



FIRE & LIFE SAFETY ECOSYSTEM

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# IN THE SUMMER OF 2017,

Mohammad Alhajali lived on the 14th floor of Grenfell Tower, a 24-story block of public housing located in West London. He shared an apartment, Flat 112, with his brother, Omar, and a childhood friend, Mahmoud Al-Karad. They had grown up together in a small city in southern Syria. In 2014, as civil war wracked the country, Mohammad and Omar left their parents and siblings behind and resettled in the United Kingdom, where they hoped to rebuild their lives. By 2017, when Mohammad was 23, he was studying civil engineering at the University of West London and was engaged to be married. He was in touch with his family daily and hoped to one day return to Syria to help the country.

On the night of June 13–14, 2017, the brothers visited a cousin in London and returned home to Grenfell Tower around midnight. Their roommate Mahmoud was still at work. At around 1:30 a.m., they heard shouting—the building was on fire. They could see flames on the side of the building down around the fourth floor and noticed that smoke was curling under the door of their apartment. They decided to try to leave the building, but the lobby outside their door was dark and full of smoke. They retreated back inside and yelled down to firefighters on the ground below, who told them to stay where they were and that help was on the way.

## **The Phase 2 report details the political heedlessness, bureaucratic expediency, and corporate malfeasance that produced one of the most shocking public safety disasters in modern memory.**

A short time later, the brothers were relieved to see a firefighter from the London Fire Brigade (LFB) enter their apartment, and they begged him to get them out of the building. The LFB, though, was trying to organize a building-wide evacuation, and for now, the firefighter said, he needed them to stay put. Another resident was moved into the brothers' apartment, where the air was less smoky, and a short time later, firefighters moved them all to Flat 113, along with residents from other apartments. Mohammad called friends to tell them what was happening; he tried his family but couldn't reach them.

What happened over the next couple of hours in Flat 113 isn't entirely clear, but at some point, firefighters were able to perform a partial evacuation

of the 14th floor, and some of the people who'd sheltered in the flat, including Omar, got out—but Mohammad was not among them. He continued making calls as the fire wrapped around the tower, pushing its way into the building's interior. He spoke to Mahmoud, who'd returned from work to find the building on fire, and Mohammad told him he couldn't leave the flat because he was with a mother and child who needed his help. His last conversation was shortly after 4 a.m., with Omar and another brother, Hashem. Conditions were getting worse, Mohammad told them, and the people trapped in Flat 113 with him were no longer responding when he called their names. Minutes after that call, Mohammad fell to his death from Grenfell Tower.

It's unknown whether the fall was deliberate or accidental, but the instant that Mohammad Alhajali stepped free from the burning tower was the culmination of a troubling narrative that had been decades in the making. Seventy-two people—infants, grandmothers, entire families—died in the blaze, which burned for more than 60 hours and involved hundreds of firefighters. The fire began with an electrical fault in a refrigerator on the fourth floor before moving to the building's exterior. Fire spread was blamed on the tower's combustible exterior cladding, known as aluminum composite material, or ACM. Panels of ACM include two thin sheets of aluminum that sandwich a layer of polyethylene, a fabrication technique that allows manufacturers to reduce the volume of aluminum while maintaining the panel's structural integrity. The catch is that polyethylene is a petroleum derivative; when it burns, its heat release is identical to that of gasoline. As more was learned about the Grenfell Tower fire and how the building came to be sheathed in what critics have described as “solid gasoline,” the ripple effect of blame and culpability gradually spread to include industry, government, the local housing authority, the fire brigade, and more.

In September, the Grenfell Tower Inquiry, a years-long government-led investigation into the fire and the lead-up to the event, published the second phase of its findings. The inquiry's Phase 1 report, published in 2019, focused primarily on the fire itself and the events immediately surrounding it; the new Phase 2 report provides context for broader issues including building regulations, fire safety, and social housing. The 1,700-page Phase 2 report, sourced from more than 320,000 documents, 1,600 witness statements, and more than 300 public hearings, details the political heedlessness, bureaucratic expediency, and corporate malfeasance that produced one of the most shocking public safety disasters in

PREVIOUS SPREAD: ISABEL INFANTES—WPA POOL/GETTY IMAGES



## Government Responsibility

*From the ministerial level to the people responsible for administering Grenfell Tower on a day-to-day basis, the governmental failures described in the Phase 2 report were numerous and created conditions for additional ecosystem stresses and failures:*

**We conclude** that the fire at Grenfell Tower was the culmination of decades of failure by central government and other bodies in positions of responsibility in the construction industry to look carefully into the danger of incorporating combustible materials into the external walls of high-rise residential buildings and to act on the information available to them.

