

GENERAL:

1. The objective of this guideline is to provide minimum standards for design and installation of fire alarm systems for the University of Missouri.
2. All new buildings and major renovations at the University of Missouri will include central, zoned, addressable, microprocessor based fire alarm system with manual or automatic alarm initiation as required by code.
3. Fire alarm systems are Life Safety Systems and the utmost of care must be taken when designing these systems.
4. All designs must be in full compliance with the UM adopted version of NFPA 72 *National Fire Alarm Code* that is in effect for the project as well as all other applicable codes and standards adopted by the University of Missouri.
5. Design is to be done by an engineer who is licensed by the State of Missouri or a NICET Level IV technician certified in Fire Protection Engineering Technology – Fire Alarm Systems. Fire alarm plans and specifications must be sealed by a Missouri Professional Engineer who has training and experience in the design of fire alarm systems of the type and scope included in the project. Further, the registrant who seals the documents must be able to answer questions posed by code reviewers on the project.

DESIGN GUIDELINES:

1. This design guideline establishes the basic requirements for the design of fire alarm systems including functions, layout, industry standards, permissible systems, and materials.
2. Fire alarm system design includes but is not limited to all of the following components and systems:
 - 2.1. Fire alarm panel
 - 2.2. Initiating devices
 - 2.3. Notification devices
 - 2.4. Mass notification systems (if desired or required)
 - 2.5. Other code required element
3. Design calculations shall be done in accordance with NFPA 72 and the following requirements:
 - 3.1. Current draw on each notification circuit with allowance for 20% expansion.
 - 3.2. Voltage drop on each notification circuit.
 - 3.3. Stand-by battery capacity for entire system including any power expanders.
 - 3.4. Table showing specified device capacity for each addressable loop and the corresponding number of devices assigned.

4. Coordination

- 4.1. Coordination of design is critical to a successful building project. During the design phase of a project, promptly notify architect, structural, civil and electrical engineers of changes which affect their work. Coordination should include but, is not limited to the following:
 - 4.1.1. Confirm location of main fire alarm panel with PM. The local fire department must confirm the panel location or an annunciator with full capabilities must be provided at the designated fire department entrance.
 - 4.1.2. Provide a connection which will
 - 4.1.3. Coordinate with fire protection engineer for locations of flow switches, tamper switches, fire pumps as well as any other code required devices.
 - 4.1.4. Coordinate architectural features with Architect including door hold open devices, door locking devices that must be released by the fire alarm system, or other building related features.
 - 4.1.5. Coordinate with the electrical engineer for power needs as well as any other electrical devices requiring interconnection with the fire alarm system.
 - 4.1.6. Coordinate with the HVAC engineer for connections to air handlers including smoke devices and any code required smoke evacuation systems.
 - 4.1.7. If a new fire alarm system is being installed in an existing building, the existing fire alarm system shall be maintained fully operational until the new equipment has been tested and accepted.
 - 4.1.8. If a security system is available in the building where a new fire alarm panel is being installed, trouble and alarm outputs from the fire alarm panel will be connected to the security system to allow reporting of a fire alarm to Campus Police through the security system. All fire alarm panels will be capable of reporting through the security system or other external system.
 - 4.1.8.1. MU ONLY: If an Energy Management Controls System (EMCS) is available in the building where a new fire alarm panel is being installed, trouble and alarm outputs from the fire alarm panel will be connected to the EMCS

5. System Requirements

- 5.1. All new fire alarm panels shall be microprocessor based non-coded, addressable systems.
- 5.2. All new fire alarm panels are to be expandable. Future ability to provide fire alarm service for entire building or planned building expansion is required. Each notification circuit shall contain a minimum of 20% excess capacity. The 20% capacity should be in addition to the capacity for any planned expansion of the fire alarm or voltage drop.
- 5.3. Where voice systems are used, they must be designed to meet the code requirements for that occupancy. Installing a voice system where it is not required by code does not create the requirement for a Fire Command Center. However, where the voice system is to be used for any type notification other than fire (such as weather) then mass notification requirements in the code may be required. For information on mass notification see NFPA 72 3.3.102 for definition and Annex E or. UM will use NFPA 72 including Annex E to determine code

compliance.

