Developmental Assessment of RELAP5-3D Version 2.4.2
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This quarter, the Developmental Assessment of RELAP5-3D is highlighted. Developmental Assessment is important because it gives a basis for justifying the use of RELAP5-3D in variety of applications. This work evaluates version 2.4.2 and provides a basis of comparison with the Fortran95 version, for which a developmental assessment will be published shortly after the code is released.

The code calculations were performed on version 2.4.2is (IRUG source code version) compiled in 64-bit mode with Intel 10.1 Fortran and C++ compilers on an UBUNTU Linux workstation. Both the semi- and nearly-implicit solutions schemes were evaluated. Assessment judgments for both sets of calculations were made, although no attempts were made to explain differences between the two calculations for a given assessment case. Default code options were generally used, although some card 1 options were required to define specific assessment cases.

The developmental assessment employed a combination of phenomenological, separate effects, and integral effects cases to investigate how well selected code models perform. Judgments were made on how well the code calculations predicted the important parameters from each of the assessment cases. These judgments used criteria that evaluated the trends and magnitudes of the data and calculations to determine whether the code results were acceptable or not. Industry standard assessment findings of “excellent” or “reasonable” are considered acceptable, while “minimal” or “insufficient” indicate that additional work on the code models may be needed.

The phenomenological cases are generally simple problems that test one or two code models. They are thought problems that often have analytical solutions. Seventeen cases were included in the assessment. The principal code models addressed by these cases are:

- Momentum equations (1-D and 3-D)
- Level tracking
- Liquid entrainment
- Stratification/phase separation
- Point kinetics
- Gravity/gravitational head
- Conduction enclosure

The separate effects cases are experiments that address one or a few code models. Twenty seven individual tests were included in the assessment. The principal phenomena addressed by these cases are:

- Critical flow
- Two-phase level and void distribution
- Critical heat flux
- Film boiling heat transfer
- Reflood
- Countercurrent flow limitation
- Pressurizer behavior
- Accumulator response
- Steam generator steady-state behavior

- Jet pump flow

The integral effects cases use data from large experiment facilities. These cases are generally of greater interest because they provide an indication of how well the code performs overall in modeling transients with a large number of phenomena. Eight specific tests were included in the assessment:

- LOFT small break loss-of-coolant accident (LOCA) Experiment L3-7
- ROSA small break LOCA test SB-CL-18
- Semiscale natural circulation Tests S-NC-1, S-NC-2, S-NC-3, and S-NC-10
- LOBI large break LOCA Test A1-04R
- LOFT large break LOCA Experiment L2-5 1-D & multi-dimensional reactor vessel

Most of the calculations were judged to be in reasonable or excellent agreement with the measured or analytical data, with some minimal and insufficient judgments.

The full report is now available as a RELAP5-3D manual on the RELAP5-3D Web Site. On the Manuals page, select Volume 3 of version 2.4.2. The URL is: http://www.inl.gov/relap5/r5manuals.htm.