

FIRE ALARM PULL STATION (MANUAL ALARM BOX) CONTROL

BACKGROUND

Sheldon ISD has asked IDG Architects to explore the possibility of eliminating or somehow controlling activation of “Fire Alarm Pull Stations” throughout their schools in the district. Due to the national concern for school security and safety, the district wants to take a proactive approach to increase the difficulty for perpetrators who have a weapon, from pulling the stations and putting students, teachers and administrators in the line of fire.

OBJECTIVES

The objective of this research effort is to investigate a strategy that reduces the degree in which fire protection devices (pull stations) are used to aid terror attacks. Central to this strategy is the identification of a position for making fire notification systems absent of human interaction. The research also seeks to remove or replace the use of the Fire Pull Station Device in favor of a notification system that can identify non-fire threats/emergencies. This strategy must comply with IBC, NFPA, ASTM, ANSI, all AHJ and The SAFETY Act for code compliance and to ensure the system can aid in providing legal protection for the owner in case of a terrorist attack.

METHODS

- A) Quantitative research includes:
 - 01 Fire emergency signal device review
 - 02 Non-fire emergency signal device review
 - 03 Code Impact Review
 - 04 Fire protection data (success per device type)
 - 05 False alarm impact
 - 06 Information of Fire Protection and Security System integration

- B) These research methods will enable us to discover a means of adjusting the role and existence of the “Fire Pull Station”.

RESULTS

Early results show the most recommended course of action for new schools would be to remove all fire pull stations where a building is fully sprinkled (with the exception of high hazard areas such as labs, shops, kitchens), leaving one station in the secured administrative offices. (IBC section 907.2.3 or NFPA 101 section 14.3.4)

Existing schools may be reviewed by a building official. If there are smoke detectors in exit corridors, manual alarm boxes at hazardous areas and a working voice alarm system, with all systems operational, then the existing manual alarm boxes at the exit/entrance doors could be removed.

Consider the use of the pre-signal feature per NFPA 72 (23.8.1.1) once approved by the AHJ (authority having jurisdiction), the initial fire alarm feature will activate in school offices. This will allow human action such as the pull station activation in the office area. If there is no action after one minute the alarm will activate on its own.

Case studies include:

Ottumwa, Iowa: In this case the Fire Department suggested manual alarm stations to be removed at Ottumwa High School.

Pflugerville ISD March 30, 2018: The board of trustees voted 7 to 0 to remove the fire alarm pulls from their campuses and stop installing them in new buildings.

City of Toronto 2001: Case study to remove pull stations for "malicious false alarms in a residential housing complex"

REMOVAL OF EXISTING FIRE PULL STATIONS

A) Buildings protected by approved fire sprinkler systems.

01) Per the requirements established in IBC 2012 Section 903.2.3, an automatic sprinkler system will be required in nearly all Group E classified occupancies. There are some

exceptions to this, notably for small buildings with an area less than twelve thousand square feet, but as a general rule the construction of a new education facility will require an approved automatic sprinkler system. Existing facilities are grandfathered.

02) Where installed, automatic sprinkler systems drastically reduce the amount of manual activation devices required to protect the building. According to IBC 2012 Section 907.2, a minimum of one manual fire alarm box must be provided in an approved location for fire sprinkled buildings. All other pull stations may be eliminated.

03) IBC 2012 Section 907.2.3 lists some requirements for the automatic sprinkler system, the most relevant requiring manual activation to be provided from a normally occupied location.

04) A typical design that meets code requirements would include a single fire pull station in a normally occupied area adjacent to the fire alarm control panel or remote annunciator.

B) Buildings protected by approved smoke detection systems.

01) In a similar manner to installation of an automatic sprinkler system, installation of an approved smoke detection system can reduce the number of manual fire alarm stations required to protect the building.

