# Fall 2009 Figure Protection Issue No. 44

The National Academy's

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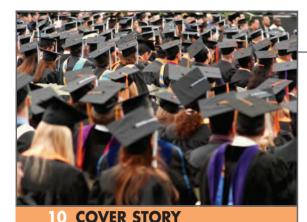
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#### From the TECHNICAL DIRECTOR



#### Update on SFPE's Canons of Ethics

t the first annual meeting of the Society of Fire Protection Engineers, Illinois Institute of Technology president H. T. Herald defined six attributes that defined a profession:

- 1. Body of knowledge
- 2. Strong motive of service over profit
- 3. Qualification in individual competency and character
- 4. Education
- 5. Recognition of status
- 6. Assuring the public of member competence

These six attributes are not mutually-exclusive, and they are provided in a number of ways: professional licensure, academic and continuing education programs, and technical publications. Another key element is SFPE's Canons of Ethics, which were written to define what constitutes acceptable practice for the purpose of maintaining public health, safety and welfare.

The Canons of Ethics were first written in 1984. Since then, the canons have been revised twice to ensure that they reflect current practice: once in 1992 in response to the increased use of computer models in fire protection engineering, and again in 2008 to recognize that choices made while practicing fire protection engineering can have an impact on the environment (an editorial change was also made in 2008 to the Canon written based on the increased use of computer models.)

Professional societies such as SFPE write codes of ethics in recognition that practitioners apply knowledge and concepts that are not widely understood by the public in a manner that can have a direct impact on the public.

The first four of SFPE's canons deal with how fire protection engineers should apply their knowledge and skill. The first canon states that fire protection engineers shall be dedicated to the safety, health and welfare of the public. The canon also states that if a fire protection engineer becomes aware of hazardous conditions that threaten present or future safety, health or welfare of the public, then they shall so advise their employers or clients. In the event that the employer or client does not act on the information, then the fire protection engineer's responsibility requires notifying an appropriate public authority. Because the engineer's first duty is to the public, simply notifying a client or employer is not sufficient if the client or employer does not investigate and, if necessary, correct the problem.

The new canon on protecting the environment was placed

into the section of the Canons of Ethics on knowledge and skill as Canon #4. This canon requires that fire protection engineers consider the potential impact to the environment of their work. While this canon is new, the concept is not. Environmental protection was the reason that the use of halons were prohibited as fire suppressants. More recently, concerns arising from the potential scarcity of water have also impacted fire protection engineering practice.<sup>2</sup>

The next five canons relate to the honesty and impartiality that fire protection engineers should apply to their work, and the final six canons relate to upholding the competence and prestige of the profession. These canons have been briefly discussed in a prior column in this magazine.<sup>3</sup>

The canon that was added in 1992 (Canon #15) was written to highlight the necessity of only using methods and tools for which the engineer has an understanding of the correct use and limitations. While it was written to clarify an engineer's responsibility when using computer-based tools, it reinforced an existing canon that stated that fire protection engineers should only work within their areas of competence. The editorial change that was made in 2008 was intended to further clarify this issue.

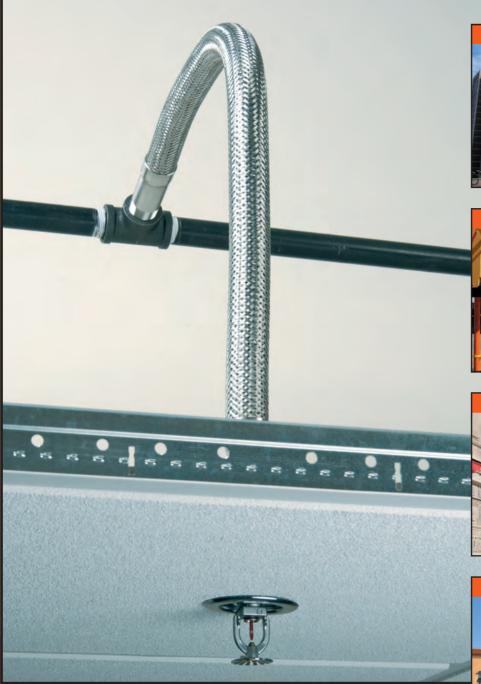
The SFPE's ethics committee recently conducted a comprehensive review of the Canons of Ethics to make sure that they reflect current practice. The complete text of the canons is available on SFPE's website – **www.sfpe.org**, and once the revisions are complete, they will be posted there as well.

Morgan J. Hurley, P.E.
Technical Director
Society of Fire Protection Engineers

#### References:

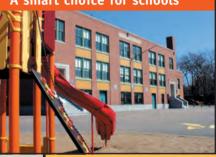
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- 2 Hurley, M., "Fire Protection Engineering and the Environment," Fire Protection Engineering, Spring, 2009, p. 2.
- Hurley, M., "SFPE's Canons of Ethics," Fire Protection Engineering, Summer, 2006, p. 2.

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#### **DEAR EDITOR**

Mr. Hurley's letter on page 2 of the Summer issue reminds me that I am a 1940 graduate of the FPE program at Armour Institute of Technology (now IIT). At that time, the capital stock fire insurance companies sponsored a scholarship program to educate promising students for entry level positions in risk reduction at the various rating agencies. The program was administered by Royal M. Beckwith through the Western Actuarial Bureau. Being in Chicago, Armour was a natural location for the program. Underwriters Laboratories were conveniently located on East Ohio Street, and they provided O.L.Robinson to supervise the laboratory courses in the junior and senior years.

Joseph B. Finnegan, a graduate of MIT and long time member of the UL staff, was the director of the FPE department at Armour and taught most of the courses. In its' early stages there were 25 scholarships awarded each year, but the great depression reduced that to only eight in the mid-30's. Each scholarship student was obligated to work for the rating bureaus for five years after graduation. A steady flow of qualified FPEs was assured for several years.

For reasons not clear to me, the Armour/IIT connection was broken some time after WWII and the whole FPE program was terminated. A real pity in light of the current shortage of talent. But it is gratifying to learn that schools like Cal Poly and others are picking up the opportunity to advance the profession.

With all best regards,

Thomas A. Hunter, FPE '40



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<sup>\*</sup>as of September 23, 2009.

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#### By Harold E. Nelson, P.E., FSFPE

ithin the last several decades, there have been fundamental changes in the understanding and quantification of fire. The fire protection engineer now has enhanced capabilities, which enable basing conclusions on an engineering appraisal of the potential harm or risk. The profession has made a series of important advances that progressively have added to the engineer's ability to predict the potential impact of fire.

Four different, often overlapping, approaches have been or are being used. These approaches are referred to as specification, component performance, scenario performance and risk appraisal. The first two of these approaches are rule bound; the last two produce a quantitative understanding of the level of risk or safety provided. The ongoing transition from design by rule to performance appraisal has had a major impact on the professional quality and value of fire protection engineering.

Fire protection engineering in 1946 was a specialty niche of engineering dedicated for the most part to the needs of the fire insurance industry. A youngster starting off in the profession would compare buildings and other facilities to a book (e.g., codes or rating schedules) to determine compliance with the prescribed document. No evaluation of the actual impact of the fire or the facility was required or normally made.

As time progressed, it became apparent that the specification approach unnecessarily constrained design. Element-by-element component performance came into use. Under this approach, any single element could be replaced by a different element, if shown to perform at least as well as the specified element. In time, a statement of required test results often replaced the original specification, producing the now common form of codes and regulations.

At the same time, designers introduced many innovative new materials, concepts and architectural treatments. Many of the tests of fire protection or fire hazard of materials attempted to imitate a fire exposure. But, the exposures used were at best only a single point on a broad spectrum of potential fire exposures. In some cases, the tests were based more on getting reproducible results than scientific validity. Test results were seldom expressed in engineering terms usable in an analytical analysis. However, there now exists a massive collection of test results, regulations and knowledgeable individuals to support the component performance approaches. Unfortunately, virtually all of the test data fail to provide quantitative information on actual fire properties.

Starting about the first decade after World War II, various research laboratories undertook serious investigations of fire phenomena and the simultaneous interrelationship of several factors, such as burning rate and ventilation. Much of the work addressed understanding and quantification of the development of fire and fire products in enclosed spaces in buildings. Some of the important outputs included the identification of the heat zones occurring in compartment fires; the phenomenon of flashover; the analytical impact of oxygen availability; fire plumes and entrainment and other quantifiable aspects of fire development.

The investigations identified a number of the physical properties important to an engineering analysis. These include values such as temperature changes in strengths of heated materials and the rate of heat release from a combustible material as a function of incident flux. In some cases, the data could be determined by using existing apparatus. In others, new apparatus such as the cone calorimeter were needed. Key in all cases is that the measurements return values of physical properties under the conditions of the exposures of interest.

Individual solution methods were assembled in a form (such as a fire model) where applying the fire property data could produce an output showing expected level of safety. The working products appear in the form of equations, models and other information needed by the engineer to describe both the facility and the initiating conditions. This approach is normally deterministic and tends to assume that all descriptions and conditions are either constant or vary in a described manner. Running multiple scenarios may be necessary to cover the full scope of the fire potential.

The scenario approach can often, depending on the selection of scenarios, provide the information needed to draw valid conclusions on the probable course and outcome of fire in a facility.

A more comprehensive set of conclusions involving both probability and potential can be derived where the input data is expressed as a distribution in terms of the environment faced. A Monte Carlo approach is often used to reduce the number of runs of the computer code needed.

The modern practicing fire protection engineer needs to have a comprehensive understanding of the phenomena-based approaches to fire hazard analysis and use the most accurate and suitable for the needs at hand. When using established models, the engineer needs to understand the phenomena being modeled and the sensitivity of the model to the data entered. The days of simple cookbook code compliance are passing.

Further information can be found in The History of Fire Protection Engineering.<sup>1</sup>

Richardson, K. (ed.), *The History of Fire Protection Engineering*, National Fire Protection Association, Quincy, MA, 2002.









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Although dust buildup is among the most serious and common fire and explosion hazards in a range of industries, little is known about how dust ignites or how dust explosions propagate, according to Ali Rangwala, assistant professor of fire protection engineering at Worcester Polytechnic Institute (WPI).

