Emergency Voice Communication in High-Rise Buildings

Presented by:
Michael J. Klemenz, PE, SFPE
Society of Fire Protection Engineers (SFPE)

- Established in 1950 and incorporated as an independent organization in 1971. It is the professional society representing those practicing the field of fire protection engineering. The Society has over 4500 members globally and over 60 regional chapters. Society HQ is located in Bethesda, MD. [www.sfpe.org](http://www.sfpe.org)

- New York Empire Chapter promotes the profession of fire protection engineering and its allied and supporting professions in Upstate New York.

- Chapter activities are found on our FB page
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Communication

The act or process of using words, sounds, signs, or behaviors to express or exchange information or to express your ideas, thoughts, feelings, etc., to someone else.
Information

Knowledge that you get about someone or something: facts or details about a subject

So, communication is the delivery method of knowledge, facts or details that we want or need to know.
Communication/Information

• We humans seek information and depend heavily on communication to send and receive it
• We are constantly bombarded with information
• Some can be contradictory and ambiguous
• How do we provide critical information in an emergency, especially to occupants in a high-rise building? With voice communication.
Emergencies Requiring Communication

- Fire
- Bomb Threat
- Hazardous Material Release
- Severe Weather
- Hostile Intruder
- WMD
- Biological/radioactive release
- Non-peaceful protests
Emergency Situations

• Natural or man-made
• Accidental or intentional
• Specific location or wide area
• Large or small population exposure
• Short duration or long term
“Mass Notification” is not new

- In early American towns, the fire warden would use a wooden rattle to rally citizen fire brigades.
- Bells and gongs have been used to alert the public to fires and severe weather.
- Air raid sirens in Europe during WWII.
- Flags to alert of hurricanes and tornadoes.
- Civil defense sirens were employed in the US during the Cold War.
Fire Rattle

Hurricane Flags

BLISS-GAMEWELL DIAPHONE HORNS FOR MUNICIPAL AND VOLUNTEER FIRE DEPARTMENTS, INDUSTRIAL AND INSTITUTIONAL FIRE BRIGADES...

The GAMEWELL Diaphone Horn, operated by compressed air, is characterized by great carrying power, distinctive tone, and the ability to sound coded signals in short and distinct blasts. It is the most powerful and efficient public alarm yet developed. The operating air pressure required at the horn is 35 pounds per square inch.

Diaphone public alarm outfits are self-contained units providing by means of automatically controlled motor-driven compressors an adequate reserve supply of compressed air for alarm purposes. The air is stored in suitable tanks and the power for operating the motor-driven compressors is taken from the local electric light or commercial power supply circuit.

Reserve capacity is of vital importance. Any means employed for announcing the existence and location of fire is inadequate and undependable if not continuously capable of performing its functions irrespective of power failure or other cause.
REVISED CIVIL DEFENSE
Air Raid Instructions
Published by the Federal Civil Defense Administration

ALERT SIGNAL
A steady blast of 3 to 5 minutes on sirens, whistles, horns, or similar devices.

WHAT TO DO
Do not use the telephone.
Tune your AM radio to a Conelrad station (640 or 1240 kc) for emergency instructions.
Do not become panicky if your radio is silent for a short time.
This is necessary to switch to emergency broadcasting frequencies.
Know your local civil defense emergency plans. Obey police and civil defense instructions.

TAKE COVER SIGNAL
Wailing tone or short blasts

for 3 minutes on sirens, whistles, horns, or similar devices.

WHAT TO DO
At Home: Get into your home shelter immediately.
If you have none, shut all outside doors and windows and take cover in the basement or an interior first-floor room.
Outdoors: Seek the best available cover.
Stay Put until you get word to come out.
Important: If you see a bright flash of light, take cover instantly.
640—REMEMBER CONELRAD IS THE KEY—1240

Maps for reproducing these in quantity are available free through your State Civil Defense Director. They may be reprinted and distributed without further permission.
“Victory” Siren

180 hp V8 Chrysler gasoline engine (331 CID)

Manufactured 1952-1957

Weighed 3 tons

4 mile range

138 dB @ 100 ft

12 ft long, 6 ft. high
Modern Communication Systems

- Modern systems can furnish real-time information and exact instructions to a population based on the type of incident
- Automatic or manual
- This is made possible by huge advances in technology
Desired Occupant Response

- Building evacuation is *not* always the best course of action
- Occupants may have to be sheltered in place or relocated
- A building “lock down” may be necessary
High-Rise Buildings