02) Per IBC Section 907.2.3 in reference to Group E Occupancies, manual fire alarm boxes are not required when all of the following requirements are met:

a. Interior corridors are protected by smoke detectors.

b. Auditoriums, cafeterias, gymnasiums and similar areas are protected by heat detectors or other approved detection devices.

c. Shops and laboratories involving dusts or vapors are protected by heat detectors or other approved detection devices.

03) A typical design that meets code requirements would include a single fire pull station in a normally occupied area adjacent to the fire alarm control panel or remote annunciator.

Downsides of Removing Existing Fire Pull Stations

A) Automatic fire detection devices rely on certain conditions being met before they will activate.

01) Smoke detectors require a critical buildup of smoke to reach their location, which is most often the ceiling.

02) Heat detectors and sprinkler heads require a critical set point of heat to be reached, or in the case of rate of rise detectors, a critical rate of temperature change.

B) Relying solely on a critical build-up of smoke or heat can delay building evacuation

01) Typically, humans can smell smoke well before we can see it, and at a level lower than is required for activation of a smoke detector. In the event that someone smells smoke, usually they will either comment on it or investigate the smell. This can lead to the manual activation of a fire pull station well before the critical amount of smoke required to activate detectors is reached.

02) Heat detectors are mainly used in custodial spaces, science rooms, and kitchens. In each of these locations it can be assumed there are trained staff members present who are able to quickly identify the hazards involved with their specific environments. If those staff members have access to a manual pull station, they will be able to quickly

activate fire alarm systems in the event of an emergency before critical levels of heat or temperature rise are reached to activate automatic detectors.

C) Buildup of deadly smoke, spread of fire, and lack of available exit paths due to these aforementioned items will increase given time. Any delay in the evacuation of a building that is in a state of fire emergency increases the danger to its occupants.

Kitchen Fire Protection Systems

A) Per IBC Section 904.11.1, kitchens containing commercial cooking systems that are protected by means other than an automatic sprinkler system require a manual activation device at or near a means of egress from the cooking area. Commercial kitchen designs typically include a hood fire suppression system, which makes this requirement true of most school buildings with kitchens. These hood fire protection systems typically use ANSUL fire activation devices which are local to the kitchen area and protection system. They are only noted here to indicate that removal of these systems is not allowed under currently adopted codes.

Pre-Signal Verification Systems

A) A pre-signal verification system has two main levels of alarm, pre-signal and general.

01) Pre-signal alarm:

a. Must initiate a fire alarm system at a constantly attended central location.

1)The alarm signal to the central location must be sent upon the first alarm signal.

2)This central location shall be able to immediately take appropriate action, such

as dispatch of emergency response.

b. The pre-signal alarm allows a responding fire authority to investigate the alarm situation prior to the activation of the general alarm state, which can be indefinitely delayed by the control equipment.

c. A means must be provided, usually through a manual activation device with special signage, to raise the alarm to the general alarm state. This should be placed in a location immediately accessible to responding fire authorities, such as the aforementioned central location.

02) General alarm:

a. All fire alarm notification devices serving the building shall activate, starting the building evacuation process.

b. The benefits of a pre-signal verification system include, but are not limited to, the following:

01) The pre-signal verification system allows responding authorities first look at the cause of the fire system alarm state. This allows them to assess the emergency situation and determine what actions are needed, if any.

02) The use of a pre-signal verification system prevents false alarms, which would otherwise serve to disrupt the learning environment. In a false alarm situation, the general alarm state would never be reached, leaving building occupants unaware as they continue the normal operations of the building.

03) In situations where the fire alarm system was activated with malicious intent to cause evacuation of building occupants, appropriate steps can be taken to safely mitigate the desired evacuation state.

a. The following are some examples where fire alarm systems were activated by persons with intent to harm the building occupants:

1) In 1998 at Westside Middle School located in Jonesboro, Arkansas, two young students conspired to pull a fire alarm. Upon activation of the fire alarm system the building occupants evacuated, unaware of what was waiting for them. Outside of the school, the two students had set up with guns. They opened fire into the evacuating students and faculty, killing five and injuring ten.

