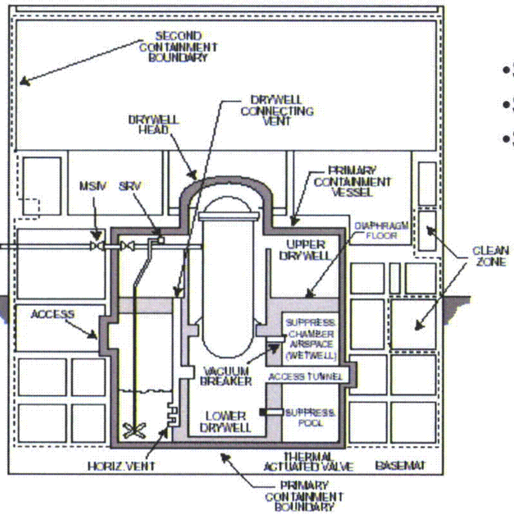
NRC Containment Audit for STP 3&4 COLA
ABWR Primary Containment Modeling with GOTHIC

Jason Douglass
March 3, 2009
Westinghouse Energy Center, Monroeville, PA

Purpose

- To briefly describe the GOTHIC ABWR containment model
- To provide the benchmark comparison results

ABWR Containment



<u>Comparison with Mark IIII</u>

- Smaller vent area
- Smaller Suppression chamber volume
- Separate lower drywell volume

GOTHIC ABWR Containment Model Features for Simulating NEDO-20533

- Single volume drywell
- Liquid break flow is released as small drops
- Drop-to-liquid conversion is turned off
- Flow path inertia is minimized
- Vertical vent pipe volume is subdivided
- Horizontal vent pipes are modeled using three flow paths from vent pipe cells to wetwell
- Vent path equivalent loss coefficient added to vent pipe entrance flow path

GOTHIC ABWR Containment Model Noding Diagram

a,c

GOTHIC ABWR Containment Model Benchmarking

- ABWR containment model benchmarking uses two approaches
  1. Short-term DCD Benchmark (Column 2)
     - Uses DCD assumptions to compare GOTHIC results to DCD results
  2. Short-term NEDO-33372 Benchmark (Column 4)
     - Uses NEDO-33372 assumptions to compare GOTHIC results to NEDO results
- Westinghouse ABWR containment model analysis approach (Column 5)
  - Incorporate NEDO-33372 revisions
  - Incorporate more realistic modeling approach
  - Compare with NEDO-33372 results

DCD Modeling Assumptions

1. The initial conditions for the FWLB accident are such that system energy is maximized and the system mass is minimized. That is:
   a) The reactor is operating at 102% of the rated thermal power, which maximizes the post-accident decay heat. Assumption Included
   b) The initial suppression pool mass is at the low water level. Assumption Included
   c) The initial wetwell air space volume is at the high water level. Assumption Included
   d) The suppression pool temperature is the operating maximum temperature. Assumption Included
2. The feedwater line is considered to be severed instantaneously. This results in the most rapid coolant loss and depressurization of the vessel, with coolant being discharged from both ends of the break. Assumption Included

DCD Modeling Assumptions *(continued)*

3. Scram occurs in less than one second from receipt of the high drywell pressure signal. Assumption Included
4. The main steam isolation valves (MSIVs) start closing at 0.5 s after the accident. They are fully closed in the shortest possible time (at 3.5 s) following closure initiation. Assumption Included
5. The vessel depressurization flow rates are calculated using Moody's homogeneous equilibrium model (HEM) for the critical break flow. Assumption Included
6. One of two HPCF Systems, one of one RCIC Systems, and two of three RHR Systems are assumed to be available. Assumption Included

DCD Modeling Assumptions *(continued)*

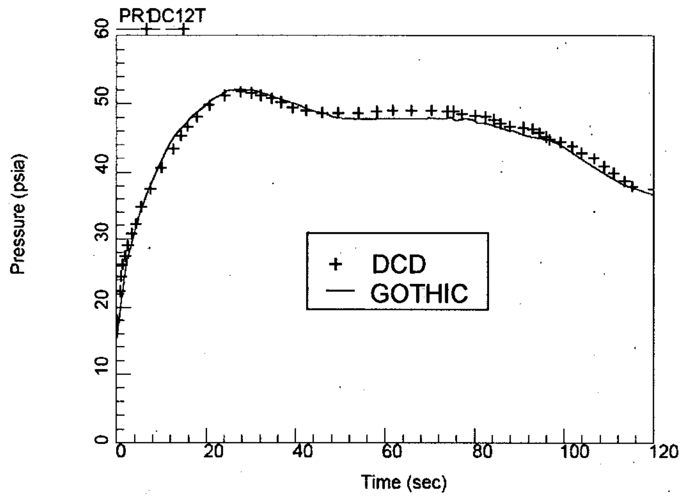
7. Drywell and wetwell airspaces are homogeneous mixtures of inert atmosphere, vapor and liquid water. Assumption Included
8. The wetwell airspace temperature is allowed to exceed the suppression pool temperature as determined by a mass and energy balance on the airspace. Assumption Included
9. Wetwell and drywell wall and structure heat transfer are ignored. Assumption Included
10. Actuation of SRVs is modeled. Assumption included in M&E releases
11. Wetwell-to-drywell vacuum breakers are not modeled. Wetwell to drywell vacuum breakers are included
12. The dynamic backpressure model is used. [

]a,c

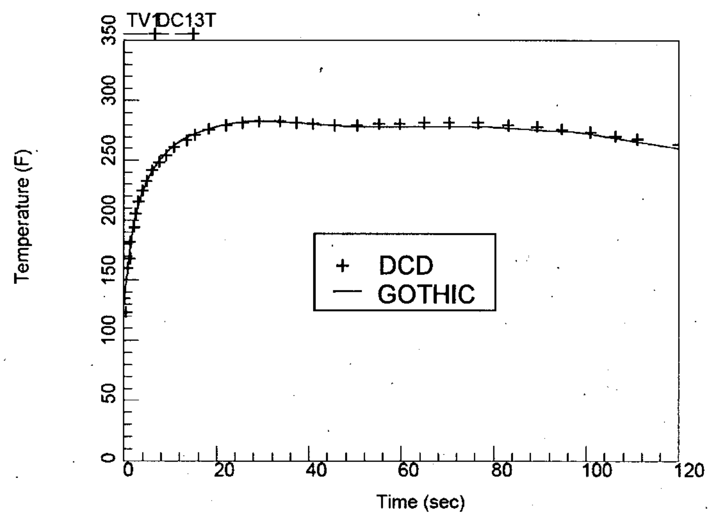
DCD Modeling Assumptions *(continued)*

14. Initial drywell conditions are 0.107 MPa, 57 °C, and 20% relative humidity. Assumption Included
15. Initial wetwell airspace conditions are 0.107 MPa, 35 °C and 100% relative humidity. Assumption Included
16. The drywell is modeled as a single node. All break flow into the drywell is homogeneously mixed with the drywell inventory. Assumption Included
17. Because of the unique containment geometry of the ABWR, the inert atmosphere in the lower drywell would not transfer to the wetwell until the peak pressure in the drywell is achieved. A conservative credit for transfer of 50% of the lower drywell contents into the wetwell was taken. Assumption Included

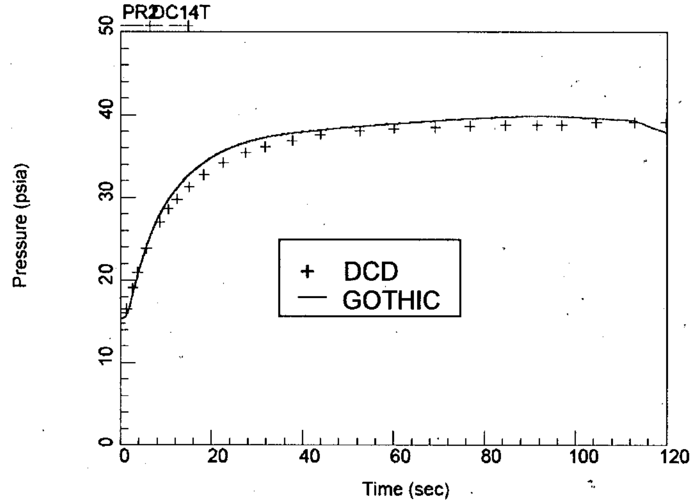
Short-term DCD FWLB
Drywell Pressure Comparison



