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RELAP5-3D Reported Problems and Requested Improvements

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Introduction

- *Reported problems usually fall into the categories of installation problem, input processing failure, code execution failure, restart/renodalization failure, and unphysical result.*
- *Requested improvements are new capabilities.*
- *This presentation will discuss some of the more recent generic code problems and improvements for RELAP5-3D.*

INEEL Contact for User Problems

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Partial Backups Replaced With Full Backups

- *Previously, code had 3 partial backups: velocity flip-flop, noncondensable appearance, water packing.*
- *Partial backups had added much complexity to the code; thus, replaced with full backups for both semi-implicit scheme and nearly-implicit scheme.*
- *Since PVM coupled computation had full backups in semi-implicit scheme, extended this to include full backups for uncoupled computation.*
- *Full backups were incorporated in nearly-implicit scheme for uncoupled computation.*

Partial Backups Replaced With Full Backups (Continued)

- *Semi-implicit scheme full-backups: velocity flip-flop (also added major edit junction printout), noncondensable appearance, water packing.*
- *Nearly-implicit scheme full-backups: velocity flip-flop, noncondensable appearance, no water packing since currently not in nearly-implicit scheme.*
- *Verification: development input decks, Zion-1 PWR small break input decks (typpwr, typ1200, etc.).*

Cladding Deformation Model Corrections

- *Previously, when cladding ruptured, change in the hydrodynamic flow area was incorrect for more than 1 heat structure segment connected to the flow area.*
- *Now, flow area change was corrected by weighting it by a factor (the heat structure segment length divided by the flow length); this was then normalized by the sum of all such factors for this hydrodynamic volume.*
- *Previously, when cladding ruptured, heat structure geometry's internal gap pressure was set to external hydrodynamic volume pressure when the number 1 heat structure segment ruptured (could be top or bottom depending on the numbering).*

Cladding Deformation Model Corrections (Continued)

- *Now, this was corrected by resetting the internal gap pressure when any of the heat structure segments ruptured.*
- *This will now occur at the same segment for any numbering; can occur at the top, bottom, or any of the middle segments.*
- *Limits were also placed on the hydrodynamic flow area so that it does not go the zero (similar to what was done when SCDAP was linked with RELAP5-3D).*

Level Model Corrections

- *Previously, level stack input processor incorrectly found 4 level stacks in pressurizer deck with 3 abrupt area junctions.*
- *Now, fixed; found missing line in subroutine LEVSKT.*
- *Previously, calculation failed with segmentation fault in subroutine LEVEL.*
- *Now, fixed; variable not set in subroutine LEVEL.*
- *Previously, calculation failed with divide by zero in subroutine LEVEL.*
- *Now, fixed; modified level velocity calculation and protected against divide by zero.*

Level Model Corrections (Continued)

- *Previously, calculation showed oscillations when compared to calculation on earlier code version.*
- *Now, fixed; bottom and top connecting u-tube junctions were made horizontal and kept above volumes in stack if bottom volume is made not vertical.*
- *Previously, calculation failed with thermodynamic property error at minimum time step in volume with level model on.*
- *Now, fixed; ramped off pancake model and ramped on non-pancake model at low void fraction.*

Pump Model Input

- *Previously, pump model did not allow the user to input the exponent, as well as the coefficients in the friction torque model (the turbine model already does this).*
- *Previously, pump model also did not allow a user supplied lower limit and critical speed ratio on the friction torque.*
- *Now, optional input words 13-17 of data cards CCC0302-CCC0304 were added to include the exponent, lower limit, and critical speed ratio.*

Metal-water Reaction Model Output

- *Previously, metal-water reaction model output variables (outside oxide thickness, inside oxide thickness, hydrogen generated) for each heat structure were only available in major edits.*
- *Now, metal-water reaction model output variables are available in minor edits/plots.*
- *The outside oxide thickness variable is OXTO, the inside oxide thickness variable is OXTI, and the hydrogen generated variable is H2GEN.*

CCFL Model Output

- *Previously, junction ccfl flag (0 if flow is not ccfl-limited, 1 if flow is ccfl-limited) was only available in major edits.*
- *Now, junction ccfl flag is available in minor edits/plots.*
- *The junction ccfl flag variable is CCFLF.*
- *This is similar to junction choking flag (variable is CHOKEF).*

Summary

- *Full backups are now used instead of partial backups (semi-implicit scheme and nearly-implicit scheme).*
- *Cladding deformation model corrected (more than 1 heat structure and resetting internal gap pressure).*
- *Level model problems (stacks, failures, oscillations) have been fixed.*
- *User-friendly changes have been implemented:*

  -Pump model input

  - Metal-water reaction model output

  -CCFL model output