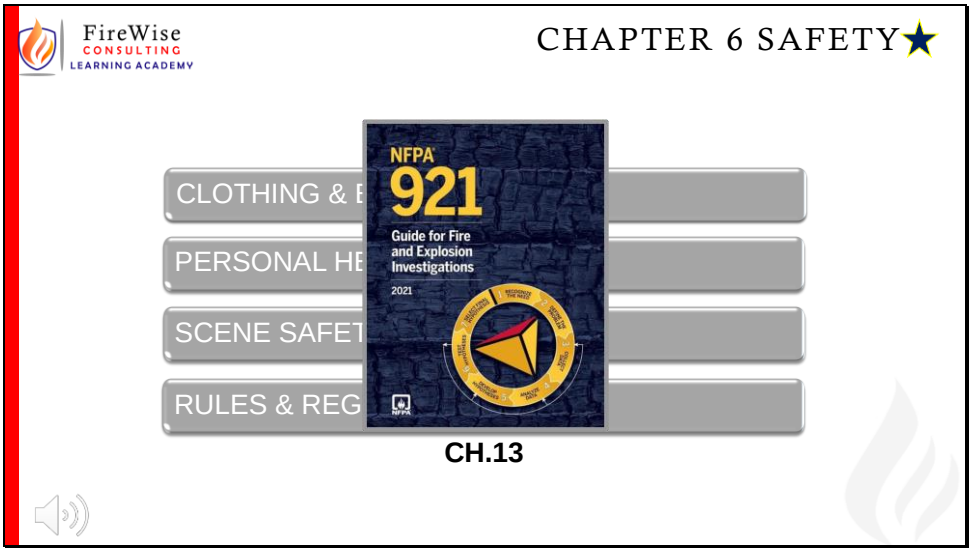
Slide 1



Welcome to Chapter **6** Safety**.** If you are following along in NFPA 921 (2021edition) we will be covering chapter 13.
In this chapter we will:

- Present a case,
- Discuss who is responsible for safety at a fire scene,
- How to safeguard personnel, bystanders, and above all, yourself,
- Explain how to conduct a thorough hazard and risk assessment,
- Describe the different types of safety clothing and equipment and when they should be used,
- List the hazards that can endanger an investigator's personal health and safety and how to avoid them,
- The various factors that may influence scene safety and how to identify them, and finally,
- We will discuss the various rules and regulations pertaining to fire scene safety.

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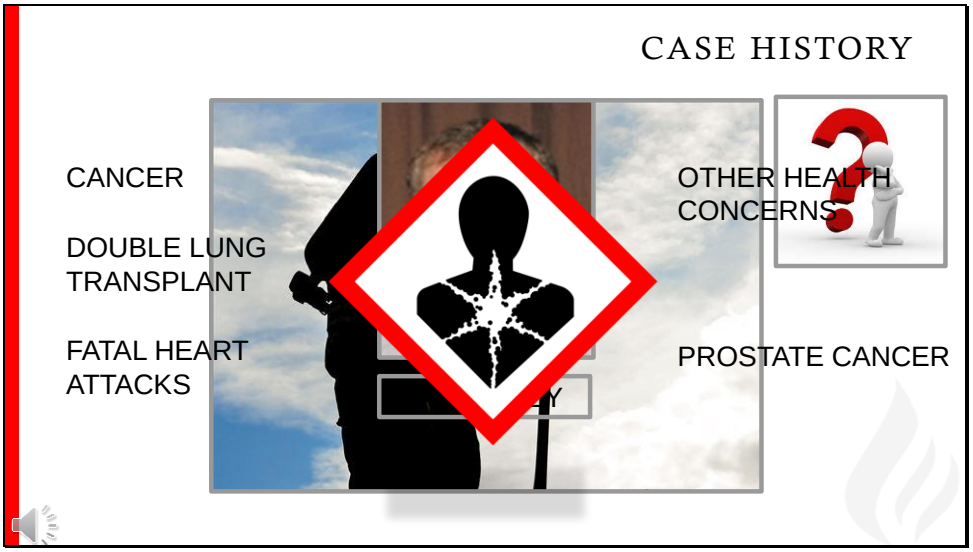

Why is it important for a fire investigator to know about scene safety? To answer this let's look at a case history.
Case History

Bob Turley joined the Office of the Fire Commissioner in 1985. At that time there were about twenty staff with fire investigations as a significant part of their job descriptions. Over the next 20 years a number of these individuals fell ill and left the job before their normal retirement age or they passed away. One died of cancer at age 46. Another received a double lung transplant while he was in his 40's. Two staff members had fatal heart attacks, the oldest was 56 years old. Two left the job before retirement age due to a number of health concerns and two were treated for prostate cancer in their 50's Bob being one of them.
Fire investigation is an extremely hazardous undertaking and many investigators do not take proper precautions. Bob often says "When I started, we used paper dust masks but I would not enter a scene today without at least a positive pressure respirator".

Slide 3

The old saying, “safety first” was never more true then when applied to the life of a fire investigator. A fire scene is a dangerous place; to keep everyone safe, the fire investigator must rely on his or her training and make sure it remains updated and consistent with current safety norms.

It isn’t only the physical dangers that can cause harm to an investigator, but also the ongoing exposure to toxins and carcinogens at harmful levels. Because of repeated exposure, fire fighters have been found to have higher rates of cancer than the general population. We are not aware of many studies performed specific to fire investigators but we suspect the health concerns would be equal too or greater than the risks to firefighters.

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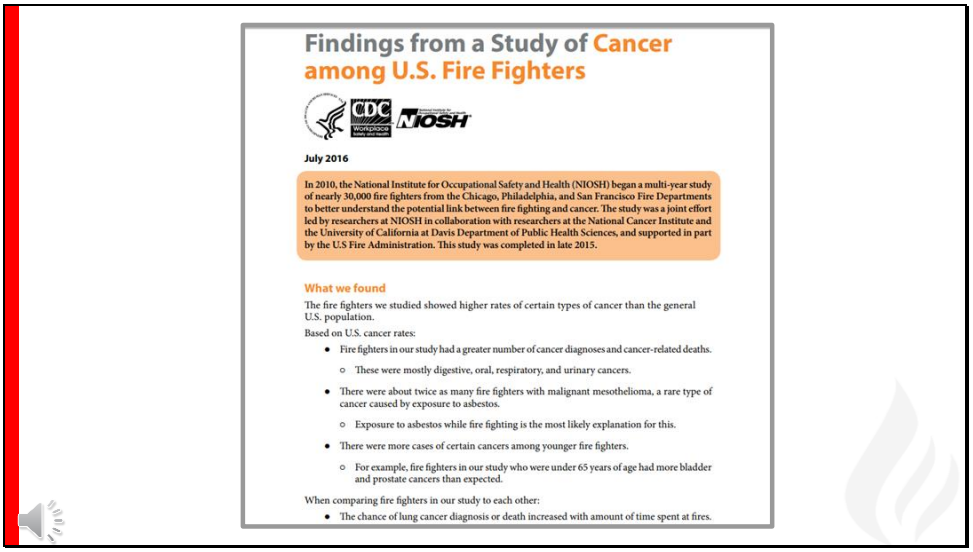

In 2010 the National Institute for Occupational Safety and Health, Niosh, launched a multi-year study to examine whether fire fighters have a higher risk of cancer and other causes of death due to job exposures. The study involved more than 30,000 career fire fighters who served in Chicago, Philadelphia, and San Francisco Fire Departments between 1950 and 2010. It is the largest study of United States fire fighters ever undertaken. In addition, both non-white and female fire fighters are represented.

The study looked not only at deaths from cancer, but also at the diagnosis of certain kinds of cancer, such as testicular and prostate cancer, which have higher survival rates. They also examined other causes of death to better understand the risk for various cancers and illnesses among fire fighters compared to the general public. If you would like to read more on this study please review the full Findings from a Study of Cancer among U.S. Fire Fighters which can be found online or in the additional resource section of this Chapter.

Slide 5

Fire investigators must also be concerned about contamination of their protective and personal clothing.

Harmful toxins are hard to control; they are small, airborne, and stick to clothing. A study conducted by the NIOSH and the Bureau of Alcohol, Tobacco, Firearms and Explosives, ATF, showed that many of the compounds found at fire scenes stick to the fire investigator's clothes. Often they would take the contaminated clothing home and wash it with their domestic laundry. This was not only putting the investigators at risk but also their families.

NIOSH investigators conducted a multi-phased field and laboratory evaluation and recommended that fire investigators use disposable protective clothing, not take clothing home for laundering, remove investigation clothing before entering personal or official vehicles and, if disposable clothing is not provided, professional laundry services should be used. In addition, fire investigators should wear disposable, chemical resistant gloves to further protect themselves from dermal exposures at a fire scene.

This study was the reason for the recommendation that all fire investigators wear protective clothing at all times.

Slide 6

As we have already mentioned , fire scenes are physically dangerous and toxic places by their very nature. Fire is first and foremost a chemical reaction that can result in compromised structures, and toxic atmospheres. The fire might have also been set through a criminal act which could also pose or add an imminent danger to the investigator.

It is the duty of the investigator to assess the dangers and protect themselves and all other personnel or bystanders by controlling the fire scene.

Although the investigative phase is not usually included in the emergency phase of the incident, the same safety standards should be kept in place. Remember: No investigation is worth risking one's life for.

Slide 7

In a perfect world, fire investigators always work in pairs. Working with another investigator means having a back-up, another set of eyes and hands to help identify risks and hazards and help should you get into trouble.

However, it is not a perfect world, and all too often budgetary concerns and staffing restrictions require fire investigators to work alone, even when there is significant risk to their safety and health. If this is the case, you should have a working alone policy and:
Communicate!

- Make sure an off-site contact person knows you are at the fire scene, and how long you expect to be there for,
- Carry a two-way radio, or a cell phone, or another way of communicating with someone if you find yourself in a risky situation and need help.
- If you are delayed for some reason, say the investigation is taking longer than the expected time, notify your off-site contact person and give them an adjusted timeline.
- The off-site person on their end should also contact you if they do not hear from you within the expected time.