Rangwala recently received a five-year, CAREER Award from the National Science Foundation (NSF) to close this knowledge gap by conducting a groundbreaking scientific study of dust layer ignition and flame propagation in dust clouds.

While a number of studies of dust explosions have been conducted over the years, none have been aimed at developing a fundamental understanding of the physics of the phenomenon, Rangwala says. In particular, his study will examine how such factors as the size of dust particles, their chemical make-up, the density of dust clouds and the heat of combustion (the heat released when a substance burns) affect how likely a dust cloud is to ignite, how rapidly it will burn and how the fire will spread. Other studies will look at the risks associated with dust as it accumulates in thick layers, particularly in corners. Fires can smolder in dust layers for long periods before erupting, often triggering dust explosions.

In addition to funding his research, the CAREER Award will enable Rangwala to promote interest in careers in fire protection engineering and fire research through educational programs. He will develop a three-week summer program for high-school students and develop an undergraduate project center at the University of Edinburgh in the UK. There, students from WPI, Edinburgh and universities in France and India will cooperate on cutting-edge projects in fire research.

For more information, go to www.wpi.edu.

#### Americans Recognize Risk of Fire, **But Don't Worry About It**

A nationwide survey conducted by the Society for Fire Protection Engineers (SFPE) revealed that more Americans believe fire is the event that will most likely cause harm to them or their family when compared to lighting strikes, hurricanes, earthquakes and floods. Forty-five percent of the survey respondents selected fire.

At the same time, only 18 percent of the respondents said they worry about the dangers of fire more than once a year.

"As a nation, there are widespread misconceptions about fire safety, and that's worrisome," said Chris Jelenewicz, Engineering Program Manager at SFPE. "Everyone should recognize that thousands of people die each year in fires, and be aware that fire safety features in a building play a critical role in protecting people, property and the environment from fire."

Americans are more likely to be harmed by fire when compared to natural disasters. For example, although natural disasters such as hurricanes and earthquakes are covered widely in the national news media, many more people die each year as a result of fire.

For more information, go to www.sfpe.org.



The SFPE Corporate 100 Program was founded in 1976 to strengthen the relationship between industry and the fire protection engineering community. Membership in the program recognizes those who support the objectives of SFPE and have a genuine concern for the safety of life and property from fire.

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### The National Academy's

# Vision of the Engineer 12020

Applications to Fire Protection Engineering

By James A. Milke, Ph.D., P.E., FSFPE, and Carl Baldassarra, P.E., FSFPE



he National Academy of Engineering (NAE) developed a report in 2004 following a workshop to provide a vision of the engineer of 2020, with particular emphasis on the future for U.S. engineers. The workshop was held in 2002 and the report was developed based on the papers presented at the workshop. Workshop attendees and the review committee that developed the report included persons from the business community and academia.

In providing the vision of the future engineer, the report outlines the roles that engineers will play in the future and also how engineering education needs to adapt in order to provide the preparation necessary for the engineer of the future. The specific questions addressed by the report are:

- What will or should engineering be like in 2020?
- Will it be a reflection of the engineering of today and its past growth patterns or will it be fundamentally different?
- Most importantly, can the engineering profession play a role in shaping its own future? Can a future be created where engineering has a broadly recognized image that celebrates the exciting roles that engineering and engineers play in addressing societal and technical challenges?
- How can engineers best be educated to be leaders, able to balance the gains afforded by new technologies with the vulnerabilities created by their byproducts without compromising the well-being of society and humanity?
- Will engineering be viewed as a foundation that prepares citizens for a broad range of creative career opportunities?
- Will engineering reflect and celebrate the diversity of all the citizens in society?

The NAE report indicates that engineers are expected to "exploit new

science to develop technologies that benefit mankind" (p. 3) and continue to pursue technological advances for use in commercial applications. In general, the importance of technology will become more important as products are developed which require more technological "know-how" in order to use them (for example, today's electronic products where the common joke is to find a teenager to learn how to use the device).

The demand for fire protection engineers has greatly exceeded the supply available from the several institutions offering degree programs.

The NAE report suggests that some of the technological developments will be in response to the challenges posed by natural disasters. In particular, it is expected that engineers will be asked to do more to predict natural disasters and their impact as well as to assist in the recovery from them.

The effect of globalization is predicted to be significant. Technological solutions are sought for the response to terrorism threats and issues of the environment. Globalization is also important for the engineering workforce in the U.S., with an increasing number of jobs being outsourced. Such outsourcing can cause the engineering teams to be spread among different continents, thereby necessitating strong communication capabilities. Given that multinational design teams are likely to have members from diverse backgrounds, engineers

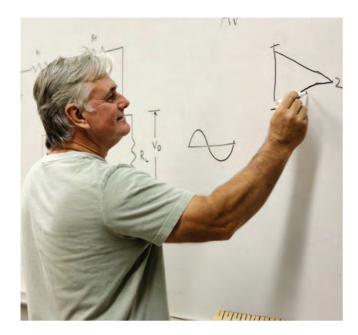
will need to be appreciative of the appropriate business protocols in those cultures.

This article discusses the applicability of the report to the practice and education in fire protection engineering. Also, being that this paper was written in 2009, representing about one-third of the time from the date of the report to the futuristic date of 2020, the authors of this paper have the advantage of making comments about the state of engineering at a date which is appreciably closer to 2020 than when the NAE report was written.

#### RELEVANCE TO FIRE PROTECTION ENGINEERING

While a wide array of engineering disciplines were represented at the workshop, no fire protection engineers (FPEs) were present and no mention is made that anyone from the FPE discipline was consulted for their input. On the surface, the report appears to be more applicable to other fields of engineering, i.e., FPEs are not involved in forecasting hurricanes and are not involved in genetics research. Nonetheless, many of the underlying principles included in the report can be applied to FPE. Certainly, a similar example of being able to predict the courses of natural disasters could be presented about fires.

The recent generation of analytical tools available to FPEs does exploit new science. For example, the capabilities of computer models such as FDS, structural fire models, evacuation models and others make use of new scientific developments. The improvement in the capabilities of computer-based models and improvements to computer hardware available to the practicing FPE in the last 12 years has been very significant. Further, numerous innovations, such as in detection, suppression and materials, are the direct results of new science. It's reasonable to anticipate that continued development will occur at least at the same pace.



Considering the technological advances in other areas of engineering, where the people have come to expect that the courses of hurricanes can be projected to direct evacuations and activate recovery systems, at what point in time is that same expectation going to be applied to fire? Advanced information systems are envisioned for buildings which link a variety of sensors to a building response system and emergency responders. The building of the future may be able to direct people to usable exits which are distant from the fire and give incident commanders information on the course of the fire, health of the building, locations of occupants and emergency response personnel and more. However, this capability is still likely to be a futuristic (almost "sci-fi") vision.

The implementation of advanced building technology is constrained by the current regulatory environment and limited demand. It's unclear what approvals might be necessary prior to the implementation of such smart building technologies, though the equipment included in most safety systems in buildings is required to be listed for such a capability and approved by the enforcement official. The demand for such was strong following 9/11, but this has waned in recent years. Mandating increased safety for building occupants and emergency responders will require a debate on public policy as a result of the impact of such a requirement on the cost of new construction. With these challenges, perhaps this topic is applicable to the engineer of 2050, rather than 2020.

#### IMPLICATIONS FOR THE FPE PROFESSION

The demand for fire protection engineers has greatly exceeded the supply available from the several institutions offering degree programs. The current economic slowdown is not expected to materially alter this demand in the long term. In addition, the anticipated retirements of "baby boom-

ers" suggest the long-term demand will continue to be great.

The current group of students in high school can be considered to get a glimpse of those beginning their practice as licensed, practicing engineers in 2020. What will high school students expect from an engineering career, and what will employers expect of them?

Fortunately, the public's perception of engineers remains very favorable. Engineers consistently rank near the top of lists of professions most trusted by the public. Clearly, the favorable perception – as well as the perceived opportunity to "make a difference" in the world by providing solutions for energy, pollution, climate change and an improved standard of living for millions of people in developing countries – will continue to draw some of the best and brightest talent to the profession.<sup>2</sup>

There are several developments which may occur in the next 10 to 15 years:

- As science and technology are expected to play a larger role in daily lives, there will be an increased need for engineers to be well-versed in all forms of communication, written, oral and visual, in order to effectively represent their area of expertise with representatives of government, business and the public. In addition, engineers having multi-lingual skills will have an advantage in the marketplace.
- 2. The technology curve is not expected to decline from current levels. In order to be proficient with the technologies associated with the FPE profession, one can expect to be engaged in a life-long learning process. This is especially true with computer-based systems and software, and their integration into ever-more complex building automation systems. Innovation will be the key for the FPE's continued success in the marketplace, but innovation will occur only if engineers are able to adapt with tools appropriate for the world as it will be, not as it is today.
- 3. Because of the increased complexity and size of systems-based engineering problems, engineers can expect to work in "teams" of multidisciplinary experts. Successful organizations will be those which have mastered their abilities to communicate across multiple fields, multiple time zones and multiple cultures, if necessary.
- 4. As the demand for health care, particularly of an aging population, is expected to increase, FPEs can expect to see increased construction of health care and residential care facilities. The fire safety challenges of those facilities are well-known; nevertheless, the sheer number of new and renovated facilities will create a demand for FPE services. Society's expectations of fire safety for those facilities may even increase beyond what is the "norm" today, creating further demands for a variety of services.
- 5. As technology drives the demand for more complex analytical methods, there will be an expected increase in the need for input data from research and testing organiza-

The complexity and scale of systems-based engineering problems is envisioned to increase as more technologically sophisticated solutions are sought.