- 5.4. All device locations shall comply with ADAAG requirements. Special care will be taken on systems for residential occupancies.
- 5.5. Wiring systems for both notification and addressable loops shall be Class B unless directed otherwise by the PM or required by other codes.

5.6. Notification zones

- 5.6.1. These requirements shall include all notification devices such as strobes, horns, or speakers. Multiple circuits may be needed as in the case of speakers and strobes.
- 5.6.2. At a minimum, each occupied floor shall be on a separate circuit.
- 5.6.3. Where a floor is divided into separate fire areas, each fire area shall be on a separate circuit unless modified by code.

5.7. Initiation zones

- 5.7.1. Addressable loops shall be designed for reliability. For that reason, the fire alarm system will require a minimum of two loops for smaller buildings and additional loops for larger buildings.
- 5.7.2. Each building shall have one addressable loop per floor to parallel the notification circuits.
- 5.7.3. Where floors are divided into multiple fire areas, each fire area is to be on a separate loop.

6. Information Shown on Drawings

- 6.1. Plans shall show all devices required by code including:

6.1.1. Alarm Sequence Matrix & Coordination

- 6.1.1.1. Provide a matrix showing alarm and initiation devices by category on one axis and device action on the second axis. An example would be elevator lobby smoke detector. Actions would be such as general alarm, elevator recall, shut down air handlers, etc.
- 6.1.1.2. Show and specify sequence on air handler shut down. Air handlers shall be controlled by the FA panel through an addressable relay and not a contact on the smoke detector.
- 6.1.1.3. Smoke detectors, heat detectors, flow switches, and pull stations activate the general alarm mode unless directed otherwise by the PM and supported by code. For example, duct smoke detectors should, but are not required to, initiate a general alarm.

6.1.2. Alarm Initiation Devices

- 6.1.2.1. Pull stations are required on all occupancies and must be located within 5' of each exit from a floor. Mounting height is to be noted on drawings. The preferred mounting height is 48" to the center of the device.

- 6.1.2.2. Smoke and heat detectors are to be shown where required by applicable codes.
- 6.1.2.3. Plans shall clearly show where more than one duct detector is required because of duct size.
- 6.1.2.4. Flow switches are to be shown on the fire alarm plan as well as the riser. These devices are to be coordinated with the sprinkler design.
- 6.1.3. Notification Devices
 - 6.1.3.1. Notification devices shall be limited to strobes, horns and speakers unless approved otherwise by the Project Manager.
 - 6.1.3.2. All strobes, horns, speakers, etc. are to be shown on the plans
 - 6.1.3.3. The mounting height, candela rating, sound level settings are to be shown on the drawings. Sound level, candela, or other information that must be set by device shall be shown next to the device. Mounting height for strobes, horns, and speakers shall be 80" to the bottom of the device. Where a low ceiling does not permit this mounting height, consult NFPA 72 for mounting height and adjustments for coverage. For residence hall sleeping rooms, consult "Sleeping Area" tables in Chapter 7 of NFPA 72.
 - 6.1.3.4. Spacing of devices is outlined in NFPA 72. Designer must be diligent in showing spacing for strobes that meet code requirements as well as the sound levels required for horns and speakers. A note shall be put on the plans to instruct the contractor to get the approval of the engineer prior to moving any device more than 12". The placement of devices on the plans shall take this movement into account when allowing for clearances and code required locations.
- 6.1.4. Supervisory Devices
 - 6.1.4.1. Show required supervisory devices including tamper switches, fire pump, engine generator, or other required supervisory signals. Coordinate the location of tamper switches and other supervisory devices with the appropriate discipline.
- 6.1.5. Emergency Control Functions
 - 6.1.5.1. All emergency control functions and their locations shall be shown on the drawings.
 - 6.1.5.2. Door hold opens are to be coordinated with the Architect for location and function. Provide required smoke detectors where applicable. Hold opens may be released by circuit or controlled by addressable relays and may, in some cases, be controlled by other systems in concert with fire alarm. Designer shall be fully aware of and design control for the functions desired and required by code.
 - 6.1.5.3. Door unlocking where desired or required shall be coordinated with other disciplines and assure that all applicable egress codes are being followed. Door security (locking) and unlocking functions must be reviewed and approved by

the AHJ.

