



TRENDS IN FIRE PROTECTION AND LIFE SAFETY FOR THE GLOBAL BUILT ENVIRONMENT

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DRIVERS FOR **15** TRENDS IN 2015

This report was produced by a team of JENSEN HUGHES global thought leaders to help our clients better understand the trends that are affecting rapid change in fire protection and life safety throughout the world.

“A good hockey player plays where the puck is, a great hockey player plays where the puck is going to be”

—Wayne Gretzky, Hall of Fame Hockey Star

These changes are occurring in technology, codes and standards and key building segments. In the next five years, our thinking and approach to fire protection and life safety in virtually every type of structure will need to be evaluated for the impact these trends will have on providing for the safety of people and protection of property.

GLOBALIZATION

Through advanced communications, the world has become smaller. Design teams are collaborating over multiple time zones. People are traveling to more worldwide destinations

than ever before. This increased activity demands the creation of all types of facilities, from hotels and hospitals to airports and transit systems. The largest location for casinos in the world today is not Las Vegas, but in Macau. The tallest buildings in the world are being designed by international firms and being built in China and the Middle-East. Internationally recognized codes and standards, such as from NFPA, play a major role by being used to provide

international best practices where local codes do not meet the design team requirements for large, complex buildings.

COLLABORATION

The complexity of technology-based fire protection and life safety systems demands that a broader range of disciplines become involved in the assessment, design, installation, commissioning and code compliance process. Digital technology tools for supporting performance-based design, field surveys and BIM are improving the quality and teamwork in the built environment. Teams are coming together today involving engineers, scientists and consultants who play key roles with the owners, developers, contractors and the authorities having jurisdiction (AHJ) stakeholders, using specialty firms to outsource compliance with global corporate guideline for due diligence and inspection, testing and maintenance.

RISK INFORMED DECISION MAKING

The move to have risk analysis as part of the design process for safety systems is continuing. Risk informed design is already being applied for this in the industrial, healthcare and mass notification systems codes. Probabilistic Risk Assessment (PRA) has been an established practice in the nuclear power industry. A risk-based approach to inspection, testing and maintenance is already being used for non-fire systems in the government and healthcare segments. This approach will continue to move into the codes for fire protection system applications during the next five years and will allow the facility operators to customize their Inspection/Testing/Maintenance (ITM) programs for the specific level of the facility risks.

Mickey Reiss, PE, FSFPE

President
JENSEN HUGHES International



James Pauley
President and CEO
National Fire Protection Association

LEADING IN FIRE AND SAFETY – NFPA AND THE FUTURE

For almost 120 years, NFPA has been on the forefront of fire and life safety. But modern day fire safety issues need modern day solutions and NFPA is constantly working to provide information and knowledge to help develop solutions.

Demographic shifts will require us to do more to ensure proper protections for an aging population that is growing rapidly and has a very different expectation of safety than previous generations. We are seeing and will continue to see the impact in our life safety and health care related codes and standards and our public education programs directed towards older adults. For example, *NFPA 99, Health Care Facilities Code* has moved from an occupancy-based document to one that is based on risk to patients. This means that the

safety provided to patients is based on the risk posed to them rather than simply on the name or designation (i.e. hospital, nursing home, ambulatory care, etc.) of the facility. A risk based approach intends to ensure that the same high level of safety is provided.

Within the U.S., the national presidential policy directive defines the key elements of resiliency as Prevention, Protection, Mitigation, Response, Recovery, which is consistent with the trend to an all hazards approach for emergency managers. NFPA's Fire Protection Research Foundation commissioned a study to explore how NFPA codes and standards address each of these concepts. *NFPA 1600, Standard on Disaster/ Emergency Management and Business Continuity Programs* is a base document that provides emergency preparedness planning guidance for organizations and facilities.

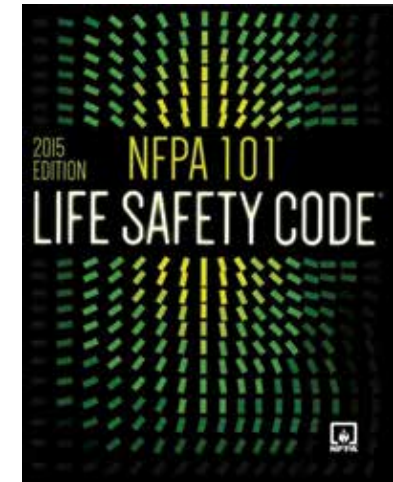
NFPA recognized the importance of globalization over 20 years ago to promote its mission and to support the membership (manufacturers, designers, consultants, end-users, government officials, etc.) who are working overseas. Historically our international efforts have centered on the use and adoption of NFPA codes and standards. Today, and into the future, NFPA is employing a more adaptive global strategy to further its mission and have greater impact against the fire problem in both developed as well as developing countries. A continually expanding portfolio of NFPA standards has been translated into 14 different languages

There is an emerging need for real time information on buildings (fire protection system performance data, fire fighting situational awareness data, community risk reduction data,

etc.). All of this information can be used to develop tools for our stakeholders.