- tions, trained persons who can interpret and apply these data, and competent reviewers to approve the designs.
- 6. Anti-terrorism measures, such as security systems, building stress sensors, real-time occupant notification and emergency responder communication systems, mass communication and more are likely to see greater application.
- 7. The sustainability movement is "real." FPEs need to prepare for a dialogue with other stakeholders to reduce the negative environmental impact of fire protection features that are currently taken for granted not just in the U.S. but on a global basis as U.S.-based codes and standards are applied in countries with fewer resources, e.g., water. Engineers will need to develop a stronger sense of how public policy affects the profession.
- 8. Globalization will have an increasing impact on the engineering profession. Some organizations already use a global engineering staff for everything from product development to building analysis and design, capitalizing on a larger, more diverse global work force and the twenty-four hour global clock to accomplish more work in the same period of time.
- 9. Natural and manmade catastrophes can affect infrastructure, food and water supplies, and electrical and communications grids. FPEs will be expected to conduct risk analyses, prepare for and help address such threats, much like today but, perhaps, with such events having greater frequency.

#### **IMPLICATIONS FOR FPE EDUCATION**

Questions in the NAE report for engineering education include (p. 40):

- While the world adjusts to a new economic order, will it be necessary for the traditional engineering schools to develop a two-tiered engineering education system?
- If routine engineering jobs are mostly outsourced, will large numbers of lower-cost engineering "technicians" be educated to do such jobs?
- Will U.S. companies be willing to trade off the lower cost of offshore engineers for moderate cost and more local control for engineers at home?

- Will "full-service" engineers require a five- or six-year "certification" or "professional" degree and act as engineering managers to coordinate the activities of overseas job shops and subsidiaries?
- What would be the role of ABET (formerly the Accreditation Board for Engineering and Technology, Inc.) in accommodating transition to a professional degree?
- If, on the other hand, the demand for engineers ultimately increases because of an expanding market, how will U.S. engineers be positioned to be prepared?
- Do engineers understand enough culturally, for example, to respond to the needs of the multiple niches in a global market?
- Can engineers continue to expect everyone else to speak English?
- What will be engineers' special value added?

There are several aspects of needed changes in FPE education addressed by the NAE report, some related to the education of FPEs and others to the education about FPE to non-engineers.

 The current "one size fits all" approach to engineering education may not be the optimum approach.
 The report acknowledges that each student has a



different preferred learning style based on their inherent learning skills and career aspirations.

A multi-tiered system for engineering education should be considered. The multi-tiered approach would better prepare future engineers for different career tracks, one in research and another in practice. Those interested in careers in the practice of engineering are better served with applications of engineering principles and design. Students interested in research careers need to have a strong background in the theoretical bases of the engineering principles and thus would benefit from courses that emphasize learning through research. Further, with the increase in technical sophistication of many consumer products, the NAE report indicates that engineering schools should provide courses to non-engineers to improve technical literacy, which would constitute a third track. Relative to future buildings, education will be needed for design professionals, building managers and emergency responders on information systems and interfaces with sensors.

Some learn from experience with research endeavors while others are more receptive by learning via applications or case studies.

This track would be especially productive at the research institutions. Another track could emphasize practical applications.

2. The complexity and scale of systems-based engineering problems is envisioned to increase as more technologically sophisticated solutions are sought. As such, it's difficult to imagine that a single person will have the expertise to be able to address all of the nuances of the problem. While teamwork has been a point of



emphasis in the evaluation of engineering programs by the Accreditation Board for Engineering and Technology (ABET) for many years, interest in team or group projects is likely to grow, especially to address multidisciplinary topics. Group projects are already included in FPE education programs, in part because of ABET interest, and in part to permit projects to be broader in scope than if a single person was completing the task.

In the past, many group projects within FPE courses have been narrowly focused, e.g., analyzing a particular hazard, developing a particular fire protection system design, etc. To prepare graduates for the multidisciplinary style of the workplace, the development of fire protection solutions for selected hazards will need to be done in a more holistic fashion. Projects will need to be revised to include societal or environmental aspects

- 3. Social elements: Engineering curricula have included environmental and energy issues. Some universities have initiated courses in counter-terrorism. Most of these courses have been offered in selected departments, and often are not taken by students outside of that major, either because of prerequisite course requirements or space limitations. These courses could become part of a required engineering curriculum, especially with ABET's encouragement or, at the very least, as electives. With increased demand for such courses, the universities would need to support the departments with increased faculty for such courses.
- 4. Many decisions made in engineering are based on public policy issues, e.g., acceptance criteria and design fire selection for performance-based designs. However, public policy topics are usually outside the realm of courses taken by most engineers. Again, such courses could be encouraged at least as electives, if not as part of the base requirements. As with the social elements courses, universities will need to provide support to departments offering such courses to handle the increased demand from engineering students.

With that vision being proposed, the difficulty in fire protection engineering is that the resources in the few existing programs are already appreciably stretched. Developing three separate tracks, each staffed with the requisite number of faculty, would require an appreciable expansion of resources. In the near future, a more likely vision would be to provide a hybrid approach, which may already be present at the existing institutions, in principle. Increased recognition of the two tracks for engineering students is important to accommodate the different learning styles as well as to educate engineers in the field with the diverse set of skills demanded by the field.

5. There is already strong interest in requiring an engineer to have a graduate degree (or an equivalent number of credits) in order to sit for the Principles of Engineering (P.E.) examination. The report makes the case that some other professions have mandated graduate degrees for many years.

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12 sprinklers	12 sprinklers	12 sprinklers	2000 sq. ft.	15 sprinklers (1500 sq. ft)	6 sprinklers (3 sprinklers on 2 lines)
1200+ gpm	1200+ gpm	1200+ gpm-UL 1352+ gpm-FM	1600+ gpm	1200+ gpm	Sys. demand 828+ gpm
250 gpm HS	250 gpm HS	250 gpm HS	500 gpm HS	500 gpm HS	250 gpm HS

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Much of the recent growth in the number of institutions worldwide considering offering courses or degree programs in FPE education has been at the graduate level. In the U.S., the existing two schools ( Worcester Polytechnic Institute and The University of Maryland) are well-positioned to provide working professionals with graduate coursework through both on-campus and distance course options. The development of the program at the California Polytechnic State University, San Luis Obispo, will be timely in helping to meet the potential demand for graduate degrees in the field, both in terms of increasing the output of the available degree programs and also to provide a western presence. If the requirement for a graduate degree in order to be licensed is adopted by the states, it will be interesting to see if additional universities initiate degree programs to meet the need.

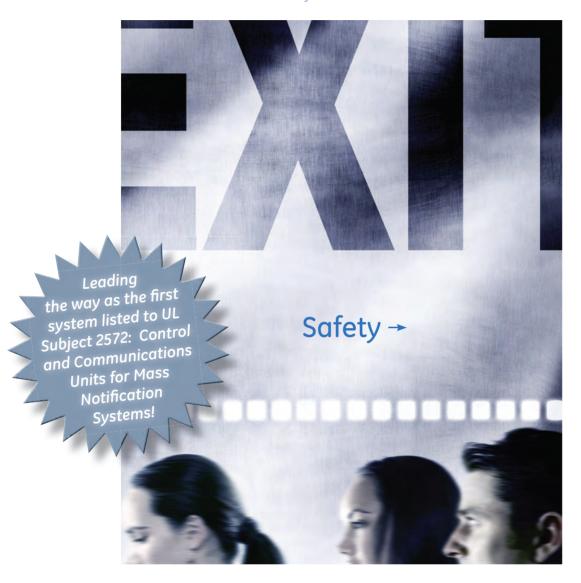
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# ERESAFETY ENGINEERING

Current Practice and Foreseen Evolution

By Joël Kruppa

Since 1999, the French regulations permit engineers to consider design fires other than the standard fire as part of a performance-based "solution" to fire resistance design.

ire safety design in France for life safety and property protection is mainly prescriptive and managed by regulation.

Depending on the use to which the building or civil engineering work is put, it comes under the responsibility of different ministries:

- The Ministry of Interior deals with public buildings including car parks and high-rise buildings, whilst having responsibility for assessment methods concerning reaction to fire and fire resistance;
- The Ministry concerned with construction deals with apartment blocks and houses;
- The Ministry of Environment deals with industrial buildings such as warehouses and silos;
- The Ministry of Employment deals with workplaces such as office buildings and, to some extent, industrial buildings;
- The Ministry of Industry deals with the nuclear industry;
- The Ministry of Transportation deals with tunnels.

Due to this fragmentation in responsibility for fire safety matters, even if views are exchanged between ministries, consistency in requirements from one building to the next can be very poor when comparing relative risk levels.

These regulations are mainly based on prescriptive requirements for the design and maintenance of buildings and civil engineering works and on levels of performance to be reached as far as reaction to fire and fire resistance are concerned. Some of these regulations have, nonetheless, introduced certain fire safety engineering (FSE) aspects, such as the regulation of the nuclear industry and for large industrial buildings. For some others, FSE is allowed as an alternative design concerning specific aspects.

In addition, there is a national research project on fire safety engineering in progress, with the aim of developing a best practice methodology for this approach and opening the door to more widely alternative designs.

#### **CURRENT PRACTICE**

Alternative designs, based on the fire safety engineering approach, have been permitted in France for some aspects of fire safety design since 1999. These include fire resistance, smoke control in public buildings and structural behavior of large warehouses.

#### **FIRE RESISTANCE**

Before allowing the FSE approach, which means design based on analysis of specific fire scenarios, calculation has been allowed in France for several decades to justify the structural fire stability of building elements, to replace test results obtained under a standard fire. This began in 1974 with a calculation method for concrete structural members, followed in 1976 with a calculation for steel structural members and then in 1988 with one for timber structures and another for composite (steel + concrete) columns.

These French calculation methods have now been more or less replaced by the fire design parts of the Structural Eurocodes developed at a European level. The Eurocodes permit the use of design fires other than the standard time-temperature curve mainly set up for testing purposes. Since 1997, use of the Eurocodes for fire safety design has been permitted.

Since 1999, the French regulations permit engineers to consider design fires other than the standard fire as part of a performance based solution to fire resistance design. In this respect, four conditions are required:

The design fire scenarios need to be agreed by Authorities Having Jurisdiction (AHJ), including generally firefighters. Additionally, performance criteria have to be fulfilled, a peer review of the fire design assessment has to be carried out by one or two authorized French fire resistance laboratories and rules for maintenance and control have to be instigated, to ensure that the design fire scenarios

will not be exceeded during the use of the building.