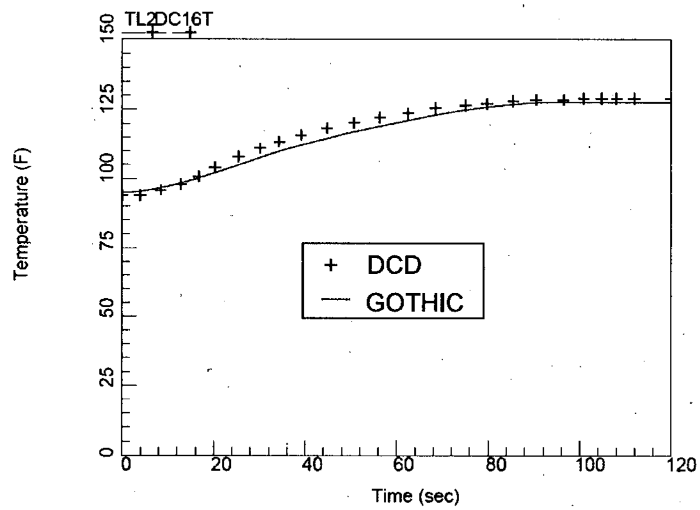
Short-term DCD FWLB
Drywell Temperature Comparison



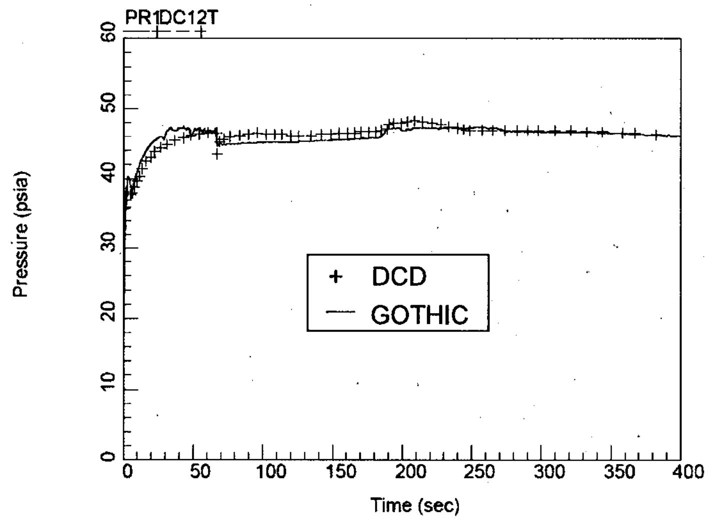
Short-term DCD FWLB
Wetwell Pressure Comparison



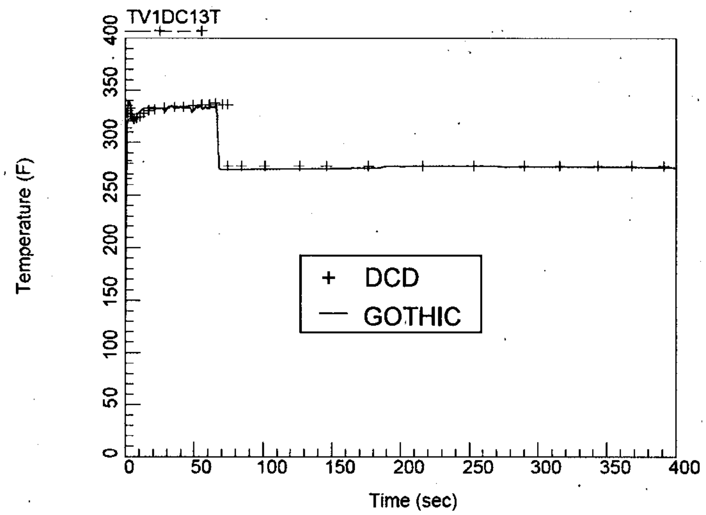
Short-term DCD FWLB
Pool Temperature Comparison



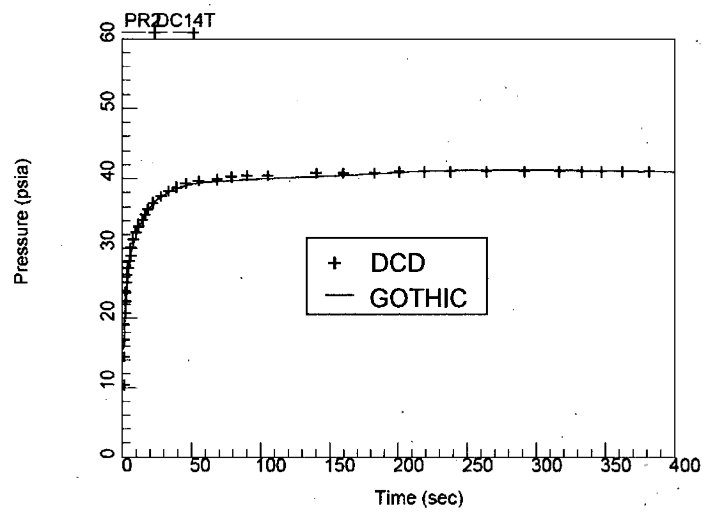
Short-term DCD MSLB
Drywell Pressure Comparison



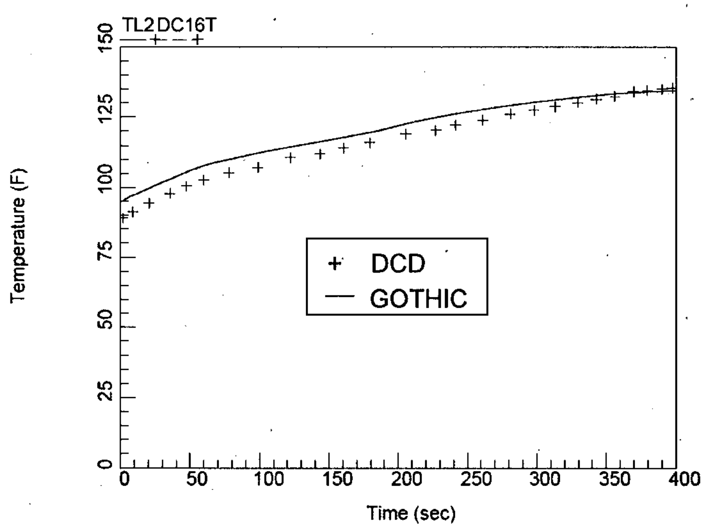
Short-term DCD MSLB
Drywell Temperature Comparison



Short-term DCD MSLB Wetwell Pressure Comparison



Short-term DCD MSLB Pool Temperature Comparison



Short-term DCD Benchmarking Conclusions

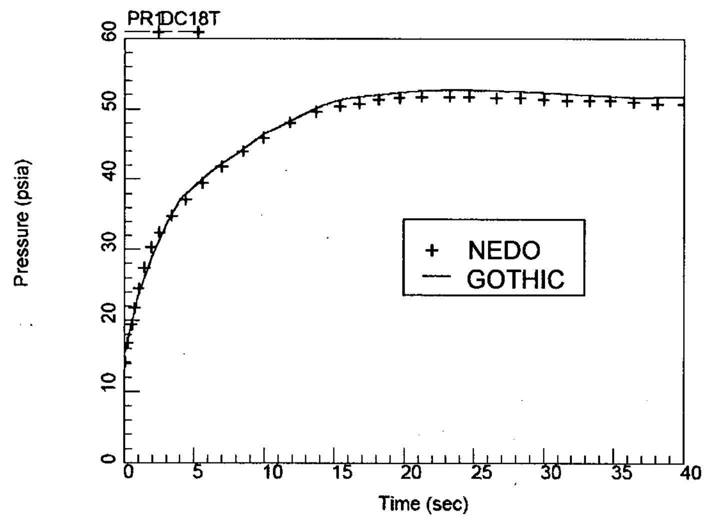
- The GOTHIC model is capable of reproducing the DCD results for both the FWLB and MSLB events
- Vent clearing process has little or no effect peak on the calculated peak drywell pressure
- For this case, the peak drywell pressure can be approximated as the sum of:

[ ]a,c

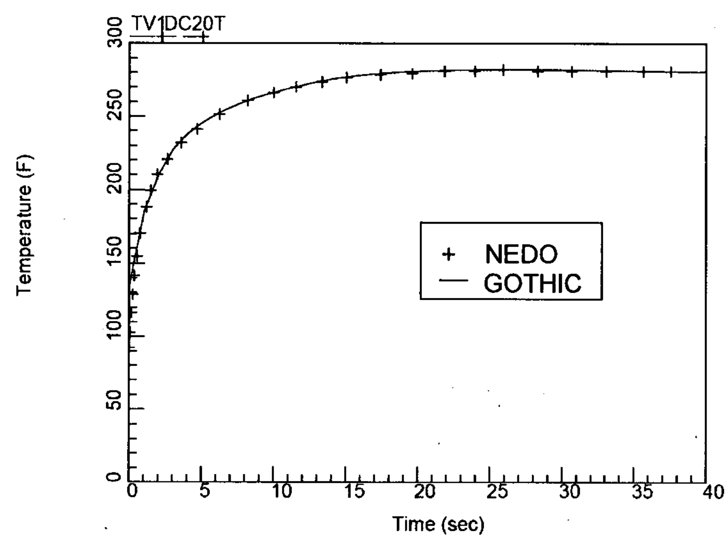
Short-term NEDO-33372 Benchmark Revisions

1. Feedwater mass and energy releases were increased
   – New M&E releases were used
2. Decay heat assumption was changed
   – New M&E releases were used
3. Drywell connecting vent losses were added
   – Vent loss coefficient input value was increased
4. Initial wetwell water volume was increased
   – HWL water volume was used
5. Wetwell interfacial heat/mass transfer was included
   – Interfacial heat/mass transfer was included

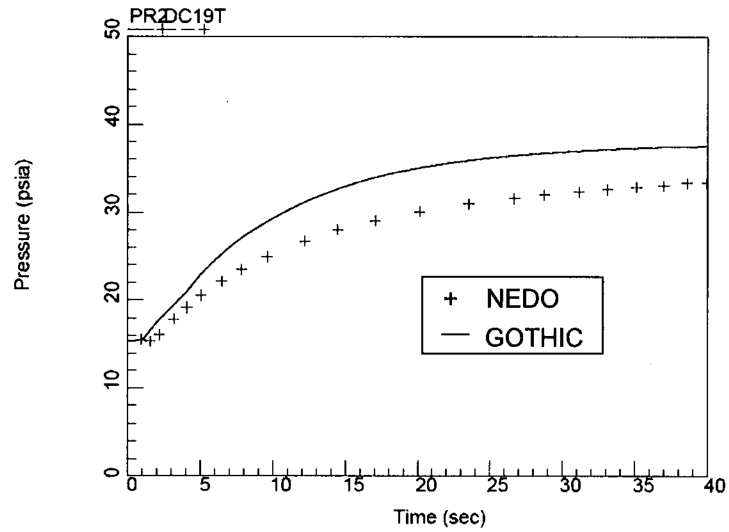
Short-term NEDO-33372 FWLB Drywell Pressure Comparison



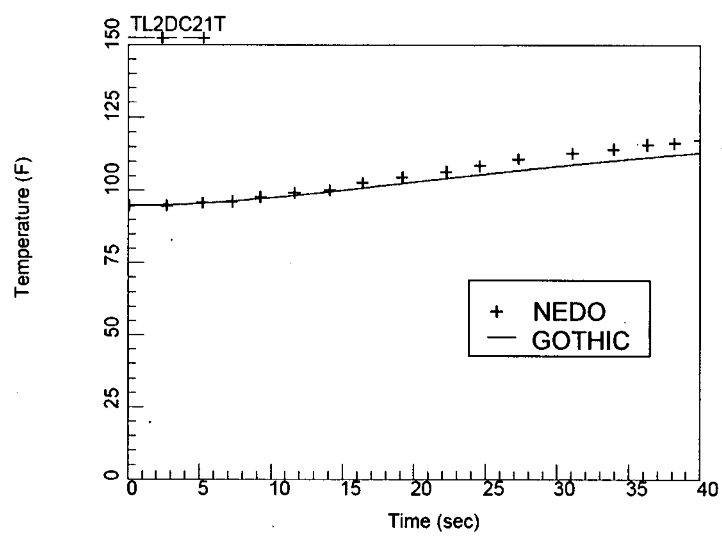
Short-term NEDO-33372 FWLB Drywell Temperature Comparison



Short-term NEDO-33372 FWLB Wetwell Pressure Comparison



Short-term NEDO-33372 FWLB Pool Temperature Comparison



Short-term NEDO-33372 Benchmark Conclusions

- The GOTHIC model is capable of reproducing the NEDO-33372 results for the FWLB event

Westinghouse Model

- Includes corrections described in NEDO-33372
- Includes more realistic modeling assumptions

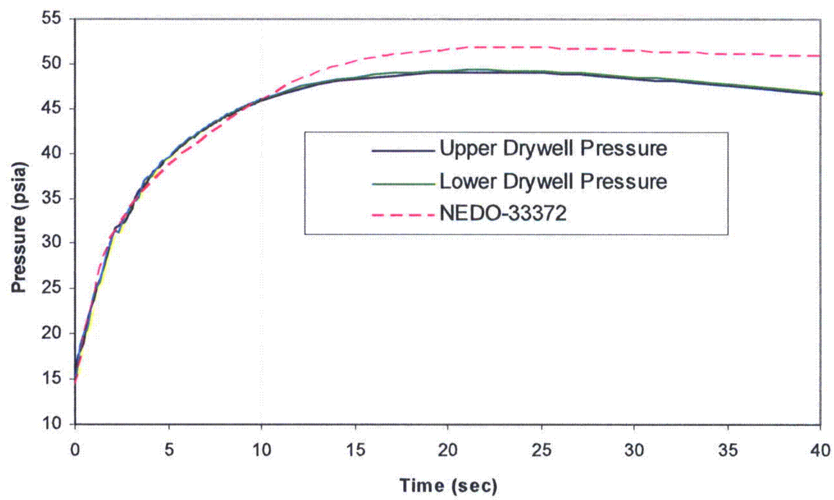
a,c

GOTHIC Noding Structure of Westinghouse Model (Rev. 0)

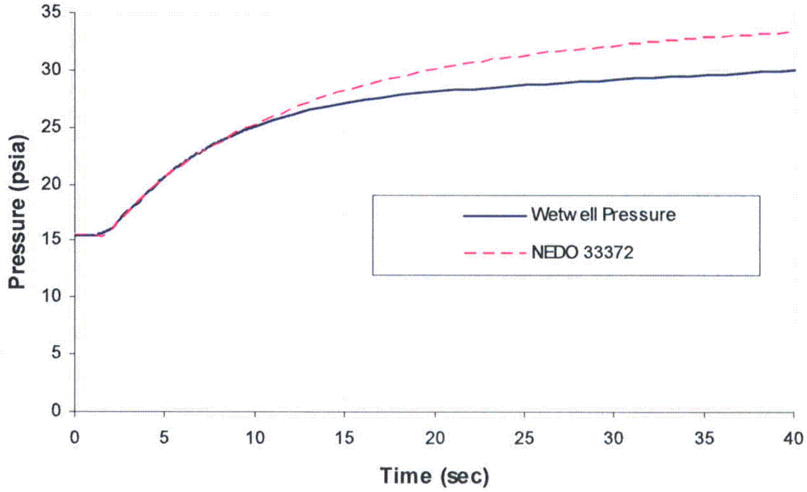
a,c

[ ]

