

IOSH Fire Risk Management Group

Back-to-Basics Webinar 1: FRMG Principal 1: Understanding the science of fire.

1230-1330. 14 October 2021.

Questions received from Zoom participants and suggested answers offered.

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2	<p>Have dates been set for the later webinars?</p> <p>Yes. The dates have been set and are published in the Calendar. The webinars will be advertised in due course and you are encouraged to sign-up as soon as you can.</p>
3	<p>Is there a required number of fire break points, extinguishers etc under legislation for a particular size of premises?</p> <p>Yes. There is extensive guidance on fire precautions such as these in Government, HSE, Industry and Commercial guidance documents for the type of premises (school, office, hospital, warehouse etc) that you are managing. However, you also have to make a judgement in the FRA as to what is appropriate and how much is required. This will be based on the hazards present that may cause a fire, the risks in terms of consequences, the number of people at risk and who they are and the resources that you have to fight the fire.</p> <p>For example: there must be at least one fire alarm call point at each final exit from the building. The call point will also be supplied with appropriate fire extinguishers etc.</p>
5	<p>Will you be providing copies of the presentations?</p> <p>Yes. The slides will be made available in Adobe document PDF format on the IOSH FRMG portal???</p>
7	<p>We have a office / warehouse based in Manchester and during a refit fire door blanks were fitted but only have two not three hinges and are also not marked up. After the refit was completed the LFA visited and passed the site as all clear, quoting building regulations over ruling fire regulations. I am really confused as to which takes precedence. I welcome any advice.</p> <p>This is a good question and unfortunately it does not have a clear answer. The principle point is that a FRA will have to be undertaken of the facilities under the FSRRO. Article 8 places a duty on a responsible person to take general fire precautions and these will include the provision of systems and fixtures and fixings etc to stop the spread of fire. <u>If the FRA of the facility</u> shows that there is little risk in the area and issues such as compartmentation are well designed and provisioned then this door may well not be required to be a fire door. It may simply be an office door or a cupboard door. As to which piece of legislation takes precedence, it is a point of debate. However, bear in mind that Building Regulations address property protection and quality and standards in construction etc whereas the Fire Safety Order addresses life safety. If you are a Responsible Person or a Duty Holder and breach the fire safety order you may be liable to an enforcement notice or a prosecution.</p>
8	<p>If a landlord declines to rectify defects (e.g. a fire door) and the tenant (client) also refuses, who can be compelled has to comply with the RRFSO?</p> <p>The Responsible Person. This is more likely to be the landlord in tenanted accommodation. If it is residential accommodation the leaseholder may well be primarily liable.</p>
10	<p>As a member of the IFE we now talk more about the square of combustion or even the fire tetrahedron so why do we still revert to the triangle of fire?</p>

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	<p>The Fire Triangle is a simple traditional concept that holds true. The tetrahedron or pyramid has a core of the chemical chain reaction at its heart but the triangle still covers the main points.</p>
14	<p>Can you offer any guidance on room occupancy levels from a fire safety perspective. There is guidance, but I wondered if this information/guidance could be summarised? Is there a calculator?</p> <p>Yes, there are several guidance documents, principally from Fire Authorities (Bedfordshire, Tyne and Wear), which allow present data and guidance from which you can calculate occupancy levels for a particular set of circumstances. There is also guidance at:</p> <p>Fire safety in the workplace: Fire risk assessments - GOV.UK (www.gov.uk) and Building Occupancy Calculator - Fire Risk Assessment Network (fire-risk-assessment-network.com)</p> <p>Before using these occupancy calculator equations make yourself completely aware of all the data and the requirements and the factors which impact on A SAFE CALCULATION.</p>
20	<p>What are microbiological sources of ignition?</p> <p>The effect of spontaneous combustion can occur when a combustible organic material is affected by oxidation or bacterial fermentation which generates heat. If the heat cannot escape, as materials such as straw, grass or peat are good insulators, the temperature rises, often with a 'thermal runaway reaction' to well above the ignition point or auto-ignition temperature. Typical materials comprise: hay, compost, cotton, charcoal, coal, nuts and oil seeds and manure piles.</p>
21	<p>What is the current requirement in terms of testing hose reels? How often it should be checked?</p> <p>Firstly, follow the manufacturer's advice. Although some authorities suggest 5 yearly checks it would be timely and efficient to combine testing with the annual fire extinguisher checks and in that way a functional test can be undertaken too. (5 years is too long to wait for a functional test!). Consider also that if a hose is not drained down it could be considered a little used outlet and vulnerable to legionella bacterial infection risks, so an annual check is worthwhile.</p>
22	<p>Outdoor vegetation fires are an increasing concern (earth getting hotter) do you offer guidance to land owners. Forestry Commission offers some guidance and in relation to their grants I believe?</p> <p>The FRMG has not specifically considered this point, but we now shall do so. The key is preparation. I would revert to first principles here and start by considering an inventory of fuels and means of ignition. Prepare plans and fire safety management systems and enhance inspections when weather conditions and circumstances of increase of land use for leisure occurs.</p>