This alternative approach to design for structural fire resistance of buildings has been mainly used in specific construction situations for which prescriptive rules are not adequate or inhibit architectural creativity. Since 2004, about 30 cases of structural fire engineering design were performed and approved by the relevant authorities.

#### **SMOKE CONTROL**

The alternative design of buildings, as far as smoke control is concerned, is only allowed for public buildings. The conditions to be fulfilled are:<sup>2</sup>

- Must be performed by a recognized design office (recognized by the Ministry of Interior);
- Must obtain agreement on design

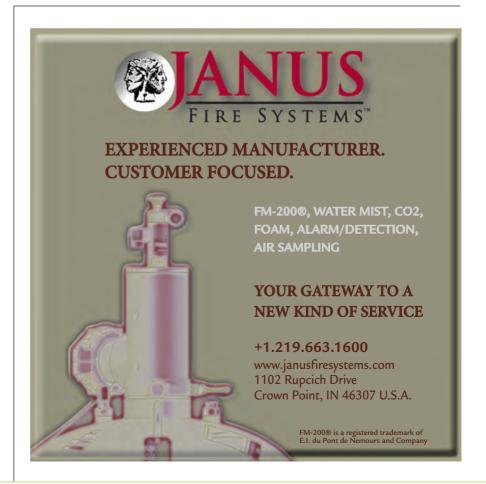
- fire scenarios from authorities having jurisdiction; and
- Must check that the clear smoke layer height is sufficient for escaping occupants (generally more than 1.8 m) and that heat flux received by occupants is tenable (generally less than 2.5 k/m²).

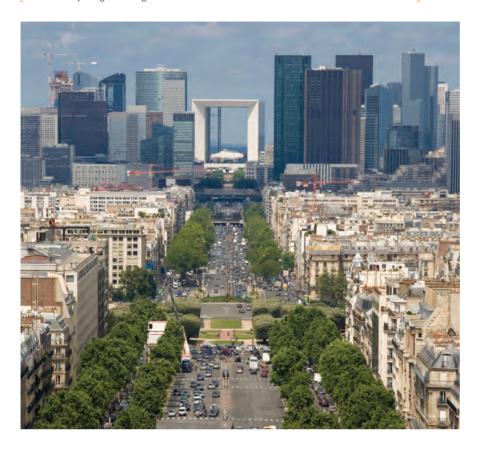
No peer review is required, since only a limited number of design offices are currently recognized in France.

About 30 cases of such smoke control designs have been performed since 2004.

#### ALTERNATIVE DESIGN OF WAREHOUSES

For warehouses with a volume exceeding 50,000 m<sup>3</sup> and for single story buildings with a roof height greater than 12.5 m, instead of fulfilling a fire resistance rating of one hour (R60 according to Euroclasses) for the





structural frame (prescriptive requirement), any non-fire-rated structure is permitted if there is a sprinkler system installed and fire safety engineering can demonstrate that:<sup>3</sup>

- Progressive collapse cannot be a result of a localized fire (meaning no collapse where fire effects are still negligible);
- If there is a collapse, the structure collapses toward the inside of the building (to protect firefighters who are, mainly, located outside the building); and
- The development of the fire does not endanger the lives of occupants and firefighters when they are still in the building

#### **CURRENT EVOLUTION:**NATIONAL PROJECT ON FSE

#### **REASONS FOR THIS PROJECT**

French representatives first became involved in the ISO standardization work dealing with fire safety engineering (ISO TC92/SC4) at the end of the 1990s. At the beginning of the third millennium, it is becoming increasingly clear that prescriptive regulations are not the only way to deal with fire safety. The fire safety engineering approach needs to be implemented more widely, rules for its use developed and gaps in knowledge filled as far as possible.

Consequently, and with the sponsorship of ministries in charge of construction and the interior, a collaborative research project has been set up in France, involving about 40 different companies including research institutes, fire brigades, design offices and users.

#### CONTENT

The project, with a budget of about 5 M€, started in mid-2005 and is expected to end by 2010. It is divided into 19 main items clustered in three main parts:

 Development of general principles for FSE assessment, verification of the approach by examples and

- comparison with real fire evidence.
- State of the art and research projects regarding fire development and spread, fire containment, fire protection, human behavior and protection of the environment.
- Proposals for regulation improvements, teaching of FSE and publication of outputs.

At the end of 2010, a final report will provide general principles for FSE assessment as well as detailed information for design offices, including proposals for control by AHJs.

#### **EXPECTATIONS**

This project has already given leading French fire safety companies the opportunity to exchange ideas about FSE and to agree on common principles. Amongst these principles, control of the AHJ, mainly for the design fire scenario proposals, and peer review are considered major needs. Regulatory authorities are waiting for straightforward statements on how to calculate occupant egress and define tenability conditions in order to broaden current regulations. Some thought is also being given to the possibility of having a unified regulation dealing with fire safety matters in buildings and civil engineering works. Such a regulation would promote consistency between requirements, leading designers to consider appropriate protective means based on risk analysis. A final guide on the main outcomes will be made publically available at the end of this research.

Joël Kruppa is with CTICM.

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– LESSONS FROM 17 YEARS of a PERFORMANCE-BASED BUILDING CODE

By Michael Dixon

www.FPEmag.com

Fire Protection Engineering

he practice of fire engineering in New Zealand has now some 17 years of experience operating under a performance-based building code. The industry emerged as a result of a radical change in building regulations in 1991, when there was a change from a heavily prescriptive regime to a performance-based set of rules almost overnight. Performance-based fire engineering was embraced as a new way of producing innovative designs.

The industry has matured over the years from a naïve start when in its infancy and has gone through some painful learning experiences. Fire engineering is still not a fully mature industry. There are still some significant challenges to be overcome as the practice of fire engineering settles into a structure and method of operating that is universally accepted by all the stakeholders.

The intention is to restore the confidence of the regulators in accepting designs of fire engineers who can demonstrate their competence.

#### **HISTORY**

To understand the current state of fire engineering in NZ, it is necessary to first understand the history of the

underlying legislation and building regulations that govern the construction and building industry in NZ. Prior to 1991, NZ operated under a fragmented set of building controls that were made up of a combination of government (national) and local authority (regional) regulations, all of which were based on prescriptive requirements.

In 1991, the NZ Building Act<sup>1</sup> was passed that created a uniform, performance-based building code throughout the country. It was administered by the local territorial authorities with regulations developed by a quasi-governmental Building Industry Authority (BIA). The performance-based building code was accompanied by a set of prescriptive, deemed-to-comply documents known as the "Acceptable Solutions". The Building Act was intended to cover all building regulations in one piece





of legislation and indeed included a clause to the effect that no authority could require a building to be constructed to a standard that exceeded the building code.

The intention was to deliver an environment that permitted innovative design of buildings while ensuring that basic code requirements were met.

In most areas of the building code, the Acceptable Solutions were prescriptive and based on generic information applicable to most buildings, but in the case of the fire safety acceptable solutions, the introduction stated:

"1.1.1 This acceptable solution is one way, but not the only way, of satisfying the New Zealand Building Code (NZBC) provisions for fire safety in buildings.

1.1.2 The methods given are particularly appropriate for simple, low-rise buildings. However, for individual buildings, alternative solutions developed from specific fire

There is nothing to stop anyone from calling themselves a 'fire engineer' and carrying out fire safety designs.

engineering design could produce more economical results."

However, the documents went on to give prescriptive requirements for all possible buildings. Although they were intended as a 'cookbook' set of documents that could be used by anyone for a simple building, they also required specific design in some circumstances but were silent on who could carry out the specific design. There was no requirement for any minimum level of qualification or competence to undertake a specific design.

Indeed, there is no protection on the title 'fire engineer' in New Zealand. There is nothing to stop anyone from calling themselves a 'fire engineer' and carrying out fire safety designs. The only protection (one not relating specifically to fire engineering) is on the status of Chartered Professional Engineer (CPEng), for which one is required to undergo a five-yearly competence assessment carried out under the auspices of the Institution of Professional Engineers NZ (IPENZ).

#### THE EARLY YEARS

In the years that followed the initial publication of the Acceptable Solutions, it became common for fire safety designs to utilize portions of the Acceptable Solutions combined

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with departures justified by anything from simple opinion to calculations. Providing the territorial authority was satisfied with the justification, a building consent could be granted and the building constructed. Some consent authorities requested an independent peer review of the design, but there was no mandatory process for checking of fire safety (or any other building code feature, for that matter).

The fire safety design was usually articulated as a 'fire report', which was often a brief document that included a mixture of analysis to show how the building complied with the building code, combined with a summary of requirements that the architect or other designers had to include into their respective designs. In many cases, the fire report was not commissioned or prepared until after the majority of the building design had been completed, so the fire engineer was under pressure to justify that the design complied with the building code. Alternatively, it was not uncommon for preliminary fire reports to be produced early in the design process and the fire engineer not consulted further. There was no mechanism in the process for ensuring that the

design intent was fully implemented in the final construction.

Where interpretations were required, the BIA was consulted and determinations issued. Despite objections from many of the original authors of the Acceptable Solutions, the determinations referenced the Acceptable Solutions as a benchmark or minimum standard, rather than a more conservative design solution as they were originally intended. The principle that specific fire engineering design could produce more economic solutions has been pushed aside.

Alongside the Building Act, there is a separate piece of legislation, the Fire Service Act, that covers (amongst other things) the procedures that govern the evacuation of buildings in the event of fire. This is the legislation under which the fire service operates and includes their powers to approve (or not) the evacuation scheme required by most commercial buildings.

#### A MAJOR SETBACK

In the mid 1990s, in areas totally unrelated to fire safety, it became apparent that there was a major problem with many of the

Some designs were being approved based on very sketchy documentation and with limited justification.

domestic dwellings that had been recently built in relation to their weather tightness. Many were seriously defective and the 'leaky building' problem (which is still a problem) is costing many millions of dollars to fix.