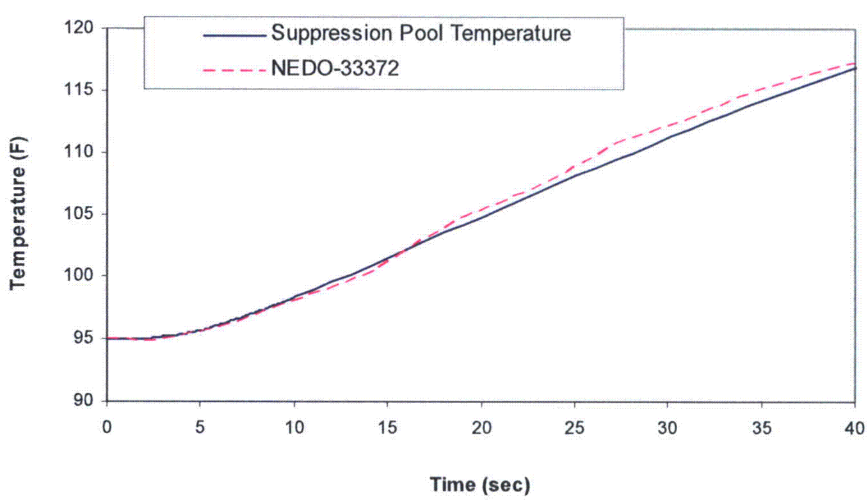
Westinghouse Model (Rev. 0) Drywell Pressure Comparison



Westinghouse Model (Rev. 0) Wetwell Pressure Comparison



Westinghouse Model (Rev. 0) Pool Temperature Comparison



Conclusions

- Benchmark models were created using DCD and NEDO-33372 assumptions
- Benchmark models demonstrate ability to reproduce results from the approved codes
- More realistic modeling of the lower drywell results in a lower peak pressure

NRC Containment Audit For STP 3&R COLA

Westinghouse ABWR Methods Comparison to NEDO-20533

TL George, NAI

March 3, 2009

Westinghouse Energy Center

Monroeville, PA

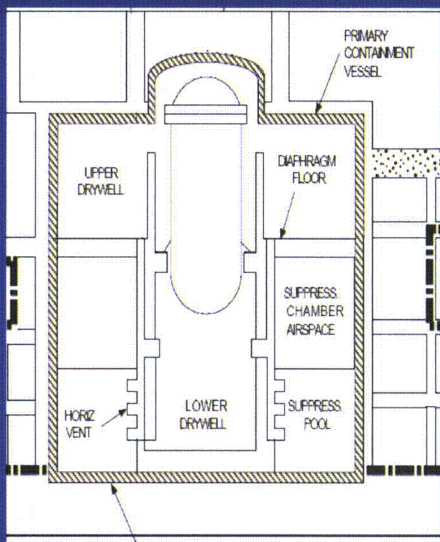
Purpose

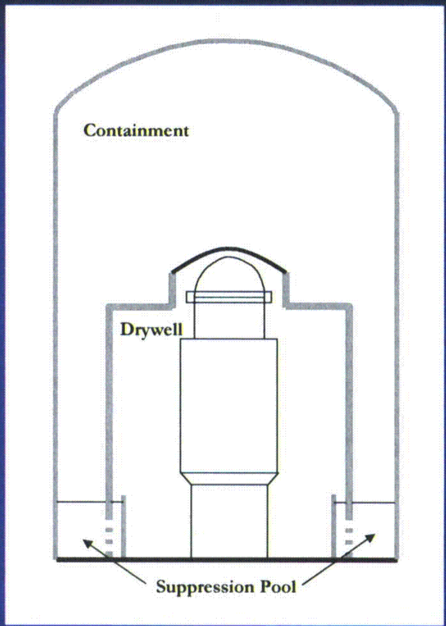
- Describe GOTHIC modeling approach for
  - Westinghouse ABWR
  - Short-term Pressure and Temperature Analysis
- Comparison with methods and assumptions in NEDO-20533 for Mark III Short-term Pressure and Temperature
- Relevant differences in ABWR DCD and NEDO-33372 methods and assumptions

Approach

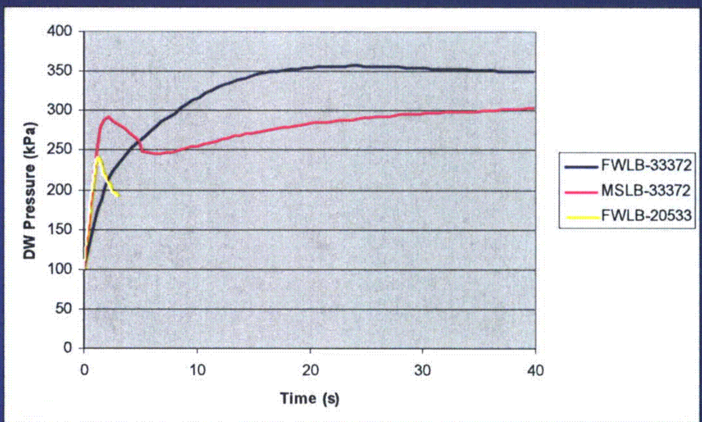
- GOTHIC 7.2a(QA) used to predict
  - Suppression pool vent clearing
  - Wetwell/Drywell pressure differential
  - Drywell and Wetwell pressures transient
  - Drywell and Wetwell temperature
- Approach similar to GE DCD for ABWR

ABWR and Mark III Containments





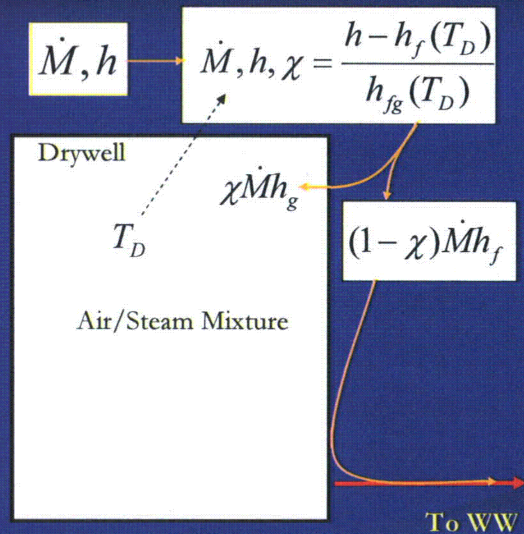
Mark III and ABWR Drywell Pressure Response



- Mark III peak pressure during vent clearing.
- ABWR peak pressure during DW gas purge.

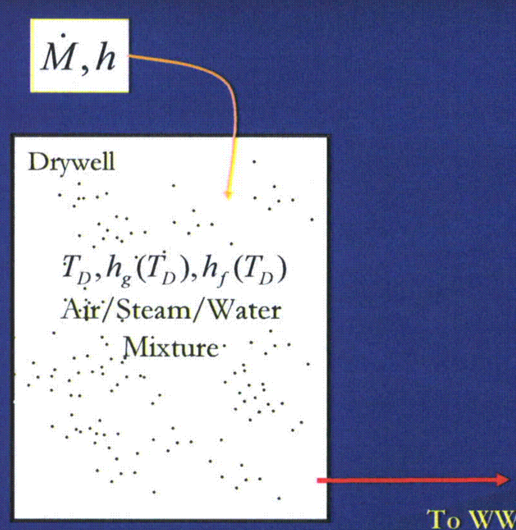
Drywell Response to Mass and Energy Release - NEDO-20533