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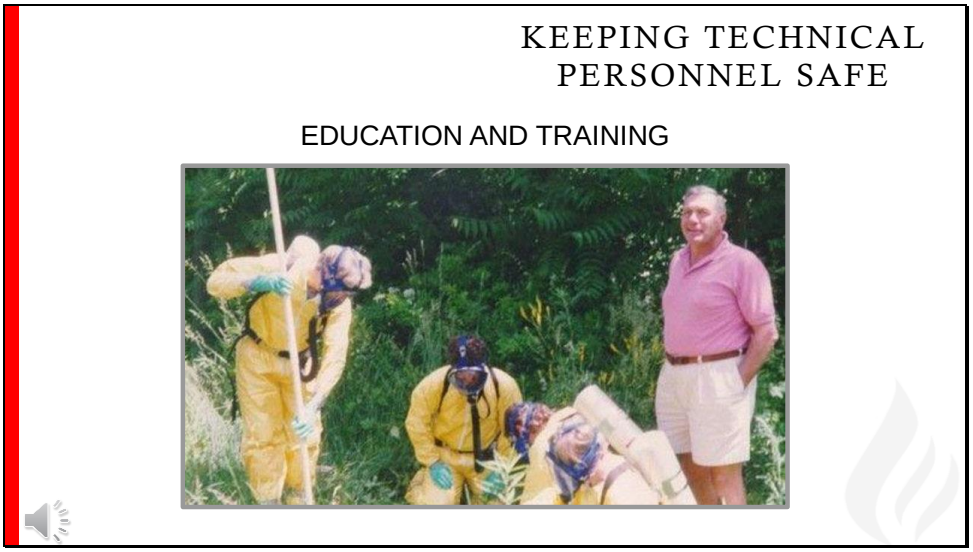

Some fire investigations require experts be brought in to give their opinions. They might be very knowledgeable in their particular field but that does not mean they know how to protect themselves at a fire scene. It is your responsibility as the investigator to make sure everyone who enters the fire scene knows about the hazards and the precautions that must be taken to mitigate them.

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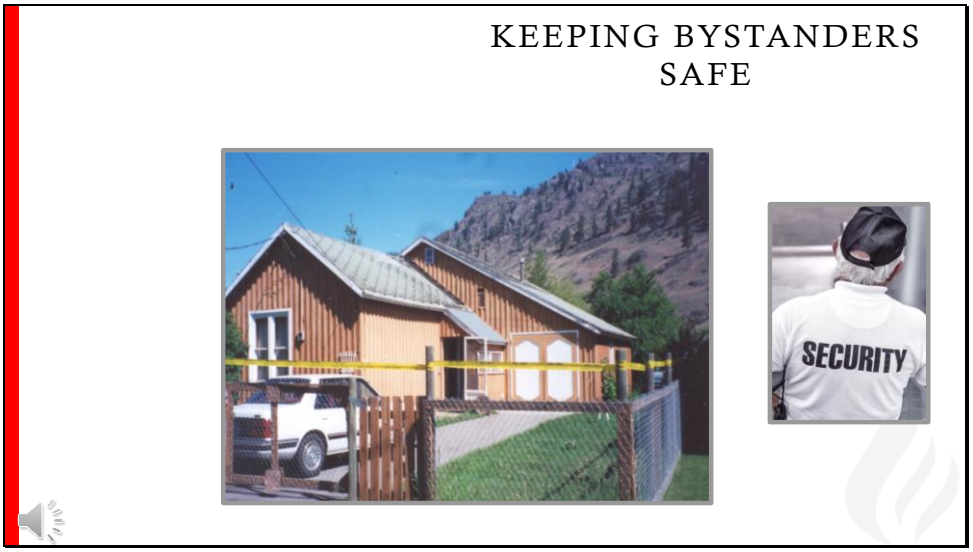

People are curious. A fire is not something that occurs everyday and will probably draw crowds of onlookers, who might try to get too close for comfort to the fire scene. This can endanger their lives not to mention the integrity of the scene.

The fire investigator is responsible for the scene which means you are also responsible for the safety of anyone who enters. It is important to have measures in place to keep all bystanders, which might even include the building occupants, at a safe distance. You might need to request help from the police or the fire personnel to set up rope, fire lines or barrier tape around the area where it is not safe for a bystander to be. Trained security people can also assist with keeping people safely away from any danger zones.

Slide 10

Keeping track of who enters the scene and when is essential. The fire investigator should keep a written log of the name, date and time of all authorized personnel who enter the scene. They should also make special note of any unauthorized entries, when they occurred, who the person was and which area of the scene they accessed.

It is also important to identify any collapse zones, or distances around a structure that might be affected if a part of the building collapses, and mark them with either barricades, vehicles or specialized scene tape. The collapse zone distance should be one and one half times the height of the wall that may fall down.

However, that is not enough. Responders are used to crossing scene tape and barricades in the course of their duties. You have to communicate verbally to responders to make sure they are very aware that a building might fall on them if they walk in that area.

The fire investigator also needs to find a safe place away from any dangers to conduct interviews.

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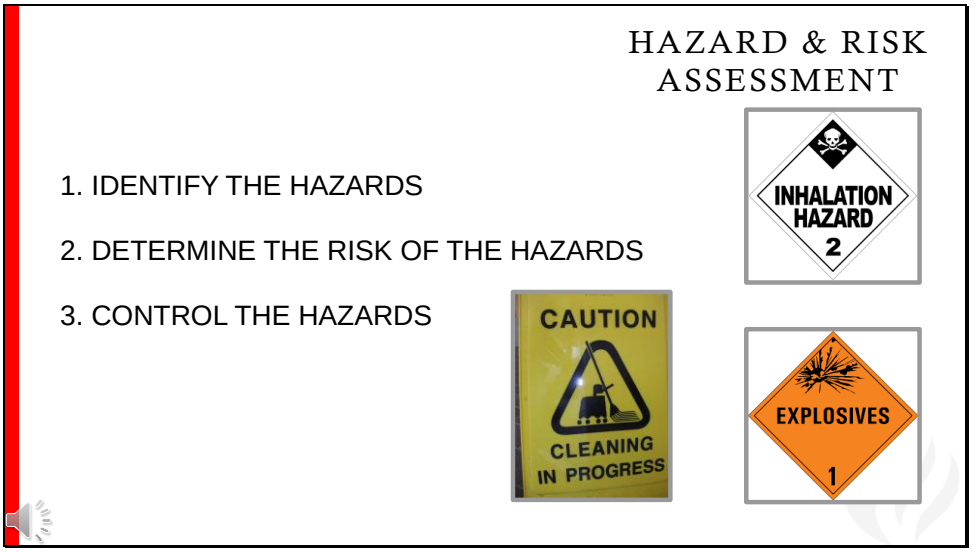

The first thing an investigator must do is conduct a hazard and risk assessment to reduce job risk. This is a three step process which includes:

- Identify the hazards,
- Determine the risk of the hazards, and finally,
- Control the hazards.

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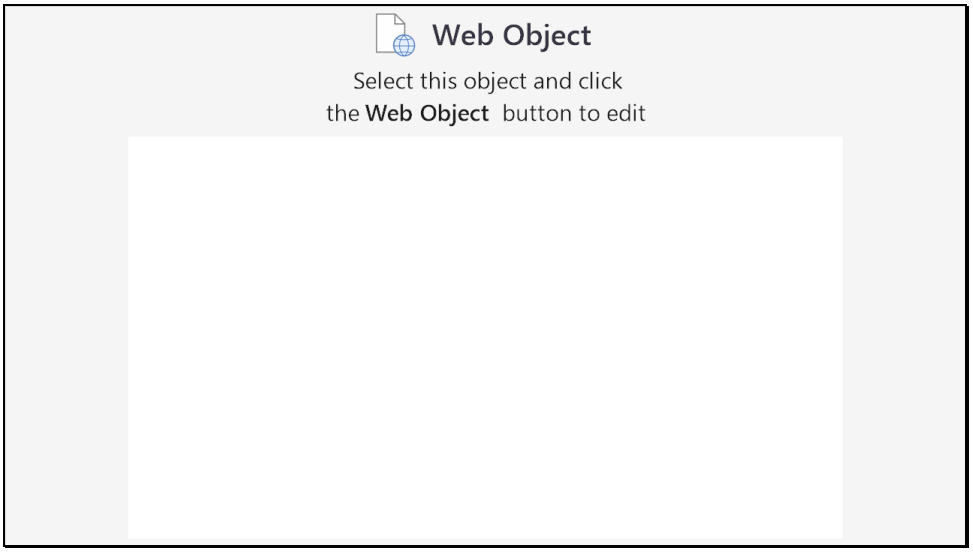
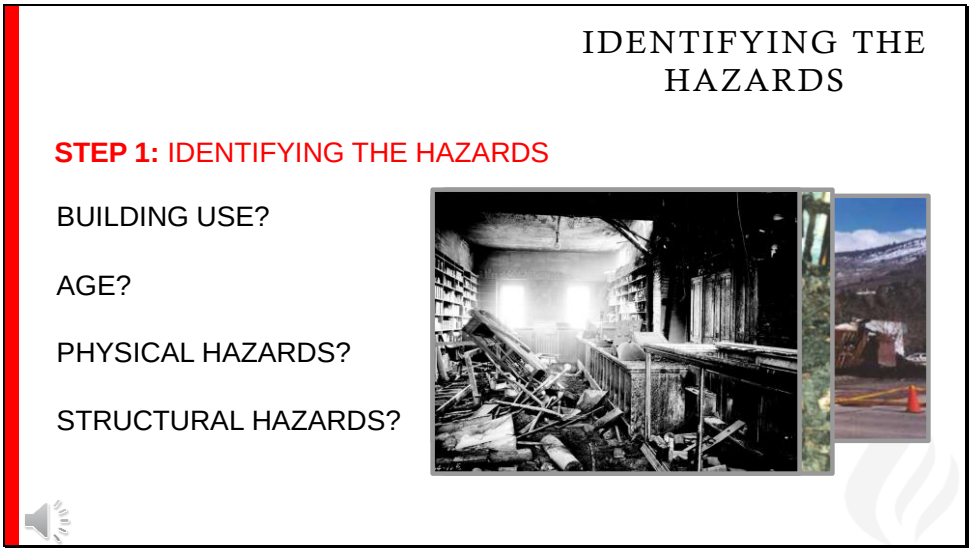


DeHaan video #17 Dr. DeHaan: Combustion Products of PVC

Slide 13



Here are the questions investigators should ask themselves when attempting to identify the hazards at a fire scene:

- What was the building or property used for? The use of the building may suggest hazards that exist because of the use. For example, what could be expected in a hardware store? (pause) Just about anything!
- How old is the building? In older buildings investigators may be exposed to hazards like asbestos or knob and tube wiring.
- What are the physical hazards? Are there any places where someone could slip, trip or fall?
- What are the structural hazards? Has the building's structural integrity been compromised in any way?