**In the years** between the fire at Knowsley Heights in 1991 [involving an apartment tower with combustible exterior cladding] and the fire at Grenfell Tower in 2017, there were many opportunities for the government to identify the risks posed by the use of combustible cladding panels and insulation, particularly to high-rise buildings, and to take action in relation to them. Indeed, by 2016 [the body then known as the Department for Communities and Local Government, referred to in the report as “the department”] was well aware of those risks,

but failed to act on what it knew. In particular, it failed to heed the warning of the Environment and Transport Select Committee in December 1999 that it should not take a serious fire in which people were killed before steps were taken to minimize the risks posed by some external cladding systems.

**The department** itself was poorly run, in as much as the official with day-to-day responsibility for the Building Regulations and Approved Document B [the building regulation in England covering fire safety matters within and around buildings] was allowed too much freedom of action without adequate oversight. He failed to bring to the attention of more senior officials the serious risks of which he had become aware, and they in turn failed to supervise him properly or to satisfy themselves that his response to matters affecting the safety of people’s lives was appropriate. It was a serious failure to allow such an important area of activity to remain in the hands of one relatively junior official.

**The department** displayed a complacent and at times defensive attitude to matters affecting fire safety. Following the fire at Lakanal House [a 2009 fire involving combustible exterior components that killed six people at a London apartment building], the coroner recommended that Approved Document B be reviewed, but her recommendations

Participants in a silent walk to mark the sixth anniversary of the Grenfell Tower fire.



GUY SMALLMAN/GETTY IMAGES



Grenfell Tower ablaze on the night of June 14, 2017. Seventy-two people died in the fire.

modern memory. The report is a dismaying litany of failures on the part of institutions, companies, and individuals; as those failures continue to mount, one after another, Mohammad Alhajali's long fall begins to look like an inevitable outcome of a process that had only one possible ending.

In 2018, NFPA introduced the NFPA Fire & Life Safety Ecosystem™ ([nfpa.org/ecosystem](http://nfpa.org/ecosystem)). Created in response to Grenfell and other devastating events, the ecosystem is a framework that defines the elements necessary to create and maintain an effective safety environment; the eight interconnected components mean that the failure of a single element can compromise the entire system, resulting in

deaths, injuries, and property loss. Through that lens, the Grenfell Tower Inquiry's latest report is a granular description of the utter collapse of the safety ecosystem. Six areas in particular—government responsibility, code compliance, referenced standards, skilled workforce, investment in safety, and preparedness and emergency response—were compromised to the point of nonexistence. The following excerpts, taken directly from the Phase 2 report, detail those fire and life safety ecosystem failings and help explain how the stage was set for disaster—and how it came to be that so many participants had a hand in the horror that befell the residents of Grenfell Tower.

GURBUZ BINICI/GETTY IMAGES

were not treated with any sense of urgency and officials did not explain clearly to the Secretary of State what steps were required to comply with them. Similarly, legitimate concerns about the fire risks of cladding raised by the All-Party Parliamentary Group on Fire Safety were repeatedly met with a defensive and dismissive attitude by officials and some ministers.

**In the years** that followed the Lakeland House fire, the government's deregulatory agenda, enthusiastically supported by some junior ministers and the Secretary of State, dominated the department's thinking to such an extent that even matters affecting the safety of life were ignored, delayed, or disregarded.



### Code Compliance and Referenced Standards

*These components were effectively removed from the safety ecosystem through improper cooperation between manufacturers and testing agencies. Standards existed in the UK for the testing of building materials, including exterior cladding assemblies that utilized ACM panels with a combustible layer, but they were subverted or ignored in a number of ways:*

**The Building Research Establishment** (originally known as the Fire Research Station) had been established in 1921 as a government body to carry out research into and testing of construction methods and products. After it was privatized in 1997 the department limited the scope of the advice it was asked to provide on fire safety matters. As a result, the department deprived itself of the full benefit of BRE's advice and experience. On occasions it deliberately curtailed investigations before any proper conclusion had been reached.