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23	<p>What are the present available AI technologies to detect heat/ fire in the market especially for Marine/ Oil & Gas industry?</p> <p>Although there are papers published regarding the use of artificial intelligence in detection of fires in buildings, in harbours and of wildfires in the natural environment (typically California CA, USA) it would not be a far stretch to adopt common principles to the offshore oil and gas industry. One obvious point would be weather and IP rating for the cameras in such a severe corrosive environment and an EX rating to ensure that the camera is not a credible source of ignition itself.</p> <p>There are some of the technologies available.</p> <p>(PDF) Fire Detection System Using Artificial Intelligence Techniques (researchgate.net)</p> <p>Technologies (oisair.net)</p> <p>AVIOTEC fire and smoke detection with artificial intelligence Bosch Security and Safety Systems Global</p>
24	<p>Is this what is referred to as a BLEVE?</p> <p>Yes. A boiling liquid expanding vapour explosion, which is characteristic of mass fire effects with LPG and similar chemicals.</p>
25	<p>Will we be considering how to risk manage and tackle EV fires should they occur, as this will be an increasing risk over the next few years? Currently there are very limited solutions to this?</p> <p>Yes, indeed. The FRMG has already considered hazards, risks, advice and guidance to one function of the EV industry in reuse, reclamation and recycling batteries from vehicles and we have published on this topic. In dealing with EV fires the topic is complicated for the following reasons.</p> <p>One such concern is related to the fumes that rise from a burning EV, specifically the potential release of toxic gasses from the batteries, including for example hydrogen fluoride (HF). Toxic HF gas can be of great danger to first and second responders and may contribute to hesitation among firefighters and affect their response strategy. These fires will release carbon monoxide, organic irritants and carcinogenic organic compounds. Burning plastics can be the source of hydrogen chloride (HCl). The soot from a fire in an EV can contain large amounts of cobalt, nickel and manganese compounds. These heavy metals can cause severe allergic reactions on unprotected skin.</p> <p>Additionally, the risk is not eliminated when the fire is extinguished, especially if an EV has been involved in an accident. If there is energy left in the battery and it is damaged, this presents a significant risk as the car can re-ignite again hours, days, even weeks after the accident. Consequently, some experts advise that a damaged battery will have to be quarantined for 14 days, before it is safe to handle.</p>
26	<p>Are there any significant risks with wool fibres and dust? I work in the carpet manufacturing industry, and am interested in the potential fire risks.</p>

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	<p>Yes. I am sorry to say that there are some considerable fire safety issues in dealing with dust and light fibres. Light fibres from combustible materials such as wool, cotton and similar natural and organic materials have a very large surface area with respect to their mass. On rising streams of hot air buoyant fibres are susceptible to dust explosions if the atmospheric humidity is allowed to drop, the fibres are dispersed into the atmosphere and ignited with a degree of confinement. The situation is compounded by the trilogy of Never-to-be-allowed-conditions. Never contaminate (with light excess machine oil), Never confine in cracks, crevices and voids in machinery (as a result of poor housekeeping and machine cleaning and Never combust the oily fibrous, dusty debris through poor electrical safety, poor cleaning out of machinery vents, poor mechanical machinery maintenance or poor control of sources of ignition.</p>
31	<p>What advice can be given to manage fire in a laboratory?</p> <p>There are several key issues with laboratory safety and excellent advice and industry guidance, with some significant publications from the academic quarter.</p> <p>Fire safety guidance Safety Office (ox.ac.uk)</p> <p>Fire safety Administration and support services Imperial College London</p> <p>https://staff.napier.ac.uk/services/governance-compliance/healthandsafety/guidance/Documents/fire%20safety%20in%20labs%20-%20european%20guidelines.pdf fire safety in labs - european guidelines.pdf (napier.ac.uk)</p> <p>Laboratory Safety Guidance (osha.gov)</p> <p>Laboratory Fire Safety Environmental Health and Safety (queensu.ca)</p> <p>As well as following IOSH FRMG Principles 1-5 the general rules on minimising inventories of flammable substances, particularly HFL liquids and gases, and minimisation on the number of sources of ignition and available ignition energies you should consider limiting the number of people exposed to a potential incident. In terms of designing for fire safety benches and lab hardware should be arranged in parallel to an MOE. You don't want to have to run around a bench to reach the nearest fire exit quickly. Consequences of fires in laboratories can be particularly significant with issues surrounding biosafety, toxic flammables, compressed gases, radiation chemical hazards, laser safety and high-energy devices, ovens and centrifuges. In the FRA pay particular attention to Emergency Planning with readily available emergency gas and power shut-down systems.</p>
32	<p>Maltings have particular dust risk explosion.</p> <p>Yes, indeed. But the hazards and risks are similar to those in dusty environments with flour, wood meal, custard powder etc. In addition to minimisation of means and sources of ignition fire precautions and minimisation of inventories of combustible materials are very important.</p>
33	<p>Should the dust pentagon be applied to the spread of fire gases as that are flammable?</p> <p>No, the Fire Triangle will address fire safety of flammable gases adequately. Gases are already in a dispersed state and are harder to compress.</p>