• Other SFPE presenters today will discuss issues relevant to high-rise buildings
• This presentation addresses emergency voice communication systems
• Prescriptive code requirement is for fire emergencies; currently no requirement for other emergencies
• However, Voicecom systems can also be used for non-fire emergencies- Mass Notification Systems (MNS)
Learning Objective

At the conclusion of this presentation, we should be able to identify:

• Basic building code requirements for emergency voice communication systems in a high-rise building

• Awareness of certain design and engineering considerations
Presentation Questions

• What differentiates evacuation in high rise buildings from evacuation in low rise buildings?
• What is circuit pathway survivability? Why is it essential in high rise buildings?
• What is the difference between ‘intelligibility’ and ‘loudness’?
Topics

• Building code chapters 4 and 9 relative to emergency voice communication systems
• NFPA 72, *National Fire Alarm (and Signaling) Code* as applied to voicecom
• Circuit pathway survivability
• Unique emergency communication considerations for high-rise buildings
• Voice intelligibility
• Acceptance Testing
BCNYS Definitions

- **High-Rise:** Buildings having an occupied floor located more than 75 feet above the lowest level of fire department vehicle access.

- **Emergency Voice/Alarm Communications:** Dedicated manual or automatic facilities for originating and distributing voice instructions, as well as alert and evacuation signals pertaining to a fire emergency, to the occupants of a building.
Why Emergency Voice/Alarm Communications?

• Non-voice emergency communication systems still have a place in buildings
• The FP industry has conditioned occupants how to react to buzzers and lights
• Large, expansive and high-rise buildings with massive populations have distinct emergency communications needs
FIGURE A24.4.2.8

Key Steps in Person’s Reaction.
Consider...

- 9:30 AM, Ground floor of a low-rise conference center building
- Flashing strobes, horns with temporal pattern
- No visible smoke, odors, etc.
- How do you react?
Now Consider...

- 9:30 AM, 60th floor of a high-rise building
- You hear a ‘boom’ and feel a slight vibration
- What’s happening? How bad is it?
- Do I need to exit the building (60 floors!) via stairs? Are elevators usable? Should I stay in place?
- Wouldn’t information and direction from an authoritative source be reassuring right now?
Topics

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BCNYS Chapter 4
(High-Rise)

• 403.1 The provisions of 403 apply to high-rise buildings

• 403.6 Emergency voice/alarm communication systems IAW Section 907.2.12.2.

• 403.7 A two-way fire department communications system IAW Section 907.2.12.3.

• 403.8 A fire command center shall be provided
Side Note

- BCNYS requires covered mall buildings exceeding 50,000 sf in total floor area shall be provided with an emergency voice/alarm communication system.
- Why?
BCNYS Chapter 9

907.2.12.2 A fire alarm initiating device shall automatically sound an alert tone followed by voice instructions giving approved information and directions for a general or staged evacuation on a minimum of the alarming floor, the floor above and the floor below.

Speakers shall be provided in paging zones at least in:
1. Elevator groups
2. Exit stairways
3. Each floor
4. Areas of refuge as defined in Section 1002.1

BTW, Section 404 of the FCNYS requires a high-rise building fire safety and evacuation plan
907.2.12.2.2 Capability of automatic and live voice messages on a selective and all-call basis.

907.2.12.2.3 Comply with NFPA 72.

907.2.12.3 Two-way fire department communication system shall operate between the fire command center and elevators, elevator lobbies, emergency and standby power rooms, fire pump rooms, areas of refuge and inside enclosed exit stairways.

   Exception: Fire department radio systems are permitted where approved
Mass Notification System

- Currently, neither the building code nor NFPA 72 require MNS in buildings
- DOD projects require MNS as part of ‘force protection’
- MNS can be combined with fire, but visible signals must be different
Topics

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NFPA 72, National Fire Alarm (and Signaling) Code

- BCNYS references 2007 edition of NFPA 72
- 2007 edition covers voicecom in Chapter 6 and MNS in Annex E
- 2013 edition covers voicecom, including MNS in Chapter 24
- 2013 edition is used in this presentation; Concepts are not affected
- Voicecom shall be installed in occupancies where required by the authority having jurisdiction or by other applicable governing laws, codes, or standards.
NFPA 72, National Fire Alarm (and Signaling) Code

