ENCLOSURE 2

MFN 13-011

2012 Technology Update Presentation

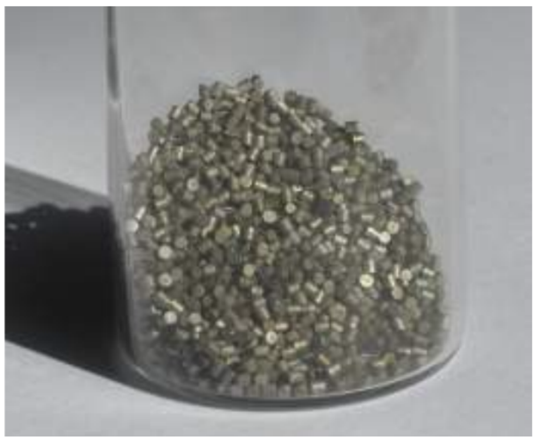
Non-Proprietary Information – Class I (Public)

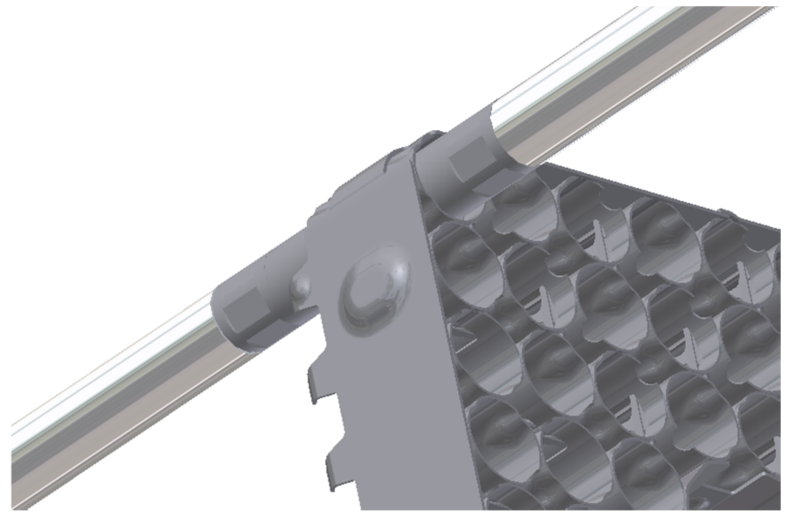
IMPORTANT NOTICE

Enclosure 2 is a non-proprietary version of the 2012 Technology Update Presentation from Enclosure 1, which has the proprietary information removed. Portions that have been removed are indicated by open and closed double brackets as shown here [[ ]].

Non-Proprietary Information – Class I (Public)

Technology Update for the US NRC
August 2012





GE14i Isotope Test Assemblies

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Clinton Inspections

Following first cycle of irradiation at CPS (~22 mo, [[ ]]) - one GE14i bundle removed from core

- Visual exam of external components to confirm mechanical adequacy
- COINS to examine rod profilometry and oxide layer to confirm mechanical adequacy and corrosion characteristics
- Gamma scan cobalt rods to confirm activation calculations
- Gamma scan local fuel rods to confirm power suppression magnitude and population of rods surrounding cobalt rods are appropriate
- Single rod harvest and off site shipment
- Single rod replaced with fresh cobalt segmented rod and bundle reinserted in same outage for continued operation
- Destructive exam to confirm mechanical adequacy ongoing

CPS Inspection – Bundle Observations

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CPS Inspection – Fuel Rod Observations

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CPS Inspection – Isotope Rod Observations

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CPS Inspection - COINS

- Fuel rods
  - Small amounts of liftoff/oxide layer
  - Normal OD profile
- Segmented rods
  - Negligible amount of liftoff/oxide layer
  - Normal OD profile
- All well within experience base

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CPS Inspection – Gamma Scan

- Adequate agreement between measurements and TGBLA06/PANAC11 predictions
- Corrected standard deviation of [[ ]]
- Validates applicability of lattice power distribution uncertainties used for modern BWR core and fuel designs for GE14i
- [[ ]]
- [[
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CPS Inspection – Destructive

- Segment external visual exam
- Additional detailed activity profiles
- Internal component/cladding ID exam
- Capsule external visual exam
- Removal of targets and assay in process
- Capsule component/cladding ID exam in process
- All inspections show design has performed as expected

HCGS Inspection

Following first cycle of irradiation at HCGS (~18 mo, [[ ]]) – one GE14i bundle removed from core

- Visual exam of external components to confirm mechanical adequacy
- Single rod harvest
- Single rod replaced with fresh cobalt segmented rod and bundle reinserted in same outage for continued operation
- Off site shipment for destructive exam to confirm mechanical adequacy ongoing

HCGS Inspection – Bundle Observations

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Side 2, LTP

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HCGS Inspection – Fuel Observations

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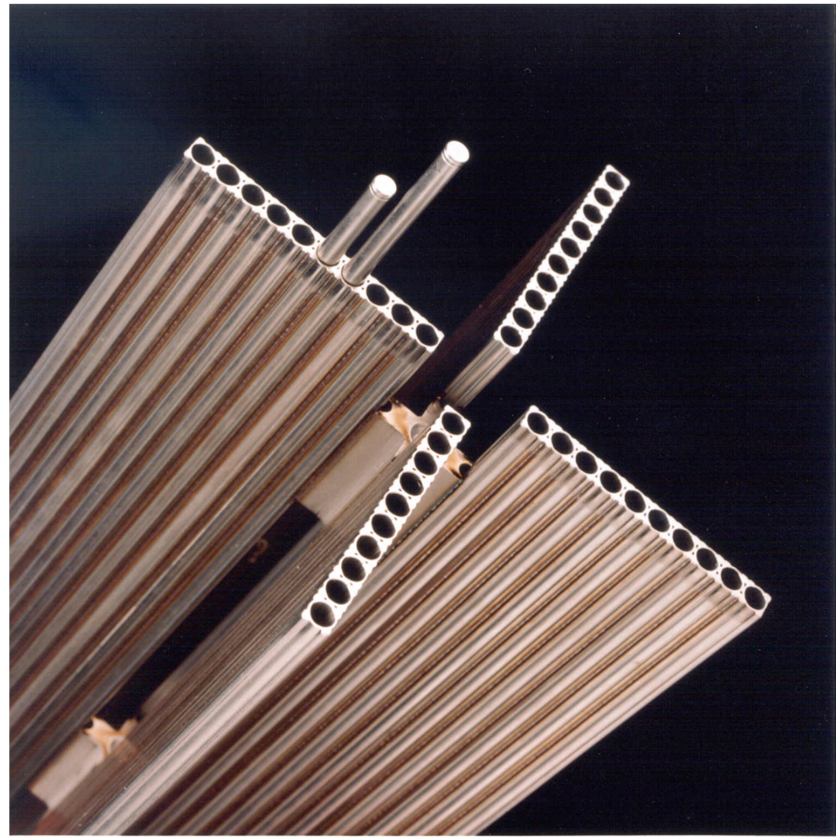
CPS & HCGS Inspection

All inspection results show as-expected performance and behavior

Project Benefits

- Fostering positive perception of commercial nuclear power
- Illustrating power generating reactors have other uses
  - Supporting medical and industrial communities
- Ensuring supply of ^{60}Co
  - Prevent disruptions in global isotope supply

Technology Update for the US NRC
August 2012



Control Rods

W Patrick Davis

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Ultra Control Rod Description

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- Licensed in 1991 via NEDE-31758P-A
- Over 2000 Delivered Worldwide
- Last Marathon deliveries in 2013

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- Licensed by NEDE-33284P-A: June 2009
- [[

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- Licensed by NEDE-33284 Supplement 1P-A: March 2012
- [[

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Marathon Design Comparison

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Marathon Control Rod Inspections

- All new inspections are D/S lattice.
- [[

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Marathon Control Rod Inspection Evaluation

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Marathon Control Rod Inspection Evaluation

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Ultra Control Rod Inspections

- The first inspections of Ultra MD (Marathon-5S) control rods have been completed.
- No crack indications have been observed.
- [[