Before Peak Pressure

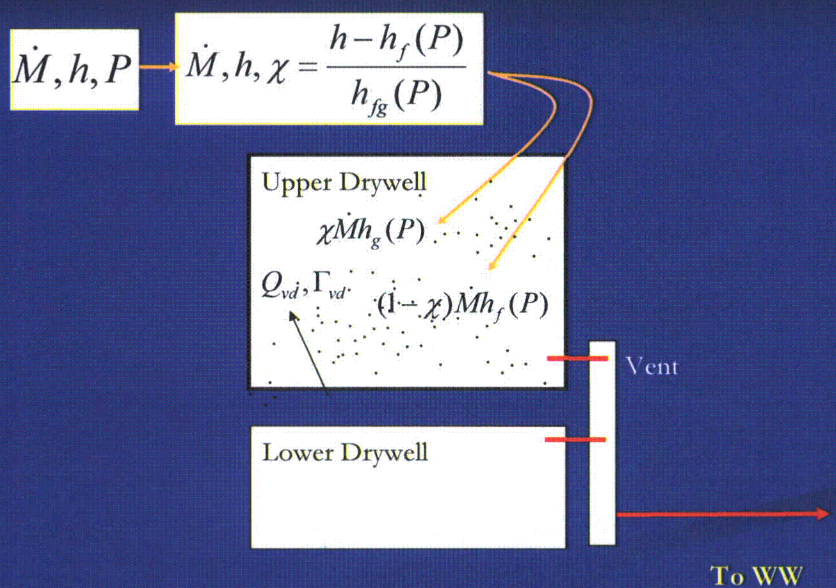


Drywell Response to Mass and Energy Release - NEDO-20533

After Peak Pressure



Drywell Response to Mass and Energy Release – Westinghouse ABWR/GOTHIC



Drywell Mass and Energy Balances

	NEDO-20533	Westinghouse ABWR/GOTHIC
Before Peak Pressure	■Break flow steam/water split at $\chi(T_D)$ ■Water direct to vent ■Mass balances - Steam - Gas ■Energy balance - Gas/steam mixture	■Mass balances - Steam - Gas - Drops ■Energy balances - Gas/steam mixture - Drops ■ Thermal non equilibrium with interface heat and mass transfer - Vapor/Drops ■Drop deposition - Ignored
After Peak Pressure	■Mass balances - Steam/water - Gas ■Energy balance - Homogeneous mixture of steam/gas/water at saturated or superheat conditions	
Heat Sinks	■Ignored	■Ignored

Drywell Mass and Energy Balances

- Westinghouse ABWR/GOTHIC
  - Break water injected as small drops [ ]a,c
    - Drops and Vapor in near thermal equilibrium
    - Interphase heat and mass transfer models
      - Forced and free convection
      - Flashing to $T_{drop} = T_{sat}(P)$
      - Heat and mass transfer analogy for evaporation and condensation includes noncondensible effects
  - Drop deposition ignored
    - No water hold up in DW
    - Maximum vent pressure drop

Drywell to Vent Pressure Drop

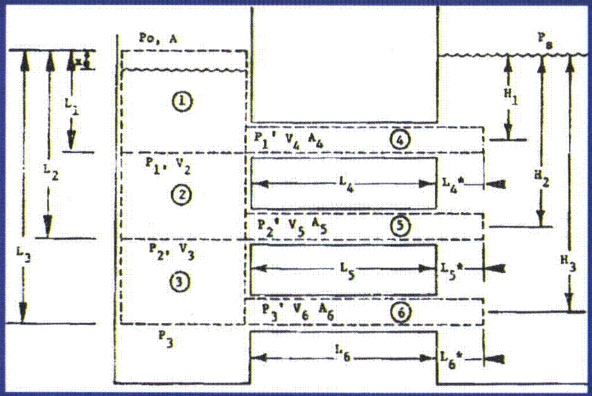
	NEDO-20533	Westinghouse ABWR/GOTHIC
Thermodynamics	1D adiabatic flow	1D adiabatic flow
Inertia	Ignored	Included
Inlet loss	Unclear	Included
Friction loss	Included	Included
Steam Properties	Ideal gas	Real steam
Drop/Vapor Slip	No slip	Included (small due to small drop diameter)

Drywell to Vent Pressure Drop

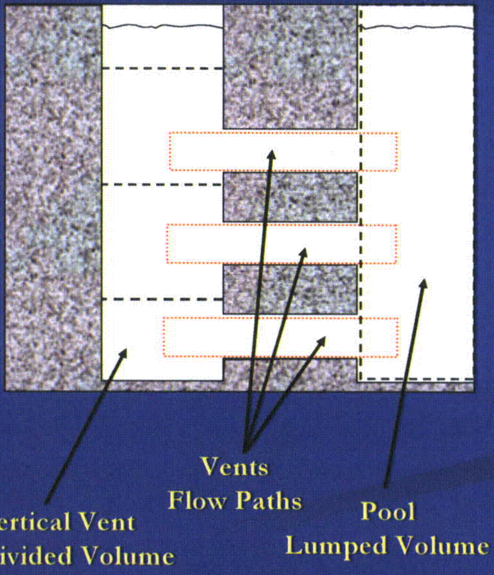
	NEDO-20533	Westinghouse ABWR/GOTHIC
Drop Vaporization	Ignored (constant quality)	Included
Choking	Ideal gas for air/steam mixture – drops ignored	Homogeneous Equilibrium Model for gas/steam/water mixture
Gravity Head	Ignored	Included
Turning and Exit Loss	Included	Included

Vent Noding

Mark **III/NEDO-20533**



Westinghouse ABWR/GOTHIC



Vertical Vent Dynamics

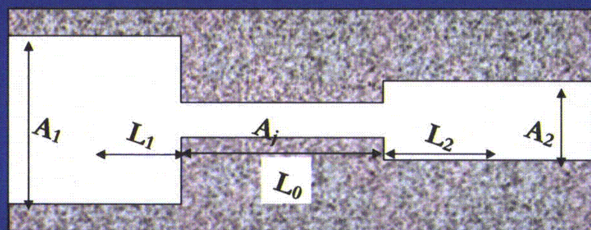
	NEDO-20533	Westinghouse ABWR/GOTHIC
Approach	Coincident mass and momentum control volume	Staggered grid for mass and momentum control volumes
Flow geometry	1D stratified pool/gas with level tracking	1D stratified pool/gas with level tracking
Gas Dynamics	1D adiabatic flow	1D adiabatic flow
Momentum Transport	Included	Included
Gravity Head	Included	Included
Turning and Exit Loss	Included	Included
Friction	Ignored	Included

Horizontal Vent Dynamics

	NEDO-20533	Westinghouse ABWR/GOTHIC
Upstream Pressure	Stagnation pressure in vertical vent at vent centerline	Static pressure in vertical vent at vent bottom
Downstream Pressure	Gas space pressure + hydrostatic head + bubble inertia pressure	Gas space pressure + hydrostatic head
Momentum Transport	$(u\rho u)_{out} = (u\rho u)_{in}$	$(u\rho u)_{out} = (u\rho u)_{in}$
Effective Inertia Length	$L_{vent} + 1.25 D_{vent}$	[ ] a,c

Effective Inertia Length

- Based on numerical experiments
  - Compares multidimensional flow through connections versus flow through an equivalent Flow Path



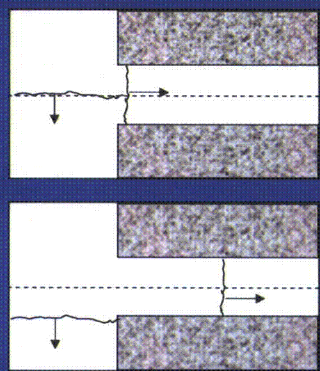
a,c

Horizontal Vent Dynamics

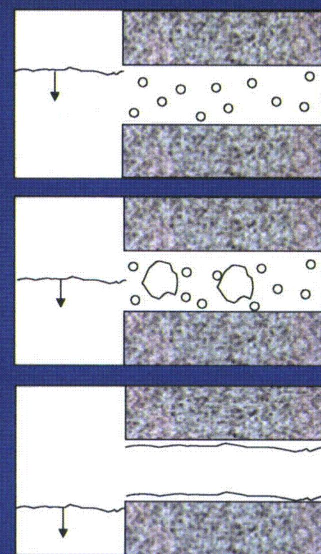
	NEDO-20533	Westinghouse ABWR/GOTHIC
Multiple Vents	Sequential Clearing based on inlet liquid level	Sequential Clearing based on inlet liquid level
Friction Loss	Ignored	Ignored
Turning loss	Included	Included
Exit loss	Unclear	Included

