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ERCES System Monitoring and Fire Alarm Connections

Are your ERCES to alarm system connections done correctly? Maybe not!

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All ERCES must be monitored by the fire alarm system in accordance with the code/standard determined by the AHJ/ Fire Code Official. It is important to note the requirements of the National Fire Alarm Code NFPA 72 as well.

Monitoring by Fire Alarm Required – Codes and Standards References:

IFC 2015	IFC 2018	IFC 2021	IFC 2024 DRAFT
510.4.2.4	Yes - Sec. 510.4.2.5	Yes - Sec. 510.4.2.5	Yes - Sec. 510.4.2.5
NFPA 72-2013	**NFPA 1221-2016**	**NFPA 1221 - 2019**	**NFPA 1225 - 2022**
Yes - Sec. 24.5.2.6	Yes - Sec. 9.6.13	Sec. 9.6.13 & Chapter 10 of NFPA 72	Sec. 18.14 & Chapter 10 of NFPA 72

IFC and NFPA vary slightly, but the concepts are the same. It is essential to confirm what version of codes and standards the jurisdiction is enforcing, and to understand any local amendments.

Following are variations on supervisory signal requirements:

IFC 2021

IFC 2021 defines the following as required automatic supervisory signals:

- Loss of normal AC power supply.
- System battery charger(s) failure.
- Malfunction of the donor antenna(s).
- Failure of active RF-emitting device(s).
- Low-battery capacity at 70-percent reduction of operating capacity.
- Failure of critical system components.
- The communications link between the fire alarm system and the in-building, two-way emergency responder communication coverage system.*
- Oscillation of active RF-emitting device(s).

**Note – monitoring of the communication link is not a supervisory signal created by the ERCES. It is a trouble condition detected by the fire alarm system. This will no doubt be corrected in an upcoming code revision.*

Is monitoring the communication link for integrity a supervisory alarm generated by the ERCES? NO!

Think about it. If the ERCES was responsible for generating a supervisory alarm based on disconnection from the fire alarm system, how would it communicate that alarm if the link is broken? That wouldn't work.

Monitoring of communications links is a normal function of any fire alarm system. It is the fire alarm system that must monitor the ERCES communications link for integrity.

NFPA 1221 – 2019

The system shall include automatic supervisory signals for malfunctions of the ERCES that are annunciated by the fire alarm system:

- Monitoring for integrity of the system shall comply with Chapter 10 of NFPA 72
- System Supervisory Signals:
    - Donor antenna malfunction
    - Active RF-emitting device failure
    - Low-battery capacity indication when 70 percent of the 12-hour operating capacity has been depleted
    - Active system component failure
- Power supply supervisory signals shall include the following for each RF-emitting device and

active system components:

- Loss of normal AC power
- Failure of battery charger

Finally, the communications link between the fire alarm system and the two-way radio communications enhancement system shall be monitored for integrity.

Note that NFPA 1221 separates the defined supervisory alarms from the requirement to monitor the communication link for integrity. This is better language.

NFPA 1225 2022

The system shall include automatic supervisory signals for malfunctions of the ERCES that are annunciated by the fire alarm system:

- Monitoring for integrity of the system shall comply with Chapter 10 of NFPA 72.
- System supervisory signals shall include the following:
  - Signal source malfunction
  - Active RF-emitting device failure
  - Low-battery capacity indication when 70 percent of the 12-hour operating capacity has been depleted
  - Active system component failure
- Power supply supervisory signals shall include the following for each RF-emitting device and active system components:
  - Loss of normal AC power
  - Failure of battery charger
- The communications link between the fire alarm system and the in-building emergency responder communications enhancement system shall be monitored for integrity.
- Where approved by the AHJ, a single supervisory input to the fire alarm system to monitor all system supervisory signals shall be permitted.

Why allow a single (summed) supervisory alarm? Two main reasons:

1. Regardless of which supervisory condition is reported, under the current typical monitoring scenario, the same action would occur: a dispatch to the fire alarm company (or ERCES contractor) to visit the site to correct the alarm. There is currently no incremental value in remotely reported ERCES alarms by type.
2. Individual supervisory alarms could drive up system cost without providing additional value, in some cases substantially, such as where an alarm system must be upgraded to provide more connection / monitoring points.

Donor Antenna Malfunction? Signal Source Malfunction?