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Planned Inspections

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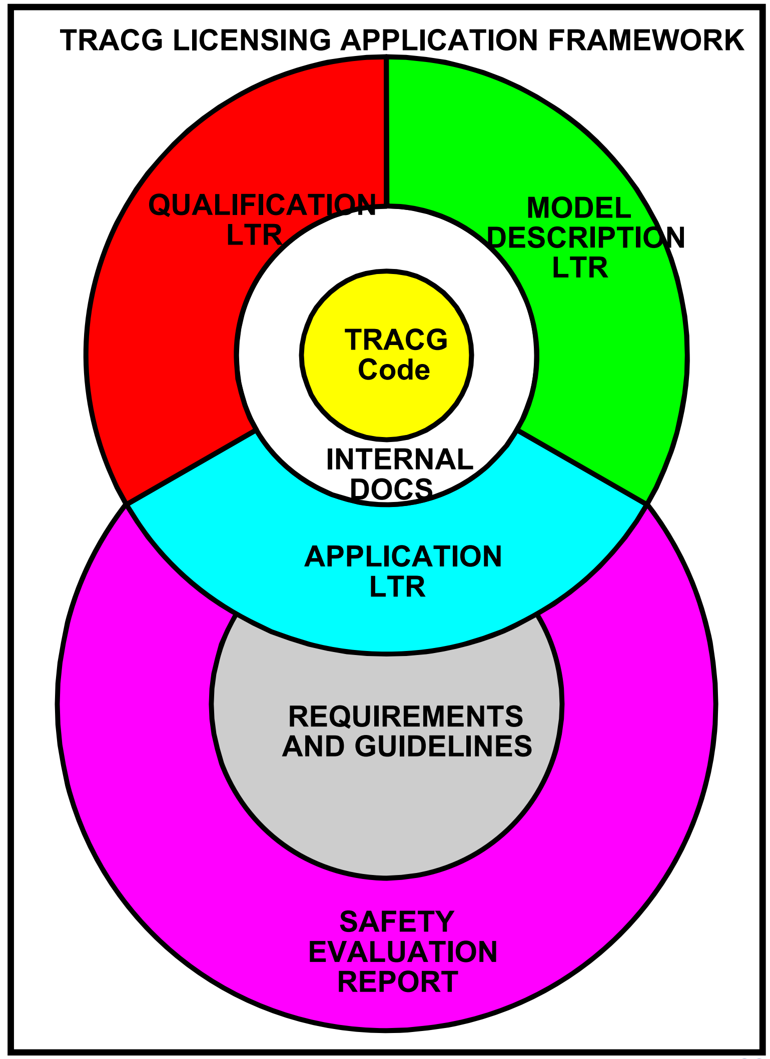
Technology Update for the US NRC
August 2012

TRACG ATWS Methods Status and ATWSI TMIN Investigation

Charlie Heck
Mike Cook



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TRACG ATWS LTR Scope

- Applicable to BWR/2-6 and EPU/M+ operation for ATWS long-term and ATWS with Instability (ATWSI)
- Follow SRP 15.8 guidance and acceptance criteria
- Follow previous ATWS CSAU based applications: ESBWR ATWS (NEDE-33083P-A S2) and BWR/2-6 ATWS Overpressure LTRs (NEDE-32906P-A S1)
- Address ATWSI in separate LTR

TRACG ATWS Status

- CSAU Method complete though "Determination of Effect of Scale" (Step 10 of 14)
- CSAU methodology not required but is only used to determine prudent bias and uncertainty to apply.
- Demonstration analysis in progress including:
  - Determine effect of reactor input parameters and state (~50% complete)
  - Perform NPP sensitivity calculations (~50% complete)
  - Determine prudent combined bias and uncertainty (to do)
  - Determine prudent total uncertainty (to do)
- ATWS calculations incorporate imbedded prudent conservatisms.

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TRACG ATWS Submittal Plan

- CSAU material and ATWS long-term demonstration analysis submittal in one LTR
  - Planned submittal in [[ ]]
- Separate Submittal for ATWSI generic evaluation
  - Planned submittal in [[ ]]

Minimum Stable Film Boiling Temperature

- In late 2011, NRC Research communicated concerns about the calculated PCT from TRACE
- GEH and NRC communicated effectively and worked toward resolving differences in TRACG and TRACE models and calculations
- GEH wants to continue communicating and working effectively with NRC to resolve concerns

ATWSI MSFBT (TMIN) Investigation

- **In late 2011, NRC Research communicated concerns over the calculated PCT from TRACE**
  - Very high PCTs calculated by TRACE compared to TRACG (Over 2200 °F, 1477 K)
  - Research suspects differences in TMIN
  - Research communicates concerns over void dependence in Shumway correlation (used in TRACG)
- **GEH performs sensitivities and concludes:**
  - If TMIN is reduced, similar high temperatures are calculated – confirming that TMIN is important
  - [[ ]]
- **NRC calculations with TRACE do not show same sensitivity to quench as seen in TRACG**

TRACE versus TRACG TMIN Correlation

- TRACE uses Groeneveld-Stewart correlation
  - Not dependent on wall material properties, flow, etc.
  - Depends only on pressure
  - Based on Inconel. Under predicts TMIN for Zircaloy
  - TMIN predicted at ATWS conditions (7 MPa) is ~ 690 K, 782°F or about 130 K, 234°F above Tsat (for Inconel assuming no subcooling)
- TRACG04 uses Shumway correlation (EGG-RST-6781)
  - Includes material property, void, and mass flow dependency
  - Void dependency data is unpublished and has been challenged as potentially causing TMIN over prediction at low void fractions
  - GEH Initiated a PRC investigation to determine if the potential non-conservatism in TMIN is reportable.
  - TMIN predicted at ATWS conditions (7 MPa) is ~ 850K , 1070°F or about 290 K, 522°F above Tsat (for Zircaloy assuming 100% voids)
- Large difference in TMIN-Tsat margin is very significant
  - Shumway margin 2.2 times Groeneveld-Stewart margin

ATWSI Calculated PCT and Tmin

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PRC Investigation

- Current ATWSI basis is BWROG NEDO-32047-A and NEDE-33006P-A for MELLLA+
- Both generic evaluations predict high PCT temperatures (over 2200°F, 1477 K)
- High PCTs were accepted in the NEDO-32047-A SER on the basis that a coolable geometry is maintained and acceptable radiological consequences
  - EPGs changes to require prompt water level reduction to about 1 m below the feedwater sparger
- NEDE-33006P-A SER reaches a similar conclusion
- Previously approved evaluations used TRACG02 and Iloeje correlation for TMIN
  - Iloeje predicts higher TMIN at high pressure than Shumway but does not have void dependence.

PRC Conclusion

- Qualitative evaluation concluded that only ATWSI for forced flow plants application affected
- Plant Specific Evaluation (With water level reduction)
  - [[

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- Generic Evaluation (No water level reduction)
  - [[
  -]]
- No substantial safety hazard – not reportable

TRACG Benchmarking to GNF2 Flow Oscillation CPR Tests

- Stern lab flow oscillation tests used to demonstrate transient applicability of GEXL in predicting BT onset
- TRACG benchmarking sensitivity
  - No quench, Shumway with void effect
  - Quench activated, Modified Shumway with no void effect (BT occurs at the top spacer where void fraction is >90% so removing void credit from Shumway has little effect)

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Benchmarking Sensitivity Results, Test 952

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Benchmarking Sensitivity Results, Test 2469

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Conclusions

- Benchmarking results show good agreement
- [[ ]]
- Shumway credit for void effect removed because it has insufficient pedigree. Modified Shumway (without void effect) is adequate for ATWS applications.
- TRACE TMIN value should account for material properties
- Potential Future Work
  - Perform TRACE benchmark to flow oscillation tests
  - Perform TRACE quench model sensitivity
  - Perform single channel TRACE/TRACG ATWSI flow oscillation comparisons

GE Hitachi Nuclear Energy

2012 Technology Update:
LOCA Status & Perspective

Kurshad Muftuoglu

08/09/12

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Outline

Outline

- EM errors and changes for 2012
- Status of TRACG LOCA Review
- 10CFR50.46 Rulemaking Remarks

50.46-Reportable EM Changes

50.46-Reportable EM Changes

- There are no errors or changes with estimated impact equal to or greater than the 50 °F significance threshold.
- Errors are discovered as a part of the code maintenance activities and corrections will be included in the upcoming “L2” version of SAFER04A (3Q12).

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50.46 PRIME ΔPCT Reporting (1)

- The major change for 2012 is PRIME.
- The implementation of PRIME models in downstream methods, including ECCS performance evaluation, is presented in NEDO 33173 Supplement 4 :

  > *"The impact of using PRIME properties instead of GSTRM properties will be treated as a change in the approved methodology, per the reporting requirements of 10CFR50.46. The impact of this change can be conservatively estimated from the stored energy sensitivities that are carried out as a part of the Upper Bound PCT and oxide thickness calculations."*

- PRIME ΔPCT adder is the surrogate to PRIME analysis:

  [SAFER-GESTR PCT] + [PRIME 50.46 ΔPCT] ≡ [SAFER-PRIME PCT]

50.46 PRIME ΔPCT Reporting (2)

- The major June 17-19 Audit reviewed the details of estimating the impact. The impact estimation is more conservative or comparable to actual difference with the change.
- The PRIME 50.46 ΔPCT only applies to plant/fuel LOCA analyses that are based on GESTR T/M model.
- PRIME is already in use for LOCA: All new analyses will be based on PRIME.
- GNF/GEH is currently developing and supplying the input for licensee's 50.46 reports.