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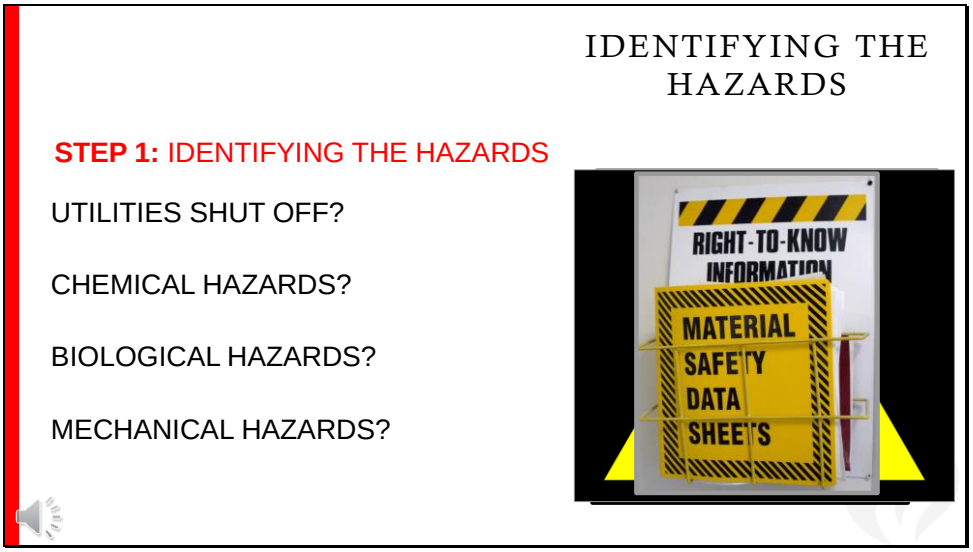
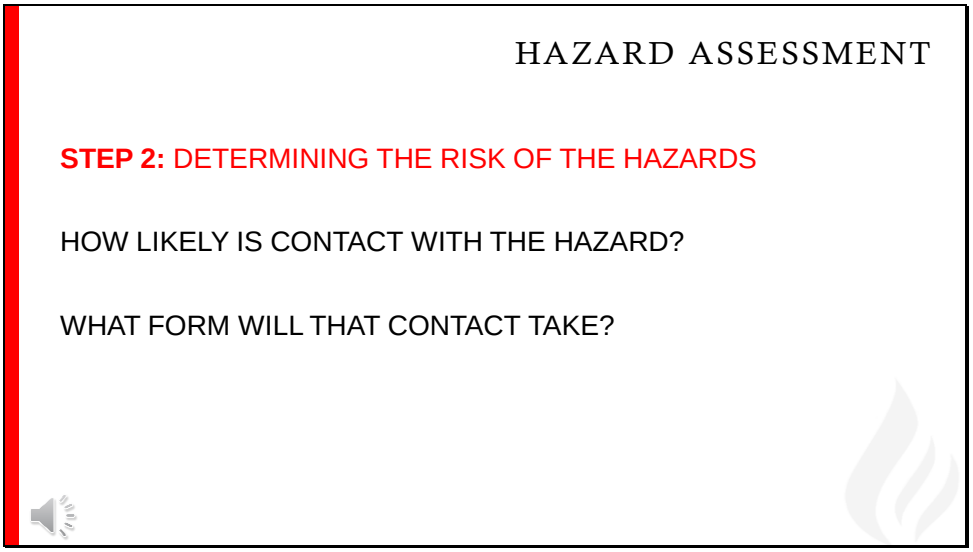


- Has the electrical and/or gas systems been shut off or are they still operational?
- What are the possible chemical hazards at the scene? Do any reference materials exist such as material safety data sheets (MSDS) or a safety data sheet (SDS) that could shed some light on the chemical hazards present?
- Are there any biological hazards present caused by bacteria, virus, insects, plants, humans or animals? And finally,
- What are the mechanical hazards? Are any machines still running or functional? Is a technical expert required to manage them? Is all moving equipment properly secured?

Slide 15



Now that the hazards have been identified, the fire investigator must determine how risky they are for the health and safety of any personnel entering the scene. Some questions to ask are:

- How likely will personnel be in contact with the identified hazard? If likely,
- In what form will they have contact?

This information will be essential in determining the next step, controlling the hazards.

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The hazards have been identified and the risk to the investigator and personnel assessed. Now it is time to determine what kind of control is needed to reduce the risk.

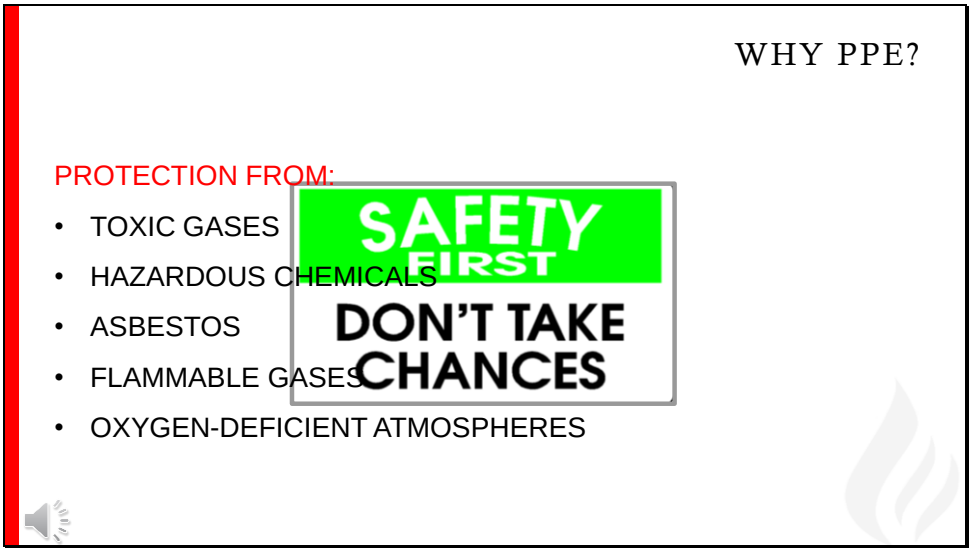
There are three types of controls:

- Engineering controls: these include reinforcing damaged structural areas, any sort of demolition needed (after documentation, of course) and, where required, obtaining the services of a structural engineer.
- Administrative controls: these include isolating an area with effective signage and barrier tape that informs personnel of the hazards as well as restricting entry to only key personnel.
- Proper Selection and Use of Personal Protective Equipment (PPE): These include:
    - Boots,
    - Gloves,
    - Helmet,
    - Clothing,
    - Eyewear and
    - Any other piece of equipment or level of protection deemed necessary to mitigate the risks.

    Please note that PPE is considered the least effective of the safety measures but may be appropriate depending on the conditions identified by the investigator.

If there is any doubt about your safety stay out and seek expert help!!

Slide 17



Though fire investigators are rarely asked to enter a scene while it is still burning, that does not mean there are not significant safety risks. They still need to protect themselves from physical, biological, chemical and radiological hazards while they conduct their investigation.

Some of the dangers include:

- Toxic gases,
- Hazardous chemicals,
- Asbestos,
- Flammable gases and
- Oxygen-deficient atmospheres.

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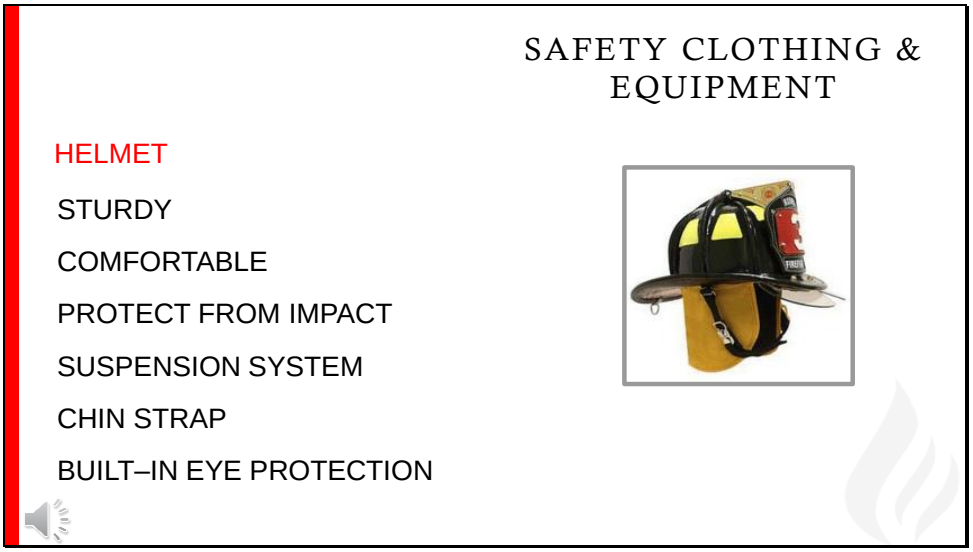
If for some reason the fire investigator has to enter the building before the fire is completely out, they are required to be equipped with and know how to properly use, structural fire fighting gear as well as a self-contained breathing apparatus (SCBA).

This equipment has to meet or exceed the NFPA standards. Just as police officers and firefighters are saved by the use of their gear, so are fire investigators' lives saved by the use of their protective clothing and equipment. That is why it should be worn and used at all fire scenes and why fire investigators need to be well trained in the proper use of the equipment and knowledgeable in its limitations.

They also need to have a thorough knowledge of decontamination or disposal procedures for all equipment used at a fire scene. All equipment and clothing should be decontaminated before the investigator leaves the scene. If this isn't possible, the clothing and equipment should be transported in a way where they can't contaminate anything and then washed according to the manufacturer's instructions.

Slide 19



Let's start with the most important part of the body: protecting the head. The helmet should be worn at all times during a fire investigation. It needs to:

- Be sturdy enough to provide adequate protection,
- Be comfortable enough to be able to wear for long periods of time,
- Be able to protect the wearer from impact as well as electrical hazards,
- Have a suspension system to absorb strong impacts,
- Have a chin strap that is used at all times to keep the helmet in place after impact, and
- Have a form of built-in eye-protection made out of a material that resists scratches.

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As we mentioned before, fire scenes are dangerous, toxic places. Every fire scene you enter will expose you to toxins. For instance, Benzene and hydrogen cyanide, two toxins present at every fire scene, are absorbable through the skin. These toxins also become embedded in your clothes and anything you touch which puts you, your family and your co-workers at risk for long term exposure at harmful levels of these toxins if you do not take precautions.

To avoid contaminating their street clothes, fire investigators must always wear protective clothing during an investigation. These could be fire-fighting turnout gear or coveralls. These should be washed after every fire scene examination in a machine used only for fire gear, or sent out to a company that specializes in cleaning fire-fighting gear. If not cleaned properly, you are putting everybody at risk of repeated exposure to carcinogens. Another alternative is using disposable coveralls, which eliminates the need to wash protective clothing.

