Studies Related to the Oregon State University High Temperature Test Facility: Scaling, the Validation Matrix, and Similarities to the Modular High Temperature Gas-Cooled Reactor

Publisher:
INL
Date:
Wednesday, September 1, 2010
Abstract:

The Oregon State University (OSU) High Temperature Test Facility (HTTF) is an integral experimental facility that will be constructed on the OSU campus in Corvallis, Oregon. The HTTF project
was initiated, by the U.S. Nuclear Regulatory Commission (NRC), on September 5, 2008 as Task 4 of the
5-year High Temperature Gas Reactor Cooperative Agreement via NRC Contract 04-08-138. Until
August, 2010, when a DOE contract was initiated to fund additional capabilities for the HTTF project, all
of the funding support for the HTTF was provided by the NRC via a cooperative agreement. The U.S. Department of Energy (DOE) began its involvement with the HTTF project in late 2009 via

the Next Generation Nuclear Plant (NGNP) project. Because the NRC?s interests in HTTF experiments
were only centered on the depressurized conduction cooldown (DCC) scenario, NGNP involvement
focused on expanding the experimental envelope of the HTTF to include steady-state operations and also
the pressurized conduction cooldown (PCC).
Since DOE has incorporated the HTTF as an ingredient in the NGNP thermal-fluids validation program, several important outcomes should be noted:

1. The reference prismatic reactor design that serves as the basis for scaling the HTTF, became the
modular high temperature gas-cooled reactor (MHTGR). The MHTGR has also been chosen as the
reference design for all of the other NGNP thermal-fluid experiments.

2. The NGNP validation matrix is being planned using the same scaling strategy that has been implemented to design the HTTF, i.e., the hierarchical two-tiered scaling methodology developed by
Zuber in 1991. Using this approach, a preliminary validation matrix has been designed that integrates
the HTTF experiments with the other experiments planned for the NGNP thermal-fluids verification
and validation project.

3. Initial analyses showed that the inherent power capability of the OSU infrastructure, which only
allowed a total operational facility power capability of 0.6 MW, is inadequate to permit steady-state
operation at reasonable conditions.

4. To enable the HTTF to operate at more representative steady-state conditions, DOE recently allocated
funding via a DOE subcontract to HTTF to permit an OSU infrastructure upgrade such that 2.2 MW
will become available for HTTF experiments.

5. Analyses have been performed to study the relationship between HTTF and MHTGR via the hierarchical two-tiered scaling methodology which has been used successfully in the past, e.g., APEX
facility scaling to the Westinghouse AP600 plant. These analyses have focused on the relationship
between key variables that will be measured in the HTTF to the counterpart variables in the MHTGR
with a focus on natural circulation, using nitrogen as a working fluid, and core heat transfer.

6. Both RELAP5-3D and computational fluid dynamics (CD-Adapco?s STAR-CCM+) numerical models of the MHTGR and the HTTF have been constructed and analyses are underway to study the
relationship between the reference reactor and the HTTF.

The HTTF is presently being designed. It has 1/4-scaling relationship to the MHTGR in both the
height and the diameter. Decisions have been made to design the reactor cavity cooling system (RCCS)
simulation as a boundary condition for the HTTF to ensure that (a) the boundary condition is well
defined; and (b) the boundary condition can be modified easily to achieve the desired heat transfer sink
for HTTF experimental operations.

Next Generation Nuclear Plant (NGNP) project sept 2010.pdf[1]

Author Name:
Richard R. Schultz
Paul D. Bayless
Richard W. Johnson
Glenn E. McCreery
William Taitano
James R. Wolf

Products:

Industries:

Links:
[1] http://www.cd-adapco.com/sites/default/files/technical_document/pdf/Next%20Generation%20Nuclear%20Plant%20%28NGNP%2