Second Revision No. 5156-NFPA 72-2023 [Detail]

24.4.6.3 ~~8~~ .~~5.4~~ [relocate existing 24.4.8.5.4 to 24.4.6.3]

Loudspeakers shall conform to Section 24.4.

Submitter Information Verification

Committee: SIG-ECS
Submittal Date: Tue Aug 01 17:23:40 EDT 2023

Committee Statement

Committee Statement: The existing 24.4.8.5.4 is out of place and is moved to 24.4.6.3, the loudspeaker section. This change will allow the text to flow more accurately.

Response Message: SR-5156-NFPA 72-2023

Public Comment No. 241-NFPA 72-2023 [Section No. 24.4.8.5.4]

Second Revision No. 5067-NFPA 72-2023 [Section No. 3.3.267]

3.3.269 Risk Analysis.

A process to characterize the likelihood, vulnerability, and magnitude of incidents associated with natural, technological, and manmade ~~disasters~~ hazards and other emergencies that addresses scenarios of concern, their probability, and their potential consequences. (SIG-ECS)

Submitter Information Verification

Committee: SIG-ECS

Submittal Date: Mon Jul 24 09:34:49 EDT 2023

Committee Statement

Committee Statement: The term “natural…disasters” is inappropriate, as a disaster can really only be determined after the fact. Rather, this term should be replaced with ‘hazards’ as this more closely relates what should be identified during a Risk Analysis. Hazard events that do not rise to the significance of a “disaster” still need to be addressed in a Risk Analysis. This new language more closely aligns with the Risk Analysis Checklist provided in A.7.3.6.

Response Message: SR-5067-NFPA 72-2023

Public Comment No. 79-NFPA 72-2023 [Section No. 3.3.267]

Second Revision No. 5073-NFPA 72-2023 [Section No. 24.2.2]

24.2.2*

This chapter shall establish minimum required levels of performance, reliability, and quality of installation for ECSs ~~but does not establish the only methods by which these requirements are to be achieved~~ .

A.24.2.2

Emergency communications systems are unique for each given facility,therefore minimum required levels of performance, reliability, and quality cannot be established for each situation. See 24.3.13 for information that should be considered in a risk analysis.

Submitter Information Verification

Committee: SIG-ECS

Submittal Date: Mon Jul 24 10:18:10 EDT 2023

Committee Statement

Committee Statement: This revision removes vague and unenforceable language and added Annex A language to provide a direction to have unique items considered by the risk analysis.

Response Message: SR-5073-NFPA 72-2023

Public Comment No. 137-NFPA 72-2023 [Section No. 24.2.2]

Second Revision No. 5071-NFPA 72-2023 [Section No. 24.2.3]

24.2.3*

An ECS shall communicate information about emergencies ~~including, but not limited to, fire, human-caused events (accidental and intentional), other dangerous situations, accidents, and natural disasters~~ .

A.24.2.3

Emergency situations are not limited to fire, human-caused events, and natural hazards, but also include any situation that presents an immediate threat of injury, death, or property loss. Natural hazard emergencies include events that create a risk of injury, death, or property damage, such as flooding, wind, earthquakes, landslides, volcanic eruptions, or avalanches.

Submitter Information Verification

Committee: SIG-ECS

Submittal Date: Mon Jul 24 10:07:12 EDT 2023

Committee Statement

Committee Statement: This revision moves examples from the mandatory text to the annex to comply with the Manual of Style.

First, it is not the intent of an ECS to communicate information about “accidents”. This is the only use of the word “accidents” in the body of NFPA 72. The sentence already includes the thought of accidental human-caused events, and thus the word is redundant. Also, an event that is an “accident” can only be determined as such after the fact and the intent of an ECS is to address hazards to life and property whether they are accidental or not.

Second, the term “natural disasters” is inappropriate, as a disaster can really only be determined after the fact. Rather, this term is replaced with ‘natural hazards’ as this more closely relates to an event that an ECS should communicate information about, whether it is ultimately deemed to be a disaster or not. This new language more closely aligns with the Risk Analysis Checklist provided in A.7.3.6.

Response Message: SR-5071-NFPA 72-2023

Public Comment No. 78-NFPA 72-2023 [Section No. 24.2.3]

Public Comment No. 138-NFPA 72-2023 [Section No. 24.2.3]

Second Revision No. 5090-NFPA 72-2023 [New Section after 24.3.9.2]

24.3.10 Audio Notification Appliance Circuits (A-NACs).

24.3.10.1*

Audio notification appliance circuits (A-NACs) with loudspeakers connected to them shall comply with the following:

(1) A-NACs shall be designed for a maximum of 1.0 dB electrical loss.