The blame was laid at the door of inadequate building controls, and the liability was often ultimately left with the territorial authorities, as the original developers had disappeared. However, it also became apparent that the buildings had been constructed based on only very sketchy documentation with minimal justification of how the designs met the building code.

This has resulted in the territorial authorities becoming very risk-averse in all areas of building compliance. Any design that departed from the Acceptable Solutions was treated with a high degree of suspicion to the point where the time and effort spent justifying the design was often more onerous than the potential benefits that the alternative design could deliver.

In parallel with leaky buildings, there was some concern with the quality of fire safety designs that were being produced. Some designs were being approved based on very sketchy documentation and with limited justification. There were instances of buildings being denied their evacuation scheme approval, even though they complied with the building code

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Customer Service Representatives are available Monday through Friday 5:30 am to 5:00 pm PST. Call 877-222-5356 or 805-226-6297, info@zurnwilkins.com or visit us online at www.zurn.com (despite the legal position where features in excess of the Code could not be mandated). This has led to a lack of confidence in 'fire engineers' to produce designs that will satisfy the regulators and thereby meet the client's objectives.

In part, the blame for this situation can be laid with an inadequate process to develop a fire engineering brief in the early stages of the project. Some designs were undertaken almost in complete isolation of the remainder of the stakeholders outside of the direct project team. This was partially in ignorance of the importance of the process, but was also due to bad experiences with regulators who did not understand the concept of a performance-based design. A lack of general agreement on some of the basic design parameters also meant that some projects bogged-down as agreement could not be reached.

#### **RECENT CHANGES**

Move forward to 2004, and the Building Act was given a major rewrite with the intention of tightening the building controls and improving the level of documentation that was required before an approval to build (a 'building consent') could be granted. It also established a Design Review Unit (DRU) within the NZ Fire Service which is tasked with reviewing certain aspects of designs that are not wholly based on the Acceptable Solutions.

At about the same time, a task force was established under the umbrella of the IPENZ to investigate the state of fire engineering in NZ. The task force report<sup>2</sup> was published in late 2007 and included a series of recommendations for fire engineers and other stakeholders in the design and construction process.

The DRU is tasked with reviewing

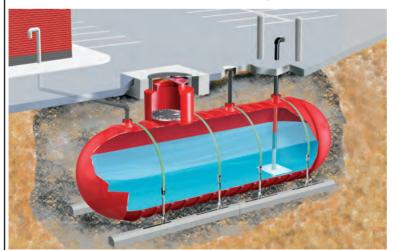
aspects of fire safety designs relating to means of escape and fire service operations that deviate from the Acceptable Solutions. They are intended to be independent of the design process and so will not engage in any discussions during the design process or during their reviews.

This has led to some friction with the practicing fire engineering community when review comments are perceived as being out of context of the design or asking for features that are seen as exceeding the requirements of the building code. Some territorial authorities have also been using the DRU for carrying out full peer reviews of designs – a task that is outside of their mandate.

It has also been recent experience that the amount of documentation and calculation (and hence cost to the client) required to justify an alternative

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design (even when based closely on the Acceptable Solutions) is disproportionate to the benefit gained by the design. Clients and their architects have less confidence that the performance-based design route will deliver any value or innovation.

#### **CURRENT CHALLENGES**

So to summarize the issues that the fire engineering profession are currently facing:

- Design documentation that is of a highly variable quality
- Regulatory authorities that are reluctant to accept alternative designs as these are seen as a liability risk
- Designs being carried out by unqualified 'fire engineers'
- A fire engineering briefing process that is underutilized and not well understood by designers or regulators
- A lack of consensus on basic design data
- A lack of consistent design implementation during construction

Pivotal in the recommendations of the IPENZ task force is a program to educate other stakeholders in what qualifications and experience should be held by individuals before they can rightly be called upon to carry out specific fire engineering designs. Membership in SFPE and having CPEng status are obvious items. The intention is to restore the confidence of the regulators in accepting designs of fire engineers who can demonstrate their competence. The NZ SFPE executives have been meeting with the territorial authorities to improve the dialogue between the regulators and practicing engineers.

Another branch to the task force outcomes has been a drive to improve the quality of fire engineering design documentation. There have been some workshops held amongst the practicing fire engineering community to gain consensus on what is

Fire engineering has been in danger of being forced out of existence due to the perception that alternative designs were too risky or did not deliver benefits to the clients.

appropriate to include within the design documentation and how

the design should be articulated. The move is away from a 'fire report' to properly separate the design specification (e.g., the requirements of the fire safety design that must be included in the designs of the architect and other design professionals on the project) and the design verification and calculations that demonstrate to the approving authority that the design meets the objectives of the building code. This is an ongoing program that will result in guidelines that will assist both fire engineers and those using their services.

#### **SUCCESSES**

However, it is not all doom and gloom. There have been some good examples of successful projects where the design team and other stakeholders have developed a fire engineering brief and followed through to a properly documented and approved design, with successful implementation in construction. These projects have recognized the value in investing time early in the project to gain agreement of the stakeholders.

An example is a recent major redevelopment of an art gallery

where the client has been able to incorporate their own requirements and procedures for property protection to exceed the minimum Code requirements but also make use of this additional protection to allow a relaxation of other features that would otherwise have been mandatory.

There have also been some successful projects that have utilized specific fire engineering design as alternative solutions to the prescriptive documents, which have allowed the building design to incorporate features that would otherwise have been impossible. The client's input at the early stages of the design has encouraged their complete involvement in the process and enabled them to make well-informed decisions in the full knowledge of the possible outcomes.

The challenge remains to make these successes the benchmark for all projects.

#### **THE FUTURE**

Fire engineering has been in danger of being forced out of existence due to the perception that alternative designs were too risky (by the regulators) or did not deliver the benefits (to the clients).

However, with a move to more involve the stakeholders in the briefing process and to improve the quality of the design documentation, practicing fire engineers who are already doing quality designs, or those who recognize the problem and take action, will lift the discipline of fire engineering to where it should be.

The challenge is to maintain and increase the confidence of the clients and their architects to allow them to produce designs that are innovative without being stifled by the current prescriptive Acceptable Solutions.

Michael Dixon is with Stephenson & Turner NZ Limited.

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# past, oresent+ of fire protection engineering practice in Japan

By Isao Kasahara and Ai Sekizawa

This article reviews the role of fire protection engineers and the progress of fire protection engineering in Japan and then introduces the future tasks of the SFPE (Society of Fire Protection Engineers) Japan Chapter.

#### DAWN OF PERFORMANCE-BASED FIRE SAFETY DESIGN AND THE PROGRESS OF FIRE PROTECTION ENGINEERING IN JAPAN

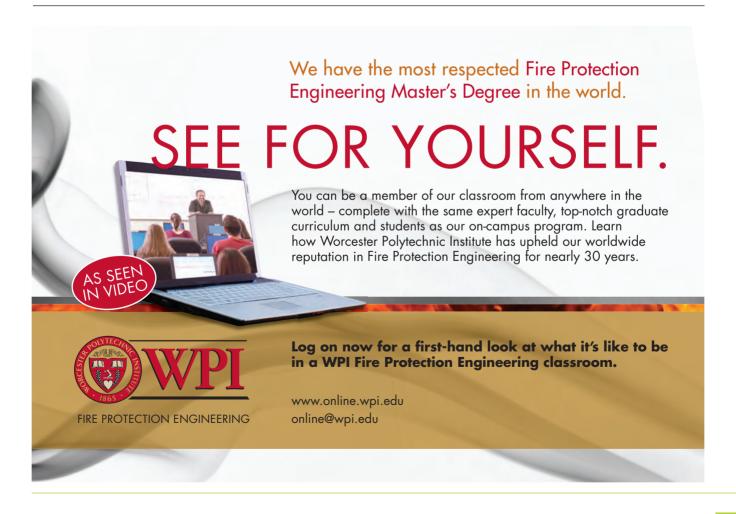
Buildings used to have a height of less than 31m and most were designed according to the prescriptive building regulations in Japan. This started with the construction of the Kasumigaseki Building in Tokyo, the first skyscraper with 36 stories above ground level, in 1968. In the next three decades, Japan achieved considerable economic growth, resulting in the construction of numerous skyscrapers, atriums and domes. In order to apply technical innovations to the design of such buildings, Article 38 concerning the approval of alternative solutions was added to the Building Standard Law of Japan in 1969. At the same time, the

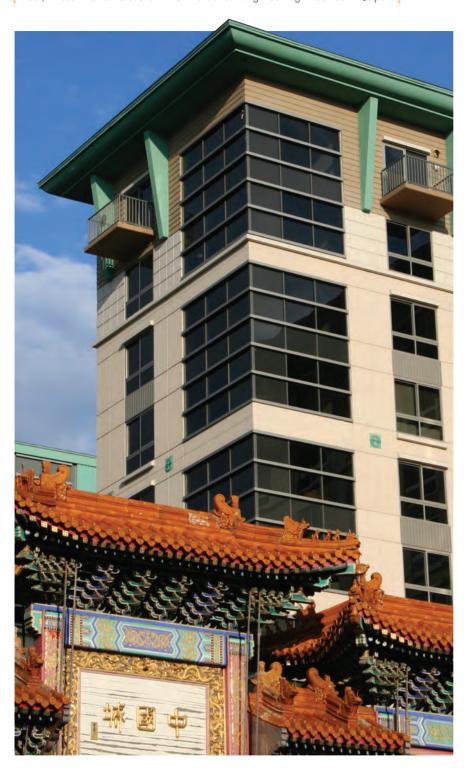
Japan needs to establish an official qualification for fire protection engineers.

Performance Evaluation Committee for Fire Safety was established in the Building Center of Japan for authorizing alternative solutions in accordance with the article.

Article 38 of the Building Standard Law stipulated that "a technique that is deemed by the Minister of Construction to have the level of performance equivalent to or higher than the level specified by the Building Standard Law may be adopted." The Performance Evaluation Committee for Fire Safety was organized based on the provision and staffed with researchers and experts in the relevant fields. The provision was presented to encourage the development of new techniques. The framework enabled any technical challenges and promoted performance-based design and the development of fire protection engineering in Japan. New techniques were applied to numerous buildings. But Article 38 together with the Performance **Evaluation Committee for Fire Safety** was eliminated when the Law was revised in 2000.