Enforcers play a central role in safety, but their efforts are under increasing financial and resource pressure worldwide where enforcement exists. These everyday pressures and challenges faced by enforcers at the local, state, and national levels compromise safety. In some areas of the world there is little to no enforcement. There is a need to offer greater support and tools to enforcers to make their jobs easier and assist in establishing systems of enforcement where it is not happening.

These are just a few of the shifts we see occurring today and we are making sure we are in a position to help make your jobs easier and more effective through the right information and knowledge to address them.





Phil Rogers
CEO
JENSEN HUGHES

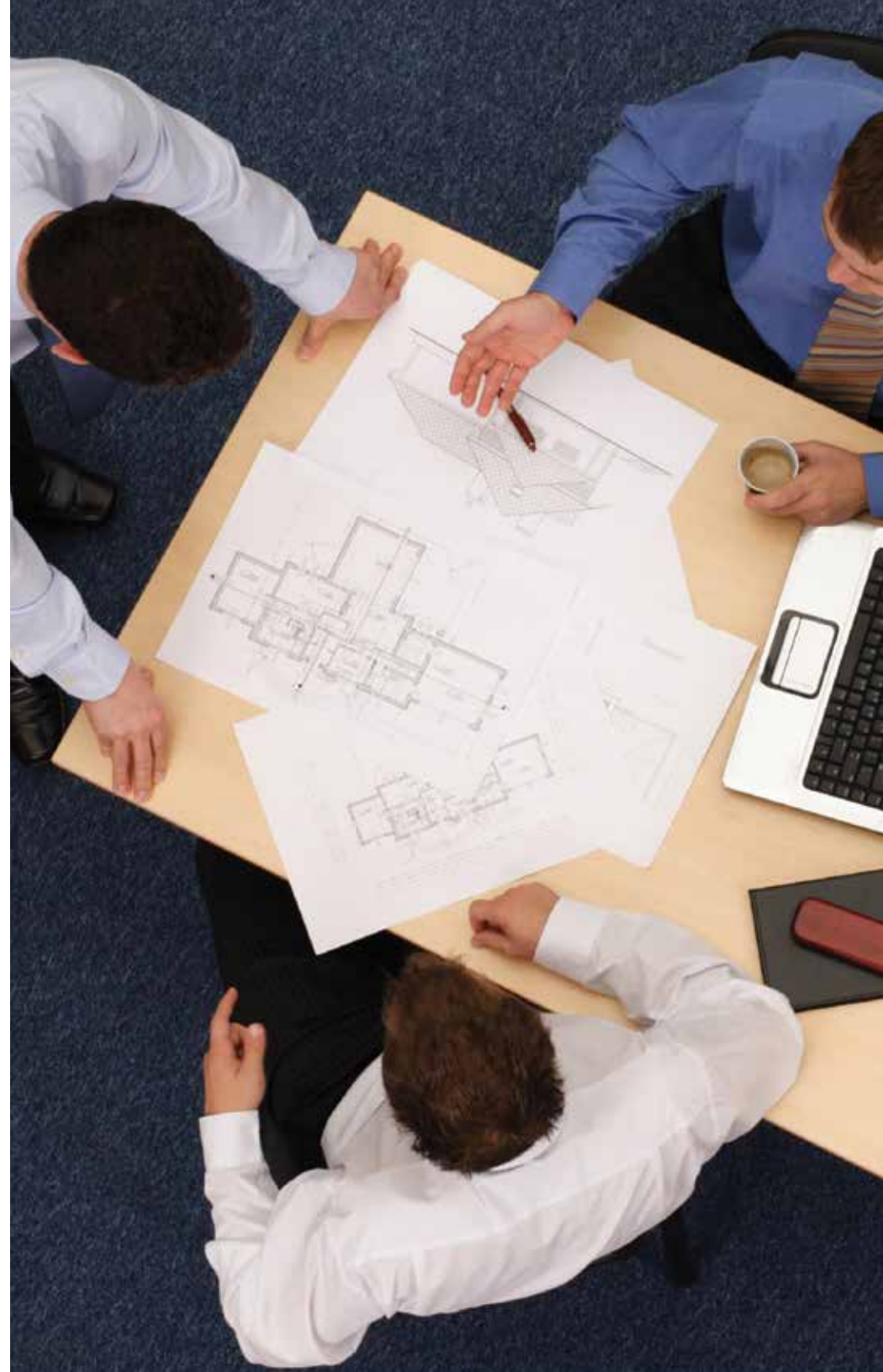
THE EXPANDING ROLE OF THE SAFETY CONSULTANT