There is considerable debate among those in the NFPA, IFC, and UL 2524 technical committees on the subject of Donor Antenna and Signal Source malfunction.

Cellular-based public safety networks (such as FirstNet) often use directly connected base stations as signal sources instead of donor antennas. So, a system might not have a donor antenna. In fact, some LMR-based systems are directly connected (such as sections of the BART system in San Francisco).

Secondly, there are a variety of ways a signal source or donor signal could be compromised:

- Donor cable cut
- Donor antenna moved or damaged
- Path blocked
- Source stops transmitting
- Etc.

The signal could simply be degraded instead of cut. What constitutes a degradation worthy of an alarm? How do you handle the wide power swings in cellular services? What about analog LMR where there is no constant control channel (but UL 2524 requires an alarm after 200 seconds?).

We have work to do!

Dedicated Annunciation

The purpose of a dedicated annunciator is to provide a local, visual, and audible indication of the health of the ERCES system.

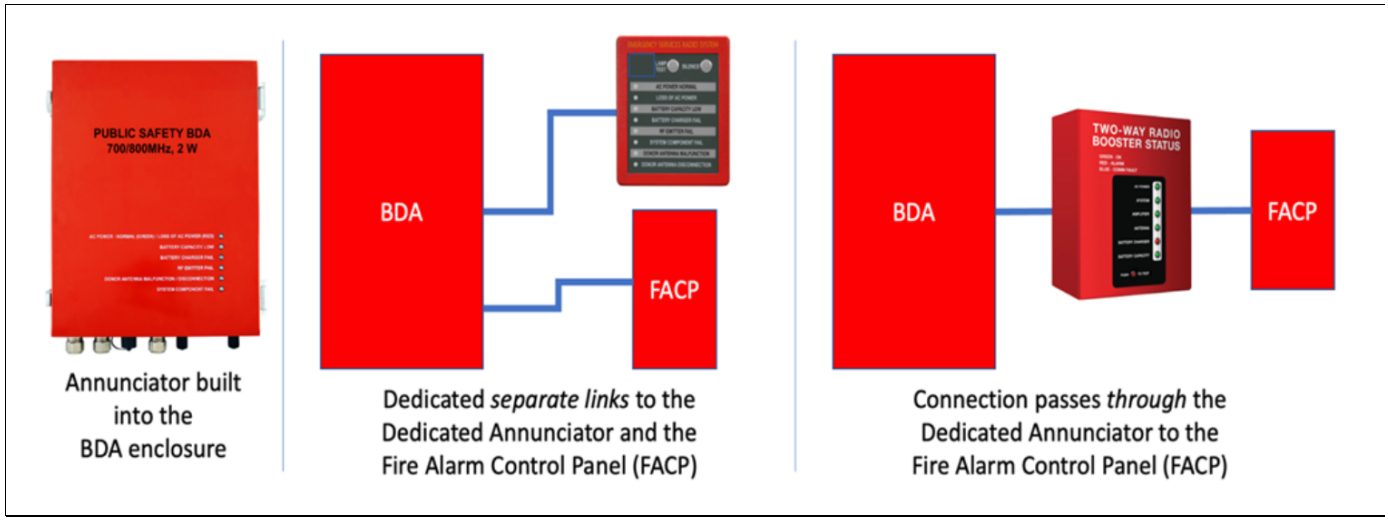
The dedicated annunciator should be located where the AHJ indicates. In some cases, in the Fire Command Center (if there is one), in some cases, in a continuously occupied area of the building such as the lobby.

The annunciator must provide visual and labeled indications of the following (NFPA 1225):

- Normal AC power
- Loss of normal AC power
- Battery charger failure
- Low-battery capacity (i.e., to 70 percent depletion)
- Signal source malfunction [See A.18.14.1.2(2)(a).]
- Active RF-emitting device malfunction
- Active system component malfunction

Variations of manufacturer configurations:
There are three main configurations available for ERCES / Fire Alarm / Annunciator connections:

1. Dedicated Annunciator built into the cover of the BDA, separate cabling to fire alarm.
2. Outboard Dedicated Annunciator unit, cables run to annunciator and fire alarm panel in parallel.
3. Outboard Dedicated annunciator unit, cables run through annunciator to the fire alarm panel in series.



Of these variations, the configuration using separate links to the dedicated annunciator and the FACP provides the most flexibility in locating the dedicated annunciator where the AHJ wants it – especially if it is far away from the fire alarm panel.