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Status of TRACG LOCA Review

Status of TRACG LOCA Review

- Key steps/activities to date:
  - NEDE-33005P submitted for review/approval – 01/27/11 (MFN 11-001)
  - Review acceptance letter issued – 06/30/11 (ML111610407)
  - Review kickoff meeting held on 10/04/11 (MFN 11-234)
  - TRACG Code Request – 10/27/11 (ML1128706001)

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Next Steps for TRACG LOCA Review

- Formal RAIs to be issued:

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TRACG LOCA Review Schedule

- Acceptance letter dates:
  - RAIs: April 20, 2012
  - Draft SE: November 21, 2012

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Revised 50.46 Criteria Rulemaking

Revised 50.46 Criteria Rulemaking

- No BWR units are expected to fall under a different Tier. But, definition of categorization instead of actual plant names in the rule would be more descriptive and less restrictive.
- For BWRs:
  - Tier 1: No new methodology / no new analysis needed. (Track 1)
  - Tier 2: No new methodology / revised analysis needed. (Track 3)
  - Tier 3: New methodology / new analysis (Track 2)
- Use of Cathcart-Pawel oxidation kinetics instead of Baker-Just does not constitute a new methodology. This can be accomplished in both SAFER and CORCL codes via input, without requiring coding/model change.
- The figure of merits for the new acceptance criteria can be extracted from existing analysis and compared against the new criteria.
- Use of a hydrogen model to transform the criteria to exposure-based limits is not considered a change in EM in the sense of departure from the acceptance basis.

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Options for Hydrogen Model

- GNF/GEH is currently developing a proprietary hydrogen model for GNF fuel. Submittal is expected in 2014.
- The clad-specific model will be based on GNF data and will consider pertinent independent operational variables.
- For the margin assessment work (BWROG-TP-11-010 Rev.1), FRAPCON model was used. The model is comparable to the hydrogen model used for AOO.
- Continued use of FRAPCON model for new rule compliance should be acceptable.

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Transition Logistics

- A common report detailing how the existing methodology can be used to meet the new criteria will be provided.
- Licensees will inform NRC on compliance with all new criteria by issuing one-time letter. There will be no need for LAR.
- Licensees will continue reporting all new criteria *in yearly 50.46 notifications* and will add the reference in *Supplemental Reload Licensing Reports* without requiring a change in Tech Specs.
- Compliance is not interim.

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Breakaway Oxidation Testing

GEH/GNF Perspective

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Alternate Approach

Current NRC draft language: requiring each licensee to *measure* breakaway oxidation behavior for each reload batch

Alternate approach: consider requiring licensee to *report* on breakaway oxidation behavior for cladding used in reload.

Flexible approach would benefit licensee and vendors in providing assurance of cladding oxidation behavior in a practical manner.

Key Elements (1)

Apply combined testing and Quality Assurance approach to ensure no alteration of breakaway oxidation behavior due to inadvertent changes in ingot **impurities** and **manufacture process** modifications.

Oxidation testing at ingot stage allows alloy impurity effects to be assessed without introducing manufacturing variables.

Vendor compiles tests results and generates yearly report – demonstrates material consistency with respect to impurities.

Zry2
Kroll
Remelt

Zry2
Electrolytic
Remelt

Early onset of Breakaway Oxidation in Electrolytic Zirc is retained after remelt, i.e. impurities effect can be detected at ingot stage, without manufacturing factors

Key Elements (2)

Leverage vendor Quality Assurance program to qualify and control relevant manufacture steps.

- Surface roughness
- Change of polishing material
- Use of HF-containing acid after polishing – NOT current practice

Conduct oxidation tests on finished cladding to qualify acceptance criteria for surface roughness and polishing material.

Vendor QA program ensures surface roughness is controlled to within qualified range and correct polishing material is used.

- Inadvertent use of HF-containing acid after polishing would be a major breakdown of process control, quality assurance and product certification

Vendor generates qualification tests reports.

Key Elements (3)

Licensee reporting consists of vendor reports on:

- Most recent yearly report on oxidation tests performed at ingot stage (for impurity effects).
- Most recent process qualification report based on oxidation tests.

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Test Frequency Options

Based on the per reload concept, ingot-stage tests conducted by vendors at, for example, ~20,000 tubes (approx. equivalent to per reload) would be more practical.

Flexible approach whereby ingot-stage test frequency is high initially (TBD) and reduces later based on demonstrated process capability.

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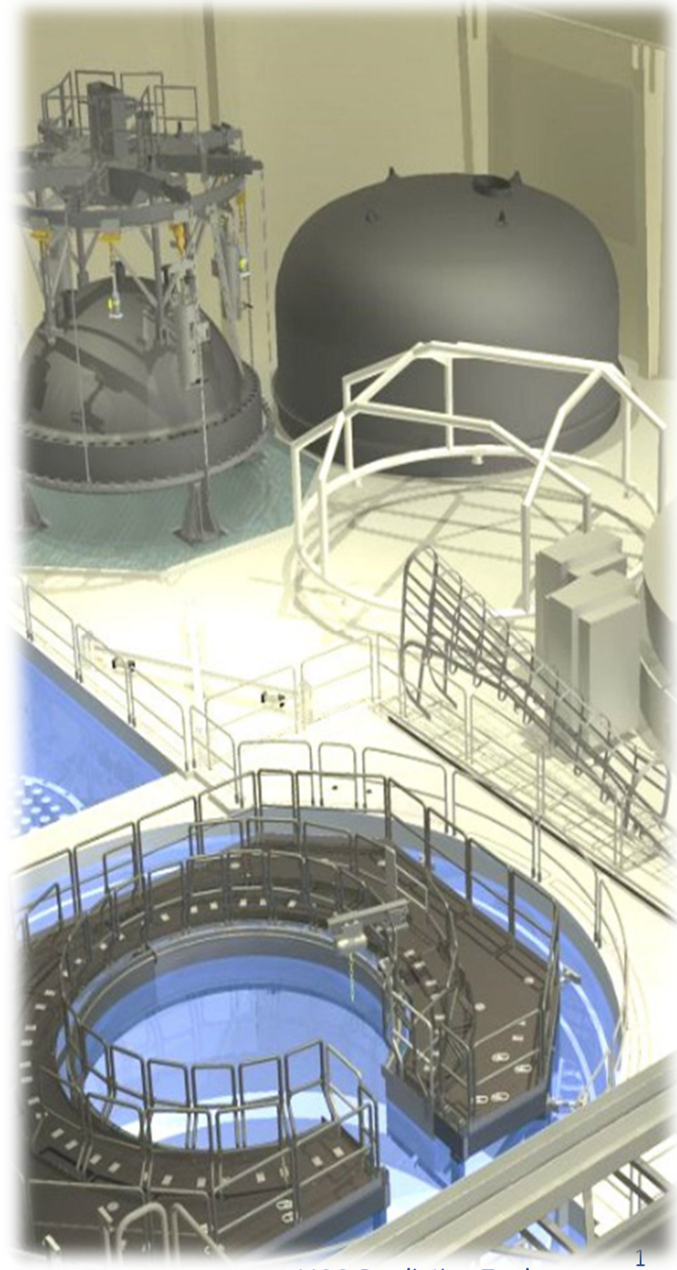
Moisture Carryover (MCO) Prediction Tool



NRC Technical Exchange Meeting
August 9th, 2012

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Project Overview

Develop software to assess steam dryer and separator performance for the BWR fleet using GEH proprietary design methodology and actual plant performance data

Product Features

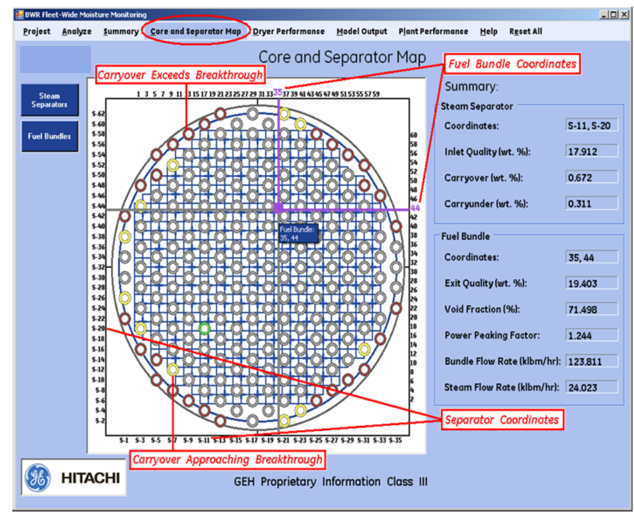
- Plant Design-Basis MCO prediction
- Plant Performance MCO prediction
- 2D Core and Separator Map indicating regions of Separator/Dryer performance degradation
- Automatic Calibration
- Uncertainty quantification

MOISTURE CARRYOVER TOOL

Plant Analysis software to predict and monitor MCO

Features

- Dryer Moisture Carry Over analysis
- Bundle exit steam conditions
- Upper Plenum steam parameters
- Core/Separator performance map for bundles/separators
- Separator and Dryer performance parameters
- Core Out/Upper Plenum/ Separator/Dryer/ performance charts



Developmental Version

Benefits

- Plant performance optimization
- Reduce plant BOP dose
- Reduce maintenance cost due to high MCO