The emergence of the Internet of Things (IoT) for the interconnection of all building systems. The complexity of new equipment and materials. The use by governments of Public Private Partnerships to build everything from airports to jails. Increased demand to analyze fire and security risk through research prior to design. A continuing need to communicate with building occupants in emergency situations. All of these trends come with a global view and challenges for the safety consultant.

They will have a profound effect on the built environment. At JENSEN HUGHES, our vision is **Advancing the Science of Safety**. It's what we call our 'moral compass.' As you will learn from

this report, the fire protection and life safety profession is continuing to evolve. But the one factor that remains constant is our willingness and ability to support our clients in saving lives and protecting property and business assets anywhere in the world.

Where once we were just considered consultants applying codes and standards, we are now a global team of engineers, scientists and researchers integrating solutions for the life cycle of the built environment involving fire protection, risk analysis and management, security, forensics and emergency management. We can both understand and influence the direction of our profession. The future will be both exciting and challenging.





TRENDS IN DIGITAL TECHNOLOGY



There continues to be a push for integrating building systems, diverse technologies and developing the Internet of Things (IoT). The IoT is the networking of physical items with electronics and software over the internet to allow for enhanced capabilities and data management without the input of humans. Enabling the IoT are mesh networks, where every device serves as a node in the network to relay data from point to point and not back to a central hub. This distributed approach of connectivity can improve reliability and redundancy.

As mesh networks develop, codes and standards organizations are working to keep up with appropriate requirements that ensure current levels of safety without restricting technology in this fast moving development

environment. Examples of this include *NFPA 72 National Fire Alarm and Signaling Code*, which addresses the installation and use of fire alarm and notification systems. Fire alarm systems have traditionally been independent systems with strict test standards and equipment requirements compared to other building systems, such as security and audio systems.

With IoT networking bringing fire protection into the virtual, wireless world, security of the network is paramount. Fire protection system design will need to include the understanding of how the systems interface with the network. Those responsible for the security of the network, usually the information technology group of the user, will be a key partner in implementation.



1

THE INTERNET OF THINGS IS IMPACTING BUILDING SYSTEM INTEGRATION





Though no longer a new technology, the use of building information modeling (BIM) is expected to continue to expand and evolve to provide post-construction value to owners savvy enough to embrace its features. BIM is currently being used mainly as a design and construction tool, in most cases the initial push for its use and overall development coming from design teams led by architects. That push resulted in better visualization of the building by the design team and the end user through three-dimensional (3D) model development. It also allowed better coordination of design team members by inserting their respective designs within the model and running clash detection software to identify major conflicts.

BIM also offers features designed to benefit building owners and managers. The first benefit is increased visualization of the design through the 3D interface. This visualization is simple to understand and has been a primary driver of the design process towards BIM and away from traditional 2D designs for larger, more complex projects. The efficiencies provided to

the construction team also benefit building owners, as cost and schedule overruns can be reduced, resulting in more buildings delivered on time and within the construction budget. These benefits have been well-documented. What has not received as much attention as an end-user benefit is the population of the model with information specific to the building that can help provide savings over the life of the facility.

This is the “I” in BIM, and though its potential benefits have been documented over the years, its implementation as part of the BIM process has been limited. There are many reasons for this, including the need for more informed BIM implementers within the design and construction teams to populate the model database with building specific information, owner unfamiliarity or indifference to making it a requirement of the project, and concerns over the abilities of building managers and facilities directors to manipulate the model and extract the data. These issues can be overcome, and when they are, the ceiling will again be lifted on the benefits of BIM.

2

BUILDING INFORMATION MODELING WILL EVOLVE TO THE BENEFIT OF THE FACILITY MANAGER





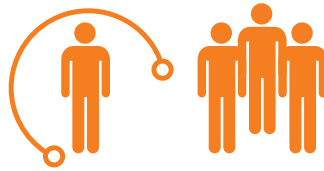
Another byproduct of BIM that is distinct to the fire protection and life safety disciplines is the potential future integration of fire modeling software with a 3D model. Several models currently offer 3D evaluations and corresponding interfaces as a means of displaying model output. We anticipate that a method will be developed in the future that will allow the Fire Dynamic Simulator (FDS), developed by NIST, output to be imported back to the building model with the future potential to incorporate the fire model into

the building model such that fire model scenarios can be run and viewed within that building model.