**The department** also failed to pay due regard to the striking results of a large-scale test in 2001 involving aluminum composite panels with unmodified polyethylene cores, which burned violently, or to take any steps either to ascertain the extent to which panels of that kind were in use or to warn the construction industry about the risks they posed. It failed even to publish the results of the test.

**One very** significant reason why Grenfell Tower came to be clad in combustible materials was systematic dishonesty on the part of those who made and sold the rainscreen cladding panels and insulation products. They engaged in deliberate and sustained strategies to manipulate the testing processes, misrepresent test data and mislead the market. In the case of the principal insulation product used on Grenfell Tower, Celotex RS5000, the Building Research Establishment (BRE) was complicit in that strategy.

**Those strategies** succeeded partly because the certification bodies that provided assurance to the market of the quality and characteristics of the products, the British Board of Agrément (BBA) and Local Authority Building Control (LABC), failed to ensure that the statements in their product certificates were accurate and based on test evidence. [The United Kingdom Accreditation Service, or UKAS], the body charged with oversight of the certification bodies, failed to apply proper standards of monitoring and supervision.

**BRE's reports** into the major fires at Knowsley Heights (1991), Garnock Court (1999) and The Edge (2005) [all fires that involved combustible exterior cladding] were far from comprehensive and in each case failed to identify or assess important contributory factors. The reports of fires it provided to the department were characterized by superficiality and a lack of analysis, with the result that they gave the department the false impression that the regulations and guidance were working effectively.

**There were** weaknesses in the way BRE carried out tests in accordance with BS 8414 and in its record-keeping, which exposed it to the risk of manipulation by unscrupulous product manufacturers, as happened in the case of the second test carried out for Celotex, the manufacturer of the insulation specified for use on Grenfell Tower. Senior BRE staff gave advice to customers such as Kingspan and Celotex [both exterior panel manufacturers] on the best way to satisfy the criteria for a system to be considered safe, thereby compromising its integrity and independence. In some cases we saw evidence of a desire to accommodate existing customers and to retain its status within the industry at the expense of maintaining the rigor of its processes and considerations of public safety. The unprofessional behavior of some of BRE's staff was in part the result of a failure to provide them with adequate training in their responsibilities.

**Celotex manufactured RS5000**, a combustible polyisocyanurate foam insulation. In an attempt to break into the market for insulation suitable for use on high-rise buildings, [a market] created and then dominated by Kingspan K15, Celotex embarked on a dishonest scheme to mislead its customers and the wider market.

**With the complicity** of BRE, in May 2014 Celotex tested in accordance with BS 8414 a system incorporating RS5000 that contained two sets of fire-resistant magnesium oxide boards placed in critical positions to ensure that it passed. It then obtained from BRE a test report that omitted any reference to the magnesium oxide boards, thereby rendering it materially incomplete and misleading.

**Celotex then** marketed RS5000 as “the first PIR [polyisocyanurate foam] board to successfully test to BS 8414,” and as “acceptable for use in buildings above 18 meters in height.” However, the test on which Celotex relied in support of that claim had been manipulated as we have described above, a fact that Celotex did not disclose in its marketing literature. Moreover, BS 8414 is a system test and does not involve the testing or classification of individual products. Celotex deliberately tucked that information away in the small print of its marketing literature.



### Investment in Safety

*The Phase 2 report is highly critical of the tenant management organization, or TMO, responsible for administering Grenfell Tower along with a number of other residential buildings totaling nearly 10,000 units of public housing in the Kensington and Chelsea areas of London. The TMO is characterized in the report as careless and ineffectual, with little regard for maintaining building features designed for the safety of residents:*

**...There was no** adequate system for ensuring that defects identified in fire risk assessments [for Grenfell Tower] were remedied effectively and in good time. The TMO developed a huge backlog of remedial work that it never managed to clear, a situation that was aggravated by the failure of its senior management to treat defects with the seriousness they deserved. Indeed, on one occasion senior management intervened to reduce the importance attached to the implementation of remedial measures. The demands of managing fire safety were viewed by the TMO as an inconvenience rather than an essential aspect of its duty to manage its property carefully.

