Talk by Dr. Monideep Dey

Working Toward an Enhanced and Integrated Performance-Based Regulatory Regime for Fire Safety

Biography

Dr. Monideep Dey is President of Deytec, Inc., providing training and consulting services for fire safety engineering, and also audit and certification of fire safety programs. The services of Deytec, Inc. include sectors such as the built environment, tall buildings and iconic buildings, industrial facilities, warehouses, tunnels and nuclear power plants. The emphasis of Deytec, Inc. is on quality assurance to improve fire safety by preventing fires and minimizing its effects, if fires do occur.

Dr. Dey has been involved in the International Organization of Standardization ISO TC 92, Fire Safety, since 2009. He is presently the Chairman (Convenor) of ISO TC 92 SC 4 WG 7 on verification and validation of fire calculation methods. In his work at ISO TC 92, he has developed standards to ensure reliability of calculation methods for fire safety engineering, taken initiatives to make ISO standards practical and usable, improved standards to address quality in fire safety programs.

Dr. Dey has an in depth familiarity with ISO fire safety engineering standards and also the product fire performance standards of ISO. He recently has taken an initiative at ISO TC 92 to integrate all ISO fire safety standards, those for fire safety engineering and product performance.

Dr. Dey has a PhD in nuclear engineering from the University of Michigan, USA.

Talk

Thank you _____ for the introduction. It is my pleasure to be here at this conference and I thank TFRI for inviting me to give this talk to this esteemed audience. I hope you will find it useful for your work for fire safety in China.

Slide 1

I will be talking about *working toward an enhanced and integrated performance-based regulatory regime for fire safety*. This talk is applicable to our fire safety industry in general but also for any specific country that wishes to improve its fire safety program. I have specifically designed the talk for fire safety in China.

Slide 2

The aim of my presentation is firstly to present current practices for fire safety worldwide. Then I will discuss developments and the status of performance-based fire safety design, specifically the enhancements that are needed for performance-based fire safety design. I will also discuss the need for integration of prescriptive fire performance standards with performance-based design. The ultimate goal is to improve quality of fire safety programs and thus fire safety in China.

Slide 3

Let me now discuss the current practices in fire safety.

Fire safety design is presently done with the prescriptive product performance fire standards for combustibility and flammability, resistance to fire, for determining the effects of fire effluents and tenability conditions. The organizations that publish prescriptive product standards are the International Organization of Standardization,

or ISO, the American Society for Standards and Materials, or ASTM, the National Fire Protection Association, etc.

Slide 4

In contrast performance-based, or (P-B) standards, also known as fire safety engineering – FSE – standards, one defines, safety objectives, functional requirements, and performance criteria first. From now on I will use the term fire safety engineering and performance-based interchangeably as meaning the same. Then the standards require the most important step which is to define fire loads in building or facility for which the fire safety plan is being developed. Then one conducts engineering calculations to determine if performance criteria are met which were set in the first step. Examples of performance criteria are tenability for the life safety objective, or heat flux or smoke density if equipment performance in a fire is the objective.

Slide 5

This slide shows the fire safety engineering design process for a fire safety plan. The figure is taken from ISO 23932 which contain the general requirements and procedures for a fire safety engineering design. Initially, the scope of the project must be defined, what safety objectives are of concern and is fire safety in the whole building or facility being analyzed, or just part of it.

Then as I have described before, the safety objectives, functional requirements, and performance criteria are developed, followed by the most important step to define fire loads in building or facility for which the fire safety plan is being developed. Based on these fire loads, one has to develop a preliminary fire protection plan which one believes will provide a level of fire protection so the performance criteria

will be met. Then a set of design fire scenarios and design fires are developed for which one conducts engineering calculations to determine if performance criteria are met. If they are not met, then one has to modify the fire safety plan until the performance criteria are met.

Shown on the right side of the figure is the most important part of fire safety engineering, that is to document the initial plan and implement it, but also to establish a fire safety management and audit program to continual monitor changes in the fire loads and to determine if the fire safety plan needs to be modified. At ISO TC 92 SC 4, Fire Safety Engineering, we are currently emphasizing this part of fire safety engineering in the ISO standards.

Slide 6

In ISO, we have developed a set of ISO fire safety engineering standards which we call the Global Fire Safety Engineering Analysis and Information System. This set of standards include general procedures and requirements, and procedures to develop design fire scenarios and design fires, fire loads. There is a very important standard for verification and validation of fire calculation methods which has recently been improved to ensure reliability and quality in fire safety engineering. There are also standards for structural failure calculations, fire detection and suppression, and evacuation modeling.

Slide 7

This slide shows a schematic of the Global Fire Safety Engineering Information System in another format. At the left you have the prescribed parameters given by the architect, the building or facility size, number of rooms, type of materials in the rooms, fire loads etc. On the top you have first the design scenarios which is the

basis of you fire protection system design. The fire phenomenon are analyzed for these scenarios, the initiation and development of fire and fire effluents, movement of the fire effluents, structural response and propagation of the fire beyond the enclosure of origin, and finally detection and suppression of the fire. It is important to understand the interrelationships between these phenomena in fire safety engineering.