Pathfinder, developed by JENSEN HUGHES, is a people movement model with the capability to evaluate occupant movement within a 3D building representation. The model includes the ability to impose specific behaviors and movement characteristics on individual occupants, groups, or the entire building population. Like FDS, it can allow 3D model development and output.

3

FIRE & BUILDING MODELS ARE COMING TOGETHER IN 3D



International mobility increasingly makes our cities, airports and transit hubs more complex. Planning for the effective movement of people differentiates the experience when moving through the space. Careful planning and dynamically studying the movement of people allows for more effective design and for optimization of space, queues and travel times. Effective design results in an overall positive experience by the users of the facilities that have been well designed.

The design of large assembly, transient occupant load buildings such as airports, transit terminals and multimodal hubs requires the consideration of both normal

and emergency passenger flows concurrently. Providing effective and efficient flow for normal and emergency scenarios is important for both operational and life safety requirements. The impact of access restrictions (i.e. security barriers at airports) can influence occupant movement and building access.

The outputs provide designers, operators, and owners with clear information about crowding, usage patterns, and occupant safety. This predictive power enables positive decisions to be made early in the design process with minimum cost and disruption.



4

PASSENGER AND EVACUATION MODELS WILL SUPPORT PEOPLE MOVEMENT PLANNING

EXIT



5

TRUE DYNAMIC WAYFINDING IS JUST AROUND THE CORNER



Dynamic electronic wayfinding systems are already here – but “true dynamic wayfinding” is coming. If you’ve ever been in a large, complex structure and needed to find your way, you often find yourself looking for a building map. We find these in many facilities, but especially in airports, transportation hubs, hotel conference centers, exhibit halls, and similar very large, complex structures. The building maps have become electronic, you enter the name of the room you are trying to find, and the electronic map outlines the location of the room, and the very advanced electronic systems can show you the path from where you’re located in the building to lead you to your intended destination.

These electronic maps also can show exit locations, refuge areas and other fire safety related

information. So, one might ask, can they show me an exit path in case of a fire emergency? The answer is yes...it is possible today. However, if you were to ask, can they show me a safe exit path in case of fire emergency, then the answer would likely be “not yet.”

In the future, fire detection and alarm systems will provide input into electronic wayfinding, which will then identify exit paths that do not lead you towards the fire area. This is truly dynamic wayfinding, and we believe it will become a reality in the near future...and may ultimately become a prescriptive based code requirement for buildings of a certain size or complexity. Shortly thereafter, it will be automatically sent to your smart phone so you will be able to navigate your way out of the building.

General contractors see hardware and software as a means to an end. Large, fundamental technology changes in general contracting are focused on process: making design, build, and operation more efficient, thereby increasing value while decreasing risk.

Fast-tracking has helped popularize collaborative delivery methods, such as design-build and integrated project delivery. In ten US states, more than half of the buildings were delivered via design-build in 2014. For life safety, the ability of design-build to specifically take advantage of design ingenuity aligns with the value engineering and alternative means and methods that the fire protection engineer can employ to meet the design intent while still complying with code criteria. Typically, the end user will receive an end product that meets their vision, instead of a trade-off between code and design. With design build becoming more

popular worldwide, its very nature assures that construction is often started before design is finalized.

The ability to electronically deliver files for review and mark-up—even on site—has made review and correction much faster. For life safety in preconstruction, this allows for over the shoulder plan reviews without physically being “over the shoulder,” while still maintaining a quick response time for the GC. For life safety on site, the fire protection engineer can perform quick reviews identifying construction deficiencies so the contractor can make corrections quickly and effectively, notably prior to on-site inspection. Ultimately, this allows the GC to deliver life safety with less chance of error, risk, and construction delays with the goal of shortening the punch-list. Subsequently, the end user will receive their end product on schedule and in compliance.

6

TECHNOLOGY WILL ENABLE MORE EFFICIENT PROJECT DELIVERY AROUND THE CORNER



The background of the slide is a detailed architectural drawing, likely a floor plan, showing various rooms, corridors, and structural elements. A hand is visible in the foreground, holding a blue pen and pointing at a specific area on the drawing. Another hand is visible below, holding a ruler. In the upper right, there are two rolled-up blueprints and a pair of compasses. The overall scene suggests a professional architectural or engineering workspace.