(2) A-NAC design and installation shall consider all electrical adjustments (loss or gain) from the primary audio source, through all circuit wiring, from any control unit (CU) circuitry, and from any control module (CM) circuitry to the last loudspeaker on the circuit.

A.24.3.10.1

A-NACs, when active, use AC derived from an audio amplifier and are typically designed for a 1.0 or 0.5 electrical dB loss. The following example is for a circuit designed for a 0.5 dB loss:

$$\text{db circuit loss} = 20 * \text{Log10}\frac{\text{load impedance}}{\text{load impedance+circuit resistance}} \quad \text{[A.24.3.10.1a]}$$

$$\text{load impedance} = \frac{\text{circuit voltage}^2}{\text{circuit wattage}} \quad \text{[A.24.3.10.1b]}$$

An example of such dB circuit loss for a 70.7 VRMS system with a 19.2 watt load on 16 AWG stranded wire would result in the following:

$$-0.15738 = 20 * \text{Log10}\frac{260.338}{260.338 + 4.76} \quad \text{[A.24.3.10.1c]}$$

Load impedance is calculated as follows:

$$260.338 = \frac{70.7^2}{19.2} \quad \text{[A.24.3.10.1d]}$$

To calculate wire length based on a given load, the following calculations can be used:

$$R_L = \frac{V^2}{P} = \text{load resistance } (W) \quad \text{[A.24.3.10.1e]}$$

where:

R_L = load resistance

V = amplifier output voltage (V)

P = power in load (W)

To solve for wire resistance, wire resistance (RW) is converted to wire length as follows:

$$D = \frac{R_W}{R/_{1000\text{ ft (300 m) pair}}} \times 1000 \quad \text{[A.24.3.10.1f]}$$

where:

D = distance in feet

R_W = maximum allowable wire resistance

$R/_{1000\text{-ft-pair}}$ = wire resistance per 1000 ft (300 m) pair

For a 0.5 dB loss calculation, the following applies:

$$\text{max length} = \frac{59.25 \times \text{amplifier output}^2}{\text{wire resistance} \times \text{circuit load}} \quad \text{[A.24.3.10.1g]}$$

where:

amplifier output = signal level in VRMS supplied by the amplifier driving the circuit

wire resistance = resistance rating of the wire per 1000 ft (300 m) pair

circuit load = total watts required by the audio circuit

For 25.2 VRMS systems, the maximum circuit length based on wire resistance is as follows:

$$\text{max length} = \frac{59.25 \times 635}{(\text{wire resistance} \times \text{circuit load})} \quad \text{[A.24.3.10.1h]}$$

For 70.7 VRMS systems, the maximum circuit length based on wire resistance is as follows:

$$\text{max length} = \frac{59.25 \times 4998}{(\text{wire resistance} \times \text{circuit load})} \quad \text{[A.24.3.10.1i]}$$

24.3.10.1.1*

A-NACs using CMs that are not integrated directly into the control unit(s) shall include their module insertion adjustment (MIA) in circuit designs.

A.24.3.10.1.1

Control Modules. These typically field-installed (i.e., not integrated directly into control units) addressable CMs provide electrical supervision of the A-NAC and provide control of the audio power riser coming into the CM. Any module or device that is in the power riser electrical path or that can impact the performance of the riser must be considered in the system design, installation, and testing. Other examples of CMs can include, but are not limited to, the following:

(1) Relay

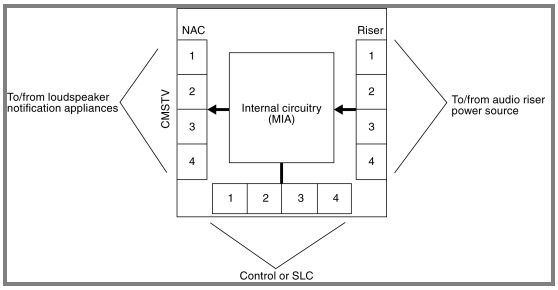
(2) Coder

(3) Supervision

(4) Synchronization

Figure A.24.3.10.1.1 provides a block diagram of the internal sections of a typical A-NAC CM. For A-NACs, the module insertion adjustment (MIA) is factored into the calculations.

Figure A.24.3.10.1.1 A-NAC CM Internal Block Diagram.