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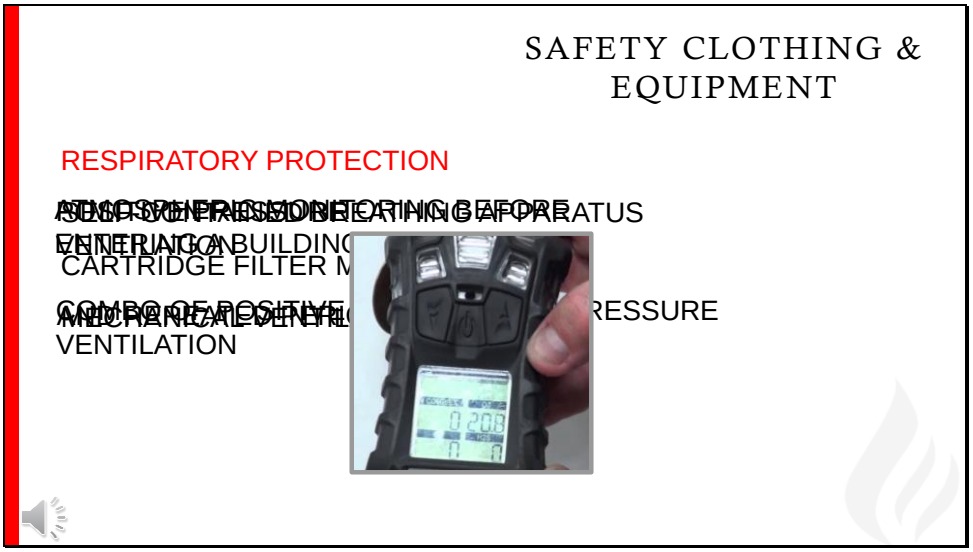

It is very important to think about protecting your lungs at each and every fire scene. Respiratory protection can come in the form of:

- Self-contained breathing apparatus,
- Cartridge filter masks, or
- Engineering controls such as mechanical ventilation.

Even with the above protection, air quality needs to be monitored at all times during the investigation. Ideally, many of the hazards can be mitigated by engineering controls, including the following:

- Positive pressure ventilation which provides the work area with fresh air in an efficient manner. If that is not possible,
- A combination of positive-pressure ventilation which brings fresh air in and negative-pressure ventilation which helps remove or reduce toxic gases from the area.

It is important to have a firm grasp of the theory behind mechanical ventilation to be able to select the appropriate method.

Atmospheric monitoring should be done before entering a building without respiratory protection and be repeated periodically during the investigation because even though the main work area is deemed to be safe, you might find hazardous atmospheres in closed hidden spaces, basements and other below-grade areas.

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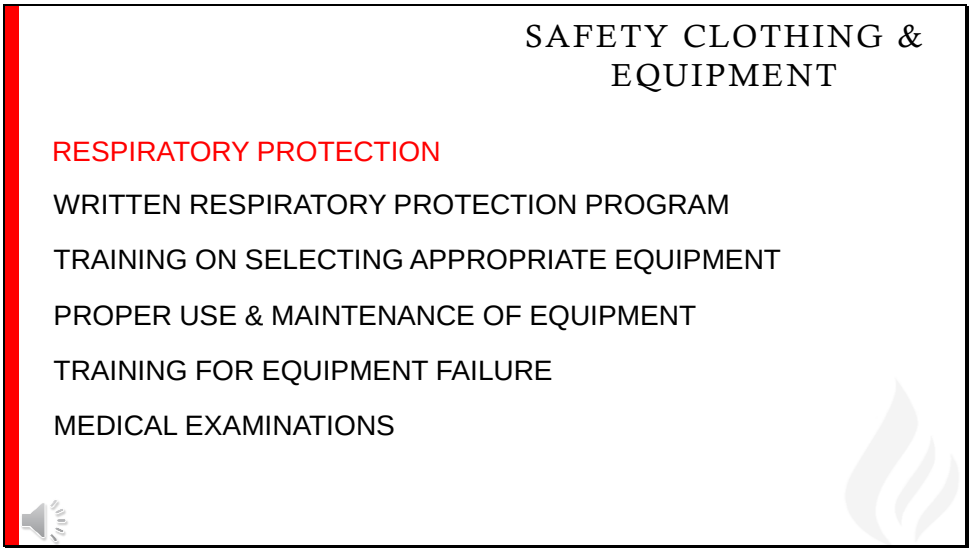

When respiratory protection is used, the employer has the following responsibilities:

- Have a written respiratory protection program in place,
- Provide all employees who will be potentially using these devices with training on how to select the appropriate piece of equipment for the hazard, as well as the proper use and maintenance of the equipment,
- Provide employees with training on what to do in the event of equipment failure, and
- Require all employees using respiratory equipment to undergo periodic medical examinations to monitor their physical abilities and limitations and to make sure they have not been exposed to a toxin that can cause any long term health issue.

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Sometimes engineering controls are not enough to make the air safe for breathing. If this is the case, you will need to use respiratory protection equipment. A self-contained breathing apparatus or SCBA provides the highest level of respiratory protection.

However, SCBAs have considerable constraints, including:

- Limited breathing time: a cylinder gives you between 30-60 minutes depending on your physical condition and your physical and/or mental strain at the time,
- Your vision is also restricted your ability to observe the scene is limited.

An alternative to the SCBA is a Supplied-air breathing apparatus (SABA) which provides the wearer with longer breathing periods. On the downside, the hose is limited to 300 feet. To see more information on SABA's there are several links to YouTube videos in the resource section of this Chapter.

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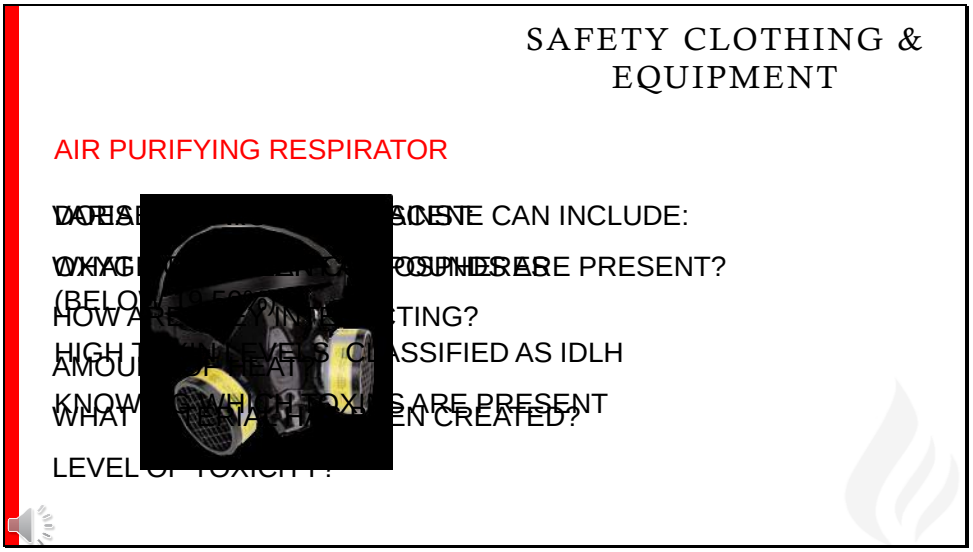

An APR, or air-purifying respirator, can be used for some fire scenes but be warned: their use is extremely limited.

- Wearing an APR does not protect you against oxygen-deficient atmospheres, that is, oxygen levels below 19.5%. Therefore air-monitoring is required at all times.
- They also do not protect you from areas where the toxin level is so high it is classified as Immediately Dangerous to Life and Health, or IDLH.
- Because APRs are toxin-specific, you need to know exactly what toxin will be present to choose the most effective filter, which is impossible to do. Nobody can identify all hazards at a fire scene as there are too many variables including the following:
    - What molecular compounds are present? How are they interacting?
    - What is the amount of heat they have been exposed to?
    - And because of the above, what material has been created? What is the level of toxicity?

APRS come with or without eye protection. If using one without eye-protection, the investigator should wear vented goggles.

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Another type of APR is a powered air-purifying respirator (PAPR) also known as a PAP-PER. PAPR's consist of a respirator in the form of a hood or helmet, full-face mask, a powered fan which forces incoming air through a filter, and a battery power source. The fan, filter, and power-pack are secured by a belt around the waist.

The type of filter incorporated into a PAPR must be appropriate to the contaminants that need to be removed. Some filters are designed to remove fine particulate matter while others are for volatile substances. The fire investigator must insure they are using the right filter for the hazard they are protecting against.

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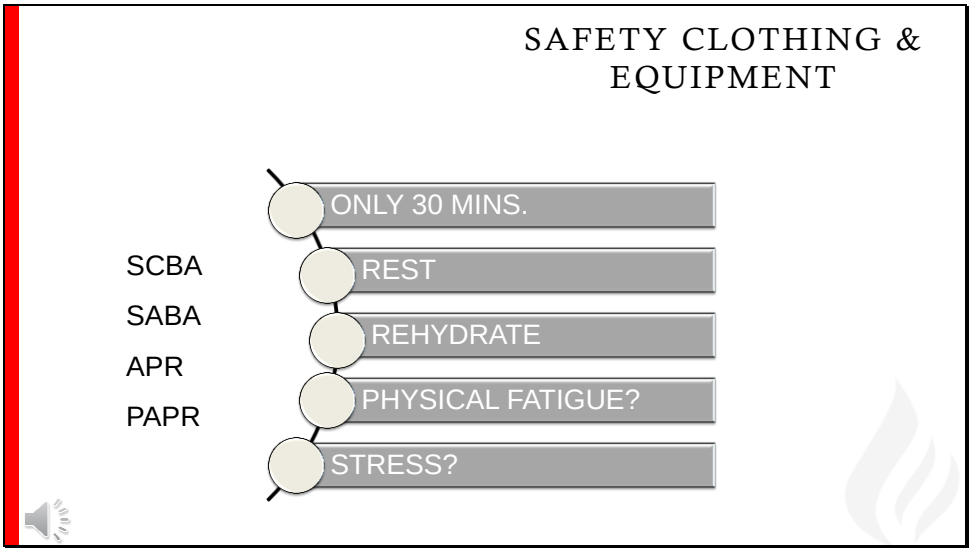

No matter what device you are wearing, SCBA, SABA, an APR or a PAPR you should have specialized or appropriate training on the specific equipment.

