Ninth International Conference on CFD in the Minerals and Process Industries
CSIRO, Melbourne, Australia
10-12 December 2012

LARGE-SCALE SIMULATION OF BUBBLE PLUMES AND SUBSEA HYDROCARBON BLOWOUT JETS

Djamel LAKEHAL*
ASCOMP Switzerland & ASCOMP Inc. USA
*Corresponding author, E-mail address: lakehal@ascomp.ch

ABSTRACT

The goal of the simulation work to be presented is to improve the understanding of the flows occurring in risers and associated equipment with particular reference to deep sea oil production systems and possible incidents such as the Macondo event. This includes possible subsea pure gas leaks as well. More specifically, our objectives are to improve the realism and accuracy of predictions of the behavior of subsea multiphase flows through advanced simulation of the complex phenomena associated with hydrocarbon spills. This includes multiphase flow jet evolution, hydrate formation and dissolution, thermodynamics of hydrocarbon mixtures during fast pressure and temperature changes, and transient interaction of plume constituents with the surrounding sea currents.

We will show in this contribution the state of the art reached by the ASCOMP group using their CMFD code TransAT to predict subsea multiphase flows. TransAT is specifically dedicated to N-Phase flow systems featuring complex fluid physics, including hydrate kinetics, formation and dissolution, deep-sea thermodynamics, and very complex rheology, capable to predict wall adhesion and melting of the hydrates and pipe plugging. The model has proven robust in predicting a 3D unsteady multiphase plume (Fig. 1) in the aftermath of a hypothetical 1000m depth blowout. The five phases within the plume included water, gas, light oil components, heavy oil components and hydrates. The model has been used to predict hydrate induced plugging in prototypical canopies used today to collect spilled oil in the aftermath of a blow out. We will discuss selected results and comment on both difficulties and success of the model.

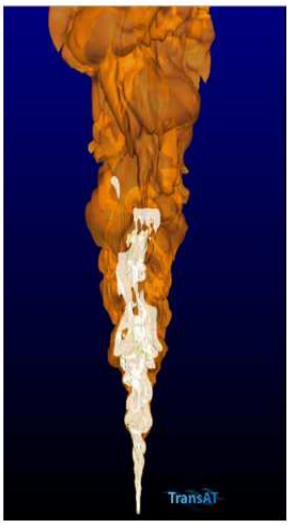

Figure 1: Beginning of gas injection (gas colour is brown; white represents hydrates).