BEN-GURION UNIVERSITY OF THE NEGEV
P.O.B 653, BEER-SHEVA 84105, ISRAEL

אוניברסיטת בן-גוריון בנגב
ת.ד. 653, באר-שבע 84105

DEPARTMENT OF MECHANICAL ENGINEERING

SEMINAR

To be held on Thursday, September 14, 2017, at 11:00
in the Seminar Room (#117) of the Mechanical Engineering Building (#55)
at the Campus of the Ben-Gurion University of the Negev

Mixing Effects in Fluid Flows with Buoyancy and Stratification

Liel Ishay
Department of Mechanical Engineering
Ben-Gurion University of the Negev, Be'er-Sheva, Israel

The seminar is based on PhD thesis supervised by

Prof. Gennady Ziskind
Dr. Alex Rashkovan

Abstract:

In case of a severe accident in the cooling circuit of a nuclear power plant, the liquid water coolant is boiling and a chemical reaction between the steam and the cladding of the fuel leads to production of hydrogen. A mixture of hydrogen and steam may escape into the containment filled with air. Stable stratification of hydrogen and air is expected at the upper part of the containment, due to the different densities of these fluids. Once a stable layer of hydrogen is formed, a free vertical jet would pass through the air layer and impinge at the bottom of the hydrogen layer. Knowledge of hydrogen distribution in the containment is needed in order to prevent hydrogen combustion and potential explosion. Prediction of hydrogen concentration by accurate and reliable numerical modeling is a complex and multi-phenomena problem that constitutes a challenge to the international professional community, and many efforts have been made to achieve this goal, including building of special experimental facilities. This research deals with modeling of three comprehensive experiments that were conducted in two of those large-scale facilities. In these experiments, an air jet eroded a stable stratification layer of helium, used instead of hydrogen for safety reasons, placed at the upper-most part of the containment, and led to helium mixing. In order to reach an accurate and reliable modeling of the experiments, the separate effect study approach is used. Namely, modeling results are compared with well-known jet experiments from the literature and with analytical solutions. Thus, the study includes modeling of a pipe and contraction nozzle turbulent jets, positively and negatively buoyant jets, jet impingement, and some additional phenomena. The study shows that an accurate prediction of a round jet directly affects the helium concentrations. It is also shown that URANS-based turbulence models, e.g., k-ε, k-ω SST, and others, over-predict velocity decay rate when compared with the experimental results, and modification in one of the turbulence model constants is needed. Consistent advantageous results of such modifications are demonstrated and discussed.

me@bgu.ac.il
טלפון: 08 6477043 • פקס: 08 6472813