- 6.1.5.4. Elevator recall shall be done in accordance with the UM adopted version NFPA 72 and the latest ASME A17.1 elevator code. All work shall be coordinated with other disciplines. Typical recall is as follows and each requires a separate output device on the system.
 - 6.1.5.4.1. Elevator recall to designated level
 - 6.1.5.4.2. Elevator recall to alternate level
 - 6.1.5.4.3. Visual warning for elevator(s) activated by equipment room or hoistway devices.
 - 6.1.5.4.4. Elevator shutdown initiated by equipment room heat detectors. Elevator shutdown on sprinkler activation shall not be permitted.
- 6.1.6. Expander Panels
 - 6.1.6.1. Expander panels should only be used on renovation projects. New buildings should use panels and sub-panels that are capable of full coordination and communication.
 - 6.1.6.2. Where used, expander panels will not be placed above ceilings, in closets or other hard-to-find places. The designer will show the location of all expander panels clearly on plans.
- 6.1.7. Sub Panels and Annunciators
 - 6.1.7.1. Sub panels and annunciators shall be clearly shown on the plans.
- 6.1.8. Riser diagrams are required for the entire system including:
 - 6.1.8.1. Notification devices for each and every floor indicating circuiting which will correspond with calculations done under paragraph 3 above.
 - 6.1.8.2. Expander panels including notification devices connected to expander panel and sufficient information to verify calculations required in paragraph 3 above.
 - 6.1.8.3. Addressable loops showing all initiating devices, supervisory devices and output devices on each loop that will correspond to paragraph 3 above. This includes all relays and monitoring devices for air handlers, elevators, fire alarm systems, kitchen suppression systems, etc.
 - 6.1.8.4. Sub panels and annunciator panels.
- 6.1.9. Power
 - 6.1.9.1. Alarm power supply disconnect, where not in a panelboard, shall be painted red and labeled "FIRE ALARM." Where in a panelboard provide with lockable handle or cover and red laminated plate next to breaker with white lettering "FIRE ALARM". Location for power shall not be located in corridors or other public areas. Power disconnect shall be in a secure space accessible only by authorized personnel.

7. Specifications

- 7.1. All items in this section **must** be included in the fire alarm specifications.
- 7.2. All devices, equipment and installation are to be provided by a single source who assumes responsibility for the entire system per NFPA 72. Non addressable devices do not have to be of the same brand as the main system, but must meet the manufacture's requirements and UL ratings for the system installed.
- 7.3. Fire alarm cabinet shall be lockable dead-front, steel enclosure arranged so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control panel, provide exactly matching modular unit enclosures. Provide cabinets large enough to accommodate all components and to allow ample gutter space for interconnection of panels as well as field wiring. Identify each enclosure by an engraved red laminated phenolic resin nameplate. Lettering on the enclosure nameplate shall not be less than 1 inch high. Identify individual components and modules within the cabinets by machine lettered signs or labels.
- 7.4. System submittals must include:
 - 7.4.1. Power Calculations:
 - 7.4.1.1. Battery Capacity Calculations: Battery size shall be a minimum of 125% of the calculated requirement. Batteries must be capable of operating the panel in normal mode for 24 hours with sufficient capacity to operate the panel in alarm mode for 15 minutes at the end of that 24 hour period.
 - 7.4.1.2. Supervisory power requirements for all equipment.
 - 7.4.1.3. Alarm power requirements for all equipment.
 - 7.4.1.4. Power supply rating justification showing power requirements for each of the system power supplies. Power supplies shall be sized to furnish the total connected load in a worst case condition.
 - 7.4.2. Complete manufacturer's catalog data on all devices, modules, bases, etc.
 - 7.4.3. Submit panel and annunciator panel configuration showing layout including the following as applicable:
 - 7.4.3.1. Master system CPU including all fire detection, evacuation alarm control modules, and supervised power amplifiers with the required back up modules.
 - 7.4.3.2. Circuit interface panels including all modules.
 - 7.4.3.3. Power supplies, batteries and battery chargers.
 - 7.4.3.4. Pre-amplifiers, amplifiers, and tone generators.
 - 7.4.3.5. Equipment enclosures.
 - 7.4.3.6. Alarm monitoring modules, and supervised control modules.
 - 7.4.3.7. Initiation loop must be capable of supporting at least 60 devices of any type. If the loop supports different numbers of different type devices, it must be capable of supporting at least 60 devices of each type.
 - 7.4.3.8. Alarm notification circuits must be capable of 1.5 amps per circuit at 24vdc.