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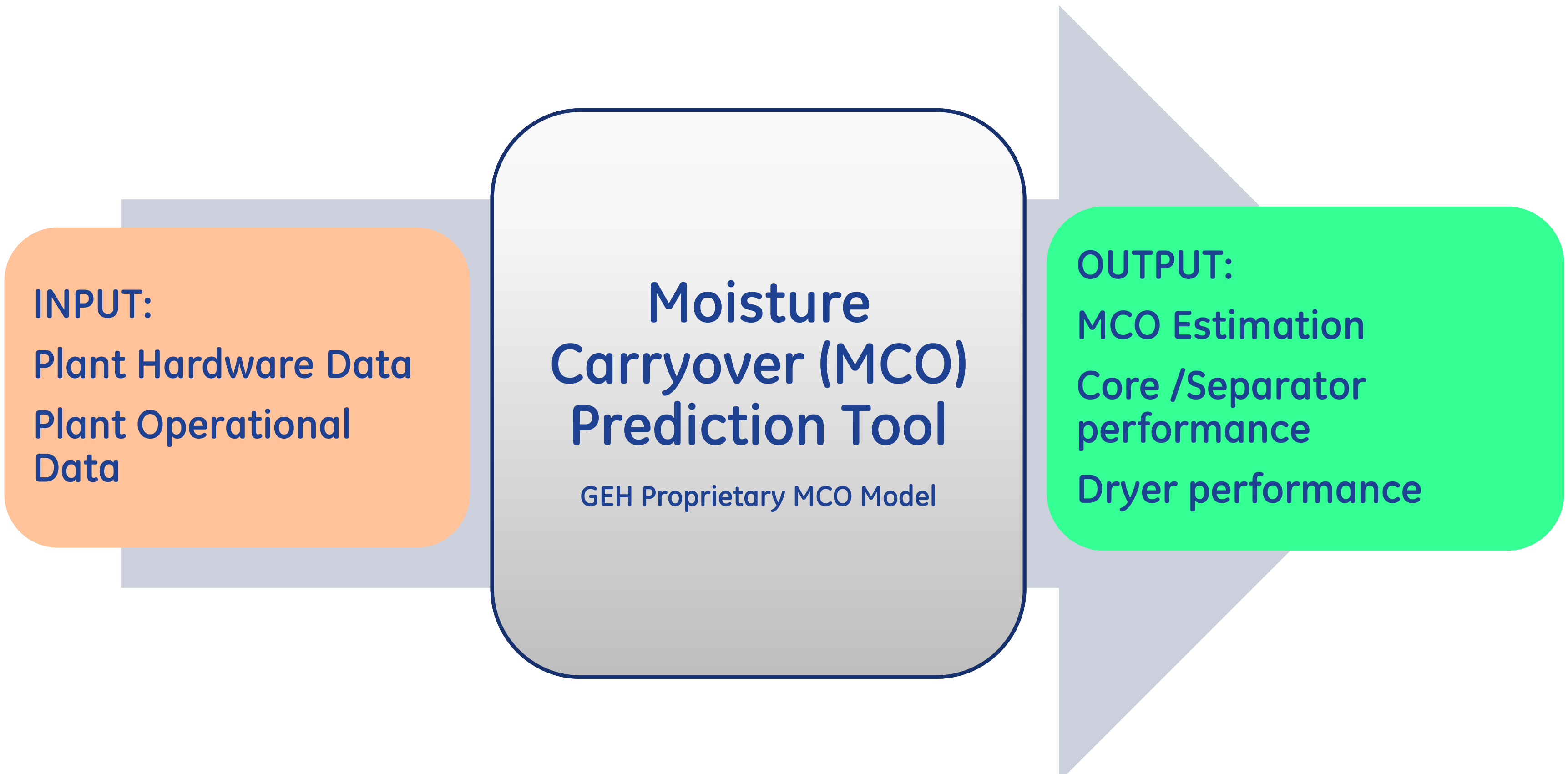
Product Structure



Overview

Steam Dryer/Separator Performance and Background Theory

MCO Tool Overview and Background Theory

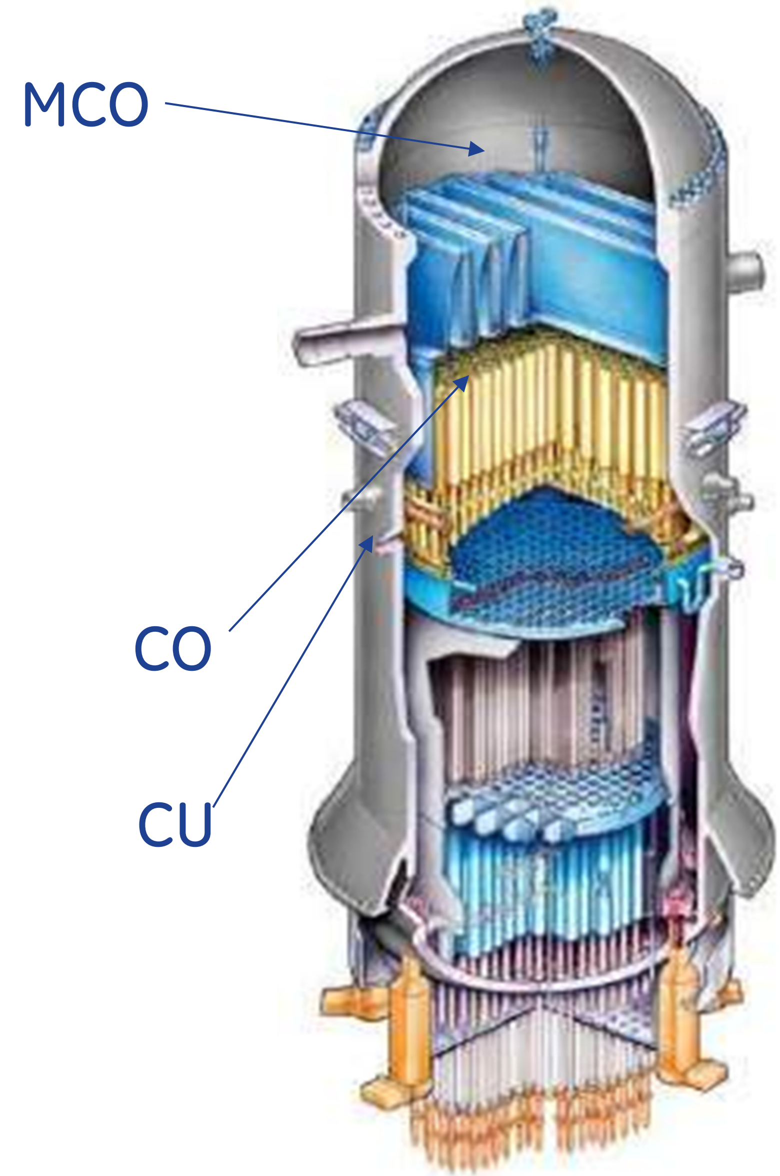
- Overview
- Background Theory
  - Definitions
  - BWR steam separator and dryer design
  - Causes of high MCO
  - Consequences of high MCO

Overview

- Terminology
- Performance Specifications
- Dryer Performance
- Separator Performance
- GEH Modeling Approach
- BWR Fleet Plant Performance Data

Terminology

- MCO – Fraction of liquid in dryer outlet steam flow.
- Carryover – Fraction of liquid in separator steam flow (CO).
- Carryunder – Fraction of steam in separator return liquid flow (CU).



Moistur Carryover Performance Specification

Performance Specifications

Three Specifications:

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Elevated MCO Consequences

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Dryer Performance

Dryer Performance

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Dryer Performance (Level)

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Separator Performance

Separator Performance

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- GE developed three types of steam water separators depending on core power density:
  - 65PL (BWR2, BWR3)
  - 67PL (BWR4, BWR5)
  - AS-2B (BWR6, ABWR)