24.3.10.1.2

CMs shall be permitted to be dually rated for MIA and module voltage adjustment (MVA) when the modules are designed and listed or certified for A-NACs and DCNACs.

24.3.10.1.3

All wiring for A-NACs shall be designed for a minimum of 167°F (75°C) or for the expected circuit operating temperature if the circuit will be subjected to temperatures above 167°F (75°C).

24.3.10.1.4*

A-NACs shall be designed based on one of the following methods of calculation:

(1) End-line-loaded (ELL)

(2) Point-to-point (PTP)

A.24.3.10.1.4

Line Loss Calculations. This is the key design factor. All conductors in a circuit must be considered, including drops, risers, whips, service loops, and any other conductors in a circuit. There are two acceptable methods, as follows:

(1) End-line-loaded (ELL): ELL circuits are designed and tested based on the total circuit resistance and loss and is also referred to as lump-sum loading. This method assumes that all the appliances are at the end of the circuit and are activated at one time. This is the most conservative method and is the recommended design method for all systems.

(2) Point-to-point (PTP): PTP circuits are designed based on the individual segment and tested on total resistance and loss. This method requires that the designer know the exact wire distance between every appliance. If the installed values are different than the design values, the circuit might not work correctly. This method requires close coordination with the design and field work.

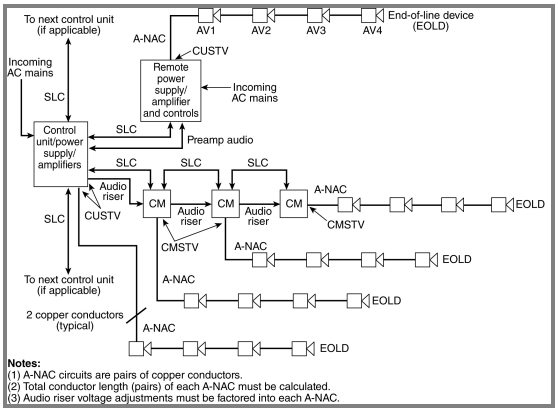
24.3.10.2*

Class B circuit length shall be calculated from the circuit start to the last loudspeaker on the circuit.

A.24.3.10.2

Figure A.24.3.10.2 depicts the overall audio power flow and areas of concern for a typical system.

Figure A.24.3.10.2 A-NAC End-to-End Concept Diagram.



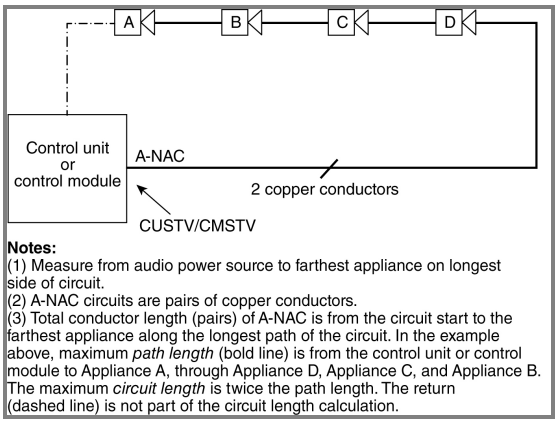
24.3.10.3*

Class A or Class X circuit length shall be calculated from the circuit start to the last loudspeaker on the longest side of the circuit.

A.24.3.10.3

Figure A.24.3.10.3 depicts how to measure the circuit length for a Class A or Class X NAC.

Figure A.24.3.10.3 Class A Measurement for Circuit Length.



Notes:
(1) Measure from audio power source to farthest appliance on longest side of circuit.
(2) A-NAC circuits are pairs of copper conductors.
(3) Total conductor length (pairs) of A-NAC is from the circuit start to the farthest appliance along the longest path of the circuit. In the example above, maximum *path length* (bold line) is from the control unit or control module to Appliance A, through Appliance D, Appliance C, and Appliance B. The maximum *circuit length* is twice the path length. The return (dashed line) is not part of the circuit length calculation.

24.3.10.4*

Circuit length calculations shall comply with the following requirements:

(1) Circuit length shall follow the intended path, including right angles for conduit paths and vertical changes in elevation when applicable.

(2) Circuit lengths identified within calculations shall include the total length of both conductors.

(3) The user shall clarify on the calculation form if the length displayed complies with one of the following:

  (a) The length of the path displayed is the length between devices and the length is doubled in the calculations.

  (b) The length of path displayed already reflects conductors out and back.