In the same period, Professor Kunio Kawagoe played a central role in the development of new scientific research and computational tools required for performance-based





fire safety design through the efforts of the Building Research Institute, universities and private research organizations. As a result, the "Comprehensive Fire Safety Design Method" was published to share techniques and information between the public and private sectors. This

was an epoch-making step from a global viewpoint, since there are still many countries where the information and computational tools required for performance-based fire safety design are not yet fully available.

The report systematically specified the engineering methods required for

protecting buildings from fires with respect to the properties of fires, structural fire resistance design, design for safe evacuation and smoke control. The report made great contributions to the progress of performance-based fire safety design in Japan. With the high economic growth in Japan until around 1995, performance-based design was selected for many buildings where technical innovations were used. Figure 1 shows the number of submittals annually prepared using performance-based fire safety design.<sup>2</sup>

In the meantime, fire research progressed also in private construction companies and design offices. Figure 2 shows the number of research papers submitted to annual conferences of the Japan Association for Fire Science and Engineering (JAFSE). However, while fire protection engineering is practiced in Japan, neither the status nor the position of fire protection engineers have been officially recognized there.

#### REVISION OF PERFORMANCE-BASED CODES

With the revision of the Building Standard Law in 2000, provisions concerning performance-based design were incorporated into the law. At the same time, the provision concerning ministerial approval in Article 38 of the law was eliminated. Most fire protection engineers welcomed the announcement of the revision of the law and hoped for improvements. The revision, however, did not fully realize their expectations. The new provisions focused on verifications of only two types of performance – evacuation safety and fire-resistance.

Figure 3 shows the framework for design approvals in the new provisions. These provisions stipulate three paths of approval – routes A, B and C. Route A is a deemed–to–satisfy option, which is also know as prescriptive requirements. Routes B and C are performance-based codes. Route B stipulates calculation methods and main calculation conditions.

The provision concerning evacuation safety stipulates that performance should be determined by comparing the time for the smoke to reach a specified level and the time required for evacuation. In the cases of structural fire resistance design, the duration in which structural stability is maintained should be compared with the duration of the fire. Highly simplified calculation methods have been adopted in Route B.

In the Route B provisions, the transparency and simplicity of performance-based design procedures are emphasized. And accordingly, performance-based design methods and calculation tools are fixed and generalized. This has enabled people who are not fire protection engineers to utilize performance-based design.

While adopting simple calculation methods is useful in Japan where no system is available for recognizing fire protection engineers, a result is that fire protection engineers are frequently not used for routine designs. As a consequence, satisfying simple requirements becomes the objective of design. Other important factors that might be recognized by fire protection engineers are likely to be disregarded.

In the process of Route C, fire protection engineers have free rein over their choices of analysis methods and calculation conditions, provided that the validity of the calculation methods and design conditions are substantiated. The scope of application of performance-based fire safety design has, however, been restricted. In the past dozen years, construction demand has been deteriorating in Japan under severe economic conditions, resulting in reduced opportunities for designing buildings. With the maturity of performance-based fire safety design techniques, fire protection engineers have not continued to advance the profession at the same pace as before. The revision of the Buildina Standard Law in 2000 restricted the applications of performance-based design. Now that ten years have already passed since the establishment

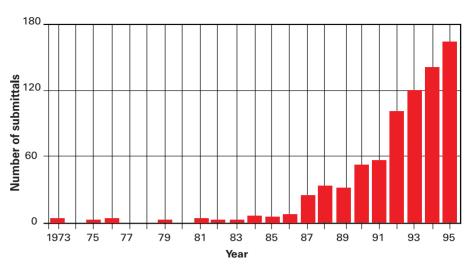


Figure 1. Performance-Based Design Submittals

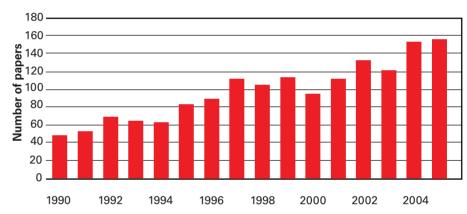


Figure 2. Fire Research Papers Published

of the new provision, work has been started to review the provision.

# FIRE PROTECTION ENGINEERS' AWARENESS OF THEIR PROFESSION IN JAPAN AND THE MISSIONS AND TASKS OF THE SFPE JAPAN CHAPTER

The Japan Chapter was formed in May 2002. Prior to the formation of the Japan Chapter, engineers were responsible for performance-based fire safety design in construction companies, design offices or manufacturers of fire protection equipment in the private sector, but neither fire protection engineers nor fire protection engineering were officially recognized, and engineers were regarded simply as fire protection staff in their

respective departments. They were in contact with one another mainly through academic organizations or while participating in the Performance Evaluation Committee for Fire Safety.

The categories of members of the Japan Chapter are shown in Figure 4. More members work for general contractors than any other category. Japanese general contractors have design and research departments. The chapter members also belong to fire protection consultants, design offices, educational and research institutions, administrative organizations (e.g., fire personnel) or other organizations. Fire protection consultants are represented by a few members at present.

The major target of the Japan Chapter is to establish an official auglification for fire protection engineers. Only architects are officially qualified in Japan in the field of architectural design. It has, however, long been pointed out that with remarkable technical developments, architects who are engaged in general design cannot understand the detail of structural and/ or mechanical and electrical systems in a building and assume the responsibility for the design. In the wake of the revelation of improper structural design in 2006,3 the architectural design systems were reviewed and a system was established in December 2008 for authorizing structural design and the design of mechanical and electrical systems. No authorization system is, however, available for fire protection.

Now that performance-based design has progressed to fire safety, practitioners of fire protection engineerina design need to have scientific and engineering knowledge. Architects engaged in ordinary design cannot understand fire safety design techniques in detail. Thus, the participation of fire protection engineers in design is essential. Officially certifying that practitioners of fire protection engineering design have the knowledge necessary for performance-based fire safety design is essential to assure safe design. At present, however, administrative authorities do not recognize this need. The Japan Chapter will make continuous efforts to encourage the authorities for recognition.

The Chapter is also performing working group activities, conducting

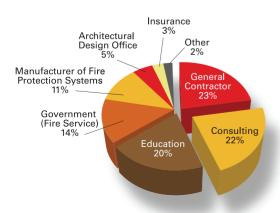


Figure 4. Member Categories

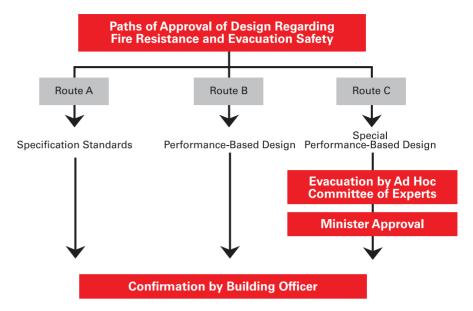


Figure 3. Framework for Design Approval

excursions and holding symposiums. The proposed design for the case study presented at the 7th International Conference on Performance-based Codes and Fire Safety Design Methods held in Aukland, NZ, in April 2008 was the result of activities of a working group composed mainly of young members of the Japan Chapter. Also, the chapter has made a comprehensive pamphlet by the effort of another working group for fire safety of facilities for the elderly, which has recently been a big issue in Japan. This pamphlet will be distributed to the general public to help ensure the safety of facilities for elderly people.

#### **FUTURE TASKS OF SFPE JAPAN CHAPTER**

The first task is networking among the SFPE chapters in the Asian region. Since cities in the Asian area are rapidly being developed, growing numbers of high-rises and very unique buildings have appeared. This has also resulted in the increase of fire risk. In addition, residential fires as well as fires in nursing homes for elderly people has become one of the main concerns from the viewpoint of fire safety in Japan, as the number of fire deaths in those facilities is

increasing year by year. Contributing to the control of this problem must be the social responsibility of fire protection engineers. This activity would also be useful in the near future in other Asian regions. In such a situation, the regional cooperation of SFPE chapters can contribute to fire safety.

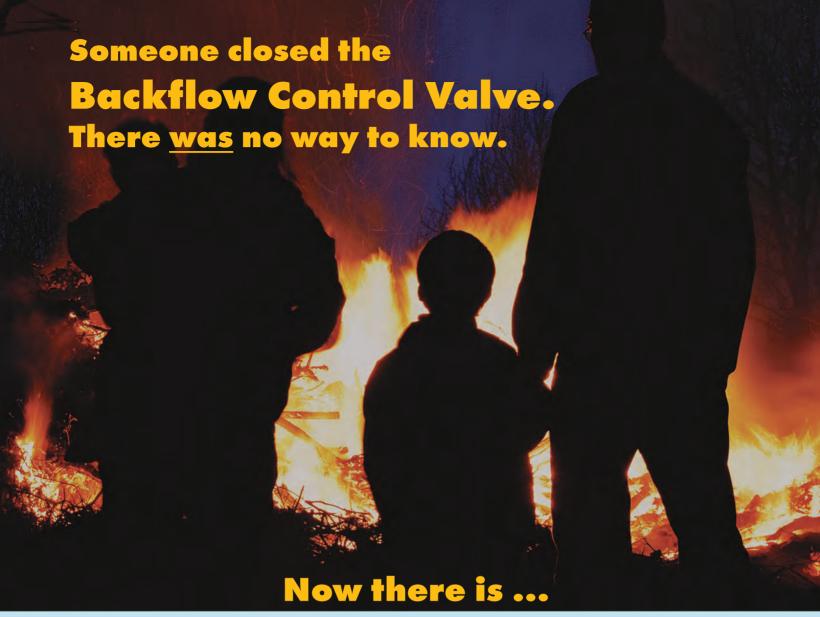
The second task is advancing one more step toward the establishment of the fire protection engineering profession in Japan. Although the profession has not yet been established in Japan, a framework for the performancebased fire safety design should be established based on the premise that fire protection engineers, who are equipped with engineering knowledge concerning fire protection, are engaged in design.