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Moisture Carryover Modeling

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Moisture Carryover Modeling

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MCO Tool Plant Performance

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Plant Performance Modeling

- Comparison of Plant Performance Model Results against Measured MCO Data

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Plant Performance Modeling

- Comparison of Plant Performance Model Results against Measured MCO Data

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Plant Performance Modeling

- Comparison of Plant Performance Model Results against Measured MCO Data

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Plant Performance Modeling

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Plant Performance Modeling

- Comparison of Plant Performance Model Results against Measured MCO Data

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Plant Performance Modeling

- Comparison of Plant Performance Model Results against Measured MCO Data

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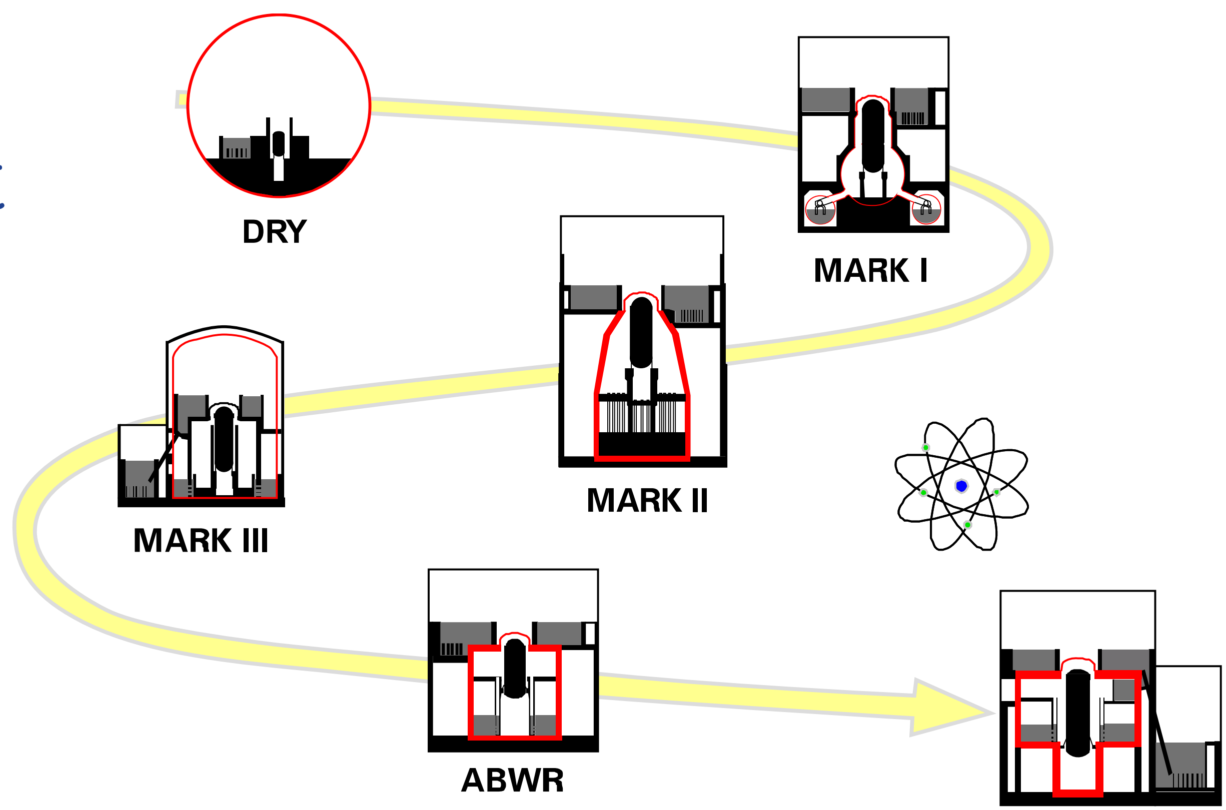
Conclusion

BWR (2 through 6) fleet wide Level II software is available to assess steam dryer and separator performance using GEH proprietary design methodology and plant specific performance data.

Technology Update for the US NRC
August 2012

TRACG Containment Application



Charles Heck

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Overview

- New Technology Introduction (NTI), New Product Introduction (NPI) multi-year program to develop detailed TRACG coupled Reactor Pressure Vessel (RPV), Reactor Coolant System (RCS), and containment models for operating BWRs
- Intended first to address extended Station Black Out (SBO) scenarios like the one at Fukushima-Daiichi (1F1, 1F2, 1F3)
  - Extend coping time, evaluate coping procedures, optimize equipment performance, evaluate new equipment options
- Protect public **AND** preserve asset by NOT
  - Damaging core, over pressurizing containment

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1. Capable of simulating Fukushima-like SBO scenarios
2. Capable of coupled RPV, RCS, and containment simulation for operating BWRs
3. Capable of modeling hydrogen production
4. Capable of modeling hydrogen transport
5. Capable of providing an effective means of communicating the results

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Key Outputs

- Core, RPV, and RCS
  - Core: PCT, void fractions
  - RPV: pressure, water level, leakage
  - RCS: leakage, flows, SRVs
- Drywell (DW)
  - Pressures, temperatures, hydrogen
- Wetwell (WW)
  - Pressures, temperatures, hydrogen
  - Suppression pool (SP) temperatures, level, voids
- Other SBO equipment alignments and parameters
  - CST, RCIC, HPCI, IC

Modeling Approach and Considerations

- RPV considerations [[

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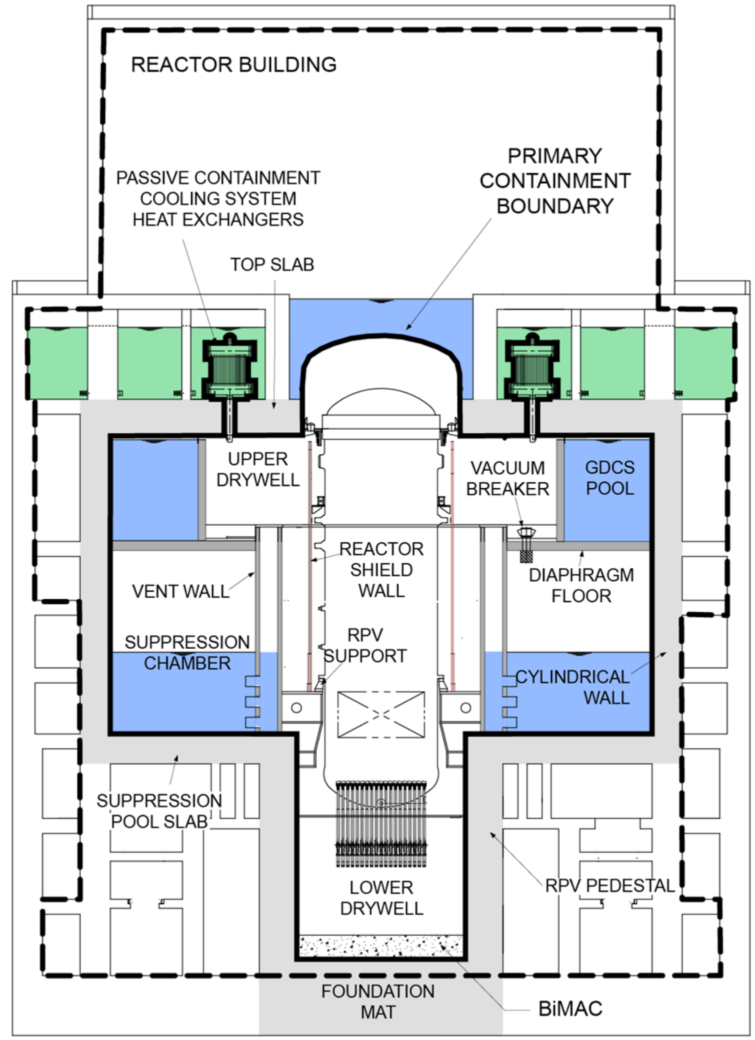
- Containment considerations
  - Learn from ESBWR modeling and SHEX SBO experience
  - Focus first on Mark I, extend to Mark II and finally Mark III as needs dictate
  - Nodalization detail roughly equivalent of RPV and sufficient to obtain distributions in: masses, energies, pressure, temperature, hydrogen

ESBWR Containment

TRACG modeled coupled RPV, RCS, and containment with key supporting systems

- 42 axial levels, 8 radial rings
- Containment stacked above RPV
- Included PCCS and isolation condensers
- More compartmentalized than Mark I, II, III containments



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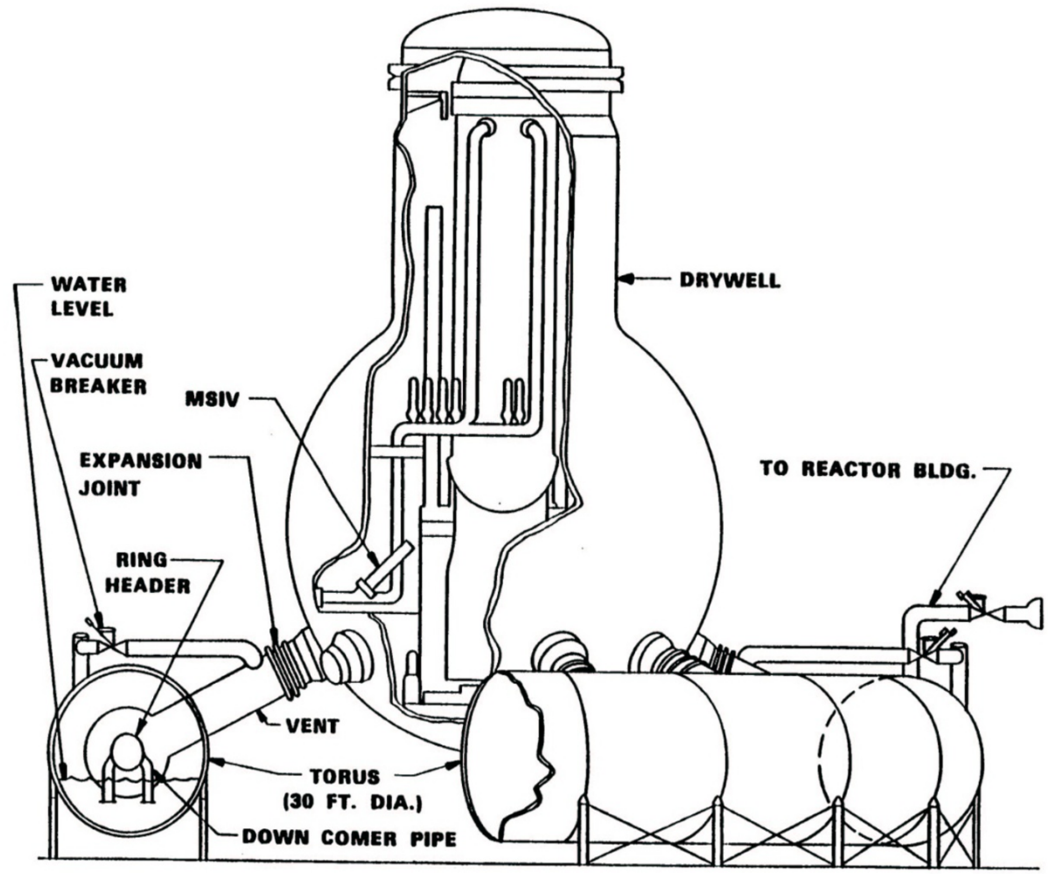
Containment Types – Mark I