**Certain important** features of the fire prevention measures at Grenfell Tower were not of an appropriate standard. For example, the new front doors installed by the TMO in 2011 and 2012 did not meet the fire resistance standards suggested by Approved Document B because the TMO had failed to specify the correct fire safety standard when ordering them.

**Inspection and** maintenance regimes affecting fire prevention systems did not reflect best practice and were inconsistently followed. Many self-closing devices on the front doors of flats in Grenfell Tower failed to work effectively and some were missing entirely. The TMO did not institute an effective inspection and maintenance program for self-closing devices on entrance doors despite an Enforcement Notice issued by the LFB in late 2015 relating to ineffective door closers in another high-rise residential



building it managed, Adair Tower, and a Deficiency Notice issued in 2016 in relation to Grenfell Tower itself on the same grounds.



### Skilled Workforce

*The report illustrates a number of ways that skilled workforce failures contributed to the disaster that befell Grenfell Tower, notably through the TMO’s “ill-qualified” fire assessor and in the form of the principal players in the 2015–2016 refurbishment of Grenfell Tower. That refurbishment included the selection and application of the ACM panels that were responsible for the fire’s spread, a component that had been selected as a cost-saving measure over the zinc cladding that had originally been proposed:*

**...The TMO’s** only fire assessor for its entire estate, Carl Stokes, was allowed to drift into that role without any formal selection or procurement process. He had misrepresented his experience and qualifications (some of which he had invented) and was ill-qualified to carry out fire risk assessments on buildings of the size and complexity of Grenfell Tower, let alone to hold the entire TMO portfolio. As a result, there was a danger that fire risk assessments would not meet the required standard.



Cladding is removed for testing from a residential tower in England. Numerous buildings across the country were found to be outfitted with ACM panels with combustible polyethylene.

**One very significant reason why Grenfell Tower came to be clad in combustible materials was systematic dishonesty on the part of those who made and sold the rainscreen cladding panels and insulation products. They engaged in deliberate and sustained strategies to manipulate the testing processes, misrepresent test data, and misled the market.**

materials to be used in the external wall thought that responsibility for their suitability and safety lay with someone else.

**None of those** involved in the design of the external wall or the choice of materials [which also included Exova, a fire safety consulting firm, and the Royal Borough of Kensington and Chelsea (RBKC) and its public-housing building manager, the Kensington and Chelsea Tenant Management Organization (KCTMO)] acted in accordance with the standards of a reasonably competent person in their position. They were not familiar with or did not understand the relevant provisions of the Building Regulations, Approved Document B or industry guidance. Studio E demonstrated a cavalier attitude to the regulations affecting fire safety, and Rydon and Harley relied on their previous experience rather than on any technical analysis or expertise. The risks of using combustible materials in the external walls of high-rise buildings were well known and they should have been aware of them.

**...Although Mr. Stokes'** methods for carrying out fire risk assessments generally reflected the Health and Safety Executive's five steps for managing risks, the LGA Guide [produced by the Local Government Association], and PAS 79, they suffered from serious shortcomings. He often failed to check whether the TMO had taken action in response to risks he had identified in previous assessments. Despite the concerns expressed by the LFB about his competence, the TMO continued to rely uncritically on him, a situation which made the danger more acute in the absence of any arrangements for assessing the quality of his work.

**The choice** of combustible materials for the cladding of Grenfell Tower resulted from a series of errors caused by the incompetence of the organizations and individuals involved in the refurbishment. Studio E [the architect], Rydon [the contractor], and Harley Facades [the exterior cladding subcontractor] all took a casual approach to contractual relations. They did not properly understand the nature and scope of the obligations they had undertaken, or, if they did, paid scant attention to them. They failed to identify their own responsibilities for important aspects of the design and in each case assumed that someone else was responsible for matters affecting fire safety. Everyone involved in the choice of the



### **Preparedness and Emergency Response**

*The Phase 1 report identified the urgent need to adapt fire strategies for high-rise buildings with combustible cladding. According to reporting by Reuters, "a 'stay-put' strategy remained in effect for more than an hour, resulting in dozens of lost lives. The strategy effectively failed after just 12 minutes, when the fire spread to other flats. However, an evacuation order was only issued by the London Fire Brigade after 1 hour and 39 minutes, with 61 flats affected by the flames and 107 people still inside the building. Only 36 of those who remained at that point made it out alive." The Phase 2 report noted the failure on the part of the tenant management organization to maintain*