Only work in 30 minute increments because wearing these devices is hard on the body. Make sure to rest, rehydrate and be aware of your physical fatigue and stress level. Though it is tempting to work with an SABA or APR for longer, don't do it- you will be exposing yourself to dangerous strains and exposures to heat stress.

The following video demonstrates a PAPR.

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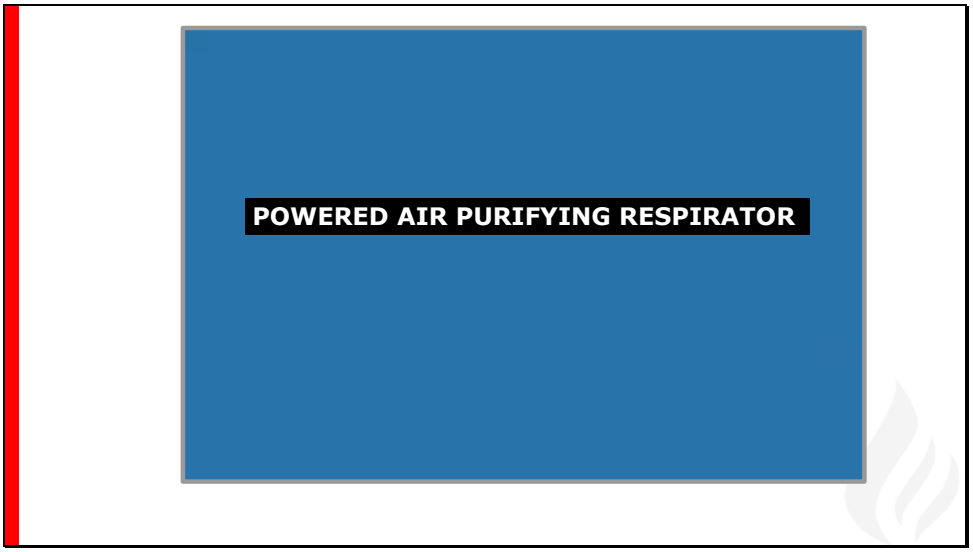


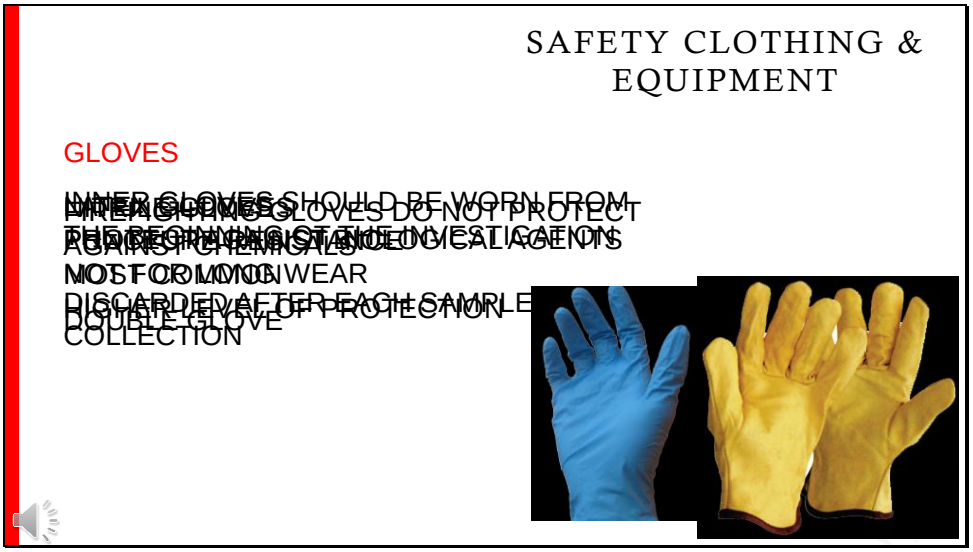
Slide 28

If the fire investigator is not wearing a face shield they need to protect their eyes.
In this case, more is better than less. It is important for a fire investigator to remember that they are in danger of not only regular eye injuries, but if any toxins get in their eyes they will rapidly enter their circulatory and nervous systems.

Therefore, wear eye protection that provides the maximum level of safety. Goggles that fit closely to your face are better than the built-in face shields of the helmets in terms of protection from any airborne toxins. The best possible combination is using safety goggles along with the face shield of the helmet.

Do the safety dance and protect your feet! A safety shoe will provide protection from hazards like stepping on sharp objects or from heavy objects falling on your toes. As well, a waterproof shoe will protect you from exposure to toxins. Rubber boots or the thigh-high firefighting boots pulled up over the knee and used with hard knee pads provide a very high level of protection. Whatever footwear chosen, it should conform to NFPA 1971.

Slide 29



Don't forget about the hands. Fire investigators should be wearing gloves at every scene. It is important to remember that traditional firefighting gloves protect against heat and injuries but do not protect against chemicals. Therefore, it is recommended that fire investigators double-glove their hands when at a fire scene. The outer glove should be a work glove providing physical protection. The inner glove provides some protection against chemicals. Latex gloves provide protection against biological agents but are not very effective if worn for too long or if they get wet. Nitrile gloves, which have some puncture resistance, are the most commonly used and provide a higher level of protection.

Inner gloves should be worn from the beginning of the investigation as they protect your hands but also allow you to use the tools required to document the scene. They can be discarded as frequently as needed but must be discarded after each sample collection in order to avoid cross-contamination.

Slide 30

Sometimes additional equipment is necessary to make a fire scene safe. For example, all work areas should be well-lit. Almost every fire scene requires portable lighting. Having said that, never bring a generator into an enclosed area because carbon monoxide can build up quickly and become a serious health hazard. Gasoline powered equipment can also compromise your investigation by contaminating the scene.

Some fire scenes require additional equipment such as lifelines and fall protection. Make sure to maintain and store this equipment according to the specifications set out by the manufacturer. As well, no one should use any ladder found on the scene as these could have been compromised by the fire or have been poorly maintained. If a ladder is needed, assess its condition, and whether it is the right height and style for the intended use before climbing it. Best to BYOL: bring your own ladder!

Depending on the situation, specialized equipment, or experience such as shoring equipment or other urban search and rescue techniques might be necessary. In these cases, it is recommended that an operator or expert who uses the equipment or technique regularly take the lead to ensure a safe work environment for everyone.

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Don't get complacent about your personal health and safety; it could mean your life. There is an ever-present danger at every scene of injury and/or harmful exposure to toxins. If you do not remain vigilant about protecting your health, these risks and exposures may accumulate over the course of your career which can lead to life-threatening health issues.

Besides risk of physical injury, the hazards that can threaten your health and safety at a fire scene can be chemical, biological, or radiological. For example, fires at a medical facility or construction site will contain the risk of exposure to radiological materials that are stored in these facilities.

Slide 32

It is also important to remember that every fire scene contains biological hazards. It is rare that a fire destroys all the bodily fluids of a victim. Toxic levels of cyanide have been found in the blood of almost every fire victim. These levels are so high that the medical examiners are questioning whether it is the carbon monoxide or the cyanide that is killing people in fires.

Potential Hazards can also include:

- Non-human biological materials which can cause allergic reactions, infections and/or disease as well as
- Biologic substances from plants, animals, insects, bacteria, viruses and even trash.

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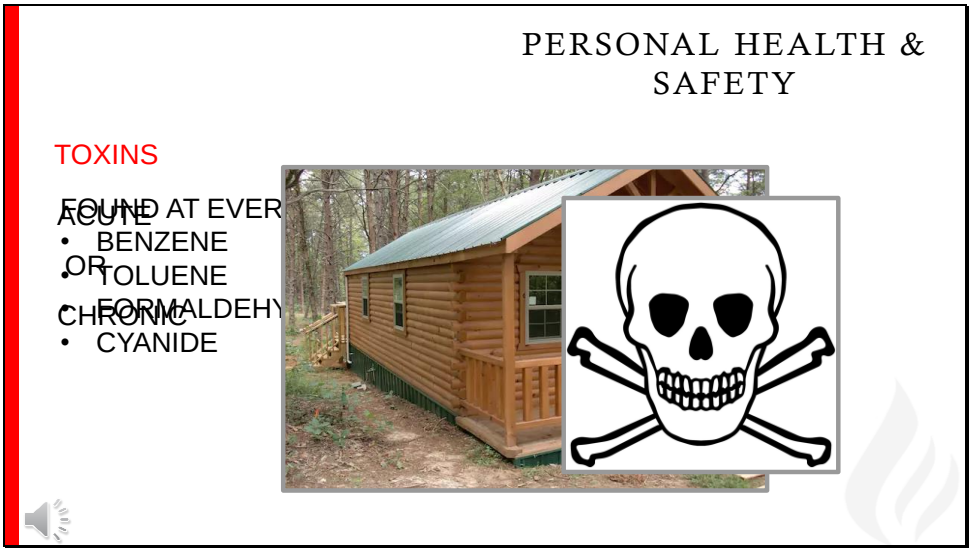
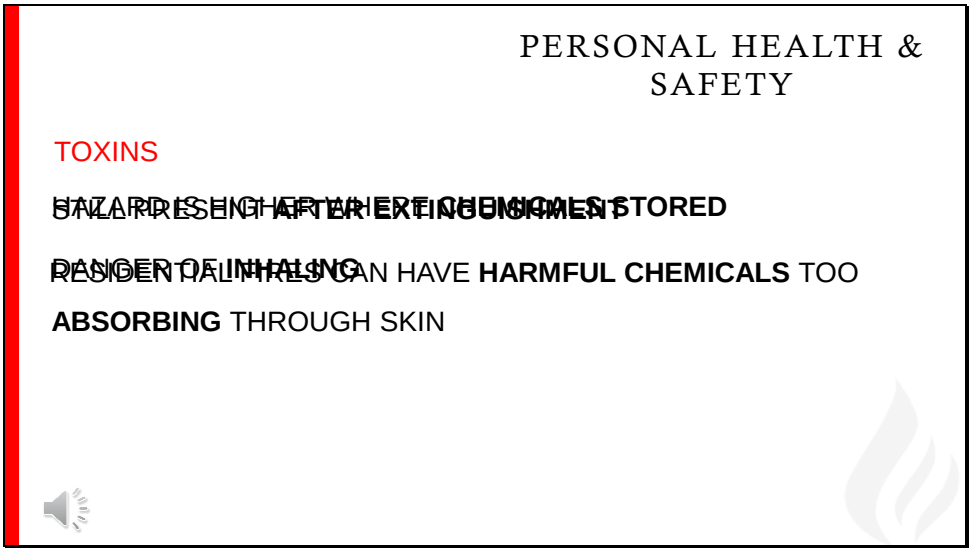


Fires are not what they used to be when building materials were restricted to simple materials such as wood and brick. The materials we use today to build and furnish our structures have made every fire scene that much more dangerous.
Here are a few toxins that are now present at every fire scene:

- Benzene,
- Toluene,
- Formaldehyde and
- Cyanide

If the dose and duration of exposure is too high and too long, this can cause some major problems to the target organ. This exposure can either be acute, where a single incident exposes the investigator to harmful levels of a toxin, or chronic, where the investigator has been exposed repeatedly to a lower concentration of the toxin but has accumulated over time harmful doses of it in their system.