Monitoring Communication Links for Integrity

Fire alarm systems commonly monitor communication links for integrity. There are four kinds of conditions the fire alarm system can detect:

1. **Normal**
2. **Alarm signal:** Fire is detected. System must alert occupants, activates suppression systems, notifies authorities.
3. **Supervisory signal:** Indicated there is a problem being reported by a system attached to the fire alarm system.
4. **Trouble Signal:** Detection of a fault, such as an open in the communication link.

Communication links are monitored for integrity by detecting trouble conditions. Trouble conditions are detected by the fire alarm system by using a nice little bit of basic electronics: the End of Line (EOL) Resistor.

End of Line Resistor: Purpose, How it Works, Correct Placement, Responsibility

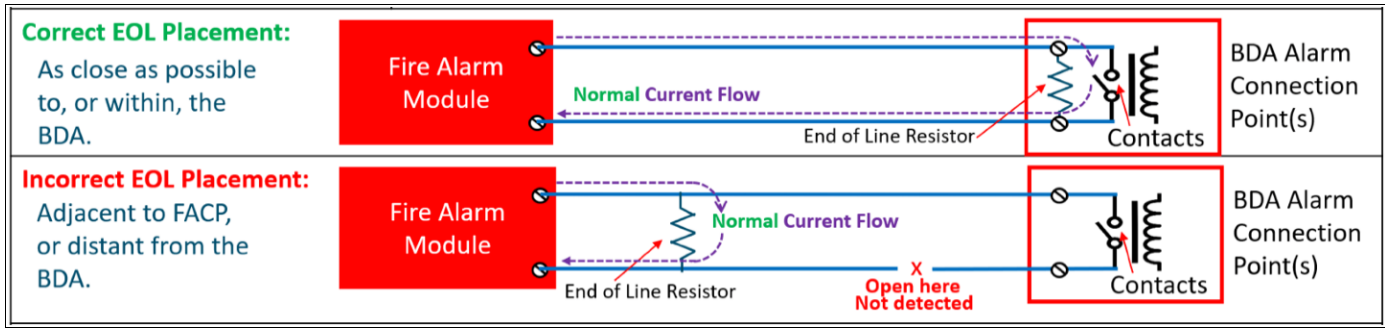
The purpose of the EOL resistor is to allow the Fire Alarm Panel to supervise the fire alarm field wiring for open or other fault conditions. This is also known as monitoring the circuit, or communication link, for integrity.

How it Works: The End of Line (EOL) Resistor completes a circuit connected to a Fire Alarm System, establishing an expected value for current and voltage in the circuit. This allows the Fire Alarm Panel to distinguish among three states:

- **Normal** — Small, predictable amount of current flows through the resistor.
- **Off-Normal** — Short Circuit - higher current indicating an alarm contact closure or alarm cable short. (Supervisory alarm for example).
- **Trouble** — Open Circuit - no current indicating the alarm cable has been cut or the monitored device has been disconnected.

The placement of the EOL resistor is critical. It must be literally at the end of the line. In the case of ERCES, it should be as close as possible to the BDA, and if possible, inside the BDA. Current from the fire alarm system must not be able to reach the EOL resistor if the line is cut, or the alarm cable is unplugged.

See the following diagram:



Responsibility:

- Connection of the ERCES signal booster to the Fire Alarm System is the responsibility of the Fire Alarm Contractor. This contractor is usually licensed as a fire alarm contractor by the State where the project is located.
- The Fire Alarm Contractor is usually responsible for supplying the End of Line Resistor of the correct value for the system being connected, for determining the correct installation location, and for installing the resistor in the circuit.
- EOL resistors are provided as optional parts for some BDAs. Check with the manufacturer for options

Conclusion

As a life-safety system, the ERCES of course should be monitored for proper operation. But as illustrated in many cases above the codes and standards are not yet mature enough to cover every scenario. AHJs must work with system integrators (and vice versa) to arrive at technically rational, commercially feasible, solutions that accomplish the intent of the codes and standards while allowing for common sense and cost-consciousness.

For extensive discussions of the codes, standards, and best practices related to ERCES monitoring, check out Chapters 5 and 25 in the Complete ERCES Handbook with NICET In-Building Public Safety Communications (IB-PSC) Study Guide. www.erceshandbook.com

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