Isao Kasahara is with Sound and Environment Research, Inc.

Ai Sekizawa is with Tokyo University.

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- Tanaka, T., "Development of performancebased fire protection design method", BRI 50th anniversary 1996, BRI, pp. 156-159, Tsukuba, Japan, 1997
- The Japan Times Weekly, May 6, 2006. Accessed from http://www.japantimes.co.jp/weekly/news/nn2006/nn20060506a1.htm on May 19, 2008.



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## ACCREDITATION BOARD FOR ENGINEERING AND TECHNOLOGY

By Richard J. Davis, P.E., FSFPE

BET)

n February 24, 2009, the Member Societies of the Accreditation Board for Engineering and Technology (ABET) ratified the admission of the Society of Fire Protection Engineers (SFPE). SFPE now joins this federation of 28 other professional and technical societies. This is another big step forward in advancing fire protection engineering as a standalone field of engineering.

Joining ABET allows SFPE to provide support to the educational institutions that teach fire protection engineering in the U.S., and should encourage more schools that teach fire protection to seek accreditation. This benefits those schools and also benefits the profession directly by helping supply qualified graduates to the field. Currently, there are only two schools in the U.S. that have ABET accredited programs in Fire Protection Engineering (FPE) or Fire Protection Engineering Technology (FPET). They are the FPE BS program at the University of Maryland at College Park (UMCP) and the bachelor's program in Fire Protection and Safety Engineering Technology (FPST) at Oklahoma State University (OSU).

The ABET currently accredits some 2,700 programs at more than 550 colleges and universities throughout the U.S.\(^1\) Over 1,500 dedicated volunteers participate annually in ABET activities. A record was set in 2008 when ABET accredited 895 programs.

Recently, the ABET approved a change to their Accreditation Policy and

Procedure Manual that will allow institutions to seek accreditation for their engineering programs of the same name/discipline at multiple levels (i.e., bachelor's and master's) concurrently. The change will go into effect with the 2009-2010 accreditation cycle.

#### WHAT IS ABET?

ABET is a federation of societies organized for the public good. It is a non-stock membership corporation based in the United States and focused on quality assurance and world leadership in fulfillment of its educational, charitable and scientific purposes. ABET improves public welfare through the accreditation of educational programs, thus assuring the competence of graduates entering professional practice.

ABET educational programs include applied science, computing, engineering, technology and other disciplines as approved by the ABET Board of Directors.

#### **HISTORY OF ABET**

Surveys conducted by professional engineering societies in the 1920s determined that there was a need to build up engineering as a profession. Consequently, ABET was

established in 1932 as the Engineers' Council for Professional Development (ECPD). The original focuses of the ECPD were in the following areas:

Guidance — Supply information to engineering students and potential students.

Training — Developing plans for personal and professional development.

Education — Appraising engineering curricula and maintaining a list of accredited curricula.

Recognition — Developing methods whereby individuals could achieve recognition by the profession and the general public.

The ABET was founded by seven engineering societies: The American Institute of Chemical Engineers (AIChE), the American Society of Civil Engineers (ASCE), the American Society of Electrical Engineers (ASEE), what is now the American Society of Engineering Education (ASEE), the American Society of Mechanical Engineers (ASME), what



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is now the American Institute of Mining, Metallurgical and Petroleum Engineers, and what is now the National Council of Examiners for Engineering and Surveying (NCEES).

In its first year, ECPD developed itself as an accreditation agency. In 1936, ECPD evaluated its first engineering degree programs and in 1946 began evaluating its first engineering technology degree programs. By 1947, ECPD had accredited 580 undergraduate engineering programs at 133 institutions. It produced dozens of books, pamphlets, brochures and two movies on guidance and training.<sup>1</sup>

In 1980, ECPD was renamed the Accreditation Board for Engineering and Technology (ABET) to more accurately reflect its focus. In 1983, ABET created

what is now known as the Applied Science Accreditation Commission (ASAC). Since 1997, ABET has been recognized by the Council of Higher Education Accreditation (CHEA).

After nearly a decade of development, in 1997, ABET adopted its Engineering Criteria 2000 (EC2000). EC2000 was revolutionary to accreditation criteria as it focused on what is learned rather than what is taught. It called for a continuous improvement process informed by the specific mission and goals of the individual institutions and programs.

#### **INTERNATIONAL ACTIVITIES**

ABET's international activities are now a flourishing part

EC2000 was revolutionary to accreditation criteria as it focused on what is learned rather than what is taught.

of the organization. This began in 1979, when as ECPD, it signed its first mutual recognition agreement with the Canadian Engineering Accreditation Board. By 1989, ABET was a consultant to both beginner and established international accreditation boards, a "substantial equivalence" evaluator of international programs, and a founding member of the multinational Washington Accord.

The Washington Accord was the first international agreement governing mutual recognition of engineering qualifications and professional competence and recognizes substantial equivalence in the accreditation of qualifications in professional engineering, normally of four years duration.<sup>2</sup> The Washington Accord recommends that graduates of programs

accredited by any signatory to the accord be recognized by the other signatories as having met the academic requirements for entry to the practice of engineering. These activities are consistent with SFPE's goals to also serve their membership outside the U.S.

#### **ABET'S VISION AND MISSION**

ABET's vision is to provide world leadership in assuring quality and in stimulating innovation in applied science, computing, engineering and technology education. Their mission is to serve the public through the promotion and advancement of education in applied science, computing, engineering and technology by:

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- Accreditation of educational programs.
- Promotion of quality and innovation in education.
- Consultation and assistance in the development and advancement of education worldwide in a financially self-sustaining manner.
- Communication with their constituencies and the public regarding activities and accomplishments.
- Anticipation of and preparation for the changing environment and the future needs of its constituencies.

#### THE ABET STRATEGIC PLAN

The ABET Strategic Plan includes the following areas:

- Accreditation of educational programs.
- Promotion of quality and innovation in education.
- Consultation and assistance as requested in the development and advancement of education worldwide in a financially self-sustaining manner.
- Communication with constituencies and the public regarding activities and accomplishments.
- Anticipation and preparation for the changing environment and the future needs of constituencies.
- Managing the operations and resources to be effective and fiscally responsible.

#### STRUCTURE OF ABET

With the admission of SFPE, ABET is now a federation of 29 professional and technical societies. The body of the ABET is formed by individual members of the societies, including practicing professionals from industry and academe. Various positions include the Board of Directors, Program Evaluators (PEVs), and the Commissioners for the following:

- Applied Science Accreditation Commission (ASAC)
- Computing Accreditation Commission (CAC)
- Engineering Accreditation Commission (EAC)
- Technology Accreditation Commission (TAC)

The EAC will evaluate the FPE program at UMCP and the TAC will evaluate the FPT program at OSU.

The primary responsibilities of ABET Board of Directors are to set policy and approve accreditation criteria. The PEVs and commissioners make up the accreditation teams, which visit and evaluate the educational programs seeking accreditation. The commissioners implement accreditation procedures and decisions.

#### **OTHER COUNCILS AND COMMITTEES**

ABET councils include the Industry Advisory Council, whose members represent the major industries that ABET

serves; the Accreditation Council, whose members are leaders of ABET's four commissions; and the International Activities Council, whose members are current and former Board and commission members.

#### **VOLUNTEERS REPRESENTING SFPE FOR ABET**

SFPE is represented on the ABET Board of Directors.

Other volunteer positions include Commissioner for the EAC, Commissioner for the TAC, two Program Evaluators for the EAC and two Program Evaluators for the TAC.

#### LINK TO PROFESSIONAL LICENSURE

An indirect benefit to joining ABET is provided within the U.S., and increasingly in countries outside the U.S. That is, it is essential to maintain accredited programs in fire protection engineering (FPE) in order to retain the Professional Engineers (P.E.) licensing exam in FPE that SFPE has worked long and hard to provide. The P.E. registration process includes eligibility and educational requirements that reference ABET-accredited engineering programs.

The NCEES exams are gradually being offered in countries outside the U.S., beginning with Japan in 2008. In October of 2009, they will be offered in Korea, and NCEES also has plans to bring professional engineering exams to China, Egypt and Saudi Arabia in the next few years. Many countries do not have such an examination process. Some countries have their own licensure exam, but engineers who intend to work outside their native country may be required to be licensed via the NCEES exam.

#### **IMPLICATIONS TO THE SFPE**

Joining ABET requires a significant time burden on the volunteers of SFPE, as well as an expense to the Society. The Board of Directors has given this careful consideration over the last several years, and it was felt necessary to move forward on this in order to maintain the level of professionalism in fire protection engineering that has been attained over the last several decades and continue to move that in a forward direction. The involvement of SFPE with ABET will help assure the quality of education in fire protection engineering, which will carry over into professional practice; will support professional engineering registration; and will position SFPE prominently in the professional engineering community.

#### References

- 1 http://www.abet.org/history.shtml accessed August 31, 2009.
- 2 http://www.washingtonaccord.org/washington-accord/- accessed August 31, 2009.

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Quality and Quality in Fire in Protection Setting Standards for Excellence

hat does it mean to be "qualified" to design, install, test and maintain fire detection, alarm and signaling systems – any fire protection system for that matter? Licensing boards, owners and NFPA technical committees have struggled both to define the term and to impose it for complying with codes and standards. Their intent in defining and requiring qualified individuals or organizations is to ensure some baseline "quality" for the work that they perform and for the systems they leave behind.

The Merriam-Webster online dictionary defines "qualified" as:
"a: fitted (as by training or experience) for a given purpose: competent, b: having complied with the specific requirements or precedent conditions (as for an office or employment): eligible."

The first entry characterizes competence. A person who has had training and experience in the design of certain types of systems might be competent and, therefore, might be qualified to design such systems. The exact nature of the training and experience might not necessarily be defined.

The second entry implies a more rigid method for determining who might be qualified for a particular task. It implies that a licensing board, owner, code or standard will spell out particular qualities that someone must have to be considered qualified.