Slide 34



It is also important to remember that just because the fire has been put out, doesn't mean the toxic hazards are gone. After a fire has been extinguished, the toxic gases cool and either settle or mix with the air throughout the room where fire investigators are in danger of inhaling or absorbing them through their skin.

The severity of the toxic hazards is compounded if the fire is at a drug lab or another location where chemicals are stored. Even a residential fire can have pesticides or other harmful chemicals. Knowing the effects and routes of exposure of chemicals can go a long way in protecting fire investigators against toxins.

Slide 35

Another major hazard is the risk of inhaling, ingesting or absorbing through the skin harmful airborne particulate matter. These include asbestos, silica dust and heavy metals among many others present at fire scenes. Just like any other contaminant, these particulates can stick to clothing and equipment which is why following the proper decontamination procedures is essential.

Because fire consumes oxygen, it can create an oxygen-deficient atmosphere in confined spaces. Chemicals could have been released in the air if their containers were compromised. As well, there is a real danger of asphyxiation caused by carbon monoxide, which is a common by-product of fires. Carbon monoxide joins with hemoglobin 250 times quicker than oxygen. In doing so, they act as an oxygen barrier in the body's cells. Smoking is a good example of cumulative carbon monoxide poisoning.

Slide 36

Remember that the fire scene can turn from a relatively safe environment to a toxic one at any time hence there may be a need for regular atmospheric monitoring. Because there are so many synthetic materials in use today, one of the most dangerous toxins present at a fire scene is hydrogen cyanide which is caused by the smoldering of such materials. It is recommended that a hydrogen cyanide detector be present at every investigation.

As well, there should be regular scheduled safety meetings during an investigation to make sure everybody is on the same page. These should occur at least twice daily, or as often as necessary. The best times for these meetings are:

- At the start of the day,
- The end of the day,
- During breaks, or
- When a new phase of the investigation is about to begin.

Before beginning your investigation make sure to:

- discuss any possible hazards with the site manager,
- Consult any Substance Data Sheets available, and
- Use the site safety plans

Slide 37

Fire scenes are cluttered, messy places filled with debris that can trip you up, places where you can easily fall, and structures that can collapse and crush you. Constant vigilance in terms of where you step, where you stand, what you touch and what state the building is in is a must. An integral part of constant vigilance is the selection and wearing of the appropriate personal protection equipment.

Are the people in these photos properly protected? What concerns do you have for their safety?

Are the investigators wearing proper PPE?

Is there potential for building collapse?

Should the investigators be concerned about the potential presence of hazardous substances?

Could there be hidden hazards not readily identifiable through visual inspection?

Obviously, they are not wearing proper PPE and there is the potential for the building to further collapse. From the photo it is hard to tell what the building was used for so the investigator must assume hazardous substances are present. There is the potential for many other hidden hazards which the investigator must consider.

Slide 38

Is this individual properly protected? (short pause) Should he be on the roof? (short pause) It is hard to make a judgement call from a photo alone. The investigator may have properly shored under the roof to prevent collapse but if that was not done he should not be there. Remember: A fire investigation is not a life or death situation. There is never a need to risk your own life or health to determine the origin and cause of a fire. Make sure to use engineering controls wherever possible to make the environment safe for people.
It is also important to be aware that hazardous substances can also be used as a form of terrorism. Be alert to this possibility or to the possibility that a crime has been committed. Resist complacency and maintain situational awareness. This will go a long way in protecting you against any known hazards.

Slide 39

Last, but definitely not least, an important hazard to your health and safety is your own fatigue level. A fire investigation can be long, tedious and physically strenuous. Because of the safety measures mentioned above, fire investigators are required to wear heavy clothing and respiratory equipment that can quickly take a toll on the body and energy level.

When people get tired, their judgment falters and they lose strength and even the ability to recognize and respond to hazardous conditions. This puts them at considerable risk of personal injury or contamination.

So take fatigue level seriously. Monitor yourself and the team to make sure everyone is getting enough rest, food and fluids in a safe, contaminant-free environment. There should also be sanitation and wash stations available as proper washing will help prevent the ingesting of any contaminants.

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SCENE SAFETY FACTORS

SUPPRESSION STATUS

PERMISSION OF IC

BE TRAINED & ACCOMPANIED

WORK WTH IC

Fire investigators should not enter a structure that is still burning without the express permission of the incident commander. If entry is necessary, then you need to be properly trained and accompanied by fire suppression personnel. The fire investigator needs to work closely with the incident commander to make sure no investigation activities get in the way of the work being done by suppression crews. As well, investigators should advise the incident commander of any areas that they are entering. Even though the two may be done simultaneously, the investigation is not the priority at this stage, but the suppression of the fire is.

Slide 41

It is important to remember that even though a fire has been suppressed, there is always the possibility of it re-kindling somewhere in the building. Firefighters are taught to limit overhaul to preserve the fire scene as much as possible for the investigators. This can result in re-kindling fires so the investigator must be constantly aware of the situation around them and maintain their exit routes.

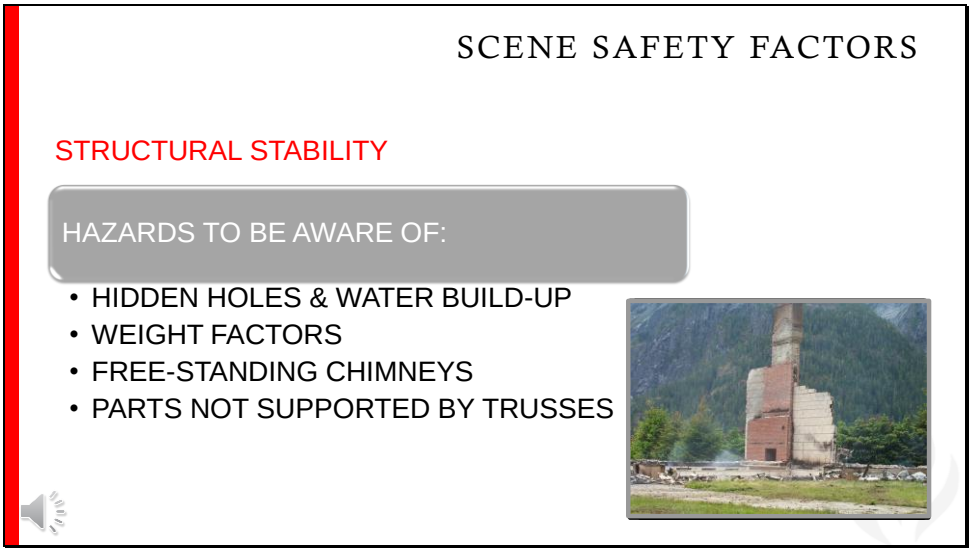
If a re-kindle happens, the means of egress could be cut off. To avoid this situation, fire investigators should make sure exit routes are at opposite ends of the work area and, if possible, that hose lines remain in place for a reasonable amount of time. The investigators must always be aware of the safest and fastest means of escape. For example, one escape route could be a ladder placed by a window. If that is the case, the ladder should remain in place during the time the investigator is in that area. The escape routes need to be monitored to make sure they are not blocked or obstructed.

Slide 42

Before entering the building fire investigators must assess the stability of the structure and eliminate any known hazards by the use of shoring materials or by demolition. In this case, the building was slab on grade, tilt up construction. The roof was burned off the building during the fire. In tilt-up construction the roof is an important element in supporting the walls, without which the walls tend to collapse. Prior to entry by the fire investigator, the walls were shored up to prevent collapse.

Do not assume any part of the building that is still standing is safe. Remember: a collapsing wall makes little sound until it either hits the ground or whatever is standing in its way.

Slide 43

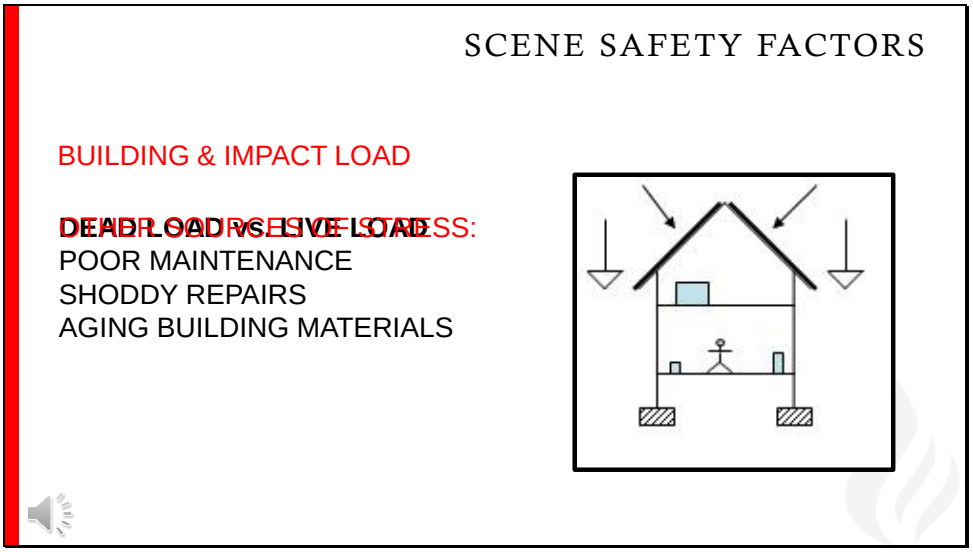


Other hazards to be aware of include:

- Hidden holes or weaknesses in the floor and water buildup from firefighting operations. In this case the floor was covered in water and the fire investigator, not knowing the hole was there, sunk up to his waist. Fortunately he was not injured.
- Weather-related weight factors caused by ice, snow, wind or rain. In this case there was no snow on the day of the fire but investigators did not arrive until the next day. The snow load and the extensive fire damage to the roof and walls created a significant collapse hazard.
- Free-standing chimneys because their stability is intimately linked to the stability of the building; if the building is compromised, so will the chimney be,
- Parts of the building that are not supported by trusses: like the chimney, most parts of buildings are interdependent: you take out one part, the other is in danger of collapsing as well.

