C56 Fire Dynamics Simulation for Courtroom Presentation

Darren Franck, BS, PE, and Harold Franck, MSEE, PE*, Advanced Engineering Associates, Inc., 4713 MacCorkle Avenue, South East, Charleston, WV 25304*

The objective of this presentation is to introduce attendees to available software and methodologies for simulating fire spread and development.

This presentation will impact the forensic community and/or humanity by presenting the availability of the latest techniques in fire dynamics simu- lation.

This case involves the use of the Fire Dynamics Simulator developed by the National Institute of Standards and Technology (NIST). The Fire Dynamics Simulator consists of a computational fluid dynamics model of fire driven fluid flow. The software developed by NIST involves the numer- ical solution of a form of the Navier-Stokes equations appropriate for low speed thermally driven flow. The emphasis of the program is on the smoke and heat transport produced by fires. A separate program called Smokeview enables the results of the simulation to be visualized. Smokeview is a soft- ware tool designed to visualize numerical predictions generated by the NIST Fire Dynamics Simulator. The visualization includes the movement of smoke and flames throughout the structure as well as temperature changes and air flow.

The authors will present a case study where multiple fire simulations were used to dispute claims regarding a large residential structure fire. In this case, the time frame regarding the development of the fire was in question. Multiple fire simulations with varying sources, heat release rates, and venti- lation patterns were developed to investigate the alleged time frame.

The fire development was documented by a passerby beginning approximately one half hour after the homeowner left the home and contin- uing for the next thirty minutes. The first photograph taken by the passerby displayed the house when it was totally involved at the half hour. At this time all the rooms of the two story structure were beyond flash-over and completely engulfed in flames. Roughly 45 minutes after the home owner's departure, the structure began to collapse. After the fire, the homeowner submitted a detailed list of the contents of every room with photographs so that the fuel load could be accurately determined. Additionally, the home-owner provided accurate plans and measurements of the home so that the structure could be accurately modeled.

Based on the information provided by the homeowner, four separate simulations were developed. Three of these simulations involved starting accidental fires at different locations and levels of the home. The fires were typified by high heat release rates, adequate ventilation, and the greatest pos- sible fuel load according to the evidence presented by the home owner. The simulations of the accidental fires revealed that within a one hour time frame, the fires would not develop as depicted in the photographic evidence. However, a simulation involving the use of accelerants throughout the home produced nearly identical results as depicted in the photographs and in conformity of the time frame of the photographs.

Fire dynamics simulations are powerful investigative tools. Coupled with physical evidence, the simulations can be used to show the progression of fires and can aid juries in the assessment of whether fires are accidental or incendiary or whether the fires originated in particular locations of a structure.

Fire Dynamics, Simulation, Heat Transport

 ** Presenting Author*