

FIRE MODELING?

By Richard Schulte

Computer fire models have been utilized in the fire protection profession since the early 1980's. Perhaps one of the unique features of computer fire models is the ability of the fire models to generate data, regardless of whether or not the data is accurate or not. To put it simply, the capability of the models to generate reliable and accurate data depends, not only upon the knowledge and skill of the modeler, but also the modeler's integrity.

The issue of the integrity of a "renowned" fire scientist in the litigation known as *lan David McAuslin, et al v. Grinnell Corporation, et al* and in research on the concept of the "ganged" operation of roof vents in buildings protected by a sprinkler system has been the subject of a number of articles on this website. Given my experience with the use of fire modeling by a highly respected "expert" in fire modeling over the past 10 years, my opinion of fire modeling has been jaundiced, but I'm not the only one in the field who questions the use of fire modeling.

It should be obvious by now that the Fire Dynamics Simulator (FDS) is a "black box" to most in the fire protection profession. Given this, the data generated by the FDS is subject to being manipulated by unscrupulous users simply by fooling around with the input, but the integrity issue is not the only "pitfall" with the use of the FDS.

An article titled "*Computer models and the limitations in safety design*" authored by Dr. Alan Beard dated January 1, 2009 is posted on the [Industrial Fire Journal](#) website and includes the following excerpts:

Perhaps one of the unique features of computer fire models is the ability of the fire models to generate data, regardless of whether or not the data is accurate or not. To put it simply, the capability of the models to generate reliable and accurate data depends, not only upon the knowledge and skill of the modeler, but also the modeler's integrity.

It should be obvious to most by now that the Fire Dynamics Simulator (FDS) is a "black box" to most in the fire protection profession.

“ . . . The point was that it is generally not difficult to run a computer-based model and get results, given the availability of packages today. However the implication was that it is very difficult to employ a model so that it makes a genuinely valuable contribution to real-world decision-making, rather than leading to inaccuracy and inappropriate interpretation.”

*“A similar point may be made about deterministic models; different users may produce very different results when applying the same model to the same case. (See April 2008 **Industrial Fire Journal** [2], where a “Round Robin” exercise was described.) In a different exercise in which different users applied different deterministic models to the same case then, again, very different results were found [3]. Further, reference [4] shows significant differences found by the same user in applying two different CFD-based models to the same case. This shows the kinds of problems which exist in using models as part of fire safety decision-making. Inter alia, the knowledge and experience of the user become crucial.”*

“. . . it is very difficult to employ a model so that it makes a genuinely valuable contribution to real-world decision-making, rather than leading to inaccuracy and inappropriate interpretation.”

“The conceptual and numerical assumptions in a model are only an approximation to the real world.”

“Systems of equations need to be solved numerically rather than analytically, except in the case of a simple model with relatively simple equations. (“Analytical” refers to a theoretical, general, solution being found to a problem, without using a computer, leading to exact results.) Different numerical solution techniques may produce different results. An example is provided by the grids used in CFD-based models to form the cells. Results usually depend upon the resolution of the grid. The differences between the results of using a coarse grid and those for a fine grid may be significant. Further, results from a CFD-based model will in general depend on the boundary conditions assumed as well as the time step, in addition to other factors.”

“The conceptual and numerical assumptions in a model are only an approximation to the real world.”

“One estimate suggests there may be around eight errors per thousand lines of computer source code and, even for safety-critical applications, there could be around four errors per thousand lines of code.”

“Procedures need to be produced in order to try to reduce the likelihood of software errors existing in models which may be used as part of fire safety decision-making.”

“It is usually assumed that hardware is very reliable and the possibility of a computer making a mistake because of its hardware has been generally ignored, at least by those who are not in the field of computer science. . . A specific case is seen in the fault in the Pentium processor which came to be realised during 1994. In this case the manufacturer “made no public announcement when it first detected the error”, see [5]. It was effectively left up to users to find the fault, by chance, and attempt to contact other users.”

