

SAFEGUARDING CONSTRUCTION WORKS

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This Tech Talk discusses the fire hazards during construction operations and ARC recommendations regarding protection and prevention measures to help mitigate these hazards.

AT-A-GLANCE

- The construction process involves many fire hazards.
- In recent years, insurance companies have had major claims due to significant fire events to properties during refurbishment, extension or new construction works.

LOSS EXPERIENCE

Over the years, several large fires have occurred during the construction of new buildings or the refurbishment of existing locations:

- Between 2010 and 2014, municipal fire departments in the U.S. responded each year to an average of 3,750 fires in structures under construction, 2,560 fires in structures undergoing major renovation, and 2,130 fires in structures being demolished for a total of \$310 million in annual property damage: (NFPA Report April 2017, Fires in Structures Under Construction, Undergoing Major Renovation, or Being Demolished).
- Windsor Tower in Madrid, Spain: on February 12, 2005, during the refurbishment of this 135 m high rise building, a fire started on the 21st floor during the night when there were no employees on site. The fire spread quickly throughout the entire building, leading to a total loss. Firefighters needed almost 24 hours to extinguish the fire caused by an electrical fault. The total loss was estimated at €122 million, including around €20 million of demolition work.



The burnt building Windsor Tower in Madrid, Spain on February 13, 2005

- Ritz Hotel in Paris, France: on January 19, 2016, a fire started on the top floor of the hotel. 150 workers were evacuated while 60 fire fighters fought to contain the fire on the seventh floor for several hours. The roof was destroyed and all the floors below were flooded.

WHY CONSTRUCTION SITES ARE EXPOSED TO FIRES

Various **ignition sources** may be present on construction sites:

- Temporary equipment using internal combustion engines, including air compressors, hoists, pumps, vehicles, etc.
- Temporary heating equipment
- Temporary electrical equipment, including wiring and lighting
- Hot work operations are common and include welding, soldering/brazing, cutting, grinding, etc.
- Roofing operations involving heated asphalt and tar kettles, torches, heat guns, etc.
- Smoking

Normally, a variety of **combustible materials** are stored on **site** during construction operations, such as flammable liquids, gas cylinders, waste materials, construction materials, such as timber joists, floorboards, roof trusses, joinery, insulation, etc.

The variety of activities and number of different companies involved in the construction process often result in common deviations from safe human element practices.

According to NFPA, the most common causes responsible for the largest share of fires include hot work operations, smoking, exposure fires, electrical fires (heating, electrical and cooking equipment) and intentionally-set fires.

Permanent fire protection systems are operational only after the commissioning of the building and often existing fire protection systems are impaired.

For these reasons, new or refurbished buildings are particularly vulnerable to the risk of fire.

Although this ARC Tech Talk focuses on property exposure, it has been proven that the adequate management of prevention and protection topics during construction operations can lead to much safer and more efficient worker operations, which can help projects remain on schedule.

ARC RECOMMENDATIONS

First of all, fire safety should be recognized as an integral part of the management strategy for every construction site. For existing locations, the current requirements for safety management should apply to areas subject to construction operations.

1. DESIGN PHASE

Start fire prevention during the design and planning stages as some initial planning can significantly reduce the fire risk:

- Use non-combustible materials whenever possible.
- Select a reputable contractor that operates an effective fire safety policy regarding construction operations.
- Use mechanical assembly methods that eliminate the need for hot work operations. The use of grooved fitting assemblies makes welding operations unnecessary for piping systems.