(4) Wire resistance values shown in the calculations (ohms) shall comply with the following:

  (a) Not be doubled for the length

  (b) Reflect the resistance values of Table 8 of *NFPA 70* or the manufacturer's published data sheet

(5) If resistance is to be based on a specific product, the product data sheet shall be included with the calculations.

A.24.3.10.4

Circuit calculations need to include total circuit length, which includes distances from panels up to above ceilings, vertically through floors, flexible drops down to suspended ceilings, and other such changes. It is critical to recognize that a 6 ft (1.8 m) flex drop with circuits down and back up adds 24 ft (7.3 m) of wire [red and black down 12 ft (3.7 m) + red and black back up 12 ft (3.7 m)]. In addition, there is to be 6 in. (150 mm) of loop in each junction box (above ceiling and at device box) in accordance with *NFPA 70* , therefore adding an additional 4 ft (1.2 m) of wire. Ten 6 ft (1.8 m) flex drops will, if not included in the total length, add an additional 280 ft (85.3 m) of wire to a circuit.

Supplemental Information

File Name	Description	Approved
Chapter_24_24_3_10_SR-5090.docx	Chapter_24_24_3_10_SR-5090	

Submitter Information Verification

Committee: SIG-ECS

Submittal Date: Mon Jul 24 16:16:11 EDT 2023

Committee Statement

Committee Statement: Added new section to clarify how to calculate Audio Notification Appliance Circuits (A-NACS). The goal is to standardize how A-NACS are calculated so that the design, authority, installation, and related communities are all using the same methods. Specific requirements are provided for how to prepare and submit voltage drop calculations because vertical lengths and actual conduit lengths are frequently left out of voltage drop calculations. This will help to standardize the review process.

The correlating committee should correlate this with the work done by SIG NAS in Chapter 18. SIG ECS recommends relocation of both sections to Chapter 7 or Chapter 10.

Correlating committee should consider taking all of the calculation procedures in the code and relocating them into a chapter for the 2028 edition.

Response Message: SR-5090-NFPA 72-2023

Public Comment No. 251-NFPA 72-2023 [New Section after 24.3.10]

Second Revision No. 5075-NFPA 72-2023 [Section No. 24.3.12.11]

24.3.13.11

The risk analysis shall consider cybersecurity risks in accordance with Chapter 11 and 7.3.6 .

Submitter Information Verification

Committee: SIG-ECS

Submittal Date: Mon Jul 24 11:12:44 EDT 2023

Committee Statement

Committee Statement: The first draft changes to chapter 11 do not provide specific guidance for a Cybersecurity Risk Assessment. However, new first draft annex material in A.7.3.6 does provides specific Cybersecurity Risk Analysis guidance. Adding the reference to Chapter 7 Risk Analysis Documentation increases the cohesiveness of Risk Analysis across the document.

Response Message: SR-5075-NFPA 72-2023

Public Comment No. 171-NFPA 72-2023 [Section No. 24.3.12.11]

Second Revision No. 5076-NFPA 72-2023 [Section No. 24.4.1.2]

24.4.1.2

If acceptable to the authority having jurisdiction, the system shall permit the following concurrent operations :

(1) Application of an automatic evacuation signal to one or more signaling zones

(2) Manual voice paging to the other signaling zones selectively or in any combination

Submitter Information Verification

Committee: SIG-ECS

Submittal Date: Mon Jul 24 11:23:32 EDT 2023

Committee Statement

Committee Statement: The revision corrects an inadvertent change in the first draft that removed the possibility of both operations at the same time.

Response Message: SR-5076-NFPA 72-2023

Public Comment No. 139-NFPA 72-2023 [Section No. 24.4.1.2]

Second Revision No. 5080-NFPA 72-2023 [Section No. 24.4.8.3.2]

24.4.8.3.2*

When the message is recorded, the repeated message sequence of 24.4.8.3.1 shall itself be repeated after a pause ~~as established by the facility emergency plan and approved by the authority having jurisdiction not to exceed 180 seconds, until manually silenced or reset by emergency personnel.~~ in accordance with one of the following:

(1) A pause of up to 180 seconds.

(2) A pause in accordance with the emergency response plan and with approval from the authority having jurisdiction.