Horizontal Vent Dynamics

Mark III/NEDO-20533



Westinghouse ABWR/GOTHIC



Horizontal Vent Dynamics

- Westinghouse ABWR/GOTHIC
  - Vapor flow starts when surface drops to top of vent
  - Vent flow regime depends on vapor volume fraction and velocity
    - Small bubble
    - Small/large bubbles
    - Stratified/slug
    - Film
  - Pseudo mass balance for Flow Paths

$$L_I A \frac{d\hat{\alpha}_v}{dt} = \dot{Q}_v - \dot{Q}_l$$

Wetwell Transient Response

	NEDO-20533	Westinghouse ABWR/GOTHIC
Thermal Dynamics	☐Mass and energy balance for pool. ☐Mass balance for air space. ☐All entering steam and water remain in pool. ☐Gas enters air space at pool temperature. ☐Air space temperature in thermal equilibrium with the pool. ☐Air space is saturated with steam	☐Mass and energy balance for pool. ☐Mass and energy balance for air space. ☐Condensation and heat transfer models for bubbles rising through pool. ☐Default heat and mass transfer at pool surface. ☐Air space may be superheated and hotter than pool.
Heat Sinks	Ignored	Ignored
Air Space Volume	Reduced to account for added pool mass.	Reduced to account for added pool mass.

- ☐ Modeling Differences
  - ☐ NEDO-20533 for Mark III BWR
  - ☐ ABWR DCD & NEDO-33372 for ABWR
  - ☐ Westinghouse ABWR

	NEDO 20533	ABWR DCD	NEDO 33372	Westinghouse ABWR
Drywell Modeling	Single Volume	Single Volume for Upper Drywell + ½ Lower Drywell	Single Volume for Upper Drywell + ½ Lower Drywell	Separate Volumes for Upper and Lower Drywells
Break/Dry-well Modeling	Before peak - Water direct to vent After peak - Homogeneous mixture of water/steam/gas	Homogeneous mixture of water/steam/gas	Homogeneous mixture of water/steam/gas	Separated phase model - Water - Steam/gas
Wetwell Pool/Gas Space	Thermal equilibrium	Thermal non-equilibrium – details unclear	Thermal equilibrium	Thermal non equilibrium – GOTHIC models for heat and mass transfer

NRC Containment Audit For STP 3&4 COLA

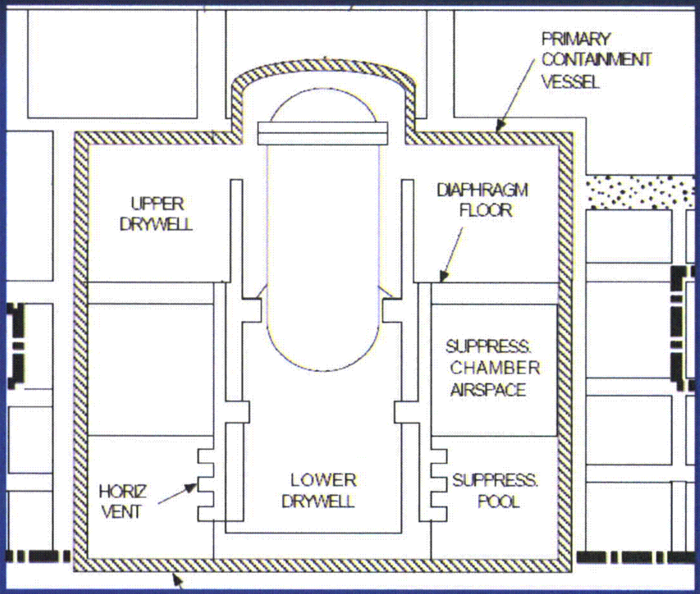
ABWR Pool Swell Analysis

TL George, NAI
March 3, 2009
Westinghouse Energy Center
Monroeville, PA

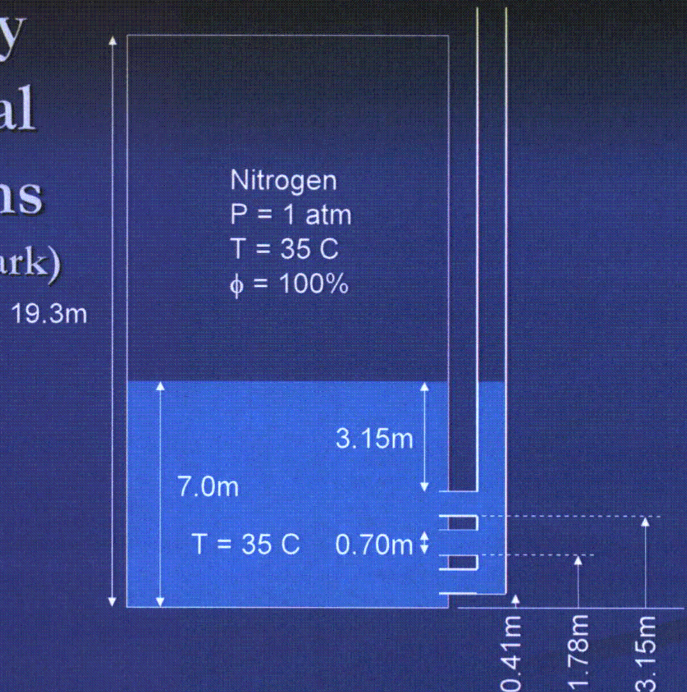
Purpose

- Compare GOTHIC modeling approach ABWR DCD for conservative estimates of
  - Maximum swell height
  - Maximum pool velocity
  - Peak gas space pressure during swell
  - Peak bubble pressure during swell
- Results comparison with
  - ABWR DCD
  - NEDO-33372

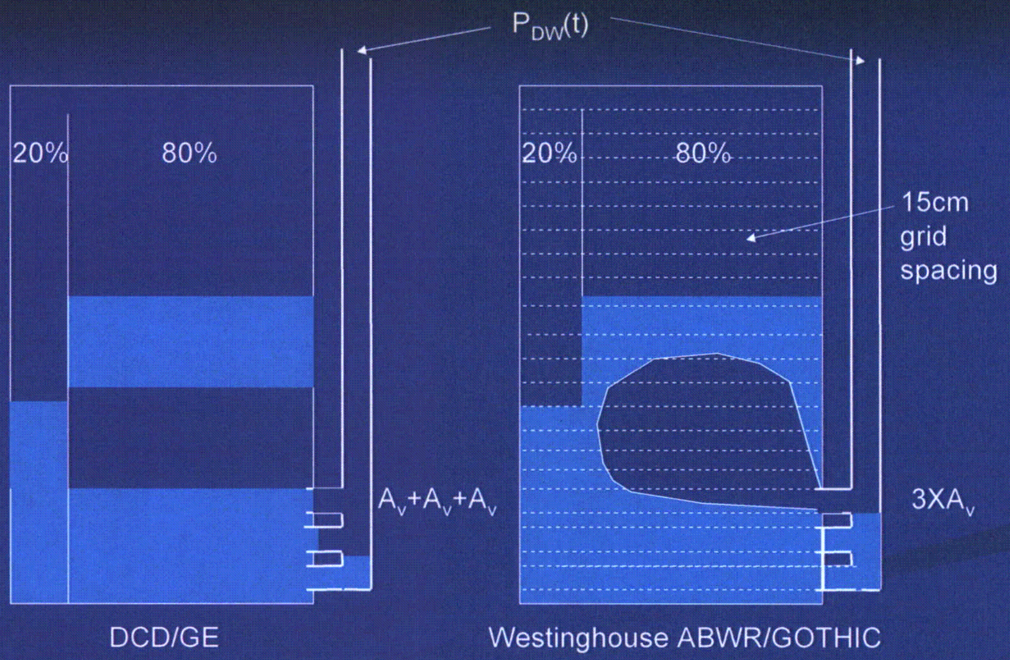
ABWR Containment



Geometry and Initial Conditions
(DCD Benchmark)