An examination of different laws, regulations, codes and standards reveals that requirements related to qualifications of designers, installers and technicians vary in exactly how they define or describe the trait of being "qualified." NFPA 72, the National Fire Alarm and Signaling Code, 2 uses a definition that originated in NFPA 96:3

**Qualified**. A competent and capable person or company that has met the requirements and training for a given field acceptable to the

authority having jurisdiction.

This definition meets the first form listed by Merriam-Webster but leaves open a path for authorities to impose a more rigid set of qualifications. The 2010 edition of NFPA 72 goes further in a new section titled "Personnel Qualifications" (10.4) where more specific requirements are listed for system designers; system installers; inspection, testing and maintenance personnel; and supervising station operators. For example, designers must follow state and local licensure regulations and must have experience for a particular task. Examples of qualified design personnel are listed in the Code and include, but are not limited to:

- (1) Personnel who are registered, licensed or certified by a state or local authority.
- (2) Personnel who are certified by a nationally recognized certification organization acceptable to the authority having jurisdiction.
- (3) Personnel who are factory-trained and certified for fire alarm system design and emergency communications system design of the specific type and brand of system and who are acceptable to the authority having jurisdiction.

The first example of designer qualifications is the most common and the one that most often leads to "specific requirements or precedent conditions" as listed in the Merriam-Webster definition. This is most often the P.E. license, which imposes very specific and thorough conditions necessary for licensure. To ensure that even a licensed P.E. is working within their expertise, the entire section on "Personnel Qualifications" in NFPA 72 (2010 edition) gives authorities the ability to "qualify" (used as a verb) designers.

Similar requirements and examples are in NFPA 72 for system installers; inspection, testing and maintenance personnel; and supervising station operators. Some argue that the requirements should be more specific and should name very specific testing, certification and licensing organizations. However, there are at least two problems with such an approach. First, NFPA regulations do not permit codes and standards to support or require such specifics. Second, there is simply no way to write a set of requirements that will apply and work well for all possible scenarios and conditions, especially when NFPA standards are applied outside of the United States.

On any one specific fire protection project, it might not be possible or reasonable to expect any one person or organization to have all of the qualifications necessary to ensure a quality project. The best project quality is the result of a successful partnership of individuals or organizations with more narrow qualifications. A person might know all of the requirements for designing a fire detection and alarm system and coordinating it with the other fire protection systems in a building, but a contractor can decrease the system effectiveness if they do not know the rules for spacing

Success Requires a Partnership

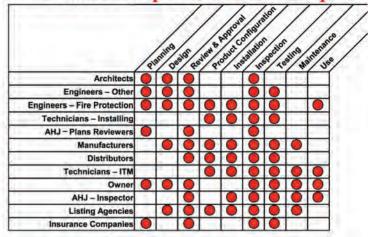


Figure 1. Partnership Matrix

detectors away from air vents. One contractor might know the electrical code inside and out and have a team that excels at quality installations, but they might be less expert at specific rules for strobe placement. Another contractor might know NFPA 72 rules quite well, but be less familiar with specific wiring requirements in the electrical code for special conditions. These are not necessarily reasons to disqualify an individual or organization, but they point to the need for someone to ensure success.

The inspection of fire detection, alarm and emergency communications systems requires qualifications that are rarely found in any one individual. Quality assurance for such an installation requires that circuits and pathways be inspected and checked for proper wiring methods and proper installation. Typically, this requires an electrical inspector that might not know much about the specifics for fire detection installation and performance or about requirements for occupant notification system design and installation. In many situations, individual qualifications must be pooled into a qualified team approach.

Figure 1 is a matrix listing the "life" of a typical fire protection system and the various stakeholders that might be involved during each stage. The entries in the matrix will vary for different systems, project sizes and risks. The matrix gives individuals and organizations a quick view at how a partnership might be needed to ensure a quality project. The best approach is to get everyone involved early in a project and to keep the lines of communication open. Everyone should have something positive to contribute, a role to play. Then, individual qualifications are combined and compounded to ensure a quality project.

#### References:

- 1 http://www.merriam-webster.com/
- 2 NFPA 72, National Fire Alarm and Signaling Code, National Fire Protection Association, Quincy, MA, 2010.
- 3 NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations, National Fire Protection Association, Quincy, MA, 2008.

#### UPCOMING EVENTS

#### February 16-19, 2010

Fire Suppression, Detection and Signaling Research and Applications Technical Working Conference Orlando, FL. USA

Info: epeterson@nfpa.org

#### March 8-10, 2010

5th International Conference on Pedestrian and Evacuation Dynamics 2010 Gaithersburg, MD, USA

Info: www.ped2010.org

#### June 8-9, 2010

11th International Fire Prevention Symposium Leipzig, Germany

Info: www.interschutz.de/60448

#### June 16-18, 2010

8th International Conference on Perfomance-Based Codes and Fire Safety Design Methods, Lund, Sweden

Info: www.sfpe.org

#### July 5-7, 2010

12th International Conference on

Fire Science and Engineering (Interflam), University of Nottingham, United Kingdom

Info: www.intercomm.dial.pipex.com

#### October 3-8, 2010

Annual Meeting: Professional Development Conference and Exposition, New Orleans, LA, USA

Info: www.sfpe.org

#### October 6-7, 2010

Fires in Vehicles, Gothenburg, Sweden Info: www.firesinvehicles.com

#### **BRAINTEASER**



#### Problem / Solution

#### **Problem**

oe says that if he adds two times his age two years from now to three times his age three years from now, he gets six times his current age. How old is Joe now?

#### Solution to Last Issue's Brainteaser

Using the digit "5" the number of times listed below, no other digits, and no addition ("+") signs, write a mathematical formula that calculates an answer of 110.

These problems have many solutions. For example, a formula for making 110 from (6) fives would be  $5 \times 5 \times 5 - 5 - 5 - 5$  (using 5 symbols). We will publish the formulas using the least number of symbols for each case below.

$$(3)$$
  $5! - 5 - 5$ 

(4) 
$$5! - \sqrt{5 \times 5} - 5$$

(7) 
$$\frac{555 - 5}{5} \times \frac{5}{5}$$

Answers submitted by Jane Lataille.

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#### MNEC Success Story The best and the brightest

In the wake of school shootings and campus violence, universities are scrambling to protect America's most precious assets – its students. At one private Midwestern university, a new Mass Notification system from GE demonstrates that safety isn't just an objective – it's part of the university's mission.

Faced with the rising challenge of keeping students and staff safe, school administrators chose GE's EST3-Sixty Emergency Communications platform for a number of reasons. First, an EST3 life safety system was already providing fire protection in some buildings. This made upgrading to EST3-Sixty a relatively easy task, thanks to the robust life safety communications already provided by the fire system.

But EST3-Sixty also had merits on its own. It has the distinction of being the first such system listed to UL 2562: Underwriter Laboratories' new Mass Notification standard. This listing, along with EST3-Sixty's concurrent UL 864 listing as a Life Safety system, was important to university officials because they had already made a long-term commitment to emergency communications, and they recognized that the fledgling MNEC industry was already showing signs of being code-driven, just like its fire and life safety predecessor.

Because of the differing ages of the buildings, and the challenges each site presented, the flexibility of EST3-Sixty and the expertise of the integrators were put to the test at every turn. As they dealt with unexpected problems, experts were actually designing and modifying the system on the fly. This proving-ground demonstrated the value of a system that can adapt to suit changing conditions – and the worth of experts who know how to tap into the features that take full advantage of its advanced technologies.

This commitment to emergency communications demonstrates that Mass Notification isn't just a buzz word – it's part of the university's mandate. As one university leader pointed out, parents who send their children there are entrusting the university with their most precious assets. They believe that, in return, the university has a responsibility to use the most effective means available to keep them safe and out of harm's way.

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#### PRODUCTS / LITERATURE >>>



#### Early Suppression Fast Response Sprinkler

The new JL-17 Early Suppression Fast Response (ESFR) sprinkler (with a K Factor of 16.8) was designed with a shorter frame that allows the piping to be installed lower from the ceiling and closer to structural members. It is designed for ceiling-only sprinkler systems with no in-rack sprinklers required, and is intended to be less susceptible to damage due to its smaller deflector and frame design. Available in either a 165F or a 212F rating, the sprinkler delivers approximately 119 gpm (450 L/min) of water at 50 psi (3, 4 bar).

#### www.reliablesprinkler.com

-The Reliable Automatic Sprinkler Co., Inc.



#### Pre-assembled Floor Control Assemblies

AGF Manufacturing has expanded its RISERPACK® line of pre-assembled floor control assemblies to include 1-1/2-in. and 2-in. male NPT x Groove connections available for both residential (NFPA 13D/13R) and commercial (NFPA 13) applications. The model 8000 Residential includes a domestically cast UL Listed bronze riser manifold, pressure gauge, water flow alarm switch, and a UL Listed/FM Approved model 3011 ball valve with NFPA required orifice. The model 8000 Commercial includes a domestically cast bronze riser manifold, pressure gauge with globe valve, water flow alarm switch, and UL Listed/FM Approved model 2500 test and drain valve with NFPA required orifice.

#### www.testandrain.com

-AGF Manufacturing





#### Ethernet Signaling System

The Keltron Ethernet Signaling System has received its UL Listing as a Proprietary, Central and Remote supervising station system. The system enables direct transmission via Ethernet of addressable information from fire and security alarm panels to the Keltron LS 7000 life safety event management system at an on- or off-site central station or PSAP. Using both input-monitoring circuitry and secure, supervised Ethernet communication, the Keltron Ethernet system leverages standard network infrastructure using XML-based message formats.

#### www.keltroncorp.com

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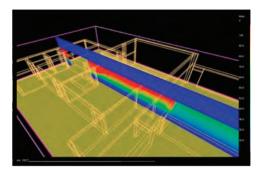
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Maryland Office: 6522 Meadowridge Rd,

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81 Pennsylvania Ave Niantic, CT 06357 Phone: 860-739-1886 Fax: 860-691-1123 Email: jlathrop@koffel.com





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