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2. FIRE SAFETY SHOULD INCLUDE

- **The designation of a person or a group of persons responsible for fire safety management.** The responsibilities should minimally include the identification, measurement and monitoring of all fire hazards. Such persons should be officially appointed and appropriately trained.
- **A fire risk assessment** that considers all fire exposures during the project.
- **A fire safety management plan** that measures and records all fire hazards. It should include formal checklists that should be conducted on a weekly basis. Please contact your ARC representative who can provide you with an example checklist for temporary building and for construction sites.
- **Adequate emergency procedures** should include fire instructions (emergency, communication), fire escape signs and lighting, escape routes, fire drills procedures, locations of portable fire extinguishers, manual alarm call points or pull stations etc.
- Ensure all subcontractors and third parties are trained and informed regarding fire safety topics. **Fire safety is essential for everyone on the site!**
- A hardstand should be designated for rescue vehicles. This should be as flat and level as possible. The location should be carefully considered to provide a secured access from the traffic flow and an easy access to the premises and water supply.

3. MANAGEMENT OF IGNITION SOURCES

Minimize **hot work operations** as much as possible. Where hot work operations are required, the hot work management program should include:

- A formal hot work permit procedure, such as the one developed by ARC, which can be downloaded at <http://www.agcs.allianz.com/insights/white-papers-and-case-studies/hot-work-management/>.
- Our construction engineers have developed a specific document for the hot work management during construction. This document can be downloaded at <https://www.agcs.allianz.com/risk-consulting/arc-downloads/>
- Training, at least annually, for all people involved with hot work activities, including permit issuers, hot work operators and fire watches. ARC also offers a complimentary hot work eLearning course at the above link covering the following topics:
 - What is hot work?
 - Hot work loss lessons
 - Managing hot work
 - ARC hot work procedures

Install and utilize **electrical supplies and equipment** in a safe manner.

- Attention should be given to electric cables/wires, which should be protected from mechanical or other damage.

- LED temporary lights are preferred over fluorescent, high-intensity discharge or incandescent lamps however care should be taken regarding the safe location of any LED driver units.
- If temporary heaters are used within buildings, they should be safely located by risk assessment, be thermostatically controlled with enclosed elements and proper clearance shall be maintained from combustible materials.

Inspect, test and maintain the equipment on a regular basis (e.g. quarterly). Records and an action plan should be recorded. The location of electrical equipment should be maintained well clear of any combustible insulation, panels or storage. Ideally, electrical equipment should be turned off during non-working hours and when the site is unattended.

Address the management of smoking. Smoking shall only be allowed in designated areas with adequate receptacles for disposal of smoking materials located at a safe distance from any combustible materials.

4. COMBUSTIBLE AND FLAMMABLE MATERIALS

Combustible material storage can provide fuel for a fire and should be located outside the building under construction. Where combustible materials need to be stored inside the building, the area should:

- Have controlled access to prevent unauthorized entry.
- Be free of ignition sources, such as hot work operations, heating and electrical equipment, designated smoking areas, etc.
- Be equipped with adequate firefighting equipment and fire detection devices.

Remove all **waste materials** including wood, plastic, pallets, oily rags, etc. from the workplace at least once a day. The waste storage area should be located at an adequate distance from the construction site depending on the height and classification of the building construction.

Locate the storage of **flammable liquids and gases** as far as possible from the construction site:

- Gas bottles should be stored upright within cages.
- Flammable liquids should be locked in approved safety containers.

Allow only minimal quantities on-site and remove them at the end of each shift. If not possible, approved storage cabinets should be provided.

5. SECURITY AND INTRUSION SYSTEMS

Implement a security policy, which may include:

- Security fencing around the site
- Surveillance and securing all entry points and openings (i.e. walls, basements, doors, windows, etc.)
- Guard service trained in fire department notification procedures, fire hazards, fire protection equipment, location and use of construction elevators, where provided

- A temporary, internal, motion-sensor intruder alarm system monitored at a constantly attended location
- Lockable containers for worker materials, equipment and tools
- Adequate Site lighting

The installation of intruder alarms is recommended in all temporary buildings.

6. VEHICLES (E.G. FORKLIFTS, SCISSOR LIFTS, ETC.)

As these vehicles generate heat and may contain fuel, they can be potential ignition/fuel sources for fires.

Do not store or handle fuel inside or near buildings. Fuel tanks should be filled only in designated outdoor areas while engines are shut off and allowed to cool.

Recharge electric vehicles in dedicated areas free of combustible storage.