*an up-to-date emergency plan for Grenfell Tower, as well as the challenges faced by the London Fire Brigade, especially its leadership, in its ability to effectively respond to fires in high-rise buildings and manage a high volume of emergency calls:*

**Although the** TMO had no obligation to produce a general evacuation plan, its Emergency Plan for Grenfell Tower was out of date and incomplete and did not reflect the changes brought about by the refurbishment. The TMO was well aware of that fact following a fire at Adair Tower in October 2015 but failed to address it. The absence of fire action notices in the tower was a prominent subject of complaints by residents and led to the issue of a Deficiency Notice in November 2016.

**The Grenfell Tower** fire revealed the importance of ensuring that the responsible person under the Fire Safety Order collects sufficient information about any vulnerable occupants to enable [their personal emergency evacuation plan] to be prepared, when appropriate, and, in the event of a fire, appropriate measures to be taken to assist their escape. The TMO did take some steps to gather information of that kind, both before and during the refurbishment, but its data systems were not properly coordinated. Such information as was collected was not always used to revise its records, with the result that the spreadsheet available on the night of the fire was incomplete. The TMO's failure to collect such information amounted to a basic neglect of its obligations in relation to fire safety.

**The Lakanal House** fire in July 2009 should have alerted the LFB to the shortcomings in its ability to fight fires in high-rise buildings that revealed themselves once more at Grenfell Tower on the night of 14 June 2017. Those shortcomings could have been made good if the LFB had been more effectively managed and led. In particular, it should have responded more effectively to its experience at Lakanal House and made better use of the knowledge it had gained of the dangers posed by modern materials and methods of construction. Importantly, it failed to ensure that in the years immediately preceding the Grenfell Tower fire regular training of a suitable kind was provided to its control room operators on handling many fire survival guidance calls concurrently and on their duties more generally. Senior managers at the LFB failed to take steps to ensure that its arrangements for handling fire survival calls reflected national guidance.

**Those failures** were attributable to a chronic lack of effective management and leadership, combined with an undue emphasis on process. Senior officers were complacent about the operational efficiency of the brigade and lacked the management skills to

## **Failures were compounded by an entrenched but unfounded assumption that the Building Regulations were sufficient to ensure that external wall fires of the kind that were known to have occurred in other countries would not occur in this country.**

recognize the problems or the will to correct them. Those managerial weaknesses were partly the result of an historic failure to integrate the operational departments and the departments responsible for support functions, in particular the control room. There was a tendency to treat problems of which managers became aware as undeserving of change or too difficult to resolve, even when they concerned operational or public safety.

**Those failures** were compounded by an entrenched but unfounded assumption that the Building Regulations were sufficient to ensure that external wall fires of the kind that were known to have occurred in other countries would not occur in this country. After the Lakanal House fire senior officers recognized that compliance with the regulations could not be guaranteed, but no one appears to have thought that firefighters needed to be trained to recognize and deal with the consequences.

**The main** failings on the part of the LFB that led to the shortcomings identified in the Phase 1 report included a failure to identify training needs combined with a system for commissioning new training packages that was cumbersome and slow. Incident command training was poorly devised and was not effectively delivered; inadequate provision was made for refresher training and regular assessment.

**The LFB** failed to ensure that the knowledge of the dangers presented by the increasing use of combustible materials, in particular the risk of external fire spread and the resulting loss of compartmentation, held by some specialist officers was shared with the wider organization and reflected in training, operational policies and procedures. Firefighters were not given proper training or guidance on how to carry out inspections of complex buildings, and there were no effective arrangements for sharing information about risks posed by particular buildings. Internal recommendations for improving the inspection of high-rise residential buildings were not implemented.

**The policy** on high-rise firefighting did not reflect national guidance, and senior management failed to recognize that producing contingency plans for





a full evacuation and training firefighters to implement them was an essential aspect of fighting fires in high-rise buildings.

**One significant** shortcoming was a failure to recognize the possibility that in the event of a fire in a high-rise residential building, a large number of calls seeking help, both from within and outside the building, might be generated. The LFB failed to take any steps to enable it to respond effectively to that kind of demand. As a result, when faced with a large number of calls about people needing to be rescued from Grenfell Tower, both those in the control room and those responsible for handling that information at the fireground were forced to resort to various improvised methods of varying reliability to handle the large amount of information they received.