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34	<p>What about if we have an environment where ignition can't occur, for example could an oxygen level reduction to 12% be used in normally unoccupied areas?</p> <p>Another interesting question. Theoretically, this could work although you would have to have an entirely closed system, such as a submarine or space capsule. If you reduced the pressure within the space to reduce the oxygen content this reduced level would have to be maintained, otherwise atmospheric oxygen would leak into the space. The theory would falter where some fuel molecules carry their own oxygen, such as some oxidant chemicals. The risks to human health if a person entered a space without breathing apparatus at O₂ levels below 10% are unacceptable. Finally, to propose this concept as a means of fire protection would be expensive and complicated and would have to be fully justified in a safety case approach.</p>
35	<p>On the LPG tank slide you pointed out a frost layer at the bottom. Can you give more information and relevance please?</p> <p>As the LPG liquid is evaporating to provide the gas to burn the liquid cools. The boiling point of propane is -42°C and for butane it is -1°C. The frost layer gives a visual indication of the residual volume or level of the liquified gas level in the tank, as the cold interface between boiling gas and liquid cools the metal of the tank. Water vapour in the atmosphere then freezes in contact with the outer metal surface of the tank and the liquid level and below.</p> <p>The physical phenomena are also seen as heavy icing on bulk oxygen gas evaporators, associated with medical O₂ storage tanks in hospitals.</p>
36	<p>Any guidelines to design the ventilation system to have good Air Change Per Hour in a particular environment to prevent fires and dust explosions?</p> <p>Excellent advice on this subject is available from the HSE and from professional and industry sources.</p> <p>Prevention of dust explosions in the food industry (hse.gov.uk)</p> <p>Safe handling of combustible dust: Precautions against explosions HSG103 (hse.gov.uk)</p> <p>Dust Explosion Prevention and Protection: A Practical Guide: Amazon.co.uk: John Barton: 9780852954102: Books</p> <p>While enhanced ventilation through higher air changes per hour is excellent for reducing the concentration of flammables in the atmosphere, with dusts and fibres <u>filtration</u> of the combustibles from the atmosphere is needed to remove the hazard at source as well as localised cleaning of machinery and surfaces with vacuum cleaners.</p>
37	<p>Can you please give more info on the flour dust risk?</p> <p>Prevention of dust explosions in the food industry (hse.gov.uk)</p> <p>Please note answers given to related questions. This is huge but interesting technical subject with risk controls that will be principally focussed on good process safety and safety engineering, supported by strong managerial and supervisory control.</p>
38	<p>We have a paper carton board waste extraction system in our factory which exits via ducting to an external compactor. This includes the extraction and collection of the board dust. Are</p>