• Follow Chapter 24 for Emergency Communication Systems (fire and MNS)
• Chapters 7, 10, 12, 17, 18, 21, 23, 26, and 27 also apply
• “An event such as a terrorist attack, an on-campus shooter, or a natural disaster would necessitate clear and on-time communication from those in authority to the occupants of the building or outside areas or via a distributed recipient mass notification system (DRMNS) directly to the people, wherever they may be during the emergency”
An emergency communications system is intended to communicate information about emergencies including fire, human-caused events (accidental and intentional), other dangerous situations, accidents, and natural disasters.
Voicecom must provide:

• Information on the hazard and danger
• Guidance on what occupants should do
• Description of the risk or hazard location
• Idea of when they need to act
• Name of the warning source (authority)
NFPA 72, National Fire Alarm (and Signaling) Code

• Pathway survivability requirements shall apply to notification and communications circuits

• Voicecom systems may be used for nonemergency uses such as background music or public address. However, the intent of the Code is to ensure that the speakers and circuits are not compromised because of this non–fire alarm use.
NFPA 72, National Fire Alarm (and Signaling) Code

- Loudspeakers used as alarm notification appliances on fire alarm systems shall also be permitted to be used for mass notification.
- Priority of mass notification messages over fire alarm evacuation shall be permitted when evaluated by the stakeholders through a risk analysis.
- The fire alarm system shall not automatically override emergency mass notification messages.
NFPA 72, National Fire Alarm (and Signaling) Code

• Provide automatic response to the receipt of a signal indicative of a fire alarm or other emergency

• **Evacuation** messages shall be preceded and followed by a minimum of two cycles of the emergency evacuation signal

• **Relocation** messages other fire emergency non-evacuation messages, a 1-second to 3-second alert tone followed by message; repeated at least three times
NFPA 72, National Fire Alarm (and Signaling) Code

• Undivided fire or smoke areas shall not be divided into multiple evacuation signaling zones
Topics

• Building code chapters 4 and 9 relative to emergency voice communication systems
• NFPA 72, *National Fire Alarm (and Signaling) Code* as applied to voicecom
• **Circuit pathway survivability**
• Unique emergency communication considerations for high-rise buildings
• Voice intelligibility
• Acceptance Testing
Pathway Survivability

- Pathway survivability requirements shall apply to notification and communications circuits.
- Fire alarm systems used for partial evacuation and relocation shall be designed and installed such that attack by fire within an evacuation signaling zone does not impair control and operation of the notification appliances outside the evacuation signaling zone.
- Voicecom systems may be used for nonemergency uses such as background music or public address. However, the intent of the Code is to ensure that the speakers and circuits are not compromised because of this non–fire alarm use.
Pathway Survivability

• **Pathway Survivability Level 0.** No provisions for pathway survivability

• **Pathway Survivability Level 1.** Pathways in buildings that are sprinklered IAW NFPA 13 with any interconnecting conductors, cables, or other physical pathways installed in metal raceways

• **Pathway Survivability Level 2.** Pathways consisting of one or more of the following:
  - 2-hour fire-rated circuit integrity (CI) cable*
  - 2-hour fire-rated cable system [electrical circuit protective system(s)]
  - 2-hour fire-rated enclosure or protected area
  - 2-hour performance alternatives approved by the AHJ
Pathway Survivability

• **Pathway Survivability Level 3.** Pathways in buildings that are sprinklered IAW NFPA 13 AND one or more of the following:

  2-hour fire-rated circuit integrity (CI) cable*
  2-hour fire-rated cable system [electrical circuit protective system(s)]
  2-hour fire-rated enclosure or protected area
  2-hour performance alternatives approved by the AHJ
*On September 12, 2012, UL and ULC publicly stated they will no longer be able to offer certification to the currently existing programs for the UL 2196 and ULC S-139 standards. UL or ULC certification mark on production for the following products:

- UL Classified Fire Resistive Cable (FHJR)
- ULC Listed Fire Resistant Cable (FHJRC)
- UL Listed cable with “-CI” suffix (Circuit Integrity)

EXHIBIT 12.5
Circuit Integrity (CI) Cable. (Source: )

Images from NFPA 72-2013 edition

EXHIBIT 12.6
Mineral-Insulated (MI) Cable — Part of Electrical Circuit Protective System. [Source: Tyco Thermal Controls (Canada) Ltd./Pyrotenax]
Example of Pathway Survivability Level 3

Sprinklered building & 2 hour FRR stair enclosure
Pathway Survivability

• For voicecom systems employing relocation or partial evacuation, Level 2 or Level 3 pathway survivability is required.

• For systems that do not employ relocation or partial evacuation, Level 0, Level 1, Level 2, or Level 3 pathway survivability is required.