Key Features

- Permits reactor servicing with removable top.
- Meets space requirements to enclose coolant system recirculation pumps
- Large DW / WW connection area to reduce peak DWI pressure during LOCA
- Large suppression pool for effective heat sink
- Inerted containment
- All US Mark I containments have hardened vents to atmosphere (NRC letter 89-16)



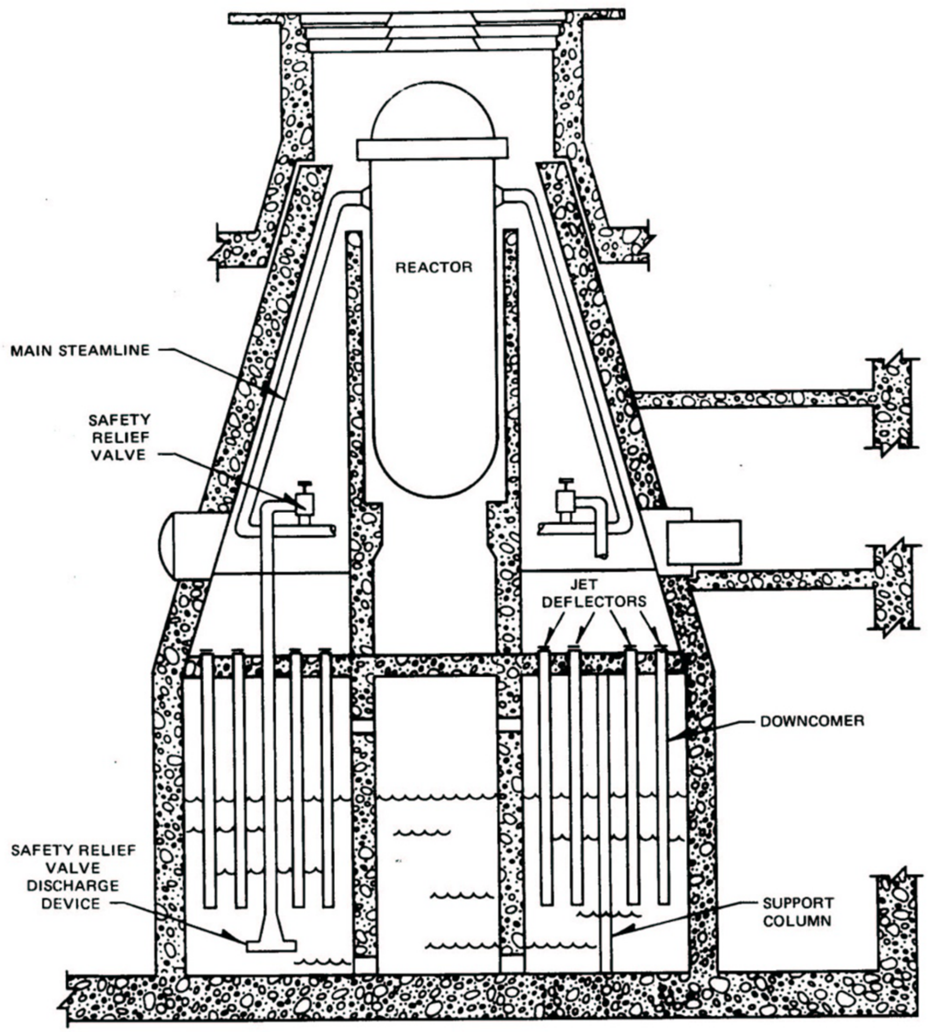
Containment Types – Mark II

Different from Mark I

- Larger DW Volume for equipment accessibility
- Design pressure reduced from 62 to 45 psig
- Simpler DW / WW connectivity
- More efficient use of building materials (concrete versus steel)
- Smaller Reactor building with better use of space
- Most Mark II containments do not currently have hardened containment vents to atmosphere

Similar to Mark I

- Large DW / WW connection area to reduce peak DW pressure during LOCA
- Post-Accident Suppression-pool temperature range



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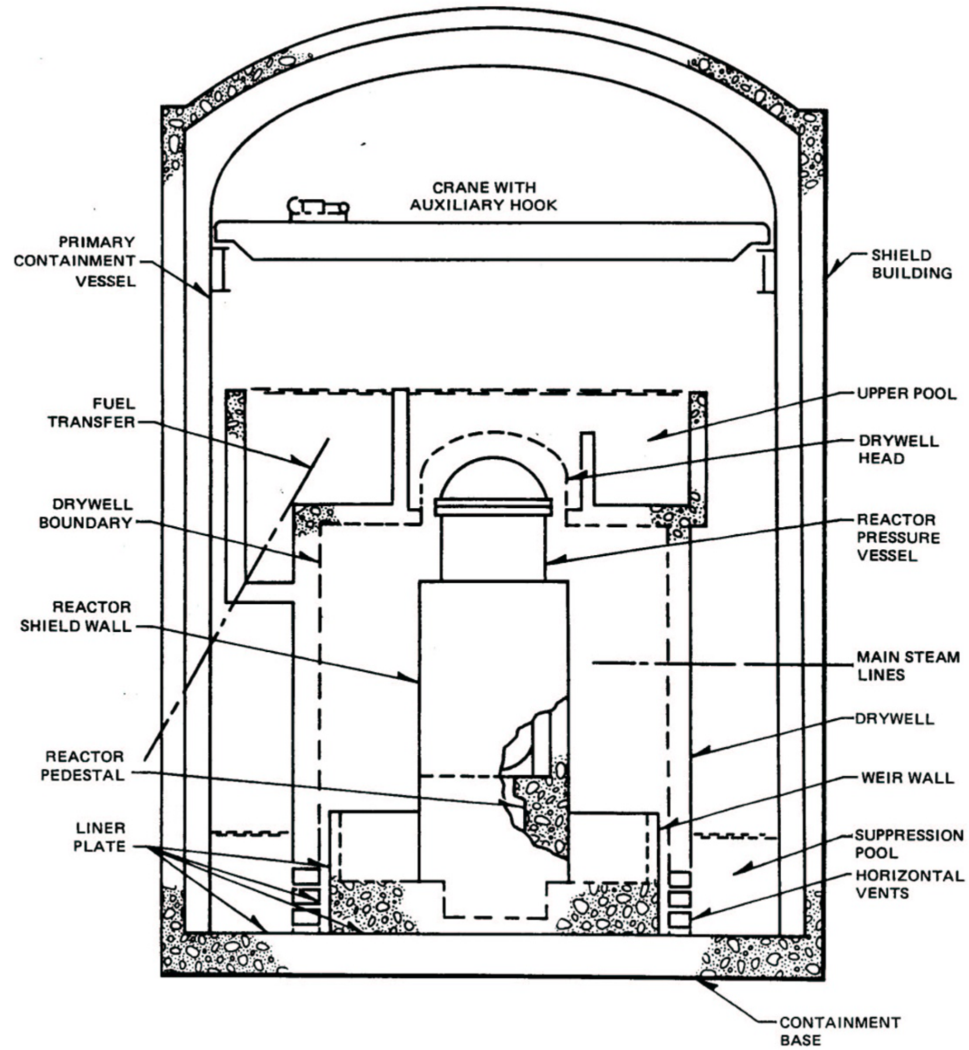
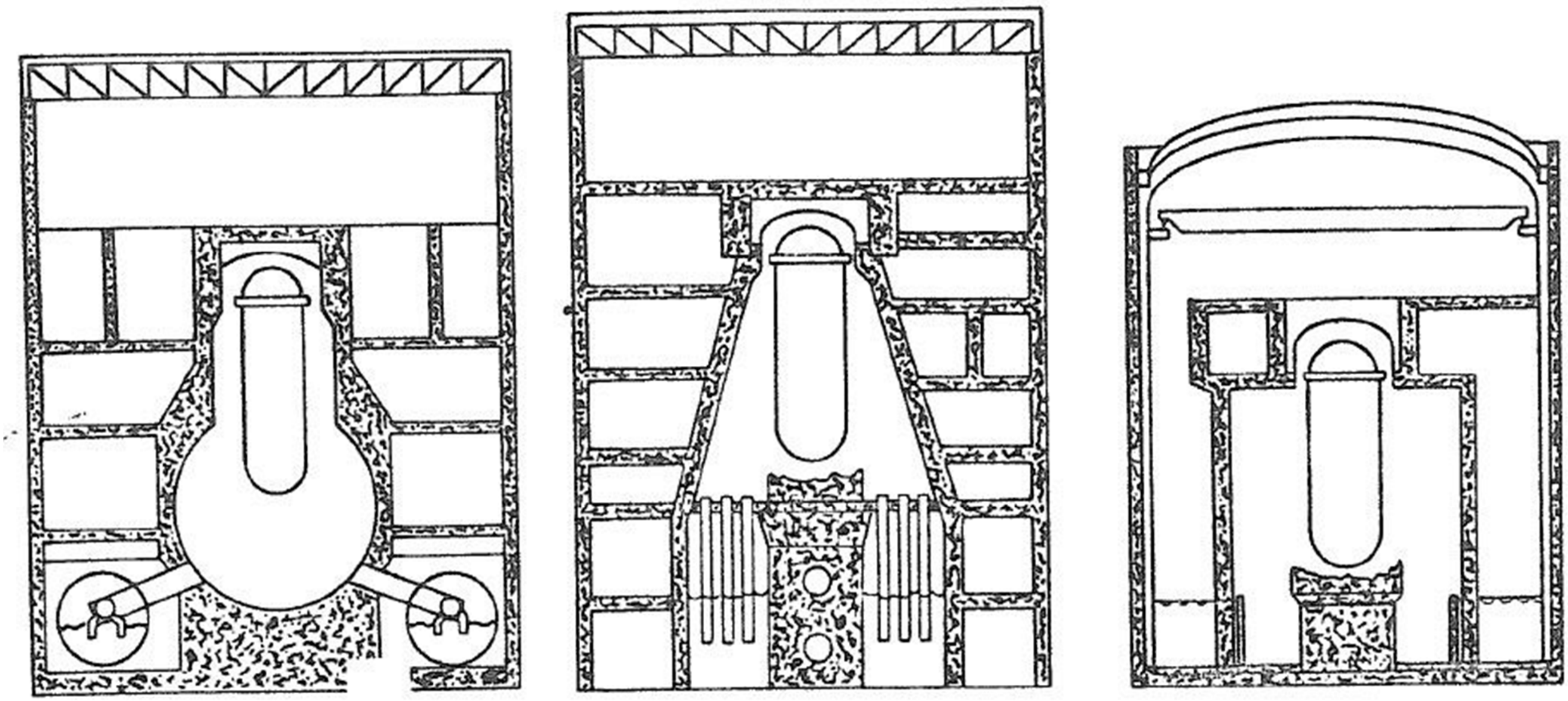
Containment Types – Mark III

