

MASTER'S THESIS WORK

High fidelity mixing simulations: Method development using Large Eddy Simulation

BACKGROUND

FS Dynamics is an independent consultant engineering company group specialized in advanced simulations and analysis of fluid- and structural dynamics. The company employs more than 170 consultants in Sweden, Finland and Portugal.

Mixing of fluid flows is an important phenomenon in a vast amount of engineering applications. FS Dynamics provides various CFD solutions to many different industry clients that need to predict the mixing performance for their specific application. As in many industries, our clients are increasingly looking to integrate simulations and models to improve their products or to pass requirements forced by legislations.

In most engineering applications the accuracy of predicting the mixing performance depends strongly on the turbulence modelling. Traditionally, turbulence is modelled based on the Reynolds Average Navier Stokes (RANS) approach. RANS models often fails to predict correct mixing characteristics. A potentially more accurate alternative is to use Large Eddy Simulation (LES).

THESIS OBJECTIVES

The thesis aims at developing existing CFD methods for mixing simulations of the accidental release of combustible gases in turbine enclosures. The work will be based on the existing methodology used by FS Dynamics to perform gas leakage simulations today.

The objective of the thesis is two-fold:

1. The flow near the leakages is highly compressible, and in current RANS mixing simulations the leakages are not resolved. Instead, a simplified theoretical model is used to prescribe a boundary condition for the flow velocity at a certain distance from the leakage where the flow returns to a subsonic state. The first task is to validate and develop the method used to estimate the boundary condition for the leakages. Compressible CFD simulations using sub-models for the leakages, as well as theoretical approaches, will be used in this task.
2. The second task is to simulate the mixing and dispersion of the combustible gas cloud in the turbine enclosure. Results based on RANS turbulence modelling will be compared to LES simulations. The geometry will be based on an existing enclosure provided by one of our clients in the offshore industry. The risk for explosion is evaluated towards legislative requirements, and the primary goal is to develop the accuracy of the predicted size and distribution of the combustible gas clouds.

FS Dynamics is a simulation focused and independent consultancy company. We recruit with diversity and equality in mind and our professional consultants provide highly skilled competence within fluid- and structural dynamics analyses.

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