TRENDS IN CODES & STANDARDS

7 CODE DEVELOPMENT WILL RELY ON A MORE RIGOROUS FIRE PROTECTION ENGINEERING ANALYSIS

JENSEN HUGHES staff participates in over 175 codes and standards technical committees. We perform this service to the profession to help ensure fire protection practices and scientific principles are used in the code development process. Our engineering staff has a history providing valuable risk informed and research-based technical input to support key changes in these codes and standards. Often our representatives serve as the chairmen, subject matter experts, and thought leaders for these technical committees. Because we are at the leading edge of the code development process, we are in a position to observe and evaluate the trends that will impact our clients in both the present and future.



PROPOSED GUIDE WILL IMPROVE FIREFIGHTER USE AND UNDERSTANDING OF FIRE SCIENCE

In some respects there has been a reversal in the thought process for developing new requirements in the codes. For example, using past fires to generate layers of prescriptive code requirements may not, in many cases, make a building safer, just more regulated. A more rigorous fire protection engineering analysis may be appropriate. The goal is to provide for safety in the built environment. To this end NFPA, based on input from the fire protection engineering community, has recently proposed the creation of a guide to improve firefighter use and understanding of fire science. The intent is to have a Fire Dynamics and Fire Science-based fire service guide for improved doctrine, tactics and procedures. Ultimately this should lead to improved firefighter safety.



CODE CHANGES WILL SAVE LIVES AND PROTECT PROPERTY

Many of the market sectors addressed by our staff are affected by developing trends in widely-used detection and suppression systems. One of the important trends is occurring in *NFPA 3, Recommended Practice for Commissioning of Fire Protection and Life Safety Systems*. The technical committee is now considering making this document a Standard. What this will mean to the built environment is a more detailed process during the final acceptance testing of systems.

In the area of detection and alarm, the committee on *NFPA 1616, Mass Evacuation and Sheltering*, is reviewing electronic IP-based systems that can track the status of evacuees, provide check-in systems at shelters and provide other related searchable systems. This would result in immediate feedback on the health and welfare of evacuated

populations. There is a large amount of work being done to accommodate the evacuation of those with mobility, hearing, or visual impairments as it pertains to access and functional needs, as well as service animals and household pets.

NFPA 72, National Fire Alarm and Signaling Code has addressed the need for complying with the intelligibility requirements by allowing non-UL listed speakers to be used in acoustically challenging spaces and the use of the Ethernet through the development of a new circuit classification labeled "Class N" which could lead to much lower installation costs and ease of system updates during a building's life cycle.

8

CODE COMPLIANCE WILL RELY ON RISK-INFORMED DECISION MAKING

In the health care sector, the allowance of larger smoke compartments in healthcare facilities governed by *NFPA 101, Life Safety Code*® is under evaluation. This is an example where a risk-informed process would guide the process: does the increase in compartment size increase the patient risk from fire, or is there a negligible increased risk? *NFPA 99, Health Care Facilities Code* is now using risk informed decision making. The 2012 edition went through a major overhaul. The premise of an occupancy-

based document was modified to become a risk-based document. The risk to the patient does not change for a given procedure. If the procedure is performed in a doctor's office versus a hospital, the risk remains the same. Therefore, *NFPA 99* eliminated the occupancy chapters and transitioned to a risk-based approach. New Chapter 4 outlines the parameters for this approach, where a documented risk assessment is required. The Code now reflects the risk to the patient in defined categories of risk.





