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Assessment of Thermal Hydraulics Codes for RTRs

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Introduction

- Inconsistencies identified between TRACE and RELAP5 code results
- NRC Assessment of RELAP5 and TRACE

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Two parallel reviews

- NRC efforts (NRR and RES)
- Argonne National Laboratories (ANL) efforts (Reference: Summary of RELAP5 Assessments Performed in Relation to Conversion Analysis of Research Reactors, Report No. ANL/GTRI/TM-14-3)

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NRC's Goal

- Ensure that Thermal-Hydraulic codes used have a well-documented regulatory and technical basis

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RELAP5 Applications

- Developed and assessed for power reactors
- Also used for RTRs:
  - Conversions
  - Other licensing actions

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Methodology

- RELAP5 results
  - compared to experiments
  - compared to other codes

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Comparison to Experiments

- RELAP5 results were compared to experiments:
  - RTR Conditions
  - Applications

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Comparison to Experiments - Results

- Good agreement under single-phase conditions for all versions of RELAP5
- Good agreement with limited subcooled nucleate boiling

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Code to Code Comparison

- ANL compared RELAP5 results to PLTEMP, PARET/ANL, STAR-CD
- Cases included:
  - steady-state
  - loss of flow events
  - reactivity insertion events

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Code to Code Comparison - Results

- Good agreement for thermal-hydraulic conditions:
  - Flow rates
  - Temperatures (coolant, cladding and fuel)
  - Power
  - Pressure drops under single-phase and limited nucleate boiling conditions

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Additional Consideration

- Critical Heat Flux (CHF) correlations in RELAP5 result in a non-conservative estimate of power at which CHF occurs
- Results vary based on CHF correlation chosen

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Conclusions

- A strong technical basis exists to justify continual use of RELAP5
- Potential improvements of the CHF modeling were identified

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NRC Future Work

- Assess RELAP5 and TRACE CHF correlations against the University of Wisconsin CHF data (Reference: Yang et al., "Critical Heat Flux at Conditions Representative of TRIGA-Type Reactors - Single, Three Rod and Four Rod Bundle CHF Data," UWFDM-1419, October 2012)

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NRC Future Work (Cont'd)

- Create models of existing RTRs using TRACE to assess licensee calculations
- Modify TRACE to include the Bernath correlation for CHF

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Questions?