Horizontal-Jets Impinging the Vertical Wall of a Containment Compartment

Domenico Paladino, Robert Zboray and Pascal Benz
Thermal-Hydraulics Laboratory
Nuclear Energy and Safety Department
Paul Scherrer Institut
5232 Villigen PSI, Switzerland
Tel: +41-56-3104152; Fax: +41-56-3104481
E-mail: domenico.paladino@psi.ch

Abstract –*One of the main objectives of the OECD SETH project is to create an experimental database suitable for assessing 3D code capabilities by analyzing the key physical phenomena relevant for LWR safety analysis. The phenomena governing the containment response in case of some postulated severe accident scenarios include gas (air, hydrogen, steam) mixing and stratification in the containment, gas distribution between containment compartments, wall condensation, etc. These phenomena are driven by buoyant high momentum injection (jets) and/or low momentum injection (plumes). For instance, mixing in the immediate vicinity of the postulated line break is mainly dominated by very high velocity efflux, while low-momentum flows are responsible for most of the transport processes within the containment. The PANDA facility (located at PSI in Switzerland) has been used in the frame of the SETH project for performing three series of experiments named: Wall Plumes, Free Plumes and Horizontal Jets tests. In addition to these series, one specific free plume test with steam, air and helium has been performed. In PANDA facility the containment is represented by two large volume vessels (Vessel 1 and Vessel 2) interconnected by a large diameter pipe (IP). The facility allows for conducting these tests in a scale approaching the dimensions of actual containment compartments. The PANDA instrumentation permits measurements of fluid and wall temperatures, absolute and differential pressures, flow rates, heater power, gas concentration and velocity fields. The measurement grid in Vessel 1, Vessel 2 and IP has been significantly refined considering the spatial resolution required in order to obtain experimental data suitable for validation of codes with 3-D capabilities.*

The paper summarizes the main results of the Horizontal Jets series consisting of eight tests. Horizontal jets impinging on a vertical wall (in PANDA Vessel 1) have been generated by changing various parameters such as: type of injected fluid (steam or a mixture of steam and helium), fluid injection velocity, elevation of the injection exit (2 m or 4 m above the Vessel bottom), initial fluid composition in the vessels (air, steam or a mixture of air and steam) and location of the vent line inlet (top of Vessel 2 or bottom of Vessel 1). The initial Froude number has been varied between 17 and 35. The paper shows the effect of this parameter variation during the test evolution with respect to: jet impinging location and variation of impinging location as a function of buoyancy variation, fluid mixing and stratification, characteristics of gas transport between the compartments (asymmetry due to 3D characteristics of the facility) and effect of condensation on the overall phenomena evolution.