“This is a crucial point; model documentation must state clearly and explicitly the conditions for which the software is suitable or unsuitable.”

“. . . although there is a humorous saying: “nobody believes a theory except the theoretician; everybody believes an experiment, except the experimenter”.

“It is necessary to assume a questioning attitude to experimental results as well as to theoretical predictions.”

“For example, ambient humidities may vary from day to day or month to month leading to different temperatures for ostensibly identical experiments.”

“One estimate suggests there may be around eight errors per thousand lines of computer source code and, even for safety-critical applications, there could be around four errors per thousand lines of code.”

“. . . nobody believes a theory except the theoretician; everybody believes an experiment, except the experimenter”

“For example, ambient humidities may vary from day to day or month to month leading to different temperatures for ostensibly identical experiments.”

“It shows that there is a need for experimental tests to be repeated in as identical conditions as possible (ie tests should be replicated) and for distributions of experimental results to be produced, for each given case. This raises problems: replication of experimental tests is expensive and there is a lack of willingness to carry out replication because of this. It is essential that it be done. . .”

“In comparing theoretical predictions with experimental results there are three generic types of comparisons: a priori, blind and open; . . . There is a need for far more a priori comparisons.”

“In comparing theoretical predictions with experimental results there are three generic types of comparisons: a priori, blind and open; see [2, and 5]. There is a need for far more a priori comparisons.”

Discussion

There is not really much to add to Dr. Beard’s comments. Beard’s comments speak for themselves. My response to the Dr Beard’s article was: “I’m speechless.”

Thank you Dr. Beard for having the courage to write this article and the article on fire modeling which appeared in the April 2008 issue of [Industrial Fire Journal](#).

Conclusion

In July 2009, this writer proposed that a moratorium on the use of the Fire Dynamics Simulator be considered on the FDS/Smokeview Bulletin Board. Of course, there were lots of “hooting and hollering”, as well as insults and snide comments, directed my way.

I’m sure the “fire scientists” will “circle the wagons” once again and ignore Dr. Beard’s comments.

I’m sure the “fire scientists” will “circle the wagons” once again and ignore Dr. Beard’s comments. There is no way that the “fire scientist elites” will ever consider a moratorium on the use of the FDS, so perhaps the best approach would be a moratorium on the approval of the use of the FDS by code enforcement authorities and a moratorium on the use of the FDS in testimony in court until the “fire scientists” clean up their act.

One of the first steps in cleaning up is getting rid of those who have “tainted” the use of the FDS by improperly using the model. The “elite fire scientist” who claimed to be an expert in the *Ian David McAuslin, et al v. Grinnell Corporation, et al* litigation and the “elite fire scientist” who used the FDS in the research on the “ganged” operation of roof vents in buildings protected by a sprinkler system ought to be the first one thrown out of the profession.

The fire protection profession owes a deep debt of gratitude to Dr. Beard for stepping up and questioning the use of fire modeling. Just a word of caution, there’s going to be a lot of “mud” thrown Dr. Beard’s way, but I’m sure that Dr. Beard knew that when he wrote his first article on the subject.

The “elite fire scientist” who claimed to be an expert in the *Ian David McAuslin, et al v. Grinnell Corporation, et al* litigation and the “elite fire scientist” who used the FDS in the research on the “ganged” operation of roof vents in buildings protected by a sprinkler system ought to be the first one thrown out of the profession.

The editors of **Industrial Fire Journal** also deserve a “hat tip” for publishing Beard’s articles. Good show.

Editor’s Note: The internet addresses of two articles written by Dr. Beard are as follows:

http://www.hemmingfire.com/news/fullstory.php/aid/460/Computer_models_and_the_limitations_in_safety_design.html

http://www.hemmingfire.com/news/fullstory.php/aid/131/Reliability_of_computer_models_in_fire_safety_design.html

* * * * *

Copyright © 2010
Richard C. Schulte