Most building codes establish the minimum level of construction requirements. It is also possible that some buildings were constructed to a level less than the building code requirements and are deficient structurally, or, that the building is so old it does not meet the current standards.

Slide 44



In assessing the structural stability of the building there are two kinds of load: the dead load and the live load. Usually a building is designed and built with a certain purpose in mind. Designers calculate its intended use and the expected live load according to this purpose. However, when occupancy changes, so too can the use of the building which means it is used in a way the designer never intended. Walls are moved and other structural changes are made which do not take into account the design and therefore may cause stress to the structure. Other sources of stress on a building are:

- Poor maintenance,
- Shoddy repairs, and
- Aging building materials

A fire can be that proverbial final straw in the building's back. It can set off a domino effect for building collapse.

Slide 45

An impact load is a sudden added load to a structure. For example, when a fire fighter jumps off a ladder onto a floor or roof, or when part of the building collapses on to another part of the building. If the structure is already weakened this can cause it to collapse.

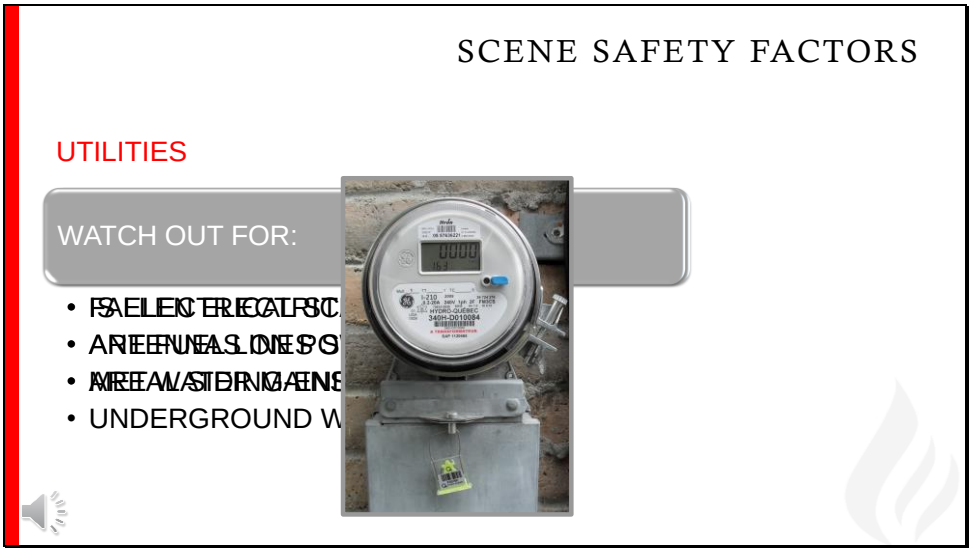
It is important to remember never to trust a free-standing wall or any wall that isn't supported by other structural components without shoring it first. The best way to deal with these is to let gravity do its work **or** knock it down at an appropriate time.

The safest way to deal with an unstable structure is to use controlled demolition and stabilization of the structure because it removes the hazard altogether. The demolition team works directly under the supervision of a trained fire investigator, who knows the details of the investigation. Parts of the structure that are unstable can be removed this way without harming the investigation. In many instances, all it takes is a good heavy equipment operator working with an experienced investigator to remove the hazard without destroying evidence.

Slide 46

In this case, the fire investigator needed to remove a heavy beam due to the potential for collapse. Before removing the beam with heavy equipment the fire investigator marked the beam with spray paint showing which way was up and which side faced the fire so that it could be replaced later in the investigation if it became necessary. This would also assist other investigators that may attend the scene later.

Slide 47



Fire investigation is the same as most things in life: Never assume anything. That goes doubly for utilities: never assume the electricity, gas, and water have been shut off. Before entering a fire scene check whether:

- An electrical system is still energized,
- If the lines of the fuel system are charged and
- If the water mains are still operating.

Even then, the fire department could have the electricity shut off during the fire suppression phase, only to have it turned on again later by someone else. Also, it is possible that there is more than one electrical feed and that just because one is shut off, it does not mean the other is.

There are many electrical hazards that can be present at a fire scene. Always act as if all wires are energized even when the meter has been removed or disconnected.

Be aware of and look for any:

- Fallen electrical wires,
- Antennas that have fallen on powerlines,
- Metal siding that has been energized, and
- Any underground wiring

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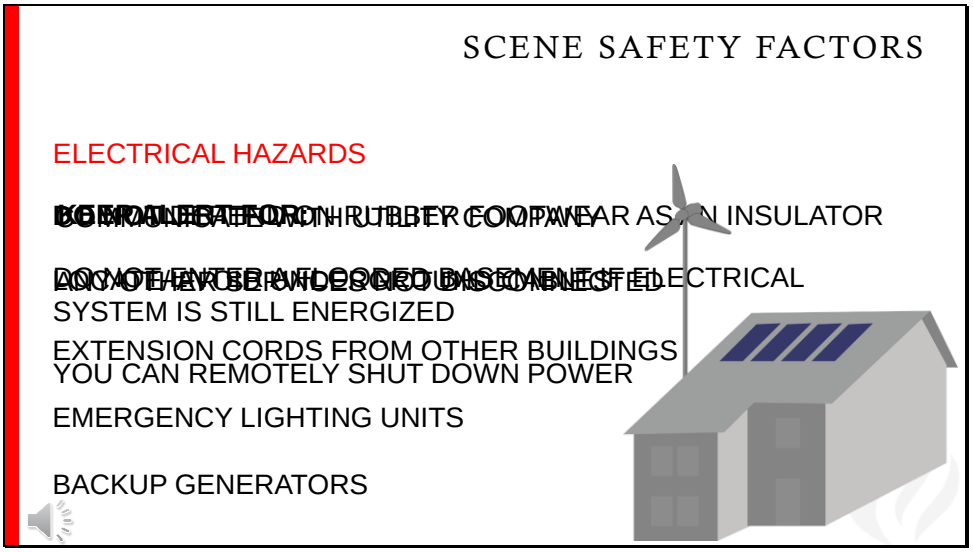
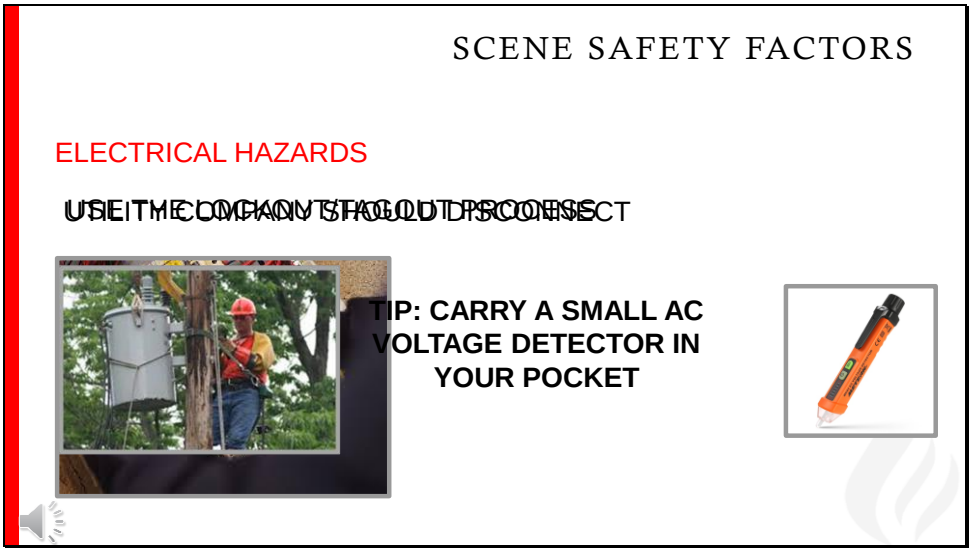


Here are a few tips in dealing with electrical hazards:

- Don't depend on rubber footwear as an insulator,
- Do not enter a flooded basement if the electrical system is still energized,
- If the fire scene could be explosive, there is the option of shutting the power down remotely,
- Make sure to communicate and cooperate with the utility company as they have valuable expertise,
- Make sure to locate and avoid underground electric supply cables before digging,
- Keep on the alert for:
    - Any other electrical services that might not have been disconnected,
    - Extension cords from neighboring buildings,
    - Emergency lighting units,
    - Backup generators, etc as these will remain energized even when the power is cut off.
    - An added concern is power generated off the grid. Check to see if there is any wind or solar systems.

Slide 49



The fire investigator should not disconnect the power but make sure the utility company does.

Investigators should be able to use a voltmeter or multimeter to test for power but make sure the testing device is rated for the voltage of the building. A useful tip is to get in the habit of carrying a small AC voltage detector during an investigation. It is smaller than a multimeter and can test for power in circuit breaker panels, outlets and electrical runs as well as voltage through the insulation of undamaged conductors.

Once the power has been disconnected, use a recognized lockout/tagout process. Basically, the investigator uses a lockout/tagout device that disables the equipment. They then place a padlock on the device and retain the only key. That way nobody can turn the power back on while the investigation is going on.

When the investigation is complete and everybody is accounted for, the investigator unlocks the device so the power can be turned on again.

Slide 50

Just before Christmas in 2000, five people were killed in a house fire and explosion on a rural farm property. The fire investigators arrived to find the fire had been extinguished and the electrical power to the building had been terminated at the street by the utility company and the electrical meter had been removed. When the investigators entered the structure, they used an AC voltage detector to double check that the power was off. Much to their surprise the detector alarmed so power was still on to the structure.

On further investigation it was learned that there were two houses on the property. The original farm house was an older home located next door to the newer home where the fire and explosion took place. To provide power during the construction of the newer home, an underground line was run from the older home to the new home. This remained live and could have posed a significant safety issue to the investigators had they not double checked to make sure the power was off.

