SFPE Standards-Making Committee on Calculating Fire Exposures

Meeting Report -- March 22, 2016 (US Eastern Time)

Present: Craig Beyler (Chair), Farid Alfawakhiri, Hosam Ali, Jonathan Barnett, Charles Fleischmann, Jeff Halpert, Sean Hunt, Barbara Lane, Panos Kotsovinos, Kevin LaMalva, Bernie Till, Jason Smart, Jonathan Weigand, Ulf Wickström and Chris Jelenewicz (staff).

Apologies: Vyto Babrauskas and Jose Torero

The following was discussed:

- **Committee Scope –** The committee will revise the existing SFPE Standard on Calculating Fire Exposures to Structures (SFPE S.01 2011). The committee will ensure the document is current and up-to-speed with other structural fire protection documents (NFPA 557, SFPE S.02 2015, and ASCE/SEI 7).

- **Review of Methodology in Existing Document –** The purpose of the existing document was to provide methodologies that predict thermal boundary conditions for fully developed fires to a structure. The standard focused on calculation methods for two types of exposures – compartment fire or local fire exposure. The compartment fire methodology was selected after assessing the performance of 24 methods by comparing them to test data from a database. The selection of the local exposure methodology was less formalized.

- **Rational for Revision --** Committee members were asked to give a brief introduction and discuss what they think should be included in the revised standard. The following are some of the recommendations:

    o It was noted that the existing document uses a deterministic approach, and as such, yields results that may be too conservative for "real-world" applications. As a result, practitioners may be reluctant to implement this methodology. It was suggested that a probabilistic approach would yield realistic results that would more likely be used by practitioners. However, determining how to develop a risk approach may be difficult.

    o AISI is interested in performance-based options so a risk approach makes sense. The committee should also consider the methodologies used in the Eurocodes, but these methods will need to be checked.

    o Wood assemblies should be considered; however, the standard should be applied uniformly for all types of materials.

    o The standard should be user friendly and provide a clear direction for the enforcement community.

- o The design community is tired of using make-believe fires in structural design.

- o SFPE Standards 1 & 2 will be referenced in the appendix of ASCE/SEI 7 that will be issued in Fall 2016. To be referenced in the main-body of the ASCE document, the SFPE standard would be required to be an ANSI accredited standard. It was noted that the SFPE Subcommittee on Standards Oversite was asked by the SFPE Board to explore the idea of SFPE becoming an ANSI Accredited Standards Developer and appointed a task group to make a recommendation (Steve Wolin, Casey Grant, Ken Isman and Paul Hart). If the committee believes this is an important issue, it should contact Steve Wolin.

- o The new document should consider traveling fires and include the work conducted by ARUP and Guillermo Rein.

- o NIST has a new structural lab. They may have data that would be appropriate for this project.

- o The local fire exposure methodology should include external exposure fires (i.e. vehicles, WUI, and combustibles adjacent to structure).

- o Ulf Wickström recently published a new book. He shared a section of this book on temperature calculations with the committee. The information in this book can be used by the committee.

- **Path Forward –** Moving forward, the committee discussed the following issues and answered the following questions:

  - o **Should the original database of fire experiments be updated?** In the existing document, the database used for validation of the room enclosure methodology was from 2010. This data needs to be updated to include new data and data missed in the original database.

    It was noted that the existing analysis focused on modeling exposures to bare steel, insulated-steel and concreate-protected-steel. Small differences were observed between the three materials. The experiments did not look at wood. It was recommended that wood should be examined; however, there were concerns if data is available for wood.

    Barbara Lane, Jason Smart and Ulf Wickström indicated they have reports related to wood that they will share with the committee.

    It was agreed that a working group will look at the quality of the existing data and decide what should remain and what should be removed from the database. They will also look at adding new data.

  - o **Should a risk approach be used and should the existing deterministic approach be maintained?** It was agreed that the committee should consider a risk-based approach. The four structural documents that are part of the suite of structural fire protection standards are not consistent when it comes to using deterministic vs probabilistic approaches.