Approach Comparison



Approach Comparison

	DCD/GE	Westinghouse ABWR/GOTHIC
Initial water in vertical and horizontal vent pipes	Ignored	Included. Vent clearing modeled.
Vent location	Gas injected at elevation of top of top vent	Gas injected at actual elevation of top vent
Vent area	Sequential addition of vents	All vents located at the top vent
Injection Pressure	Drywell pressure transient	Drywell pressure transient

Approach Comparison

	DCD/GE	Westinghouse ABWR/GOTHIC
Injection Composition	100% N_2 – perfect gas	100% N_2 – perfect gas
Injection Temperature	$T_{Drywell}$ from isentropic compression	$T_{Drywell}$ from isentropic compression
Vent Path Pressure Loss	Friction	Ignored
Vent Choking	Unclear	Included

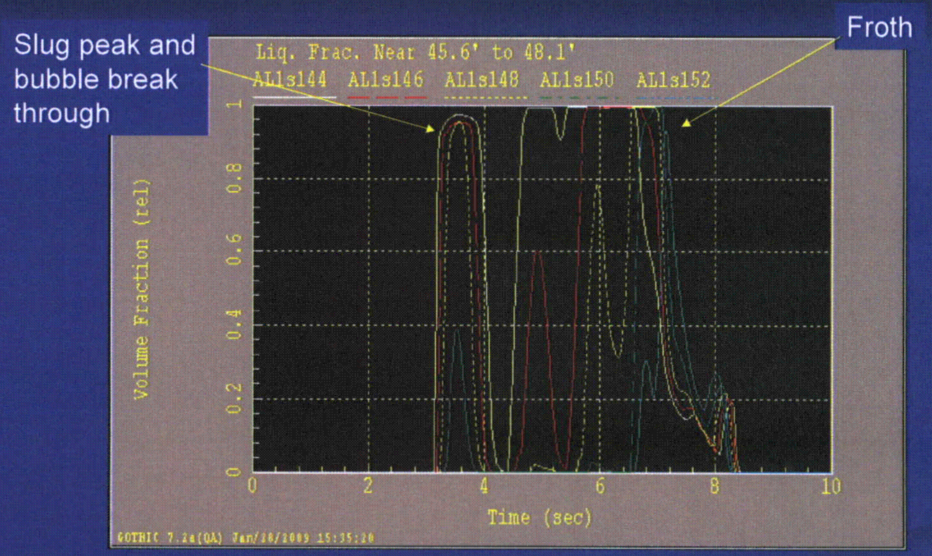
Approach Comparison

	DCD/GE	Westinghouse ABWR/GOTHIC
Gas Temperature in Bubble	Drywell temperature	Near pool temperature
Pool swell drag	Ignored	Ignored
Gas Temperature above Pool – Maximum Swell	Polytropic compression - PV^k=const (k=1.2)	Near isothermal compression
Gas Temperature above Pool – Maximum Pressure	Isentropic compression - PV^k=const (k=1.4)	Near isentropic compression

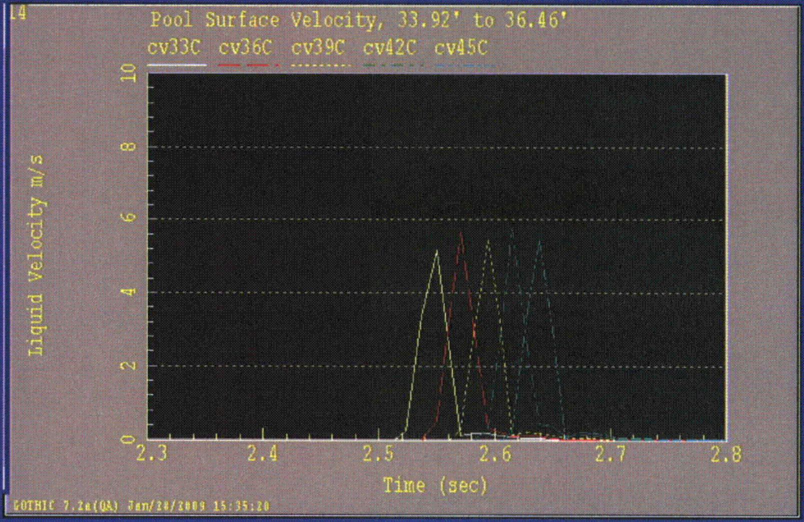
Approach Comparison

	DCD/GE	Westinghouse ABWR/GOTHIC
Pool swell region	80% of wetwell	80% of wetwell
Rising water slug	Constant thickness	[ ] a,c
Conservative multiplier on maximum swell velocity	1.1	1.1

GOTHIC Results Pool Swell



GOTHIC Results
Slug Velocity



Benchmark Comparison

	DCD	Westinghouse ABWR/ GOTHIC*
Max Swell Height (m)	7.0	7.4
Max Slug Velocity (m/s) with 1.1 multiplier	6.0	6.3
Max Gas Space Pressure (kPag)	108	113
Max Bubble Pressure (kPag)	133	155

* Preliminary

NEDO-33372 Comparison

	NEDO 33372	Westinghouse ABWR/ GOTHIC*
Max Swell Height (m)	8.3	8.3
Max Slug Velocity (m/s) with 1.1 multiplier	6.0	10.6
Max Gas Space Pressure (kPag)	154	161
Max Bubble Pressure (kPag)	185	209

* Preliminary

TOSHIBA
Leading Innovation >>>

Class 1

SSO-2009-000058-NP Rev.1

NRC Containment Audit for STP 3&4 COLA

Test Data Overview

Hirohide Oikawa
March 3, 2009
Westinghouse Energy Center, Monroeville, PA

Purpose

Class 1

- To provide overview of existing test data for potential additional verification of containment analysis model with horizontal vent configuration
  - Vent clearing
  - Pool swell
  - Pressure and temperature transient (short term response of active plant)

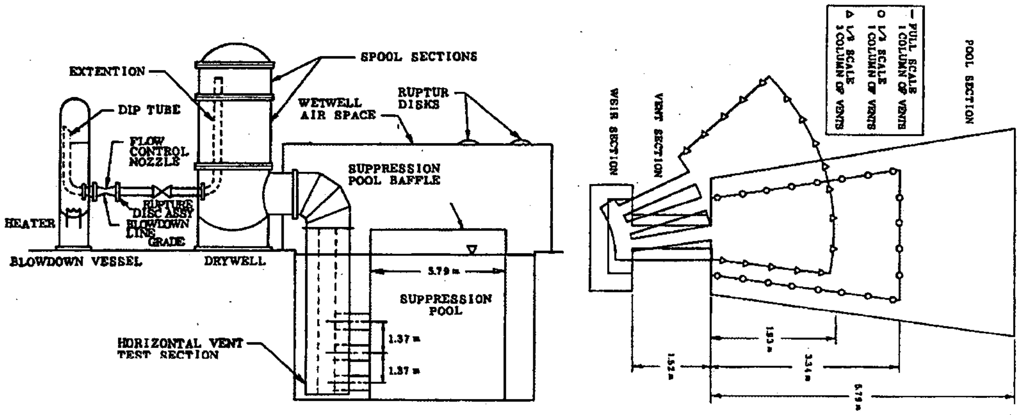
Existing Test

Class 1

	PSTF (Mark-III)	HVT (ABWR)
Program	Confirmatory test by GE	Joint study by
Test section scale	Full, 1/3, 1/9	Full (2 rows) Sub (1:2.5)
Test objectives	Vent clearing Pool swell CO / Chugging	CO / Chugging