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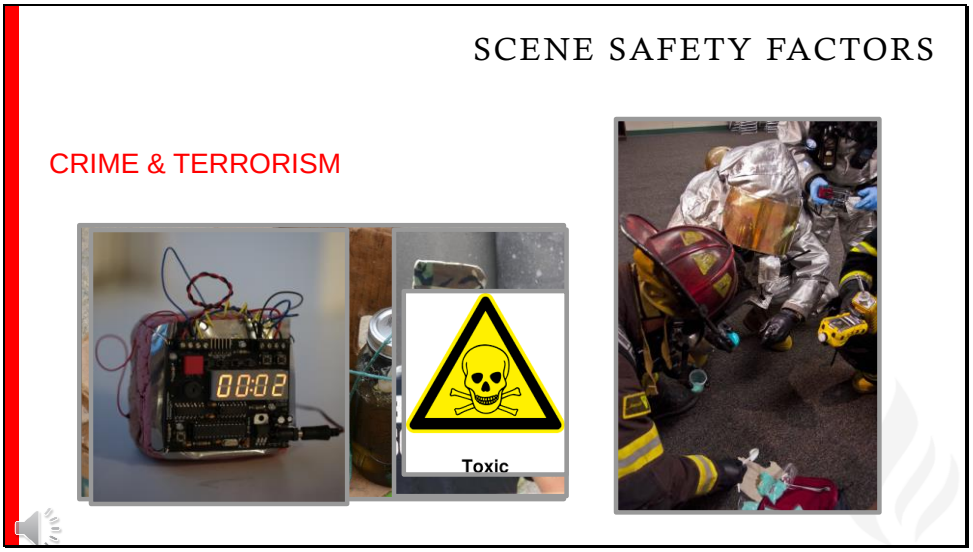


Unfortunately, fire and explosions can be used as weapons or for criminal acts. If the fire was initiated on purpose with a device, the investigators need to ask themselves if there are any more devices in the structure.

It is possible a device did not go off during the initial detonation or a secondary device has been left behind for the express purpose of harming first responders. If there are any devices, do they contain any hazardous materials? Are personnel at risk of exposure to harmful toxins? All personnel should be alert to any unusual packages or containers.

There is also the possibility that the fire was either initiated or enhanced by the use of various chemicals. Once again, the use of the appropriate PPE and respiratory equipment is a must as there is a real possibility of chemicals putting the investigator's health at risk.

Never handle any device or equipment unless you are specifically trained to do so. Stop the investigation until properly trained and qualified personnel can render the device harmless.

Slide 52

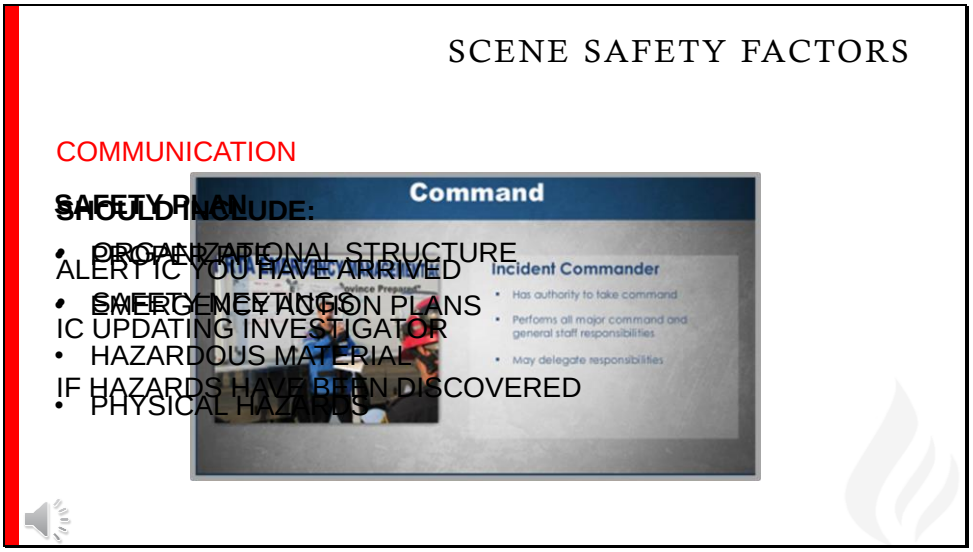
In the case of terrorism, it is possible that biological or radiological components are involved. Special safety and training measures are needed for this kind of situation and might include the safe rendering of the scene before the investigation even begins. If that is not possible, then only those with the right training and equipment should be permitted to enter the scene.

Once again, anything worn or used at the scene is a contamination risk and either needs to be properly disposed of or decontaminated. Remember: the investigation does not end when you leave the scene. All evidence and equipment that has been taken from the scene should be handled, labeled and stored in a safe manner.

Slide 53

Communication is essential to a safe, successful investigation. As the fire investigator you will often work alongside the fire fighters. Every firefighting scene operates under an incident command system. This refers to the combination of facilities, equipment, personnel, procedures, and communications found under a standard organizational structure which ensures the fire is put out, resources are effectively allocated and that everyone is safe.

Slide 54



The fire investigator works within that structure and directly through the incident commander. Communication between the fire investigator and the incident commander (IC) should include:

- The Fire investigator alerting the IC they have arrived on scene
- The IC updating the investigator on any pertinent information regarding the fire,
- The fire investigator determining whether there have been any hazards discovered by firefighters such as, structural stability, chemicals, etc.
- The formulation of a safety plan between the two that lays out:
    - Proper PPE,
    - Emergency action plans,
    - Hazardous materials and
    - Physical hazards

The safety plan might also include a formal organizational structure and safety meetings should be held several times a day and whenever an issue arises.

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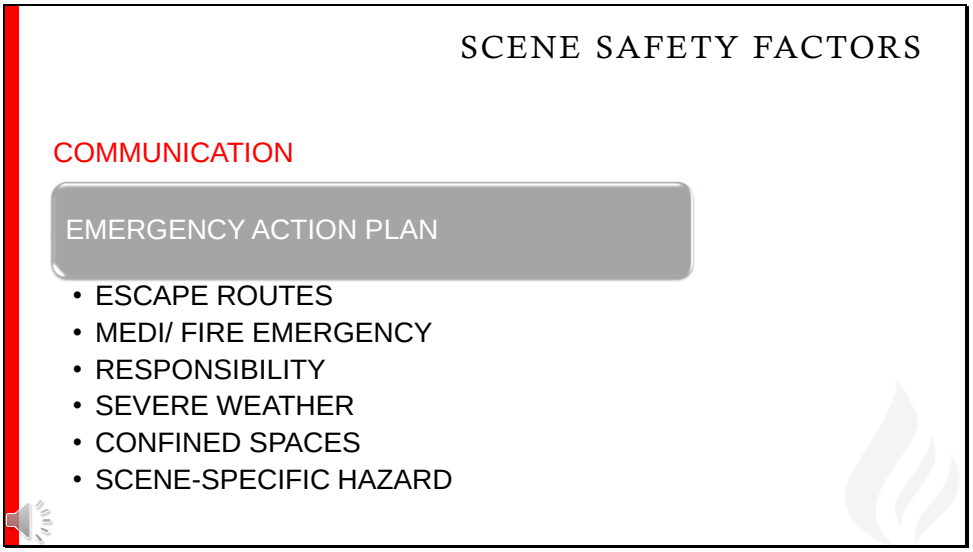

The emergency action plan should include information about:

- Escape routes,
- What to do in the case of a medical and/or fire emergency,
- Who is responsible for what,
- What to do in cases of severe weather,
- Confined spaces that might be present at the scene, and
- Any other scene—specific hazard.

Slide 56

When conducting an investigation in a large building with large losses, there is additional coordination and communication needed as it may be difficult to keep track of the investigation team, especially if the fire suppression activities are still taking place.
These include:

- Using an incident command system as well as an accountability system:
    - Everyone should report to the accountability officer on where they will be working, when they will be working there and what they will be doing.
    - When they are done in that area, they need to let the accountability officer know and inform them of their new whereabouts.

This ensures the accountability officer and incident commander know where everybody is at all times and can reach them in case of an emergency.

Slide 57

Once the fire suppression activities are completed, a face-to-face transfer of command from the Incident commander to the fire investigator should take place. The incident commander should brief the fire investigator on any areas that might pose a possible safety or health risk to personnel. Once the command has been transferred, the fire investigator assumes control of the scene and is now responsible for the safety of everyone at the scene.
They are responsible for briefing all personnel on:

- Known hazards,
- PPE requirements for the scene,
- Evacuation signals and
- Emergency medical procedures.

They are also responsible for the security of the scene which includes making sure no evidence is destroyed or removed and that no unauthorized bystanders wander through the scene.

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OCCUPATIONAL SAFETY & HEALTH ADMINISTRATION

5 COMPONENTS:

1. MANAGEMENT AND EMPLOYEE COMMITMENT
2. ASSESSMENT OF RISKS AND HAZARDS
3. HAZARD PREVENTION AND CONTROL
4. SAFETY AND HEALTH TRAINING
5. LONG-TERM COMMITMENT

EVERYBODY HAS A RIGHT TO A SAFE WORKPLACE!

NFPA 1500

The right to a safe workplace for all private and public employees is regulated through Federal, State or Provincial agencies.

There are 5 main components to a safe workplace:

1. The commitment from management and the participation of the employees,
2. Hazard and risk assessment,
3. Hazard prevention and control,
4. Proper safety and health training and education and finally,
5. Long-term commitment.

In terms of firefighting and investigation, you can find more information about hazard identification, evaluation and prevention in NFPA 1500, Standard on Fire Department Occupational Safety and Health Programs and from State or Provincial Safety Authorities.

Every worker has the right to a safe workplace!

Slide 59

In this chapter we discussed:

- General Safety considerations at a fire scene, including:
    - Who is responsible for safety at a scene,
    - How to manage safety concerns when working alone, and
    - How to keep technical personnel and bystanders safe.
- How to identify hazards, determine their risk and control them,

Slide 60

- The various personal protective clothing and equipment required for fire investigation including:
    - The helmet,
    - Protective clothing,
    - The various types of respiratory protection,
    - Eye and foot protection,
    - The importance of double-gloving, and
    - Required safety equipment,

Slide 61

The issues related to personal health and safety including:

- The various contaminants possible at a fire scene,
- Toxic gases,
- Airborne particulate matters,
- Oxygen-deficient atmospheres,
- Carbon monoxide and hydrogen cyanide,
- Physical hazards, and
- Investigator fatigue

Slide 62

We also discussed the various factors influencing scene safety such as:

- The status of the fire suppression activities,
- Structural stability,
- The building load,
- The impact load,
- Utilities and Electrical hazards, and
- Standing water,

Slide 63

- We discussed factors to consider in criminal acts or acts of terrorism including:
    - Secondary devices,
    - Residue chemicals,
    - Biological and/or radiological terrorism,
    - The exposure to tools and equipment,
- Communication between the **Incident Commander** and the investigator,
- The different standards pertaining to safety including:
    - Hazardous Waste Operations and Emergency Response,
    - Permit-required confined spaces,
    - The control of hazardous energy (Lockout/tagout) and finally
- additional safety concerns to consider.

Slide 64

That's the end of Chapter **6** Safety.

You are now ready to move onto Chapter **7** which deals with **Building Electrical and Fuel Gas Systems** but please complete the quiz for Chapter **6** first.

If you have any questions now is a good time to contact your teacher.