Case study

Argon fire suppression system: Safety case

THE CHALLENGE

Although our client had a thorough safety case for the storage of Magnox Fuel Element Debris in the Waste Vaults of Berkeley Power Station, this policy did not cover the retrieval of the waste from the vaults. A major concern was the fire suppression system, as much of the waste consists of a mixture of graphite and magnesium - both of which are flammable.

In the event of a fire, this system injects Argon into the vault, thereby starving it of oxygen. Under storage conditions, the vault covers are closed and the argon is used to displace the air in the vault due to its greater density. However, under retrieval conditions the vault covers could be open, and the thermal plume from a fire could carry some of the Argon out of the vault and into the retrieval tunnel, allowing additional air to enter the vault and feed the fire.

Frazer-Nash were commissioned to assess the effectiveness of the Argon fire suppression system to take this into account as part of the client's safety case.

OUR SOLUTION

Frazer-Nash used Computational Fluid Dynamics (CFD) to construct a realistic model of the waste vaults, and calculate the dispersion of Argon during a fire scenario (*Figure 1*). Accurately simulating this fire scenario was particularly challenging as it involved modelling the time-varying convection currents within the vault and retrieval tunnel due to the heat transfer from the fire.

A unique approach was developed to vary the size and strength of the fire during the simulation in order to improve the accuracy of the predictions. This increased the fire strength over time based on Magnox fire growth data, but also included the effect of fire suppression by reducing the fire strength depending on the Argon concentration in the vicinity of the fire.

BENEFITS

Our analysis concluded that to complete their safety case, our client needed to make modifications to their current fire suppression system in order to take into account the retrieval process.

We were also able to define which parts of the system design and procedure were most important to successfully extinguish the fire. This enabled the effectiveness of the fire suppression system to be improved with minimal changes to the design.

Client

Magnox South Sites

Business need

Ensure that a fire suppression system performed as it was designed, as part of a nuclear safety case.

Why Frazer-Nash?

Our expertise in the nuclear sector includes a strong emphasis on computer modelling for thermal and fluid analysis.

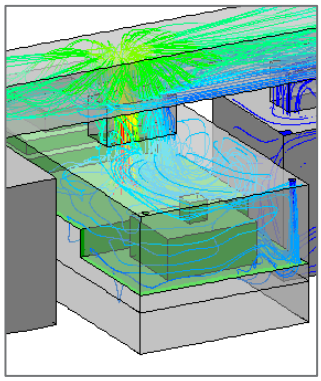

Figure 1: Streamlines from Argon injection

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