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	<p>there specific controls I should be aware of (I'm new to the company and the carton industry)? Thank you.</p> <p>Yes. The general principles and practices will apply and the collective fire protection package of fire prevention and fire precautions should be addressed. Principal FP concepts of minimising ignition sources and unnecessary fuels and contaminants are important, such as oils and greases, as well as maintaining higher humidity levels and removing dust debris in a timely manner.</p>
39	<p>In terms of fire safety material production, what new materials are being experimented with or produced that may solve the issue of elongating & improving a steel framed structures performance in a fire?</p> <p>This field of passive fire protection is vital to building safety fire precautions. The principal means of protection are based on: boards and blanket fire protection; thick film and thin film intumescent paints and coatings including expanded foams on steel structures; concrete encasement; block in-filled columns and sprayed cementations or gypsum-based coatings.</p> <p>Of these, thin film intumescent coatings have been developed more popularly recently and have the advantage of being able to be applied to steel beams and components in a QA controlled warm, clean and dry factory setting away from the construction site. The film comprises three coating layers: a primer, a basecoat and a sealer coat and can offer up to 120 minutes fire resistance. Expansion ratios of up to 50:1 are quoted, where a 1mm coating has the potential to expand to 50mm on heating.</p> <p>The advantages of off-site preparation before construction or assembly are great although on-site applications are possible. Sprayed on applications are good for complex shapes. Where amendments, changes or modifications to PFP are required spray applied systems, or fitting of blanket materials are considered, although blanket systems have the performance disadvantage of not being able to gain intimate contact with the steel or building substrate.</p>
40	<p>Thanks for this presentation. Is processing bulk sugar an explosion risk?</p> <p>Yes, particularly in bulk storage silos. Please see answers above to other questions on fire protection of dust hazards.</p>
44	<p>Issues concerning the use of fire extinguishers in modern fires where fumes are the major cause of injury/death?</p> <p>Historically, some very old firefighting media such as Pyrene carbon tetrachloride (Halon-104) extinguishers from 1911 did present safety and environmental concerns. This material was 'phased out' by the 1980s as CCl₄ presented CNS, liver and kidney issues. Other than that, modern fire extinguisher fillings are relatively safe and the risks of human toxicity from products of combustion are probably greater than those due to the extinguisher filling.</p>
45	<p>Excellent presentation Ian. Thanks for discussing the Dust Pentagon, as many people do not realise dusts can ignite and explode. My question: is Pyrolysis part of the combustion process, or something different?</p>

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	<p>Thank you. Pyrolysis is a form of combustion and is generally a controlled thermal decomposition of materials at elevated temperatures in an inert atmosphere. The process also initiates a chemical change in the structure of the material. For example, wood to charcoal.</p>
46	<p>Regarding Fire Action Notices, there is no legal requirement to use a fire extinguisher, what is the preferred current wording on the notice? Use if you feel confident? Use if safe to do so? Various versions being used. Any guidance?</p> <p>Yes, an interesting point. If your organisation does not expect or require you to fight a fire, there are fire action notices which do not mention about fighting fires, and these may be better suited for you.</p> <p>To fight a fire with an extinguisher you should be trained to do so. Wording such as “Only fight a fire if it is safe to do so, you have evacuated everyone nearby and you have been trained to operate the extinguisher”. In this circumstance, life safety is paramount.</p>
47	<p>I think when you have places which are open to the public, the staff worry about what to do if they ask someone to leave on hearing the fire alarm sounding but the members of the public refuse. I have said to ask again, then not delay your own escape.</p> <p>Yes, I agree. Ask a second time, politely but firmly and instruct with a phrase such as: “You have to leave the building now please”. Try to encourage people to leave behind anything they are carrying, except children.</p>
48	<p>A comment on the consequences of leaving a computer on charge at home.</p> <p>Agreed. No electrical equipment SHOULD be left connected to the mains and powered-up in an unattended state. This is particularly significant at night in sleeping accommodation and in particular computer, tablet, mobile and E-cigarette chargers and televisions and electrical apparatus and white goods on standby. Electrical safety issues are one of the principal causes of fire in the home.</p>
49	<p>Interesting with the examples of dust explosions. Do we have any equipment or an alarm to detect any real or potential high levels of dust in the atmosphere in a room?</p> <p>This is an interesting question. There are two issues here. Direct reading dust instruments do exist and are used for warning workers regarding high concentrations of dust in the air with regard to dangerous occupational health levels, just as there are direct reading instruments for flammable gas levels in confined spaces safety.</p> <p>Typical levels in EH40 for an 8-hour TWA for a ‘general’ or non-specific construction type inhalable dust would be 10 mg.m⁻³ and 4 mg.m⁻³ (8 hour TWA) for an respirable dust. However, levels of combustible dust may well be 1000-10000 times greater. The analogy is with flammable atmospheres.</p> <p>The OH limits may be small, typically toluene at 50 ppm 8-hour TWA, whereas the LEL, (lower explosive limit) for toluene is 1.1%, or 11,000 ppm. With dust explosions, as seen in the pentagram, in addition to the three knowns in the fire triangle (fuel, oxygen and heat) you</p>

