

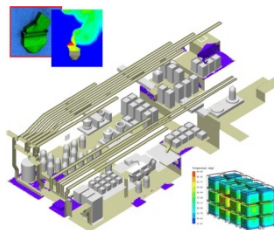
Introduction

MMI Engineering provides specialist analysis expertise for the design of Nuclear facilities, equipment, processes and systems. We use computational modelling methods to substantiate designs, improve understanding and optimise performance. Our Nuclear Services include:

- Nuclear Ventilation Systems
- Thermal Analysis
- Process Engineering Design
- Seismic and Impact Assessment
- Structural Integrity
- Geotechnical Analysis
- Conventional & Nuclear Process Safety
- Internal & External Hazards
- INSA / ITA

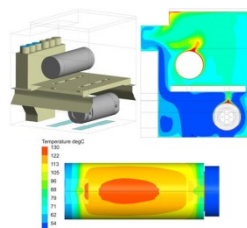
Nuclear Ventilation for Hydrogen Management

MMI has undertaken extensive analysis work to support the design of a new intermediate-level waste encapsulation plant. This project is ongoing and has required the development of detailed CFD models of the building with sub models of process equipment to examine localised releases of hydrogen, heat and water vapour, and to assess the design of various inerting systems for hydrogen hazard management. Additional sub models have been developed to calculate the conjugate heat transfer (combined convection and conduction) of the curing encapsulated product. A detailed ventilation network model was built using Flowmaster, coupled to MATLAB models of the plant ventilation stack - including flow induced due to thermal and buoyancy effects, to determine acceptable ventilation in the event of equipment failures.



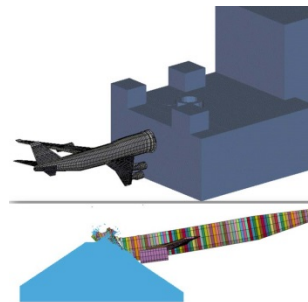
Thermal Analysis in Support of Transport Package

MMI has used CFD to calculate the temperature of a flask transporting Highly Active Waste (HAW) in a ship cargo hold. A full Conjugate Heat Transfer model of the ship ventilation hold was built using ANSYS CFX. This incorporated one complete flask so that heat transfer was calculated from the canisters inside the package, through the solid walls of the flask, and then by convection and radiation to the surrounding air. This allowed the distribution of heat flux to be calculated precisely around the outside of the flask. The calculations demonstrated that key regions of the flask were maintained below their critical temperatures during transport. From the results, a critical hold temperature was defined below which the average hold temperature should be maintained during transport. These calculations were used to support the transport safety case.



Impact Analysis: Protecting Against Aircraft

MMI personnel have extensive experience in the analysis of structures subject to impactive and blast loading, gained in projects for nuclear power, petrochemical and aero-astro applications. Analyses are typically carried out using either LS-DYNA or ABAQUS/Explicit finite element software and their explicit dynamics time integration algorithms. In the aftermath of the 9/11 attacks on the World Trade Center, MMI has performed numerous analyses of both existing and planned nuclear power plant buildings subject to aircraft impact. The figure opposite illustrates an impact of a Boeing 747 to a VVER type nuclear plant. To investigate the protection of a nuclear facility against aircraft attack with an earth berm, MMI performed analyses with LS-DYNA with the berm soil material represented with the smooth particle hydrodynamics approach.



Process Engineering Design Assessment

MMI personnel have substantial experience of modelling the settling behaviour of sludges for the wastewater treatment industry, and have applied this experience to assess and optimise the designs of settling tanks for a range of radioactive waste sludges. The sludges in question are mixtures of inorganic components resulting from the corrosion of metal waste materials and additional organic matter that has accumulated in legacy storage ponds. In a recent application, a number of settling corral geometry modifications were compared using ANSYS CFX. Sludge settlement models were developed based on a Drift Flux framework for multiphase flow. The model results showed that the best retention efficiency was achieved using a modified stilling well, designed by MMI, to separate the corral into distinct flocculating and settling zones.