    NFPE 557 –probabilistic

    SFPE Standard 1 – deterministic

    SFPE Standard 2 – probabilistic

    ASCE/SEI 7 – currently deterministic

It was noted that ASCE 7 uses a deterministic approach when calculating fire loads and the current SFPE methodology fits-in well with the ASCE document. At the same time, other calculation methods in ASCE such as earthquake loads are moving toward a risk-based approach. Therefore, it may be necessary to have both risk and deterministic approaches in the new document.

It was agreed that a working group will look at the feasibility of adopting a risk-based approach. The working group will determine what "does it mean" to adopt a probabilistic approach and how the committee can make this approach work within existing structural fire protection practice.

o **Should computer fire models be discussed?** There was a discussion about the need to provide guidance in regards to the use of computer fire models. In current structural fire protection practice, zone models are rarely used but CFD models are used extensively. Also, a current methodology for the use of computer models in structural fire protection does not exist.

Tests from SP that compared a one-zone model to algebraic equations using a gas burner fire will be published soon. Data from these tests may be useful for the committee. Ulf Wickström will share this information with the committee once it becomes available.

It was noted that the nuclear industry has guidance on use of fire models. Some of this work could be relevant for this project.

It was agreed that recommending a methodology related to computer fire models would be a lot of work. A one-zone model method could be doable, but a method for CFD models would be extremely complicated if not impossible.

It was agreed that a method for computer models is not a high priority for the committee and would not be investigated at this time. It was noted that the standard should include some verbiage about the use of computer models, but this will be decided later.

o **Should a discussion on traveling fires be included in the document?** ARUP completed work on traveling fires with Guillermo Rein and a methodology was developed. The committee was not sure if adequate data is available to validate this method. Data from the Cardington tests and small scale tests by Thomas using wood cribs may be useful. It was noted that traveling fires are non-uniform so a static fire would not fill the needs to fully represent traveling fires.

It was noted that test data from research performed after 9/11 may be available from NIST. Jonathan Weigand will provide the committee with information on these tests.

It was agreed that a working group will look at the feasibility of including traveling fires in the new document. The working group will look at possible methodologies that could be implemented and identify deficiencies.

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- o **Should the local fire exposure methodology be updated to include exterior exposures?** It was agreed that the local fire exposure methodology should be investigated to see if it needs to be improved. It was agreed that external fire exposures should be included.

    It was agreed that a working group will look at the local fire methodology and recommend improvements including adding external fire exposures.

- **Working Groups –** To get things started, the committee will have four working groups 1) Database, 2) Risk, 3) Traveling Fires and 4) Local Fire Exposure. The scope and purpose of each working group is as follows:

    1) **Database**: Review the existing database of test results to identify any tests that should be removed from the database based upon data quality (e.g. where gas temperature is a poor representation of the heating of the structure). Review SFPE Standard 2 representation of the heat transfer boundary condition and consider if any change in the database should be undertaken. Review what new data can be identified and added to the database.

    2) **Risk**: Identify how the standard should represent uncertainties in predictions to best integrate with other standards to form a probabilistic, risk-based structural fire engineering methodology.

    3) **Traveling Fires**: Review available methods for the analysis of traveling fires to identify methods that should be considered. Identify the available data for thermal exposures by traveling fires with the idea of creating a database of test results that can be used to evaluate traveling fire methodologies. Identify gaps in the available data to motivate laboratories to collect needed data. Identify conditions in which traveling fires are expected. This would allow identification of limits on the use of compartment fire methodologies that do not include traveling fires.

    4) **Local Fire Exposure**: Review and consider expanding local fire exposure to include a wider range of conditions. Review available data in consideration of developing a database of results for method comparison. Review the current incident heat flux representation of the potential for heating the structure and seek to bring into line with the SFPE Standard 2 representation of the heat transfer boundary condition.

    Each committee member will be required to join at least one of these working groups. CJ will send around a sign-up sheet. CJ can also provide working groups with support in setting up meetings and a scheduling a gotomeeting.com online meeting.

- **Next Meeting –** The date for the next meeting will be set after the working groups have made sufficient progress as determined by the chair.

End of Report