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	<p>have to DISPERSE the dust up into the atmosphere as a fine cloud and then CONFINE the dust before or simultaneously igniting it. This can and often does happen immediately after a first event which causes the initial disturbance or dispersal, such as a small fire, explosion or pressure wave, even from a sharp gust of wind or a slamming door. This high level of dust now in the atmosphere may well give rise to choking conditions which make it hard to breathe. If the dust settles, the OH hazard may still be there, but the explosion risk may have subsided.</p> <p>So, technically, it is possible by optical dispersion techniques, but it may be difficult to interpret the results clearly.</p>
50	<p>What are the consequences of sites not addressing C2 and FI on fixed electrical installation reports in a timely manner please?</p> <p>Code C2 is a fault code where the article requires attention, there is a potential danger, and the equipment is in an unsatisfactory condition. An observation code FI is described as 'Further investigation required without delay.' This means that your electrical testing engineer has observed something whilst carrying out the testing, for instance, if the emergency lights seem very dim. This might not have been covered in the report, so they have noted it separately as code FI.</p> <p>Simply, the consequences could be electrical safety, electric shock, short circuit, power surge or power failure, failure in safety critical systems and services and service delivery. Either issue should be attended to without delay, using emergency or contingency budget codes if financing immediate repairs or maintenance is an issue. Failure to do so may also compromise or invalidate insurance. Managerially, a Responsible Person could be open to enforcement action, under s. 37 of HSW for failing to take action to remedy at once these issues. Basically, for life safety and property protection, its not worth the risk!!</p>
51	<p>Fire Drills. What are the effective measures to support the disabilities in high rise office building during drill in term of Engineering Control?</p> <p>I presume you mean by this how do you deal with 'Equality Act' (as per the historic term DDA) people who need assistance during a fire drill, as opposed to a live fire event. And by engineering control I presume you mean when elimination, substitution, managerial control, changes of processes, planning and work activities and PPE have been exhausted ...</p> <p>A drill is quite different to a live fire situation where life safety is paramount. A PEEP will have been prepared beforehand for a wheelchair user so they will be familiar, rehearsed and prepared for what is going to happen. In a real live fire, they are going to be carried at best, and bundled if necessary, down the stairs in possibly an undignified fashion. In a drill, I think you want to reassure and comfort the person that YOU know how this is going to work. Use the information in the PEEP. If a passenger lift is required and YOU can control the lift by key access, use it and pass on confidence to the wheelchair user that you know how this is going to work. It's a communications exercise which needs to work first time to give them confidence. Don't forget the debrief / wash-up session at the end of the drill to pass-on lessons learned BY EVERYONE involved.</p>
57	<p>Please can the panel comment on the safety of water mist extinguishers in relation to fires involving electricity?</p>

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	<p>As a welcome innovation water mist extinguishers are determined to be safe for INADVERTANT spray on, or contact with, live electrical equipment. Water mist extinguishers are NOT specifically designed to do this. It just happens that the tiny droplets of water CANNOT conduct an electrical current. (Do not confuse this Water mist technology, which requires a separate and distinct nozzle on the extinguisher hose, with the use of demineralised water or distilled water in drench systems. These fire deluge systems were historically used in CEGB power station generator halls in the event of a catastrophe involving a fire in an AC generator spinning at 3000 rpm).</p> <p>Water mist technology is an excellent all-purpose fire extinguishant technology. The extinguisher produces a mist curtain which cools and cuts off the supply of oxygen, with droplets so small they have no adverse effect. Where possible, always try to switch off electrical and other equipment before trying to tackle the flames to help reduce the risk to you.</p>
58	<p>Where can you get the poster that you displayed entitled "Fire! life and asset safety and property Protection"</p> <p>From the IOSHG FRMG portal! It's free ... Ask Tina.</p>
59	<p>How often should fire doors be checked in tenanted properties and who is responsible?</p> <p>An annual inspection and test would be ideal, and the Responsible Person would be the landlord.</p>
60	<p>It would be good if you could do a session based on 'Fire Risk in Tall Buildings'.</p> <p>Yes. Thank you, an excellent suggestion which will be suggested to the FRMG.</p>
61	<p>I'm aware that there's no fire alarm inside an operating theatre and fire incidents rarely happen but how to prevent it if it does happen? Installing the smoke/heat or multi sensor detector?</p> <p>There are two issues here: fire detection and then raising the alarm to warn people that there is a fire. The FRA would determine the best fire precautions in a particular area to match or exceed the risk and this would be one of the fire / smoke detector systems. In general terms fire alarms in hospitals are silent alarms that will be activated and displayed on the fire annunciator panel. This may be repeated at the ward or the entrance to a theatre suite.</p> <p>There is much guidance on fire safety in healthcare as well as industry-based advice.</p> <p>Fire safety risk assessment: healthcare premises - GOV.UK (www.gov.uk)</p> <p>One of the most significant issues though is the scrupulous management of oxygen and combustible materials.</p>
62	<p>Is there any guidance on self-sustaining fires, e.g., lithium or hydrogen fire?</p> <p>Yes. Publications are coming on-line now from industry on dealing with fire safety and hydrogen when used as a fuel.</p>