At the bottom you have the possible safety objectives for the fire safety design, life safety, property loss, business interruption, contamination of environment, and destruction of heritage. The functional requirements and performance criteria are set based on the safety objective and evaluated for the design scenarios as shown in the block on the right hand side. The ISO standards for each of these blocks is also shown in the schematic.

Slide 8

The advantages of the global approach is that it provides awareness of the interrelationships between fire evaluations when using ISO or other fire safety engineering standards, and it provides logical means to organize analysis and data needed for the safety design. Computer models cover several subsystems and can become a “black box” if awareness of interactions not maintained. Also, “Quick Calculation Methods” for the fire phenomena shown in the schematic in the last slide has an important role in fire safety engineering because it facilitates understanding of fire safety engineering and can check for errors from more complex computer codes.

Slide 9

This slide lists the ISO standards available for fire safety engineering. The column on the left side lists the Chapters in ISO 23932 which contain the general requirements and procedures for fire safety engineering. The middle column lists the ISO standards available for implementing the requirements and procedures in those chapters. I won't go through the list in detail here. They are provided to you for future reference in your work.

Slide 10

This slide lists the ISO standards that compose what ISO now has named the Global Fire Safety Engineering and Analysis System. The list is contained in the paper I wrote for this conference and is provided to you for future reference in your work.

Slide 11

Let me now mention the other standards by other organizations that are available for fire safety engineering. The Society of Fire Protection Engineering (SFPE) has published Performance-Based Guidelines, the American Society of Testing & Materials (ASTM) has some standards for fire safety engineering and is now going through the process of national adoption of ISO fire safety engineering standards in the US. British Standards Institute (BSI) and Standards Australia were active in the early formulation of ISO standards and now have developed that information into their own national standards which are used around the world. Those by BSI in the gulf states mostly, and standards of Standards Australia are used in Indonesia, Malaysia, and countries in that region.

Slide 12

I would like to now summarize for you the evolution and experience in fire safety engineering around the world. New Zealand has been a pioneer in this effort and

published a Verification Method: Framework for Fire Safety Design also known as C/VM2. The fire safety requirements in the New Zealand building code is totally performance-based and I will discuss this more later. The Nordic Countries have also moved along similar lines and published, Fire Safety Engineering — Verification of fire safety design in buildings - prINSTA TS 950. Australia is embarking on a similar path as New Zealand with an optional verification method. The European standards body, CEN, has recently initiated fire safety engineering standards development and would like to adopt ISO standards as much as possible.

Slide 13

So why do I emphasize ISO standards at this conference for you. I have been involved in ISO since 2009 because I believe ISO fire safety standards will become dominant in the future. I believe China with representation by SAC in TC 92 concurs with this statement. ISO standards are developed by member national standards bodies such as SAC and the American National Standards Institute - ANSI, and not individuals. ISO and the UN are promoting the use of ISO standards around the globe, specifically in developing countries. They are hosting a conference and training in November 2015, in Geneva, Switzerland on the topic of "Using and referencing ISO and IEC standards to support public policy and regulation." This will be a very important initiative for ISO and the UN and I plan to attend this conference and will report on it later.

Slide 14

Now let me turn to the topic of improvements needed in the fire safety engineering standards. Although we currently have a good set of standards, there is a need for improvement both for the standards themselves but more importantly in the implementation.

Generally, performance-based approaches are used when prescriptive requirements cannot be met. So authorities question when P-B design is used to justify a design when the design does not meet requirements. The reason for this doubt is because currently the fire safety engineering standards are not connected and integrated with prescriptive product fire performance standards. We need to integrate performance-based with prescriptive standards.

Slide 15

Before we get to the topic of integration which I will address later, let's discuss the pros and cons of prescriptive versus performance-based standards.

Standardized fire test methods give information on performance of a material or assembly "in the test" but this may not be related to the most likely real fire scenarios. The standardized tests are valuable for ranking materials or assemblies under standard fire exposure and play important role in prescriptive regulations. They are good for ranking but do not reflect performance in real world or are suitable for supporting performance-based design.

Slide 16

For performance-based standards, the requirements are not easily understood. The standards for performance-based design that will allow uniform conformity assessment are not currently available. Therefore, there is lack of uniformity of application across the industry. But, P-B standards allow fire safety designs to be based on real fire scenarios and effects. The establishments of and monitoring of fire loads is the biggest advantage of the fire safety engineering approach.

Slide 17

Now let's talk about the improvements needed for fire safety engineering standards. First, the general improvements that are needed are that they must be practical and easily understood by practicing engineers as a cohesive set of standards. They must be able to be adopted by national authorities and form the basis of conformity assessment with minimal judgments. We need to decrease the present uncertainty in use of fire safety engineering and the variability in the results for fire safety systems design. We need to improve the quality of implementation of fire safety engineering.

