Moving Problems

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The capability to model reactors in moving environments has been added to RELAP5-3D.

RELAP5-3D has traditionally been used to model stationary reactor systems located on the earth's surface. The user can input the gravitational constant and therefore can simulate other locations, such as a stationary reactor on the surface of the moon or other low-gravity applications. Previous code versions have always assumed that the reactor system is stationary. A new capability has been added to RELAP5-3D to allow it to simulate movement, such as could be encountered in ships, airplanes, space crafts, or a terrestrial reactor during an earthquake. This new capability allows the user to simulate motion through input, including rotation about the origin implied by the position of the reference volume and translational displacement. The transient rotation can be input using either Euler or pitch-yaw-roll angles. The movement is simulated using a combination of sine functions and tables of rotational angles and translational displacement.

The simulation of movement affects many RELAP5-3D models, including the momentum equation, flow regimes, component models, and special process models. The acceleration of the center of gravity adds an additional body force term to the momentum equation. The rotation about the center of gravity can change the flow regime between horizontal and vertical, which affects virtually all of the code's two-phase models. The code's normal logic is applied to determine which flow regime map (horizontal or vertical) is appropriate for each volume at each time step. The additional body forces affect the separation efficiency of the simple separator component and the forces acting on the flapper in the inertial valve component. The rotation about the center of gravity also affects the angle of a mixture level relative to the axis of a component that was originally vertical. Therefore, the rotation can affect the interfacial area when the mixture level tracking and thermal stratification models are used.

The simulation of stationary systems requires that the input models close in the vertical direction to prevent the calculation of artificial circulation. Components that were originally horizontal can have some elevation change after rotation in moving problems. Therefore, the simulation of moving systems requires that the input models close in all three coordinate directions to prevent the calculation of artificial circulation. The simulation of moving systems requires more care in the development of input models than required for traditional models.

The capability to simulate moving problems will be included in the next code release, which is scheduled for the summer of 2013.