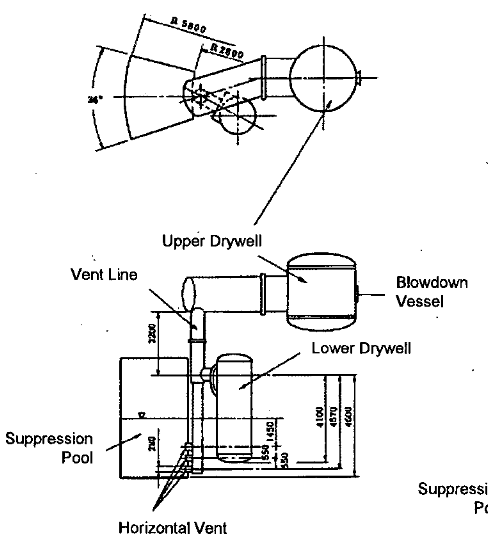
Pressure Suppression Test Facility (PSTF)

Class 1

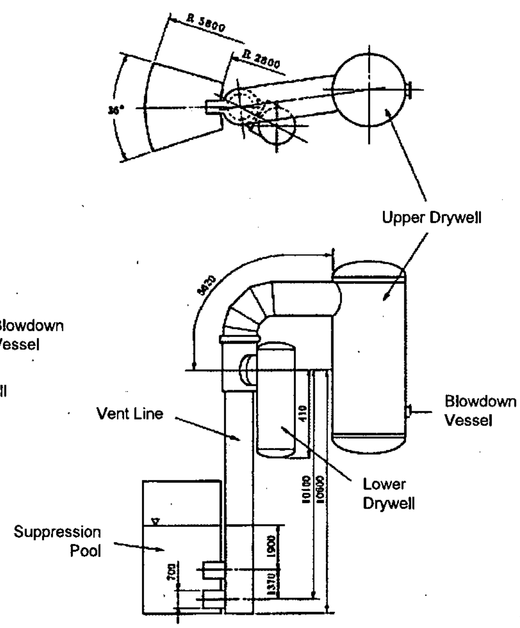


Horizontal Vent Test (HVT)

Class 1



Subscale(1/2.5) Test (SST)



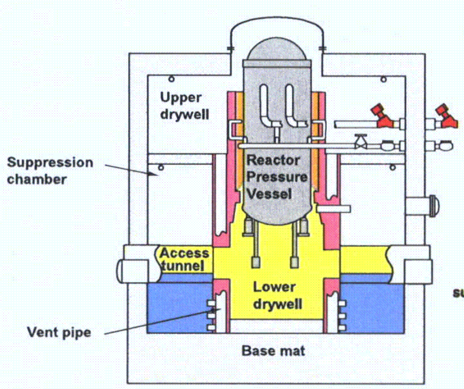
Fullscale Test (FST)

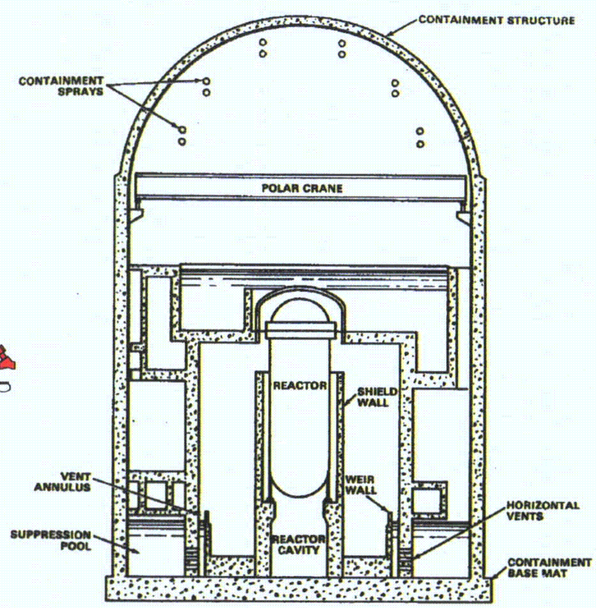
Available Test Data

Class 1

ABWR and Mark-III Containments

Class 1





PSTF Test Cases

Class 1

- More than 200 cases
  - Series 5700: Full (pool swell, chug, condensation)
  - Series 5800: 1/3 (pool swell, CO)
  - Series 6000 :1/9 (pool swell, condensation)
- NRC adopted 5800 series for pool swell evaluation basis (well scaled)

[ ]

HVT Test Cases

Class 1

[ ]

ABWR Containment

Class 1

NRC Containment Audit for STP 3&4 COLA
Summary

Bob Quinn
March 3, 2009
Westinghouse Energy Center, Monroeville, PA

Purpose

- Summarize current status of containment P/T results and discuss path forward
- Summarize current status of hydrodynamic pool swell analysis

Containment P/T Analyses

- Due to DCD analysis errors, DCD analysis results must be corrected due to errors being non-conservative (i.e., analytical margins to design basis limits reduced)
- Two approaches identified
  - Both involve using GOTHIC as analysis tool
- Confirmatory Analysis: current licensing basis – Use GOTHIC to implement NEDO-20533 methodology
- Replacement Analysis: new licensing basis – Use Westinghouse containment analysis methodology, including GOBLIN and GOTHIC, to perform "current state-of-the-art" containment analysis for ABWR containment

Containment P/T Analyses *(continued)*

- Confirmatory Analysis – Approach
  - Benchmark against DCD results
  - Rerun simplified GOTHIC model with errors corrected
  - Use NEDO-33372 values as independent method to validate results

Containment P/T Analyses *(continued)*

- Confirmatory Analysis – Advantages
  - Models DCD approved method (NEDO-20533) as closely as possible
- Confirmatory Analysis – Disadvantages
  - Containment P/T increases compared to DCD
  - Margins to design basis limit reduced to 11% vs. DCD margin of 15%

Containment P/T Analyses *(continued)*

- Replacement Analysis – Approach
  - Starting with DCD-benchmarked model, incorporate:
    - DCD error corrections
    - More accurate containment volume modeling
    - Improved mass/energy calculation
  - Prepare and submit addendum to Westinghouse topical on containment analysis to add ABWR
    - Include benchmarking to DCD analysis
    - Build on previous NRC approved applications of GOTHIC for BWR containments
    - Benchmark to available, applicable test data

Containment P/T Analyses *(continued)*

- Replacement Analysis – Advantages
  - More realistic containment P/T calculation results in lower P/T compared to DCD, even with errors corrected – margin >20%
  - Provides a current methodology to support STP 3&4 going forward
- Replacement Analysis – Disadvantages
  - NRC review and approval of new methodology may impact schedule

Hydrodynamic Loads Analyses

- Errors in DCD containment analysis also impact calculated maximum pool swell height
  - CO, CH, SRV unaffected
- Unlike containment P/T, higher pool swell height does not affect any margins to design basis limits
  - There is no design basis limit for pool swell height
  - Pool swell height and velocity are input parameters for wetwell internal structures loads development
- NEDO-33372 indicates higher pool swell height but no change in velocity
- COLA R2 included revised conservative pool swell height based on preliminary evaluations and engineering judgment

Hydrodynamic Loads Analyses *(continued)*

- Containment pressure calculation results are input to pool swell analysis
- Preliminary pool swell calculations completed
  - Confirms pool swell height increases vs. DCD but less than conservative COLA R2 value
  - Higher velocity vs. DCD
- Final calculation results to be included in next COLA revision

Hydrodynamic Loads Analyses *(continued)*

- Future activities for pool swell
  - DCD T2 Section 3B.4.2 states that hydrodynamic load calculation methodology “will be based on” NUREG-0487 & NUREG-0978
    - Plan to use these references per DCD
  - COL item 6.5 (DCD T2 6.2.7.4) requires “design features providing complete structural shielding of vacuum breaker valves from pool swell loads”
    - Features will be designed based on loads methodology (see above)
  - ITAAC item 2.14.1.14 requires confirmation of adequacy of containment internals design