TRACE Version 5.0 Development and Status

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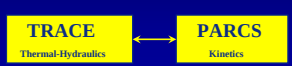
Introduction

- **Code Consolidation resulting in TRACE began approximately 10 years ago with the goals of preserving the capabilities of predecessor codes and modernize code architecture.**

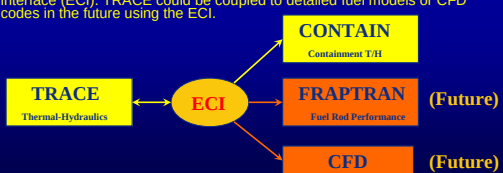
- **Maintain investment in existing RELAP5, TRAC-PWR, and TRAC-BWR input models**
- **Maintain in-house control over code development and testing process**

Coupling With Other Codes

- TRACE can be run in a coupled mode with the PARCS three dimensional reactor kinetics code.



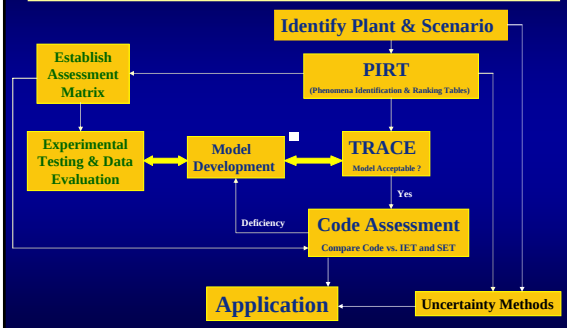
- TRACE has been coupled to CONTAIN through its exterior communications interface (ECI). TRACE could be coupled to detailed fuel models or CFD codes in the future using the ECI.



TRACE Version 5.0

- **TRACE "Version 5.0" was completed and made available to interested groups in August 2007. Associated documentation includes:**
  - Theory Manual
  - Assessment Manual
  - User Guide
- **With the release of Version 5.0, our intent is to treat the code and documentation as a consistent set. Future releases will be accompanied by updated Theory Manual and revised Assessment Manual.**

Development / Assessment



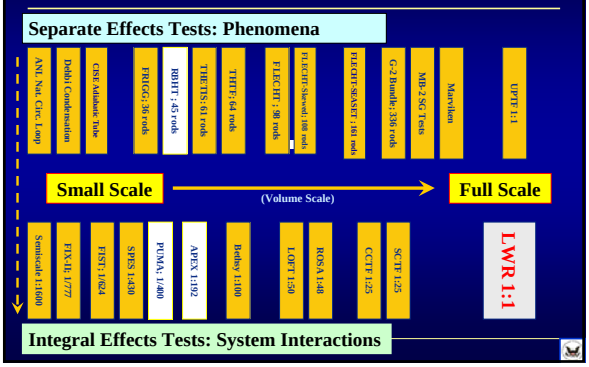
Major Model Revisions

- **Wall and two-phase interfacial drag models**
- **Reflood heat transfer models**
- **New condensation w/non-condensable gas models developed to analyze the ESBWR.**
  - Drywell condensation
  - In-tube condensation
- **Condensation (Cold Leg)**
- **Steam Properties**

Assessment

- Basic assessment matrix consists of over 400 individual experiments performed in over 35 different facilities.
- Assessments performed using a strictly “frozen” version of the code.
- Additional assessment performed for unique features of new & advanced plants:
  - **ESBWR: PUMA and PANDA IETs, PCCS HX tests**
  - **EPR: ROSA-IV NC, FLECHT and APEX Reflux Condensation**
  - **APWR: Scaled advanced accumulator tests**
  - **AP1000: APEX and ROSA-AP600 IETs, CMT tests**