### **Afterword: The ecosystem challenge**

In June 2022, five years after Grenfell Tower burned, the government announced building regulation changes throughout the UK that banned the type of ACM panels that had been used on the building's exterior. The revised regulations took effect in December of that year.

Many observers wondered what had taken so long; some pointed out that the use of combustible walls and roofs had been banned in England since the

Great Fire of London in 1666. The 2010 UK building regulations stated that “the external walls of the building shall adequately resist the spread of fire over the walls and from one building to another, having regard to the height, use, and position of the building.” In fact, the UK’s “Fire Safety: Approved Document B” allowed for combustible materials to be used on the exterior of buildings provided the materials met certain criteria when exposed to fire in a large-scale test—a process that the Grenfell investigation demonstrated was weak and easily compromised.

“The Grenfell Inquiry has revealed gaping holes in the procedures for ensuring building safety, from product manufacturers, test laboratories, third-party certifiers, builders, architects, and even regulators,” wrote Richard Hull, a professor of chemistry and fire science at the University of Central Lancashire, on [theconversation.com](https://theconversation.com) in 2022.

In addition to ACM, high-pressure laminate—also used on the exteriors of many types of residential buildings—was identified as a fire risk. Some experts have estimated that tens of thousands of residential buildings in the UK alone are sheathed in some kind of combustible exterior material, with perhaps a half million people living in those buildings. According to Reuters, ACM panels containing polyethylene are now banned in at least seven countries—Britain, France, Germany, Spain, Portugal, Sweden, and Finland—for buildings taller than 18 meters (59 feet).

**Sir Martin Moore-Bick, a retired judge appointed to lead the public inquiry into the Grenfell Tower fire. The findings of the inquiry, seven years in the making, described a near-total collapse of the fire and life safety ecosystem.**

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Read the Phase 1 and Phase 2 reports published by the Grenfell Tower Inquiry.

See a Reuters multimedia presentation on the global fire risk faced by people living in buildings covered with combustible cladding.



Ten people died in February in Valencia, Spain, when combustible exterior cladding intensified a fire in a high-rise apartment building.

Even so, many thousands of buildings with combustible facades remain in those countries and in others around the world, with millions of people at risk. In February, 10 people died in a high-rise apartment fire in Valencia, Spain, an outcome blamed on the rapid fire spread generated by the building's exterior ACM panels that included a polyethylene core.

What has come to be known in the UK as the “cladding scandal” shows no sign of abating. The government has pledged the equivalent of roughly \$6.5 billion toward remediation efforts to remove combustible cladding from buildings over 11 meters (36 feet) in height, but the cost of such work has fallen largely to property owners, who also face steep insurance hikes and an increasingly reluctant market if they try to sell their homes. Some observers fear that the financial pressure faced by many homeowners with cladding remediation needs could trigger a wave of personal bankruptcies across the UK.

The Phase 2 report contains 58 recommendations designed to close the gaps identified by the inquiry; in concert with a robust, well-articulated safety ecosystem, those recommendations could form the bedrock of a new safety ethos in the UK and beyond, especially

for the kinds of mid- and high-rise residential structures that are expected to proliferate worldwide in this century. But the embrace of a safety ecosystem is also an embrace of transparency and a willingness to acknowledge risk, which for many individuals and jurisdictions can seem like a bridge too far.

In continental Europe, for example, no national surveys exist of buildings with ACM polyethylene cladding, according to Guillermo Rein, professor of fire science at Imperial College London. “Most countries don’t want to ask how many buildings have it,” Rein told Reuters in September, “because if you start asking, you’ll find a number you won’t know what to do with. And if you have 5,000 buildings [with it], there could be a fire every year.”

As of July 31 this year, the UK had identified 4,630 residential buildings 11 meters and higher with external wall systems requiring remediation, according to Reuters. So far, 1,350 have completed remediation, and 949 are underway. Seven years after the safety ecosystem disaster of Grenfell Tower, 2,331 buildings have yet to begin any type of remediation. 🔥

**SCOTT SUTHERLAND** is executive editor of *NFPA Journal*.

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