Blind versus Open Fire Model Validation: Issues, Pros & Cons

Dr. Monideep Dey

Deytec, Inc.

Nuclear Engineering Services

Presented at the ISO TC 92 SC-4, WG 7 Meeting, Ottawa, Canada, October 18, 2011

Background

- Blind versus open fire model validation issue discussed in various forums
  - IAFSS forum
  - 2 projects examined issues:
    - Dalmarnock round robin
    - International Collaborative Fire Model Project (ICFMP)
  - Papers published, e.g., U of Edinburgh (Rein), Beard, Dey

Previous Presentations to WG 7

- ICFMP project & lessons learned presented previously:
  - Lancaster, Pennsylvania – Oct. 2009
  - Paris, France – April 2011
- ICFMP documents provided:
  - Technical findings - 2009
  - Lessons learned - 2010

Definition

- Open (a posteriori) validation: Experimental results (which fire model outputs are compared to) are available to analysts before model calculations made

- Blind (a priori) validation: Experimental results are not available to analysts until after model calculations made

Objective

- To present <u>all</u> views expressed on topic in terms of the pros & cons

- Examine the issues raised to allow discussion by WG 7

- Conclude & recommend a course of action for ISO TC 92 SC4/WG7

Comments on Topic

- Discussion in IAFSS forum
  - August 2008 (initiated my participation)
  - August 2009
  - July 2011 (extensive discussion)
- University of Edinburgh – Blog on Dalmarnock test and round robin results
- Papers: Rein, Beard, Dey, McGrattan
- Comments included in paper

Pros for Blind Validation

- Eliminate natural bias that can occur in open calculations – presently unknown
- Provide high degree of confidence in the predictive capability and model errors
- Establish confidence in setting safety factors in fire safety designs
- Establish robust & conservative methodology

Pros for Blind Validation

- Establish honesty & integrity in validation process

- "Real world" fire engineering applications are blind simulations

- Reveals areas where fire models are "primitive" & not "credible"

- Prevent misuse of models

Cons of Blind Validation

- Newer versions of model make blind validations obsolete
- Obsolete validations are of little value to regulatory authorities
- Cannot separate user effects & input data uncertainty from model error in blind validations
- Fires are too complex for blind simulations

Cons – Cont'd

- Fire experiments cannot be replicated
- Tests are seldom conducted as planned
- Large experimental uncertainties
- Initial conditions, grid size (CFD), other code options subject to variation
- Does not allow for sensitivity analysis

Cons – Cont'd

- ASTM-1355 standard exists
- Blind validations can scare public
- 30 years of experimental results should not be thrown away for blind validations
- Requires consensus on:
  - Measurement methods
  - Input parameters to fire models
  - Formal auditable procedure

Skepticism in Model Results

- Fire model predictions are not reliable & should not be used

- Deletions of useful fire protection features being justified by computer models

- Practitioners blindly use model results as the truth (reification)

- If fire science at infancy, why trust results

Skepticism – Cont'd

- Many sources of uncertainty
    - Model error
    - User effects
    - Sensitivity to unknown parameters
- Practitioners and inspectors exhibit skepticism given the sources of error

Recommendations for Fire Model V&V Standard

- Establish procedure for conducting & ensuring that *blind* calculations are used to establish predictive model errors & safety margins

- Examine and include "third party validation" as an option for establishing true model errors

Recommendations – Cont'd

- Globally harmonize definitions for verification and validation
- Globally harmonize methods for V&V
- Establish consensus on measurement methods for parameters needed as input to fire models
- Develop consensus on values for parameters input to fire models

Recommendations – Cont'd

- Examine approach adopted in medical industry (Food & Drug Administration)
- Non-developer validation
- Use phased approach as fire science matures with open and blind validations

Recommendation -
Balanced & Phased Approach

- Blind validations useful as well as open exercises
- Important to present all information to practitioners
  - Model errors
  - Sensitivity analysis
  - Implementation of code options
- Develop policy given technical limitations

Balanced & Phased Approach – Cont'd

- Revise standard as experience with blind validations is gained
- Policy accounting for technical limitations can change as fire science matures