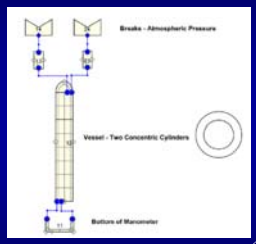
T/H Assessment Tests

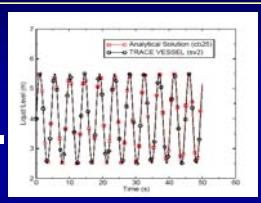


Documentation

- **The TRACE 5.0 Documentation (Theory Manual, Assessment Report, User Guide) is “generic” and is expected to be referenced as the basis for most applications.**
- **Additional documentation with supporting assessment, new model options, and modeling guidelines is produced for unigue applications:**
  - ESBWR Applicability Report (draft)
  - APWR Applicability Report (planned)
  - AP1000 Applicability Report (if needed)
  - etc.

U-Tube Manometer Fundamental Test Problem





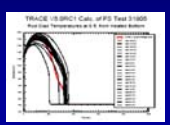
Known or well accepted solutions

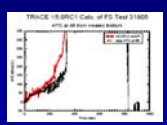
Relatively simple models

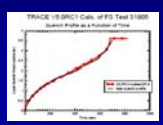
$$X(t)=\left(4.5+\frac{2.1}{\sqrt{\frac{g}{L}}}\sin\left(\sqrt{\frac{g}{L}}t\right)+0.002\cos\left(\sqrt{\frac{g}{L}}t\right)\right)$$

Reflood SET Results

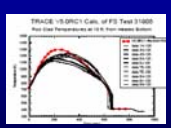
FLECHT-SEASET Test 31805

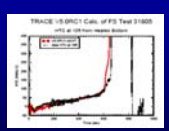


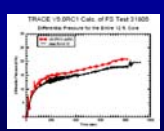




Quench Profile

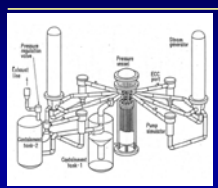


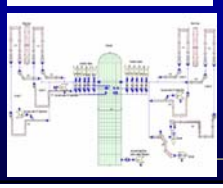


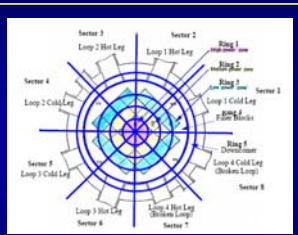


Cladding Temperatures **Heat Transfer Coefficients** **Bundle ΔP**

CCTF Run 62 Results







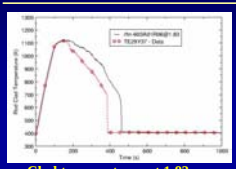
TRACE Model for CCTF:

-3-ring core, 8-sector vessel

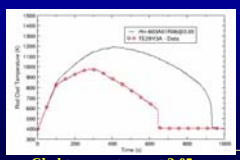
-Axial noding consistent with SETs

-Explicit loop representation

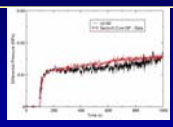
CCTF Run 62 Results



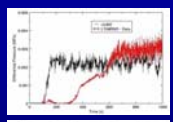
Clad temperatures at 1.83 m



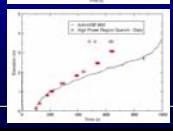
Clad temperatures at 3.05 m



Core ΔP



UP ΔP



HP Bundle Quench

Near Term Efforts

- **Most important near-term steps are to:**
  - Complete development of series of plant input decks to support agency confirmatory calculations.
  - Improve code "robustness" to insure acceptable run times and execution w/o User interaction.
  - Identify major deficiencies & begin corrective action.
  - Continue support for new & advanced reactor Design Certification reviews.
  - Expand assessment matrix for additional applications (BWR stability, UPI plants, etc.)

Longer Term Efforts

- **Model Improvement & New Features**
  - Activation of 3rd (droplet) and 4th (second bubble) fields
  - Spacer grid models.
    - Convective heat transfer enhancement
    - Droplet Breakup
    - Grid Rewet
  - Fuel rod models for burst & blockage.
  - Incorporation of thermal-hydraulic model improvements based on results of recent experimental projects.
    - RBHT
    - THI