TRENDS IN KEY GLOBAL BUILDING SEGMENTS

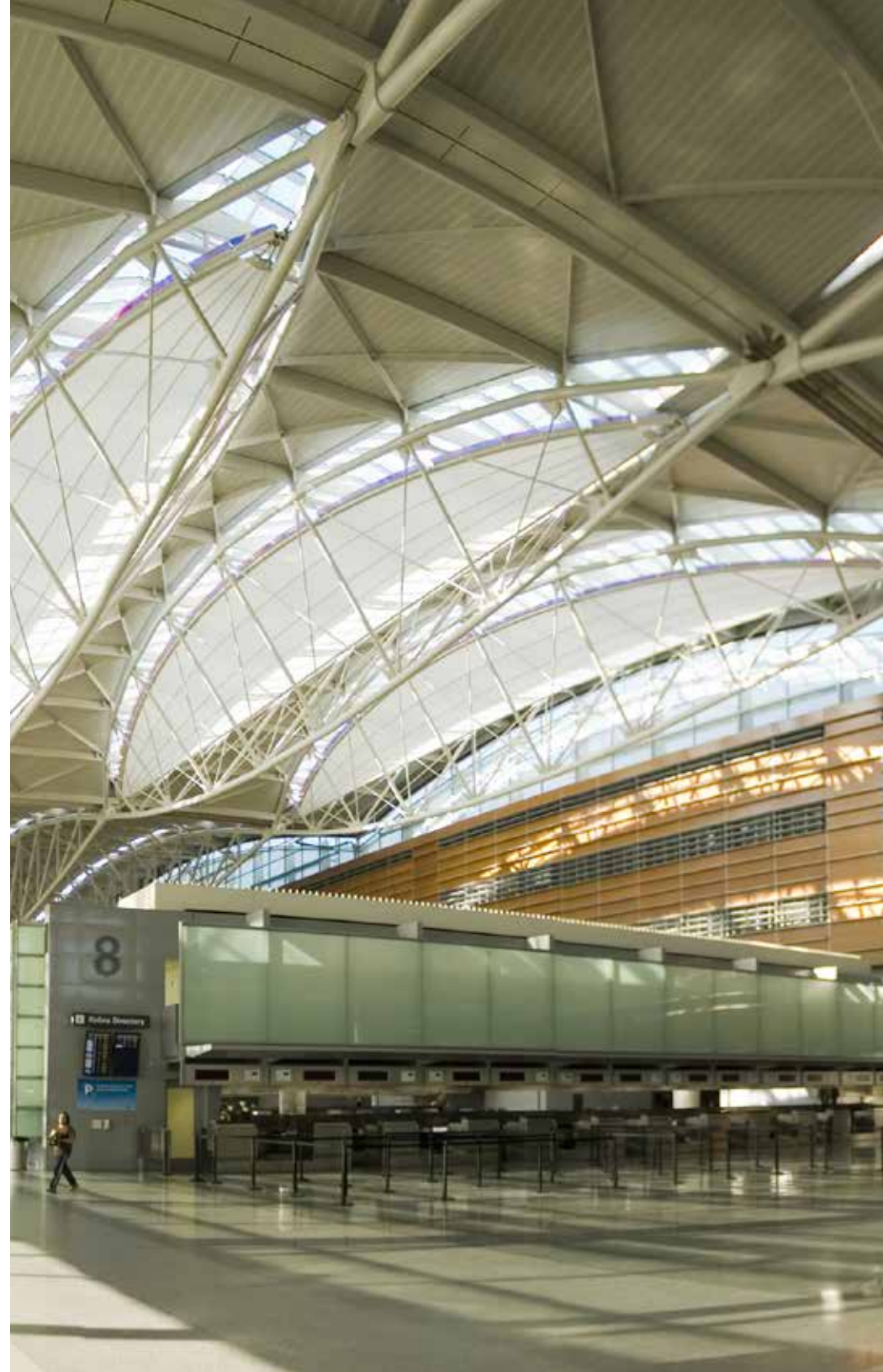
9

FUEL LOADS AND COMMUNICATION CHALLENGES ARE INCREASING IN TRANSPORTATION FACILITIES

Over the past several years there has been a widespread trend to increase the retail footprint in most transportation facilities, and to add passenger amenities and “experience” elements. In most new airports, retail revenue can exceed the revenue from flight operations. For the fire protection engineer, the corresponding passenger concourse risk quantification is vastly different from the more sterile gates and terminal seating found in earlier airport and transportation system designs. This can impact sprinkler design densities, smoke control systems, passenger densities and capacities. The designer needs to be aware of the impact of fuel loading changes for tenant improvements to older airports that may have fire protection

systems designed to less stringent requirements. The SFPE has commissioned a Design Fire task group to look at trends in design fires for different occupancies.

Transportation owners and authorities are evaluating new concepts for occupant notification, both for normal circulation and exiting for use in emergency events. Interest in dynamic signage systems to improve occupant flow has increased, along with other technologies such as cell phone applications that enable wayfinding and provide instant alerts during emergency events. *NFPA 72, National Fire Alarm and Signaling Code* provides guidance for the successful implementation of these mass notification systems.



10 HIGH-RISE BUILDING WILL FACE ECONOMIC CHALLENGES IN MEETING CODE REQUIREMENTS

Building codes in many jurisdictions are now being adopted and enforced that have incorporated layers of changes in codes that reflect modern security threats and concerns. Key issues confronting the Corporate Real Estate industry in meeting these code changes is the increase in both building area dedicated to these new requirements as well as added costs associated with changes in code. A traditional high-rise office building (over 420 feet) being designed or constructed today is on average 3- 5% less efficient as a result of

compliance with today's codes. This inefficiency is a result of newly added requirements found in the code mandating Fire Service Access Elevators, wider means of egress, and an additional exit capacity. These additional code requirements add more square footage to the building and less rentable square footage (RSF) as compared with previous building code requirements. Therefore, a new building design today needs a larger footprint to accomplish the same RSF.