2) More recently, on February 14, 2018 Marjory Stone Douglas High School in Parkland, Florida was host to a similar incident. Once again, the fire alarm system was activated by the shooter to start the evacuation process. As students and faculty streamed into the halls, the shooter opened fire into the crowd, killing seventeen and injuring seventeen others.

C. The drawbacks of a pre-signal verification system include, but are not limited to, the following:

01) The use of a pre-signal verification system requires the approval of the authority having jurisdiction. Acquiring such permission may prove to be difficult, as the AHJ must consider the implications of delaying fire alarm notification and evacuation of the building.

02) The code does not provide a time limit on the delay prior to the human action that is required to provide building evacuation. This allows for errors in human judgement, in the worst case severely delaying the evacuation of the building in a real fire emergency situation. As a result of this, approval of pre-signal systems is typically limited to buildings that have localized and quick response to emergencies, detailed and clearly defined emergency response procedures, and large occupancies where occupants would be adversely affected by an evacuation alarm signal.

03) All devices of the fire alarm system must be pre-signal alarm devices. Separating the building into pre-signal and automatic zones causes confusion to occupants and responding authorities and is not permitted.

POSITIVE ALARM SEQUENCING

A) Positive alarm sequencing is similar to pre-signal verification, but there are a few key differences:

01) Instead of indefinitely postponing the activation of the fire alarm signal, a positive alarm sequencing system gives a period of fifteen seconds after annunciation for trained personnel to acknowledge the fire alarm signal at the control unit.

02) Upon acknowledgement of the alarm, the alarm investigation phase begins. The alarm investigation phase gives a period of time, up to two minutes, for trained personnel to evaluate the fire condition and reset the system when appropriate.

a. Special considerations of building conditions and materials may allow for time extension to this phase, subject to approval by the AHJ.

03) If the system is not reset, the system enters its general alarm state and activates all fire alarm notification devices.

04) The automatic activation of a second detection device during the investigation phase will enter the system into its general alarm state and activate all fire alarm notification devices.

05) Additionally, the activation of a manual pull station will put the system into its general alarm state and activate all fire alarm notification devices.

a. This allows trained personnel to immediately activate a general alarm state should they encounter a fire emergency during the investigation phase, giving occupants more time to evacuate.

b. The benefits of a positive alarm sequencing system are similar to those of a pre-signal verification system with some minor differences, noted here:

01) In the event of a real fire emergency where human error leads to delayed evacuation of the building, the maximum amount that the building evacuation can be delayed is defined relative to the fire protection of the building. Providing that no exceptions are made by the AHJ, the

maximum delay is two minutes and fifteen seconds.

02) The activation of a second alarm device greatly increases the likelihood of a real fire emergency. In essence, this second activation indicates that the possibility of a real fire is sufficient enough to immediately begin the evacuation process, saving time that might be otherwise lost during investigation.

C) The drawbacks of a positive alarm sequencing system are similar to those of a pre-signal verification with some minor differences, noted here:

01) Evacuation plans must be developed by the school in cooperation with local fire officials and law enforcement. These plans detail the level of involvement of school staff, and what measures they are required to take in the event of an emergency. Essentially, staff must be trained on procedures and device locations that are specific to each site. This development of coordinated plans and training of on-site staff costs time and adds additional responsibility to school staff.

02) Although the fire alarm system is not supposed to be reset until the source of alarm is determined to be nonhazardous, human error can lead to the reset of the fire alarm system in the event of a real emergency. This would lead to an indefinite delay in building evacuation, as it is possible, though unlikely, that the system enters into a cycle of continuously activating and being manually reset. Well trained staff would make this highly unlikely, as activation of a manual pull station would enter the building into its general alarm state which cannot be reset until the building has been evacuated.

