

SAND2019-0129 O

New Predictive Capabilities for Nuclear Weapons in Composite Fires.

Brief: SNL is developing predictive methods for assessing stockpile hazards for a new class of abnormal thermal environments – composite material fires.

The prevalence of flammable carbon-based composite airframe materials and their use in high-temperature nuclear weapon re-entry systems requires analysts to address the abnormal thermal environment hazards associated with composite material fires. These fires tend to burn very differently than conventional fuel fires, usually burning less intensely, but much longer. This could lead to challenges in understanding margins in classic safety themes. The technical challenges in modeling the phenomena associated with these new types of fires are considerable, but new models have been developed. Their predictions have been compared with well-documented measurements of a vertical porous burner fire, known as a “wall fire” (a “wall-fire” validation simulation is reflected in the figures below). These measurements were conducted at FMGlobal, a mutual insurance company with a strong fire risk management program, as part of an ongoing collaboration between Sandia and FMGlobal. To date, the “wall-fire” scenario has been set up and initial model assessments with grid refinement studies have been conducted focusing on mesh resolutions suitable for full weapon system simulations. This work will continue with further verification and validation tasks assessing the predictions of the new model. Future work will address specific aspects of the wall models that are lacking in their predictive ability. (POC: John Hewson, jchewso@sandia.gov).

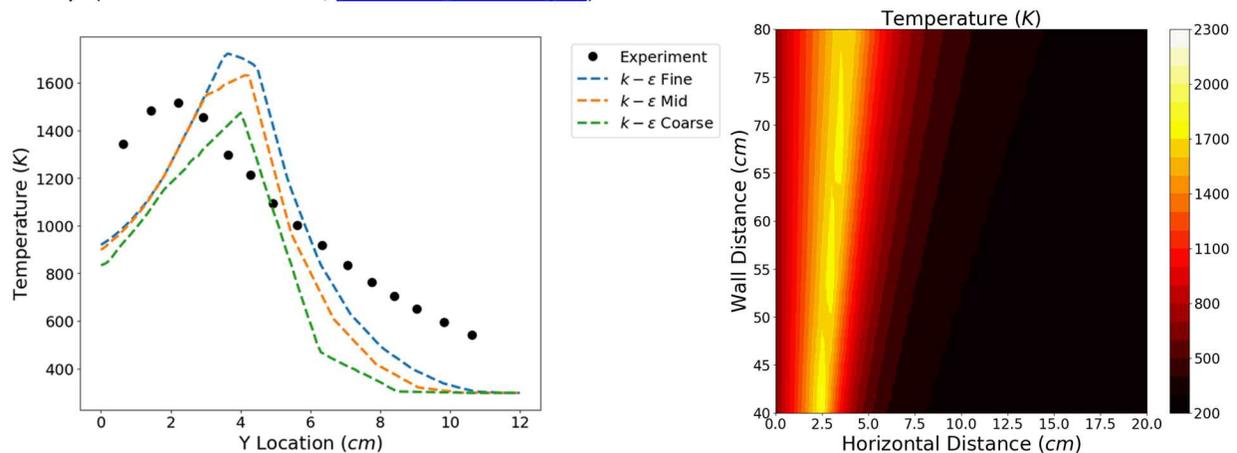


Figure: Results from a “wall-fire” validation simulation. Simulations to date using Reynolds-averaged Navier-Stokes show the resolution sensitivity and prediction challenges with the first generation of models. Ongoing work is assessing predictions of a new set of fire models, and subsequent work will address improved predictions.

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