INTRODUCTION: For facilities containing radioactive materials, DOE Standard states at least structure’s fire resistance for a two hours fire exposure. The aim of this study was to design a Fiber Reinforced Concrete (FRC) overpack that assure thermal insulation and structural integrity of the containment, limiting the release in environment in case of fire event. A standard curve (UNI EN 1363-1:2012) was used to describe the 2-hours fire event and a numerical simulation has been carried out. A thermo-elastic analysis was performed using the thermal field computed in the previous study as input, to evaluate the stress field induced in the concrete. Two prototypes were tested in a certified laboratory to confirm thermal numerical results.

RESULTS: Figures below show the comparison between numerical results and experimental data. Figures 6 and 7 show the variation of temperatures on the cutline at z=850mm (left side). Figures 6 (Case A) and 7 (Case B) show the difference between the average of numerical results and experimental data at 120 minutes (right side). The differences are less than 10%. In Figure 8, the streamlines colored by the velocity magnitude are shown. The maximum calculated velocity is 0.45m/s in cavity 1. Both the cases satisfy the requirements. In Figure 9, thermal stresses and displacement field are shown for t=120min. Tensile stresses are distributed on the inner surface walls and reach maximum values near to the bottom. Steel reinforcement bars have been designed taking into account the distribution of thermal stresses and steel temperature.

CONCLUSIONS: The comparison between numerical results and experimental data shows a good match and confirms the capability of COMSOL Multiphysics® as a multiphysics simulation tool. The development of this work enabled us to optimize the design of fire resistant overpack.