A.24.4.8.3.2

~~Only first responders or other trained authorized emergency personnel should be able to intentionally and manually silence or reset the automatic prerecorded message sequence; this is to ensure the safe evacuation or relocation of all occupants, regardless of the time it takes. Automatic termination should not be permitted. The alert status of visual appliances should be maintained. However, since~~ Since the duration of the alarm is indeterminate, audible alerts and messaging that are periodically suspended can contribute to an improved response by the occupants. ~~Suspending~~ Temporarily suspending the audible portion of the alarm can support a better community response to the instructions~~, especially where people with disabilities might be assisted by other occupants who are not trained as first responders~~ .

Approved alternative fire alarm notification schemes, such as sequences that contain only a fixed number of repetitions of the prerecorded messages and associated alert tones, or as indicated in 24.4.8.3.2, ~~should be~~ are permitted as long as the occupants are effectively notified and provided instructions in a timely and safe manner in accordance with the emergency response plan.

Research from the National Research Council of Canada, detailed in *Occupant Behaviour and Evacuation,* found that “[i]n public buildings, such as airport terminals or sport centres, occupant training is not practical; for these, much of the responsibility for safety will rest with staff. Consequently, staff training is paramount. Occupants are very likely to look for staff members to obtain information; they are regarded as knowledgeable, they are expected to know the situation, the best course of action and the closest exit. Whether heard on a loudspeaker or seen in uniform or wearing a name tag, staff are likely to be listened to.”

The National Council on Disability publication, *Effective Emergency Management: Making Improvements for Communities and People with Disabilities,* found that “[p]eople with disabilities should not be viewed as one more special interest group that drains resources from the common pool. Accommodating this large group often translates into being better equipped to serve all people. Anyone, at any moment, can incur a disability, particularly during emergencies. (Kailes and Enders~~ 2006~~ , 2007 , p. 13)”

Furthermore, Shields, Boyce, and Silcock (1997) note that “staff trained in emergency evacuation should provide guidance to people who are evacuating public facilities. Familiar and trusted staff can alert a significant portion of the public in such instances and ensure an efficient evacuation.” On the basis of census results, Morrow (1999) argues that a “sizable segment” of any community’s population will need additional assistance during evacuation.

Fire-related emergency relocation instructions and nonevacuation messages are repeated a minimum of three times. For prerecorded messages, the actual number of times the message sequence plays is indeterminate and the interval between each sequence playing is not defined by code; the interval is intended to be defined in the emergency response plan. Paragraph 24.4.8.3.2 requires that the entire message sequence, including the tone, is again repeated after a pause. So if the tone and partial evacuation message is repeated three times as required by 24.4.8.3.1, then after pausing for an interval of ~~at least 180 seconds~~ time (~~or alternative~~ time periods ~~that~~ are established according to the occupancy type and type of emergency — see the following paragraph), the entire message sequence (including tone) is repeated again three times, followed by another pause, and so on.

Research shows that effective messages should be repeated at intervals, not consecutively *(see Annex G)*. In determining the alternative interval times, consider the following:

(1) Too much time between message sequences could ~~be misunderstood by~~ mislead occupants to thinking that the emergency has been resolved.

(2) Too much time between message sequences could insufficiently communicate ~~insufficiently~~ the intended sense of urgency~~ that is intended~~ .

(3) Too little time between message sequences could impair the ability of occupants to comply with instructions, particularly for occupants that need assistance.

(4) Too little time between message sequences could make it difficult for occupants to mark a change in the message contents if partial evacuation or relocation instructions are changed and re-issued.

(5) ~~On the~~ Upon loss of primary power, secondary power is required to support continuous notification for only 15 minutes. This time could be extended based on the period of repetition of automatic messages. Too little time between message sequences could exhaust power reserves before emergency first responders arrive, compromising the responders' ability to manually transmit additional live evacuation or relocation messages.

24.4.8.3.3*

The repeated message sequence shall be continued until silenced or reset in accordance with 18.4.2.2 , 18.4.2.3 , 23.8.2.9 , 23.8.2.10 , 24.4.5.7(3) , 24.11.1.7 , or 24.11.3 .

A.24.4.8.3.3

Generally, only first responders or other trained authorized emergency personnel should be able to intentionally and manually silence or reset the automatic prerecorded message sequence; this ensures the safe evacuation or relocation of all occupants, regardless of the time it takes.

There might also be circumstances where messages are automatically changed (based on AHJ approval). For example, in a staged evacuation of a high-rise building, some floors might initially shelter in place to prevent congestion in the stairways. The message would change automatically, on a timed floor-by-floor basis, to instruct occupants to evacuate. In this case, each message is silenced and the next message takes over.