Different from Mark II

- Shorter RPV pedestal with improved seismic capability
- Enhanced integrity of concrete barrier by enclosing primary piping inside DW
- Larger WWI airspace which encloses DW
- Larger Suppression Pool
- Lower Post-Accident Suppression Pool Temperature Range
- Design pressure reduced to 15 psig
- No containment inerting, combustion control instead
- Better use of Reactor Building space
- Fuel stored at ground level
- More room for equipment in DW
- Cylindrical structure easier to construct



Similar Function, Different Geometries



Mark I Mark II Mark III

Create separate TRACG input model for each type

Flow Down of Modeling Requirements

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Capability Developed in Phases

Phase 1 (a,b)

- Functioning TRACG model implementing the coupled RCS and Mark I and II containments. Prototype models capable of simulating SBO scenarios with or without additional ECCS systems required for SBO recovery.
- Prototype model for detailed RCIC modeling demonstrated.
- Completed Conceptual Design Reviews (May, July 2012)

Phase 2

- Define & implement plant-specific inputs for Mark I and II containments.
- Qualify with steady state and transient containment data.
- Exercise for Fukushima-Daiichi 1F1, 1F3 extended SBO simulations and compare to available data
- [[ ]]

Hydrogen Subproject (requires TRACG code changes)

- Add hydrogen production and recombining
- Refine hydrogen transport
- [[ ]]

Demonstration of Mark I Model

Item	Scenario 1	Scenario 2	Scenario 3	Scenario 4
RPV depressurization?	No	Yes	No	No
RCIC?	Yes	Yes	Yes	Yes
Other ECCS?	No	No	No	No
Depressurization Rate?	NA	100F/hr	NA	NA
Coping duration	4 hr	4hr	20hr	72hr
Containment vent?	No	No	No	Yes at 20 hr
Completion?	Yes	Yes	Yes	Yes
SHEX run?	Yes	Yes	Yes	No

MarkI.avi

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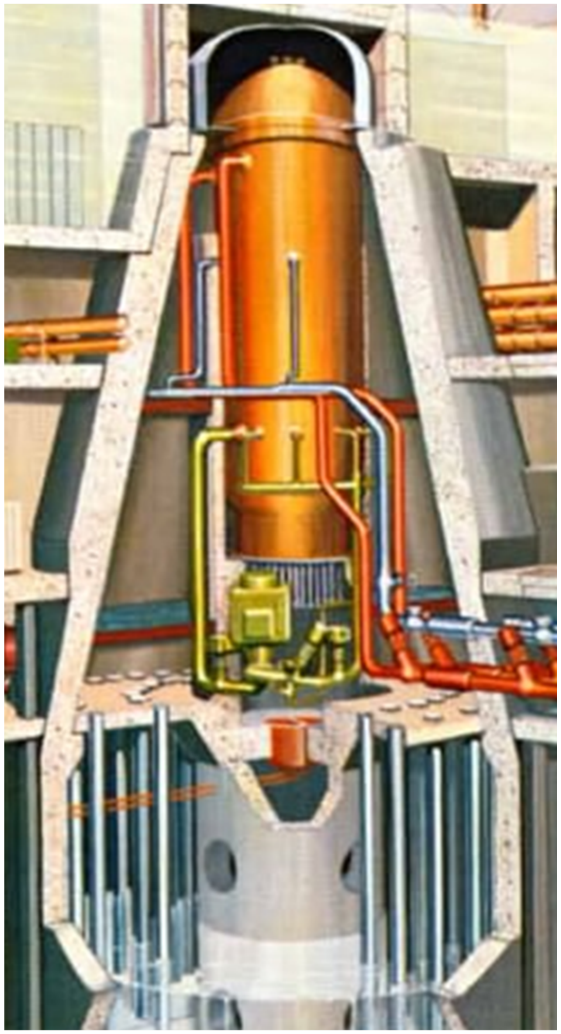
Demonstration of Mark II Model



Item	Scenario 1	Scenario 2
RPV depressurization?	No	Yes
RCIC?	Yes	Yes
Other ECCS?	No	No
Depressurization Rate?	NA	80F in 10 minutes at 1 hour. After this pressure is kept constant
Coping duration	4 hr	4 hr
Containment vent?	No	No
Completion?	Yes	Yes
RCP Seal Leakage?	No	No
SHEX Run? (unverified, alternate calculation)	Yes	Yes

MarkII.avi

Summary

- New Technology Introduction (NTI), New Product Introduction (NPI) multi-year program to develop detailed TRACG coupled Reactor Pressure Vessel (RPV), Reactor Coolant System (RCS), and containment models for operating BWRs [[