03) Approval of a positive alarm sequencing system typically requires the building to be protected by an automatic sprinkler or smoke detection system. Existing buildings that do not meet these requirements would not be eligible for delayed evacuation systems.

DELAYED EVACUATION AND POSITIVE ALARM SEQUENCING

01) The Minnesota State Fire Marshall has allowed the use of a combination of delayed evacuation and positive alarm sequencing as a response to concerns raised by school shootings. This combination has a few simultaneous processes, explained as follows:

a. Upon alarm activation, students stop what they are doing and stay put at their desks. The teacher then verifies that their surrounding areas is free from smoke or flames. If no smoke or flames are found, the students and teacher stay in place.

b. Trained staff check the fire alarm control panel and inform the custodian what alarm has activated. The custodian then investigates the area for fire or other dangers. If the custodian does not radio back to the trained staff with information about the situation within one minute, evacuation begins.

c. Trained staff members use the building's public address system to inform students and faculty that the cause of alarm is being investigated. If danger is found, students and faculty are immediately informed and begin evacuation.

02) Students and faculty are informed that if there is any doubt of what they should do, they should evacuate.

03) Listed here are some benefits to this combination of systems:

a. Every single person in the building should hear both the fire alarm and public address system, meaning everyone in the building is alert and responsive to the developing situation.

b. As information comes in, each occupant has the opportunity to make informed decisions relative to the developing situation.

1) For example, in the event of a real fire the custodian would relay relevant information back to trained staff. The trained staff would then inform building occupants over the public address system that there is a fire, where the fire was located, and what steps nearby classrooms should take to exit the building. In the event that an exit is blocked, alternate routes could be given over this system.

2) In the event of the presence of an armed person, each classroom could be informed to stay in its lockdown state, and to prepare to react according to their training regarding such a situation.

04) Listed here are some drawbacks to this combination of systems:

a. The combination of positive alarm sequencing and delayed evacuation relies on trained staff and students who react appropriately to the directions given to them. In essence, the alarm puts each classroom into a lockdown state, awaiting further instructions over the public address system. Furthermore, it relies on each teacher's ability to verify their surrounding areas and make quick judgement calls on what their individual classroom response should be. Having well trained staff and informed students is critical to the successful operation of this system.

b. This system leans heavily on the use of a public address system to inform building occupants of ongoing events. Any disruption to this system as the result of fire damage during an ongoing fire emergency could endanger occupants. It is strongly advised that the implementation of such a system meet the following requirements:

1) The public address system shall have standby emergency power

2) The public address system shall be designed so that attack by fire within a portion of the building does not impair control and operation of notification devices outside of that area.

3) All circuits necessary for the operation of the notification devices shall

be protected, such as by means of fire rated cable.

c. Approval of a delayed evacuation system typically requires the building to be protected by an automatic sprinkler or smoke detection system. Existing buildings that do not meet these requirements would not be eligible for delayed evacuation systems.

b. Programming of the security system and reception/central/remote annunciator area video display system to display the video feed on the display local to those areas.

02) This would allow trained staff to immediately identify the conditions surrounding the pull station and determine what steps must be taken given that information.

03) Typically, existing buildings that contain security/CCTV systems already have cameras overlooking each entrance/exit to the building. In buildings that already have manual pull stations at each exit being monitored by the security system, it is relatively simple to provide the interlocking necessary to accomplish this design. This assumes that the existing fire alarm system is addressable.

04) Furthermore, this design can be combined with any of the previously mentioned systems. This would reduce the time required to investigate the cause of alarm and help mitigate the delays inherent to those systems.

MODERN FIRE PROTECTION SYSTEMS

A) Modern fire protection systems generally consist of a combination of fire alarm control panels, annunciation devices, automatic detection devices, manual detection devices, notification devices, and interlocks to building systems. Each device is individually addressable and ties back into the fire alarm control panel. Essentially, this allows the system to keep track of each individual device's type, location, and address.