• Pathway survivability for in-building mass notification systems shall be determined by risk analysis.
Pathway Survivability

- Protect all circuits necessary for the operation of the notification appliances (audible & visible) until they enter the evacuation signaling zone that they serve by the required pathway survivability level
Pathway Survivability

• Don’t confuse pathway survivability with pathway class designation

• Class designation (e.g., Class A, Class B, Class C, Class D, Class E, or Class X) depends on the performance requirements applied to notification and communications circuits

• Class designation describes the ability of a pathway to remain functional during certain abnormal electrical conditions such as opens, grounds, wire-to-wire shorts, etc.
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• Voice intelligibility
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Unique emergency communication considerations for high-rise buildings

- Loooooonng travel distance from interior to exterior public way
- Large occupant population; slow egress travel
- Egress systems not designed for total evacuation
- Limited awareness of magnitude or location of an emergency
- Location of safety may be sideways or up and not down depending on the emergency
Dual Use Mean of Egress
Non-ambulatory occupants...is egress direction “up” or “down”?
Topics

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- Circuit pathway survivability
- Unique emergency communication considerations for high-rise buildings
- **Voice intelligibility**
- Acceptance Testing
Intelligibility

• The quality or condition of being understood; comprehensible; clear
• Emergency communications messages must be intelligible to be of value
• Equipment must be designed and constructed to accurately reproduce a human voice (150-11,000 Hz)
• Ambient acoustic conditions must be understood
• More speakers at a lower power setting
Intelligibility

- Emergency communications systems shall be capable of reproducing prerecorded, synthesized or live messages with “voice intelligibility”
- Provide distributed sound level with minimal sound intensity variations to achieve an intelligible voice message
- Careful selection and distribution of speakers
- More speakers at a lower power setting
Intelligibility

- **Acoustically Distinguishable Space (ADS).** An emergency communications system notification zone, or subdivision thereof, that might be an enclosed or otherwise physically defined space, or that might be distinguished from other spaces because of different acoustical, environmental, or use characteristics, such as reverberation time and ambient sound pressure level.
Intelligibility

• Intelligibility is considered acceptable if at least 90 percent of the measurement locations within each ADS have a measured STI of not less than 0.45 (0.65 CIS) and an average STI of not less than 0.50 STI (0.70 CIS)

• Buildings and areas of buildings that are not acoustically challenging such as traditional office environments, hotel guest rooms, dwelling units, and spaces with carpeting and furnishings generally meet intelligibility levels if the audibility levels are consistent with the requirements of NFPA 72, National Fire Alarm and Signaling Code.
Intelligibility

- Furnishings, interior finishes, carpeting, hard tile, large expanses of glass, and changes in ceiling height, are all factors that might affect intelligibility
- Louder is not better
- Suggest spacing at 2X the ceiling height
- Voice messages shall not be required to meet public mode audibility requirements; but, must be intelligible
- Alert tone must meet public mode audibility requirements.
- Visible notification appliances (public mode)
Intelligibility

• Areas of a typical building that can be acoustically challenging could include vehicle parking levels and large lobby areas with hard floors and wall surfaces, stairs, and other spaces with high reverberation

• ANNEX D: Speech Intelligibility contains additional information relative to design and testing for message intelligibility
Topics

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Acceptance Testing

• Follow NFPA 72 for initiating devices, ancillary functions, communication with supervising station, etc.
• Intelligibility shall not be required (by NFPA 72) to be determined through quantitative measurements
• Quantitative evaluation using intelligibility meters is permitted and is described in Annex D, but it is not required. Even if intelligibility meters were used, intelligibility testing in every office or space might not be necessary if voice messages can obviously be understood
Acceptance Testing

DSP30B/DSP30BP / DSPCIB/BP - Full Function Stand Alone Audio Spectrum Analyzers Measure Sound Level and Speech Intelligibility Index in CIS or STI formats when used with OPTion STICistm Software. DSP30BP includes OPTion PI Privacy Index. (DSP30B Shown.)

TALKBOX - Signal Generator - An Integral Part of The Speech Analysis System - Used with either DSP2B/BP, DSP30B/BP or DSPCIB/BP - Applies Specialized Test Tones To A Voice Message System or selected environment.
Presentation Questions

• What differentiates evacuation in high rise buildings from evacuation in low rise buildings?

• What is circuit pathway survivability? Why is it essential in high rise buildings?

• What is the difference between ‘intelligibility’ and ‘loudness’?
Questions/Comments?
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