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	<p>ADDRESSING THE PROPERTIES OF HYDROGEN FOR COMMERCIAL ENERGY APPLICATIONS (ukhfca.co.uk)</p> <p>There is also an HSE CRR 715 on guidance for hydrogen and fuel cell stationary applications. Guidance for hydrogen and fuel cell stationary applications (hse.gov.uk)</p> <p>Clearly, in this developing field the IOSH FRMG will be reviewing and revising guidance and advice for the benefit of members.</p>
65	<p>Make sure you include any Solar installation in your fire risk assessment, consider how these can be shut down.</p> <p>Thank you. This is strong advice. Again, fire safety in this area is a developing field which the Group will be following.</p>
66	<p>Please, this is related to gas cylinders at our homes. It's good we know the expiration date, safe usage and able to educate our families and the society at large also. Because, now and in the future, this gas cylinders usage will become the most commonly useful renewable energy and as safety professionals, we should also be making awareness including our children too.</p> <p>An excellent statement, thank you. Regarding climate change, COP 26, Glasgow 2021 and energy supplies, costs and availability this is a timely reminder. There are many International and UK guidance and industry advisory documents on this subject, which we shall be reviewing and revising for content in future presentations in CPD and update events.</p> <p>lpg-cylinders-fire-safety-guide.pdf (nfumutual.co.uk)</p> <p>appendix-13.pdf (scdf.gov.sg)</p> <p>Gas Bottle Safety Flogas</p> <p>Liquefied Petroleum Gas health and safety guidance (hse.gov.uk)</p>
67	<p>If you have metal oxides do they have zero potential to burn as they are already oxidised?</p> <p>Potentially yes in the wider view of things. But bear in mind that this is not a simple answer. There are many elements that form oxides, and a few metals that do not have commonly available ones in the natural environment. And in some instances, there are multiple oxides know: iron has 16 known oxides for example.</p> <p>So, it is always possible that a particular oxide could be more deficient in oxygen in the molecule that another variation of the oxide and therefore capable of further oxidation, for example, at a higher temperature or with more available oxygen.</p>
68	<p>Evacuation Procedures: Due to the increase in Working from Home and the offices being re-designed due to Covid, going forward there will be limited permanent staff in the building. The current Evacuation Marshal are working from home and will continue to do so therefore, no longer carrying out this role. Do you have any ideas of what we should put in place? Currently looking at front of house staff, and those perm in office possibly taking on the role of Evacuation Marshals. We are also looking at all staff being trained in fire awareness. But it is highly unlikely we will have Marshals on each floor.</p>