Slide 18

The specific improvements that are needed are that quantifiable performance measures of safety objectives must be developed for applications. We need to establish specific design scenarios and design fires and specific input data and assumptions that cover a broad range of fire scenarios. Requirements to address uncertainty and safety factors as part of quality assurance for performance-based design should be developed. All this leads to an important point that I will make in this presentation, that we need to develop application guides for different sectors. I will discuss this more later.

Slide 19

Let me present to you what we are doing at ISO TC 92 SC 4 to address these needed improvements which I have just presented. SC 4 has recently developed a strategic plan with a goal that standards should be simple, usable and practical for use worldwide. SC 4 will link the standards to make them a package, the Global Fire Safety Engineering Analysis and Information System.

ISO has recently in August 2015 published a new standard, ISO 16730-1, for the verification and validation of fire calculation methods. This work was initiated in the working group I chair (convene). I highly recommend this standard to you. SC 4 has also in initiated development of a standard for Quick Calculation Methods, and also is examining development of a standard for assessing input data for fire safety engineering which is an important source of uncertainty.

Slide 20

Now let me dis cuss an important topic, the need to develop application guidelines. ISO standards apply generally to all industrial sectors, it is very difficult to make these standards specific for a range of applications. There is a need to develop application guidelines for specific "applications" and country. These guides will depend on the fire protection practices of a particular country. We need to develop application guidelines for tall buildings, tunnels, warehouses, industrial facilities and also nuclear power plants to make the best use of the advantages of fire safety engineering.

Slide 21

The guidelines will make standards more practical and helpful for engineers, but still have the "ISO" quality brand name. They will be specific to each sector and will provide uniformity of application across China, and increase fire safety across China.

Slide 22

As I mentioned before, there is a need to integrate prescriptive requirements with performance-based requirements. Not much has been done in this respect but I will note the set of design fire scenarios provides a possible means to integrate performance-based with prescriptive requirements. We need to identify when prescriptive requirements are necessary in an overall approach for the total fire

safety design. New Zealand has taken such an approach in verification method (C/VM2) I had mentioned earlier. 10 design fire scenarios were used to encompass most fire safety requirements.

Slide 23-25

This slide presents the 10 design fire scenarios in the New Zealand verification document. I won't read them all but note that ASET/RSET analysis is used for many of the fire scenarios. For some scenarios such as fire spread in internal linings, horizontal fire spread to other buildings, and external vertical fire spread, prescriptive requirements are used to address the fire scenarios.

Slide 26

As I mentioned earlier, there is a need to develop an infrastructure for fire safety requirements. In 2004, ISO TC 92 developed and published a Framework of Standards for Fire Safety (FSFS). This document provides an interesting approach to the integration of prescriptive and performance standards, but unfortunately it was never implemented. I have recently taken an initiative at ICO TC 92 to update the document and start implementation of the framework. This effort will require national standards bodies to be interested and involved. I suggest China and SAC support this effort and be involved in the development of this framework. Once the framework is developed at ISO, it can be modified and adapted for use in China.

Slide 27

This schematic is taken from the ISO document I just mentioned. I won't go through it in detail here, but the top part shows the current practice of conducting fire test methods to support prescriptive requirements. The bottom part shows the "real world" and fires to which the materials and assemblies will actually be exposed. This

is the domain of fire safety engineering. The middle part and the schematic attempts to show a connection between the traditional fire tests, prescriptive requirements, and the need for test data and performance-based requirements.

Slide 28

Before I conclude my talk, I would like to mention something about other general areas of fire safety that require standardization. The relationship between fire safety design and the construction process is important and this process needs more requirements. Fire safety management is of utmost importance and needs to be standardized to take advantage of the main benefits of fire safety engineering to identify the real fire hazards and loads, and to continually modify the fire protection program based on this monitoring.

Standards for fire safety training and education must be developed. As I mentioned before, standards themselves are not useful unless the regulatory structure for successful implementation of the standards is in place. ISO realizes that safety regulation is important and as I mentioned before has begun initiatives for the use of ISO standards for public policy and regulation.

Slide 29

In conclusion, I recommend that fire safety can be increased through use of fire safety engineering. The major benefit of fire safety engineering is the determination of fire hazards and developing fire protection based on those fire hazards and fire loads. Safety management is an important part of fire safety engineering to monitor changes in hazards and protection in the building and facility.

Slide 30

It is necessary that we improve improve fire safety engineering technology, standards, and regulation to implement fire safety engineering successfully in our countries. There is a need to develop application guidelines for specific applications in different sectors because standards themselves cannot contain all the details necessary for successful implementation. It is also necessary to integrate the prescriptive and fire safety engineering standards so P-B is not used to only to justify the design when prescriptive requirements cannot be met. I recommend to you to follow the ISO initiatives for standards implementation through regulation and conformity assessment.

Slide 31

That concludes my presentation. I invite any comments or questions on what I have said now or any time later. My e-mail and contact information is given in this slide.

I will take any questions at this time.

Thank you.