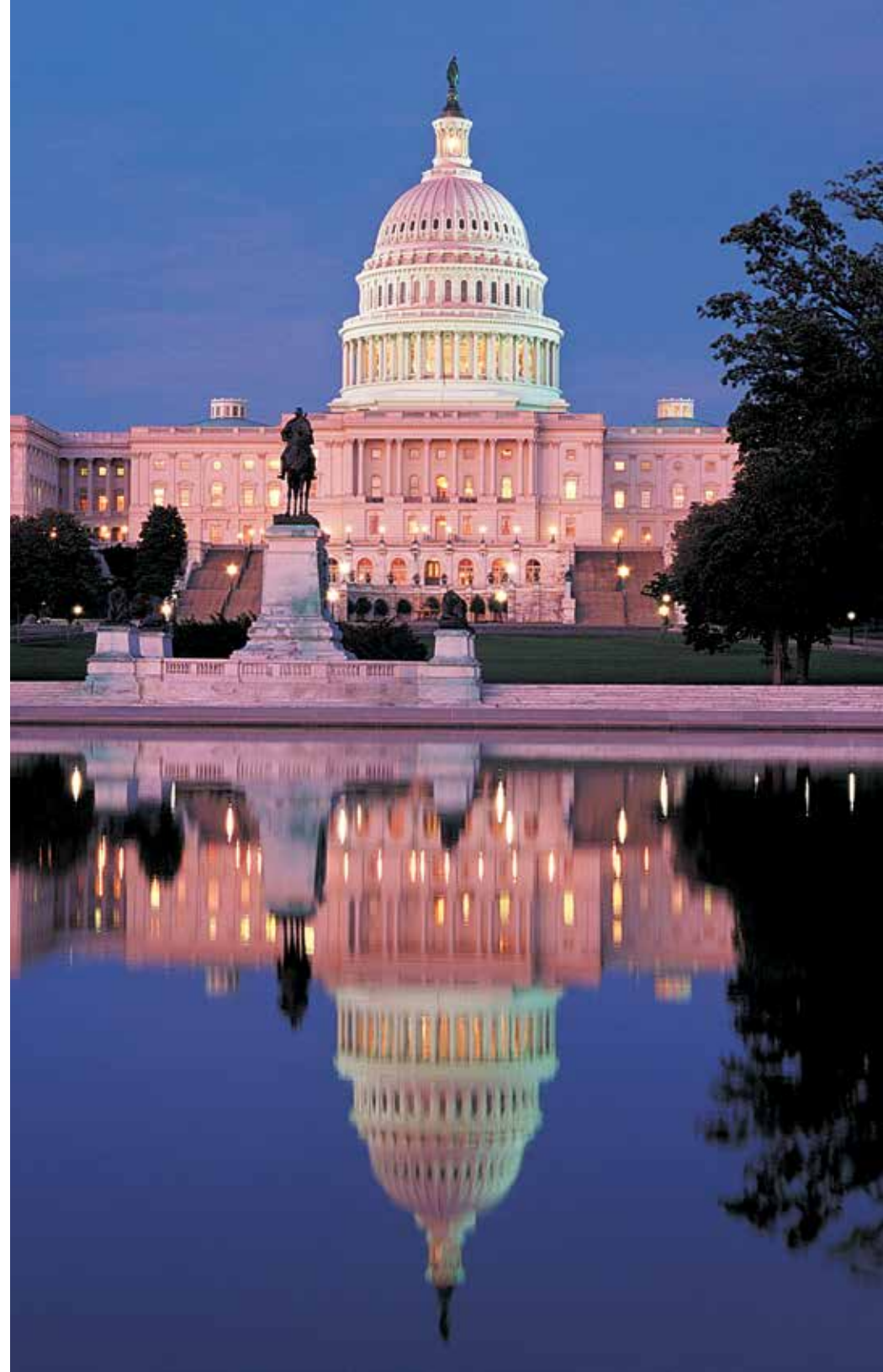
11

PARTNERING WILL OFFER COST REDUCTIONS FOR GOVERNMENT PROJECTS

Governments at all levels throughout the world are embracing a concept called Public Private Partnerships (P3). In this cooperative effort, the government unit leases the land with a private firm that builds and operates the facility and also finances, designs and/or maintains the facility. This approach has initially been used primarily for transportation, infrastructure and correctional facilities. Its'

worldwide success has led state and federal legislation to increase the use of this approach.