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	<p>This topic is timely and in a quickly developing field, where policy and strategy are potentially lagging. This is something that the Responsible Person is going to have to establish. I do not condone there being a Fire Marshal or Evacuation Marshal taking on the role but working from home and not present in the building. That seems to be counterintuitive as it serves no purpose. All staff should receive some basic professional fire safety awareness training on induction to the business (say 3 hours duration) and an annual refresher (typically 1 hour duration). In a parallel mode to appointment of First-Aiders, sufficient Fire Marshals should be appointed and trained to be responsible for each floor of a multi storey building, with 'spares' to allow cover for annual leave, sickness, absence from work etc. and to supervise fire drills. They should be trained in the use of the fire extinguishers that have been provided.</p>
69	<p>1. Are there any UK statistics regarding fires by human errors?</p> <p>Yes. There are many sources of data on fire statistics in the UK. Some references to on-line data are below.</p> <p>Fire statistics - GOV.UK (www.gov.uk)</p> <p>Fire Safety Statistics for the United Kingdom: Firesafe.org.uk</p> <p>Fire Safety Facts (firstalert-online.co.uk)</p> <p>However, what is meant by 'human errors'. Do you mean arson or deliberate ignition? All fires can be categorised by action or conditions (undertaken or not, positively or negatively) by people at all levels, including workers, supervisors and managers</p> <p>2. In one slide with serious fires with open walls or so, as we need to think of enhancing more fresh air intakes, half wall partitioning in buildings may help, while this will cause a fire risk; as wet sprinklers and fire extinguishers, hose reels are inside buildings; what other precautions or additional fire fighting equipment shall be considered?</p> <p>The slide referred to was a partially constructed building that had not been made weather tight and offered the perfect configuration of a fire crib. It was, unfortunately, a perfect bonfire! In these circumstances enhanced fire and intruder detection should be considered, enhanced site security and a fire watch should be in place until the building can be weathertight and physically secure.</p>
70	<p>Surely its the friction between the dust particles that causes the ignition risk, the fuel is the organic matter, and the O₂ in the air completes the triangle ... pentagon.</p> <p>Yes, this is certainly true. It is possible, but there are many (possibly unguarded or unprotected) sources of ignition in an industrial environment, and it is more likely that combustible organic dusts found a source of electrical ignition or hot surfaces of machinery etc.</p>
72	<p>How much fire risk increase in the mixed environment of Dust and VOCs?</p> <p>It is certainly possible that there is a synergistic effect with flammable solvent vapours in the atmosphere working in combination with a combustible dust. There is published research of synergistic effects in terms of occupational health, but I am unfamiliar with anything in the fire safety field. In a real situation, it would be most likely that the solvent vapour would pose the</p>

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	<p>greater disk, as potentially a solvent fire or explosion would then 'activate' the dust as a fuel by dispersing the dust into the atmosphere.</p> <p>The FRMG will look into this!</p>
74	<p>As hydrogen is now being considered for road vehicle and domestic applications what precautions should be considered, remember the Hindenburg!</p> <p>Hydrogen is already being used for rail transport, although the 'tank' is as large as a carriage. As replied to earlier, there is already work being done on the safety of this as a fuel and the FRMG will be following developments in this field.</p>
75	<p>Chevrolet in the US are spending \$1.5BN on recalling their EVs (car is named 'Bolt' ... so not all are safe!</p> <p>Thank you for the interesting update.</p>
76	<p>Where can I find that paper on EV's?</p> <p>On the FRMG portal. Ask Tina.</p>
77	<p>Q: Any advice on the use of hydrogen as a source of renewable fuel in the future, with the potential for fire and explosion!</p> <p>Please not previous answers on this subject and follow this space!!</p>
78	<p>How to mitigate the Fire Risks at a multi job site (Vehicle Workshop) having much more complex processes being performed under one roof.</p> <p>This is a classic example of the work of the Fire Risk Assessor, and you need to employ a competent person in this field to undertake the work for the Responsible Person. The IOSH FRMG have written and published guidance on this work and who would be ideal to undertake an FRA.</p>
81	<p>Would the change of ownership of a large multi storey shopping precinct trigger the requirement for a full FRA or would a review of the previous suffice? Previous is just a year old.</p> <p>Yes. You would be well advised to repeat the FRA as most probably the Responsible Person would have been changed and they carry personal responsibility for FRAs from then on.</p>
82	<p>Can inorganic compounds form a dust explosion?</p> <p>Yes, certainly. Metal dusts are particularly dangerous such as Be and Mg.</p>
83	<p>Not a question but info - This is the product for Li-Ion vehicle fire. It does of course rely on the ability of personnel to cover the vehicle, which would require two people.</p> <p>Fire blankets (bridgehill.com).</p> <p>Yes. Thank you for the information, which I believe is also published on YouTube.</p>