Chapter 24 stipulates that an emergency command center, which could be remote from a building, automatically control the output devices or change the message (which would also involve silencing a current message). A risk analysis is used to determine the circumstances when a message should be changed. One example could include changing an evacuation message to a shelter-in-place message if an active shooter/hostile event is occurring outdoors. Another example could include issuing an all-clear message across a campus of buildings after an incident.

Chapter 24 also requires that systems do not automatically resume playing a recorded message after that message is interrupted by a live page. Live pages have priority over prerecorded messages. Automatic resumption of the prerecorded message is permitted only when required by the emergency response plan.

Supplemental Information

File Name	Description	Approved
Chapter_24_24_4_8_3_2_SR-5080.docx	Chapter_24_4_8_3_2_SR-5080.docx	

Submitter Information Verification

Committee: SIG-ECS

Submittal Date: Mon Jul 24 13:13:33 EDT 2023

Committee Statement

Committee Statement: These revisions clarify the length of a pause and the importance of using the emergency response plan to determine system operation. The reference to the emergency response plan covers the consideration of the facility and the occupants, a separate report should not be required.

Response Message: SR-5080-NFPA 72-2023

Public Comment No. 42-NFPA 72-2023 [Section No. 24.4.8.3.2]

Public Comment No. 108-NFPA 72-2023 [Section No. 24.4.8.3.2]

Public Comment No. 123-NFPA 72-2023 [Section No. 24.4.8.3.2]

Public Comment No. 140-NFPA 72-2023 [Section No. 24.4.8.3.2]

Public Comment No. 36-NFPA 72-2023 [Section No. A.24.4.8.3.2]

Public Comment No. 43-NFPA 72-2023 [Section No. A.24.4.8.3.2]

Public Comment No. 109-NFPA 72-2023 [Section No. A.24.4.8.3.2]

Public Comment No. 165-NFPA 72-2023 [Section No. A.24.4.8.3.2]

Second Revision No. 5083-NFPA 72-2023 [Section No. 24.4.8.5]

24.4.8.5

~~Where provided, loudspeakers in each enclosed stairway, each exit passageway, each occupant evacuation elevator lobby, and each group of elevator cars within a common hoistway or bank shall be connected to separate notification zones for manual paging only.~~ Where required by other governing laws, codes, or standards, loudspeakers shall be provided in the locations specified in ~~24.4.8.5~~ 24.4.8.5.1 through 24.4.8.5.3 .

24.4.8.5.1

Where provided, loudspeakers in each enclosed stairway, each exit passageway, each occupant evacuation elevator lobby, and each group of elevator cars within a common hoistway or bank shall be connected to separate notification zones for manual paging only.

24.4.8.5.2

The evacuation signal specified in 18.4.2 shall not operate in elevator cars, exit stair enclosures, and exit passageways.

24.4.8.5.3

Manually activated loudspeakers shall be permitted in exit stair enclosures, exit passageways, and elevators in buildings that have emergency voice/alarm communications systems in accordance with Section 24.4.

~~**24.4.8.5.3**~~

~~Where required by other governing laws, codes, or standards, loudspeakers shall be provided in locations specified in 24.4.8.5 .~~

Detail SR-5156

~~**24.4.8.5.4**~~

~~Loudspeakers shall conform to Section 24.4 .~~

Supplemental Information

File Name	Description	Approved
Chapter_24_24_4_8_5_SR-5083.docx	Chapter_24_24_4_8_5_SR-5083.docx	

Submitter Information Verification

Committee: SIG-ECS

Submittal Date: Mon Jul 24 14:35:56 EDT 2023

Committee Statement

Committee Statement: The first draft made a manual of style change that placed 24.4.8.5.3 as a stand-alone statement that stated "Where required by other governing laws, codes, or standards, loudspeakers shall be provided in locations specified in 24.4.8.5". This now seems out of place and would be better placed as the charging statement located at 24.4.8.5. Then the new 24.4.8.5 will reference and renumber the existing 24.4.8.5 as 24.4.8.5.1, and the two following statements as 5.2 and 5.3 accordingly. The existing 24.4.8.5.4 is out of place and Public Comment 241 has moved this statement to 24.4.6.3. The second revision moves

existing 24.4.8.5.4 to 24.4.6.3 in the loudspeaker section.

This change will allow the text to flow more accurately.

Response Message: SR-5083-NFPA 72-2023

Public Comment No. 243-NFPA 72-2023 [Section No. 24.4.8.5]