Protect all buildings and equipment against any accidental impact.

Prohibit cars, trucks, etc. from parking near the construction site except for loading or unloading operations.

7. TEMPORARY BUILDINGS

NFPA statistics reveal that many fires start in the temporary buildings and enclosures for two main reasons:

- There are numerous electrical devices, such as heaters, cooking devices, etc.
- Due to the potential for malicious intruders searching for theft of attractive, high value tools and equipment on site.

Install temporary buildings and enclosures made of non-combustible materials. Plastic foam insulation and combustible should be prohibited.

Adequately separate temporary buildings and enclosures from the building under construction/refurbishment.

If workers are authorized to eat in temporary buildings, the installation of microwave ovens is preferred over other types of cooking equipment.

8. FIRE PROTECTION AND DETECTION

Install and maintain an adequate number of **fire extinguishers** covering the entire site. It is important to ensure the number, location and adequacy of extinguisher types is regularly audited and updated on an adequate basis depending on work operations. The best engineering practices should consist of the installation of devices at the exit points at each level of the building, where combustible materials and vehicles are stored, and where hazardous operations are performed. Ensure that at least 10% of the workers are trained in the practical use of extinguishers.

Contact **the local fire brigade/department** for complex construction projects to develop a prefire plan. Ideally, they should be invited to conduct a tour for identifying fire hazards and be familiarized with the existing and future layouts. A layout plan should indicate at least entrance points, fire hydrants and extinguishers, emergency escape routes, temporary buildings and hazardous areas (combustible and flammable materials). This plan should be updated on a regular basis as work progresses.

a. Fire Detection

Install and maintain a temporary fire detection system at least in the following areas:

- Temporary buildings and enclosures if their location exposes the construction site or existing building to fire.
- Where combustible materials are stored inside the building or in storage areas.
- Where combustible construction is on-going.

An interlinked fire alarm system should be seriously considered during both new and refurbishment construction projects. Wired fire alarm systems are often suitable for finished buildings where change is unlikely or infrequent, but radio systems allow system components to be easily positioned and re-located where necessary and are therefore often more appropriate and cost effective for construction sites.

In addition, the following should be considered:

- All systems being considered should comply with international standards, such as EN54 in Europe.
- If a radio system is selected, battery life should be for a minimum of three years. If a hard wired system is selected, the installation should include fire-resistant cabling.
- System design should be in line with the site fire risk assessment and in conjunction with advice from the equipment provider.
- All call points and detectors should be capable of being numbered or named in order to enable a quick and accurate location of a fire at the central base station unit.
- The devices should be carefully selected and positioned with respect to potential water, impact or weather damage to help reduce false alarm potential.
- It is recommended that the fire alarm incorporates both a delay function and pre-alarm mode to both reduce false alarms and improve site safety during evacuation.

Connect the alarms to a fire alarm system. The alarms should be reported either on-site if there is a 24-hour security presence or to a listed/approved central station.

b. Fire Protection

A temporary or permanent **fire protection water supply** should be made available as soon as combustible material accumulates on the site. Where underground water mains and hydrants are to be provided, they should be in service prior to commencing construction work on any structure.



Range of fire smoke detectors, central alarm and fire point which are wireless devices compliant with EN-54 – Copyright Ramtech Wes +

If automatic sprinkler protection is to be provided in the new or refurbished building(s), the installation should be placed in service as soon as possible. Combustible materials should not be moved into the building(s) until the automatic sprinkler protection is in service.

The fire protection systems should be kept operational as long as possible during refurbishment operations to reduce the duration of impairments.

Try to ensure that new or refurbished fire protection systems can be partially operational as early as possible.

Contractors prefer to commission the complete system at one time, but this can usually be negotiated early in the project.

REFERENCES

CFPA-E Guideline No 21, *Fire prevention on construction sites*

CFPA-E Guideline No 26, *Fire protection of temporary buildings on construction sites*

NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*

QUESTIONS OR COMMENTS?

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