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84	<p>Alan I'm in the food production business. DSEAR reports are not all clear on the flour. All the surveys are different on how to maintain and zone the areas. All inspectors have their own opinion.</p> <p>Thank you for the comment.</p>
85	<p>Is there any data for fires of electrical origin, i.e., regarding if the appliance has/has not been PAT (Portable Appliance Tested)?</p> <p>Yes. Please see earlier answers given on fire safety statistics, and where to find the updated data.</p>
86	<p>Is Arson the most common factor as this is the biggest factor still within hospitals?</p> <p>In house fires, the five most common causes are: cooking; heating and portable heaters; electrical fires, including white goods appliances; smoking and candles. For industrial or workplace fires, the common ones are: faulty or incorrect use of electrical equipment, misuse; inappropriate storage of waste and combustibles; smoking; storage of HFLs; kitchens and canteens and arson.</p>
88	<p>Share info about fire from cladding material?</p> <p>Thank you for the question. But sadly no, as a matter of policy. The subject matter is one of sub-judice at present.</p>
90	<p>What are the prevention measures in instances of natural lightning other than grounding or earthing?</p> <p>Lightning protection by well designed, installed, maintained and frequently inspected earthing is still the best means to protect a high building from lightning. The inspection and test of earthing fittings and fixings MUST be undertaken by competent professional lightning engineers.</p>
91	<p>How safe to store and use small Li-ion charger in HGVs as powered pallet truck is being use to move pallets? Is there any significant risk that the charger getting fire?</p> <p>Yes. There should always be consideration of electric sources, especially temporary ones and charging equipment.</p>
92	<p>There is HSE research on hydrogen RR715. Please see the link below https://www.hse.gov.uk/research/rrpdf/rr715.pdf</p>
94	<p>Can you please cover DSEAR in upcoming seminars?</p> <p>Yes. That is an excellent idea. The FRMG will work on this.</p>
95	<p>Can you explain some of the conclusions from fire investigations & complacency of behaviour?</p> <p>Yes. Over to you David.</p>

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99	<p>The Combustion Equation.</p> <p>Thank you to so many members who commented on the combustion equation and the fact that, in their opinion, the equation was 'wrong'. The author admits that the equation was NOT stoichiometrically balanced. It was not meant to be! It should have had a right arrow (mathematically leads to) as opposed to an equals sign!</p> <p>For simplicity the equation was <u>illustrative</u> and in the general form of the combustion of:</p> $\text{Hydrogen} + \text{oxygen} \leftarrow \text{carbon dioxide} + \text{water}$ <p>just as the general chemical equation of:</p> $\text{Acid} + \text{Base} = \text{Salt} + \text{Water}$ $\text{A hydrocarbon} + \text{Oxygen} \leftarrow \text{Carbon dioxide} \uparrow + \text{Water} \uparrow_{(\text{vapour})} + \text{Heat} \uparrow \text{ or } \leftarrow$ $\text{CH}_4 (\text{methane}) + 2\text{O}_2 (\text{oxygen}) = \text{CO}_2 (\text{carbon dioxide}) + 2\text{H}_2\text{O} (\text{water}) + \text{heat}$ <p>However, there are other equations, depending upon the degree of oxidation of the hydrocarbon. With partial oxidation, in reduced concentrations of oxygen in the atmosphere, a hydrocarbon can burn to give the toxic and dangerous product carbon monoxide. Sadly, this situation gives rise to fatalities occasionally with poorly maintained or serviced cooking equipment and also in the leisure field with LPG appliances on boats and in caravans and disposable charcoal barbeques, which are mistakenly left smouldering 'innocently' inside tents at night to keep campers warm. These are terrible and tragic events.</p> $2\text{C} + \text{O}_2 = 2\text{CO}$ $2\text{CH}_4 + 3\text{O}_2 \leftarrow 2\text{CO} + 4\text{H}_2\text{O}$ <p>With even less oxygen, it is possible to create carbon black.</p> $\text{Hydrocarbon} + \text{oxygen} \leftarrow \text{carbon monoxide} + \text{carbon} + \text{water}$ <p>Citing the combustion of propane (LPG):</p> $\text{C}_3\text{H}_8 (\text{Propane: an LPG}) + 5\text{O}_2 = 3\text{CO}_2 + 4\text{H}_2\text{O}$ <p>And butane:</p> $2\text{C}_4\text{H}_{10} (\text{Butane: an LPG}) + 13\text{O}_2 = 8\text{CO}_2 + 10\text{H}_2\text{O}$ <p>In plentiful oxygen, in your gas barbeque, propane burns with a blue flame to give carbon dioxide and water vapour, and hopefully hot grilled food. With diminished oxygen, propane burns with a yellow smoky flame to carbon (or CO) and water. However, it is also most likely that the carbon or the carbon monoxide could be oxidised up to $\text{CO}_2 \uparrow$ and water vapour \uparrow(steam).</p> $\text{C}_3\text{H}_8 + 2\text{O}_2 = 3\text{C} + 4\text{H}_2\text{O}$ $\text{C} + \text{O}_2 \leftarrow 2\text{CO}$

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