01) For example, upon a device's activation a message can be programmed to appear at the fire alarm panel or annunciator describing the location and type of device that is in an alarm state.

B) This combination of addressability, programmability, and interlocking allows us to customize the fire protection system to meet the needs specific to each site.

01) A design option that utilizes this combination effectively would consist of the following:

a. An interlock from the fire alarm system to the building security/CCTV system to display the video feed of a specific camera that overlooks an addressable manual fire pull station.

CONCLUSIONS

The conclusion is that according to the IBC, NFPA, and the SAFETY Act, it is legal to remove most if not all fire pull stations (dependent on building fire protection system requirements) and to refrain installing these devices in new buildings. While other districts and cities have removed or sought to remove the manual alarm systems, there is very little evidence of measures taken to increase the safety of the notification system in lieu of the removal of this device. The research and development team's suggestion is that in the event of a manual

alarm device removal, a replacement device that can identify a wider range of non-fire emergencies should be installed. Preferably linked to the mass communications or voice-based notification system. Another suggestion from the research and development department is that in the case of manual alarm system removal or any reductions made to the Fire, Emergency, or Security system should be reinforced with updated drills and training for when a building is in “lock down” or “defend in place” mode. Coordination between the Fire Department, Building Department, Fire Marshal’s Office, School Officials, and Law enforcement can approve a comprehensive plan for the district. If a current comprehensive plan exists, this comprehensive plan should be updated with the device adjustments included.

In the case of existing Group E facilities:

Per IFC 2006 Section 907.2.3 manual fire alarm boxes are not required in group E occupancies where all of the following apply:

- 2.A. Interior corridors are protected by smoke detectors with alarm verification.
 - 2.A.1. If the existing system does not comply with this requirement, additional devices are being added and the system shall be reprogrammed with alarm verification as a part of the correction.
- 2.B. Auditoriums, cafeterias, gymnasiums, and the like are protected by heat detectors or other approved detection devices.
 - 2.B.1. If the existing system does not comply with this

requirement, additional devices must be added to resolve the deficiency.

- 2.D. Off-premises monitoring is provided.
 - 2.D.1 The Existing system has off-site monitoring and does comply with this requirement.
- 2.E The capability to activate the evacuation signal from a central point is provided.
 - 2.E.1. The existing system does not comply with this requirement, a new pull station shall be provided adjacent to the existing fire
- 2.F In building where normally occupied spaces are provided with a two-way communication system between such spaces and a constantly attended receiving station from where a general evacuation alarm can be sounded, except in locations specifically designated by the fire code official.
 - 2F.1. The existing normally occupied spaces have existing two-way communications systems and do comply with this requirement.

FUTURE ACTION

- Establish a review meeting with local fire marshal to communicate intent.
- Generate surveys of existing building(s) to be affected, create a document set revealing all fire panels, smoke detectors, sprinkler heads, strobe alarms and manual pull station locations.
- Identify existing area where detector is not required to qualify for exemption from manual fire alarm boxes.
- Identify existing areas with existing adequate detector coverage to qualify for exemption from manual fire alarm boxes.
- Identify existing areas to be provided with additional detection devices to meet requirements for exemption from manual fire alarm boxes.
- Establish a second review meeting with local fire marshal to present findings and determine eligibility.
- Submit all resulting construction documents to AHJ for permit.

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ACKNOWLEDGEMENTS

- Sheldon ISD for submitting research inquiry.
- Stanton engineering for participating as research partner.

CONTACT

DeQualès A. Thompson

Director of Research and Development
IDG Architects
Department of Research & Development
440 Benmar Dr.
Suite 335
Houston, TX 77060
(832) 448-2462
dthompson@idgarch.com

Michael Stanton Phd

CEO
Stanton Engineering Group
1300 W Sam Houston Pkwy S #121
Houston, TX 77042
713.300.9292
michael@stanton-eng.com

KEYWORDS

Fire detection and alarm, Anti-Terrorism,
architecture, education, emergency notification,

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