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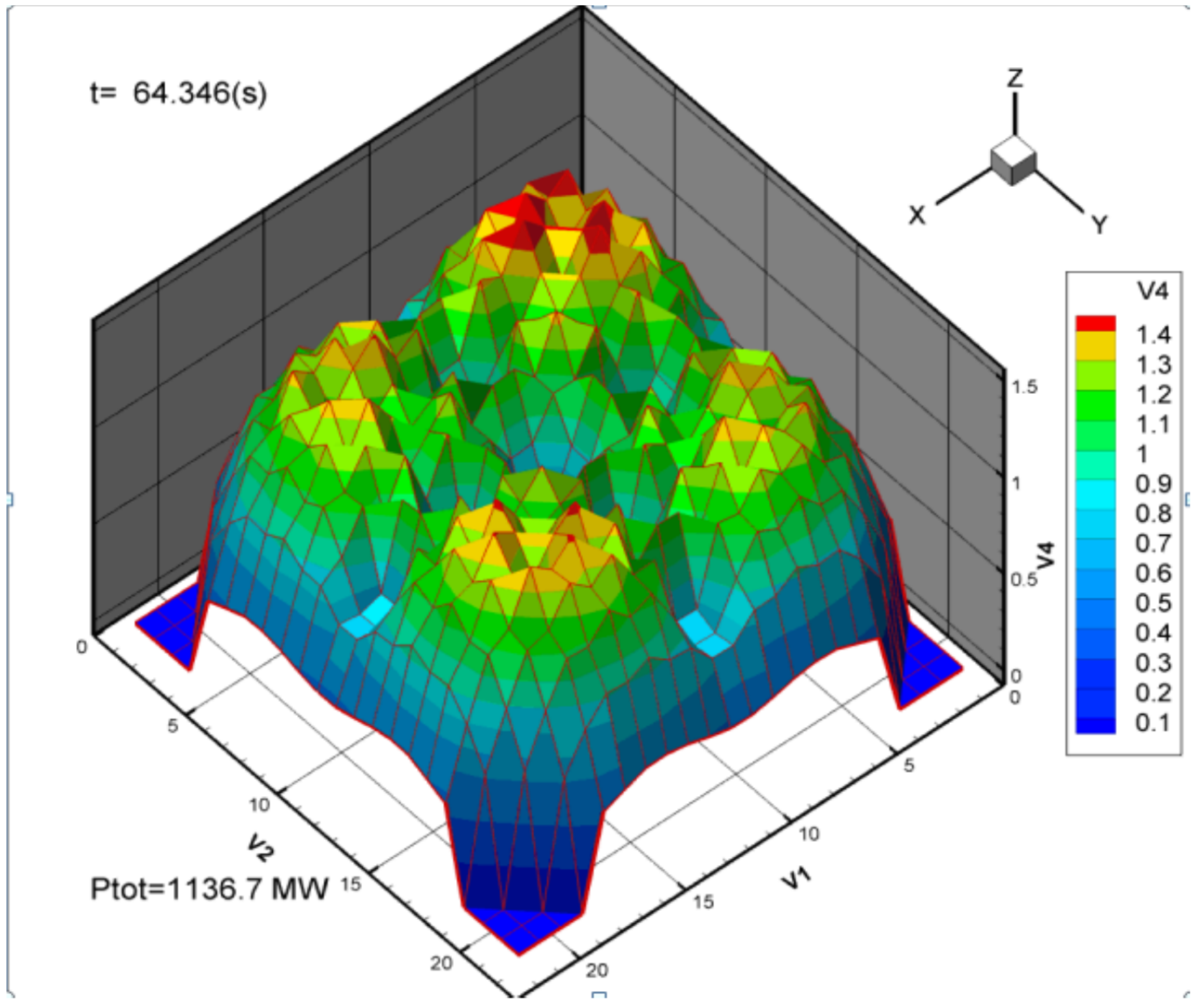
- Intended first to address extended Station Black Out (SBO) scenarios like the one at Fukushima-Daiichi (1F1, 1F2, 1F3)
  - Extend coping time, evaluate coping procedure, optimize equipment performance, evaluate new equipment options

Technology Update for the US NRC
August 2012



BWR Stability

Juswald Vedovi
Engineering Technical Leader
GEH Stability Analysis Team

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Characteristics of Existing Stability Solutions

Stability LTS	Main Protection Philosophy	Relevant Parameter for Solution	Domain Code Used for Analyses
Option 1-D	D&S (APRM)	MCPR	Time
Option II	D&S (APRM)	MCPR	Time
Option III	D&S (OPRM)	MCPR	Time
Option E1-A	Exclusion Regions (APRM)	DR	Frequency
Enhanced Option III	D&S – Exclusion Regions Hybrid (OPRM/APRM)	MCPR	Time
KKM	Exclusion Regions (APRM)	DR	Frequency
Japan Stability Solution	Exclusion Regions (APRM + SRI)	DR	Frequency
Others	Exclusion Regions (APRM)	DR	Frequency
DSS-CD	D&S (OPRM)	MCPR	Time

Different Stability LTS Approaches

Stability LTS	Methodology Approach	# of Units with LTS	BWR Type Application/ Applicability	Licensed BWR Domains
Option 1-D	Conservative	6	GE BWR/3-4	EPU[1]
Option II	Conservative	2	GE BWR/2	CLTP[2]
Option III	Conservative	32[3]	GE BWR/3-6 ABB BWRs ABWR	EPU[1]
Option E1-A	Conservative	3[4]	GE BWR/3-6	EPU[1]
Enhanced Option III	Conservative	0	GE BWR/3-6	EPU[1] & M+
KKM	Conservative	1	KKM	CLTP[2]
Japan Stability Solution	Conservative	33[5]	BWR/2-6 ABWR[6]	CLTP[2]
Others	Conservative	17	GE BWR/1-6 ABB BWRs Siemens BWR	Various
DSS-CD	BEPU	3[7]	BWR/2-6 ABB BWRs ABWR	EPU[1] & M+

[1]EPU is up to 120% of the unit Original Licensed Thermal Power (OLTP)
[2]Current Licensed Thermal Power (CLTP)
[3]Includes the 2 ABWR Lungmen Units expected to startup in 2012-2013.
[4]One plant is currently under regulatory body review for transitioning to Option III.
[5]This figure includes the 6 Fukushima Daiichi Units.
[6]This includes different BWR/ABWR NSSS vendors (GE, Hitachi, Toshiba, and Mitsubishi).
[7]Includes the 3 licenses currently under regulatory body review for transitioning to this LTS.

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Stability LTS Implemented in US Plants

Stability LTS	Methodology Approach	# of Units with LTS	Max Licensable P/F Domain
Option 1-D	Conservative	5	EPU
Option II	Conservative	2	CLTP
Option III	Conservative	26(*)	EPU
Option E1-A	Conservative	1	EPU
DSS-CD	BEPU	1(**)	EPU & M+

*Expecting at least 2 Units transitioning to DSS-CD in relatively short-term as part of MELLLA+ transition

**Plant License currently under NRC review

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Changes through the years & Challenges

- Advanced Fuel Bundles Designs and Increased Array Size
  -> challenges Stability
- Advanced, more optimized core designs
  -> challenges Stability
- Longer fuel cycles (up to 24 months)
  -> challenges Stability
- Power Increase and Flow Domain Expansions
  -> challenges Stability

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Best-Estimate vs. Conservative

- Stability LTSs Options 1-D, II, and III worked well, but based on a conservative methodologies (DIVOM , HCOM, DIRPT)
- Excessive conservatisms:
  - Impacting core designs/plant operation
  - Unrealistic uncertainty clouds understanding of the phenomena
- Best-estimate Plus Uncertainty (BEPU) methodologies advance the technology and understanding of safety analyses
- TRACG BEPU methodologies based on NRC Code Scaling , Applicability and Uncertainty (CSAU in NUREG/CR-5249) have been extensively reviewed, approved and supported by the US NRC and other world-wide regulatory bodies for LOCA, Transient and Stability analyses

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Stability LTS Vision

Stability LTS	Methodology Approach	Max Licensable P/F Domain
Option 1-D	Conservative	EPU
Option II	Conservative	CLTP
Option III	Conservative	EPU
Option E1-A	Conservative	EPU
DSS-CD	BEPU	EPU & M+

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-]] experience and CSAU approaches
  - Build on previous applications
    - AOO LTR (NEDE-32906P-A)
    - ESBWR Stability LTR (NEDC-33083P-A Suppl. 1))
    - DSS-CD LTRs (NEDE-33147, NEDC-33075)
- Uncertainty methodology based on NRC Code Scaling , Applicability and Uncertainty (CSAU in NUREG/CR-5249)

Submittal Plan

- Submittal in one Licensing Topical Report (LTR)
  - Planned submittal in [[ ]]

Non-Proprietary Information – Class I (Public)

2012 Technology Update

Planned Submittals

Jim Harrison
August 9, 2012

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GESTAR II Submittals

- NEDE-24011P – Revision 19 11-3Q

  Correct References, Clarifications, & Approved TRs

- NEDC-32868P Revision 4 (PRIME) 12-3Q

  GE14 GESTAR II Compliance

- Amendment 36 12-3Q

  -Clean up Sections 3.4 and 3.5

  -Change DIVOM Reference to TRACG04 Supplement

  -Re-Write ECCS-LOCA Section to remove SAFE-REFLOOD and add SAFER/PRIME

  -Add Reference to Completed PRIME Downstream Audit

Methods LTR

- NEDC-33173P Sup 1 — In-Review – RAI in Hand
  Void Fraction Error Based on 10x10 Pressure Drop Data
- NEDC-33173P Sup 2 — -A Version
  Power Distribution Uncertainties
- NEDC-33173P Sup 3 — -A Version
  GNF2 Supplement for Interim Methods
- NEDC-33173P Sup 4 — -A Version
  PRIME Implementation Plan — and Audit Complete

Advanced Nuclear Methods

- NEDC-33376P Stagnated
  LANCR02 Lattice Physics Model Description
- NEDC-33377P Stagnated
  LANCR02 Lattice Physics Qualification

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Fuel Improvements and Methods

- Ziron Cladding — RAI Responses In-Preparation
- Additive Fuel — Draft RAI Responses In-Review

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Stability Solutions and Methods

- NEDE-33147 Rev 3 RAI Responses Submitted
  TRACG04 for DSS-CD Application
- NEDC-33075 Rev 7 RAI Responses Submitted
  DSS-CD Revision using TRACG04
- TRACG04 Supplement for NEDO-32465
  RAI Responses Submitted

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Other Methodology

- TRACG LOCA Application Draft RAIs In-Hand

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