Interest in a risk-based approach to Inspection/Testing/Maintenance (ITM) is growing as a life-cycle cost reduction approach. Non-fire protection systems are already using this approach. Risk-based ITM will allow a team of the project stakeholders to partner in a program to fit their facility.



12

HEALTH CARE FACILITIES CODES ARE SHIFTING TO RISK-BASED CONCEPTS

The creation of the 2015 Edition of *NFPA 99, Health Care Facilities Code* presents the concept of risk-based codes which shifts more responsibility to the stakeholders than in a prescriptive code approach. Occupancy designations were replaced with risk categories. Collaboration between owners, users, designers, safety consultants, builders and the Authorities Having Jurisdiction is important to risk assessment for the procedures, care or treatments that will occur in areas of the building. Wireless technology is in heavy use for patient monitoring and controls in the building fire detection and alarm systems

now recognize this technology and can be integrated with other systems to reduce cost. The integration of the IT infrastructure with the fire detection and alarm will be the code, design and testing challenge well beyond 2020. The interest in a risk-based approach to Inspection/Testing/Maintenance (ITM) is growing. Non-fire protection systems are already using this approach. Risk-based ITM for fire protection will allow the user to fit an ITM program to their facility. The future facility operators' ITM program will be customized to that facility and its specific level of risk.



13

CAMPUS FIRE PROTECTION AND SECURITY IS BEING INTEGRATING INTO A SINGLE IT NETWORK

As tuitions continue to climb and campus security breaches occur all over the world, parents are primarily concerned with the safety of their children on campus. But students following a trend called Bring Your Own Device are demanding the best connectivity that the Internet of Things (IoT) can provide. They expect to open their devices – smartphones, tablets and computers – anywhere on campus and be able to connect. This has forced many

Universities to rebuild their entire campus IT structure. The Campus IT Director has a more involved role on every project. This includes fire, life safety and security. Many campuses have shifted their fire and security reporting over to the campus network systems. This results in a number of integration issues with the IT Department related to the security of the IT system, the operational reliability of the network and the response to fire and security signals.



14 OUTSOURCING IS BEING USED TO ENHANCE PERFORMANCE IN HOSPITALITY FACILITIES

The desire of Global hotel chains to maintain a consistent and quality standard of care to meet corporate guidelines are outsourcing the compliance to specialty engineering consulting firms with large geographical coverage. This allows them to utilize outside resources, as needed, instead of maintaining a large in-house staff with multi-lingual capabilities located around the globe. The typical services provided include verification of the required inspection, testing and maintenance for existing facilities. Additional services include due diligence when rebranding properties.

Third-party commissioning services during the construction period for large resorts, theme

parks and casinos, when the quality assurance and time schedule are critical to opening the property, is happening in locations where the developer or authorities can use outside expertise. This has led to having the owner and, in some situations together with the Authority Having Jurisdiction as part of the process, use a specialty engineering company to provide on-site staff. Their role would be to help verify that the installation is being done by the contractor in accordance with the design documents. This process will help in assuring that the final acceptance testing by the AHJ would go smoothly and allow for an on-time opening.



15

INDUSTRIAL PLANTS AND LABORATORIES ARE USING RESEARCH AND TESTING TO IMPROVE SAFETY

Codes pertinent to industrial facility design are now being updated based on sophisticated and rigorous testing standards, rather than relying on “historical” or “traditional” protection. For example, *NFPA 2, Hydrogen Technologies Code* determines setbacks for hydrogen equipment based on calculated flame impingement hazards, which are driven by the system volume and pressure; previous versions of this regulation had standardized setback distances based on the exposure. The newest edition of *NFPA 68, Explosion Protection by Deflagration Venting* has much more refined calculation methodologies for determining appropriate vent sizing, based on new research and testing results. Updates such as these have two primary implications – they require more analysis of the

actual use/storage conditions of hazardous materials, but they also dictate a level of protection which is more suitable for the hazard which is present, rather than relying on a (potentially very conservative) “historical” level of protection which may have been excessive or infeasible based on a particular site’s constraints. Finally, *NFPA 30, Flammable and Combustible Liquids Code* recognizes that spill control and secondary containment were traditionally addressed by a 4-inch curb, regardless of the hazard present; currently, when required, the system is required to be designed based on the actual hazard (size of the liquid tank plus the discharge anticipated from the fire protection system, both of which will vary). All of these are examples of risk-informed decision making.



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