Panels capable of allowing varying current draws per circuit, but allowing an average of 1.5 amps average may be allowed if the engineer designs the circuits appropriately. In that case each circuit must still have .3 amp minimum allowed for future in addition to the designed load.

- 7.4.3.9. Wireless systems are not permitted.
- 7.4.4. A complete proposed system database including a description of all logic strings, control by event programming and point identification labels on a computer CD or 3.5" high density floppy disk and in a formatted printed form, as required for offsite editing, uploading and downloading shall be submitted for evaluation by the owner. A programming manual shall accompany the submitted program and shall be adequate to allow understanding, operation and editing by the system.
- 7.4.5. The latest version of software for programming the fire alarm system. A programming manual shall accompany the submitted program and shall be adequate to allow understanding, operation and editing by the system.
- 7.5. Specification submittal requirements are to state that proposed vendors must be able to show the ability to respond to requests for service within 24 hours and the ability to supply replacement parts for the system within 48 hours relative to the site where the system is to be installed.
- 7.6. All fire alarm panels will be equipped with a "walk test" feature. This allows each activating device to be tested without the need to reset the panel after each device is activated.
- 7.7. All fire alarm panels will be equipped with a "building evacuate" switch.
- 7.8. System shall be capable of silencing horns while leaving strobes in alarm. System reset shall reset both horns and strobes. Acknowledge shall silence horns. These functions shall only be accessible to authorized personnel. This provision may be in conflict with NFPA 72, but is accepted as a variance by UM.
- 7.9. Each circuit, initiating and notification, will have a disconnect switch in the Fire Alarm Control Panel (FACP) to disable the circuit during maintenance. This may be a physical switch or a "soft" switch that disables the circuit and causes a trouble on the panel until the circuit is re-set. The circuit must be disabled and reset by one action of a qualified person who has access to these switches. These switches are not to be accessible from the operator portion of the panel but must require the panel to be fully opened to gain access.
- 7.10. If door hold-opens are used, they will be wall-mounted, magnetic type with proper mounting blocking in the wall. Combination door closer/hold-opens will not be used.
- 7.11. All pull stations will be key operated, keyed the same as the building fire alarm panel. Engineer shall verify key type used by the campus and specify that key type where the campus has a standard.
- 7.12. Smoke Detectors
- 7.12.1. Infrared detector light source with matching silicon cell receiver. Ionization type smoke detectors will not be allowed unless directed by the Project Manager.

- 7.12.2. Provide detectors that can be individually monitored at the FACP for calibration, sensitivity, and alarm condition, and have capability of individually adjustable sensitivity from the FACP.
- 7.12.3. Provide visual indication detector has operated.
- 7.12.4. Duct detectors shall be installed with sampling tube properly designed and sized per manufacturer's recommendation.
- 7.13. All detectors or other initiating devices will be installed in locations that are readily accessible for maintenance. Any initiating device installed above a suspended ceiling (i.e. duct smoke detectors) shall have an indicator showing below the ceiling the location of the device. Beam detectors will be used in atriums or other high ceiling areas.
- 7.14. Wiring shall be U.L. listed as fire alarm protection signaling circuit cable per NEC. Wire for analog loops will be a minimum of #18 AWG, twisted pair, shielded type FPL, FPLP, FPLR. Wire for notification circuits will be a minimum #14 AWG, type KF-2 or KFF-2. Alarm speaker wire will be a minimum #14 AWG, shielded type CM. Cable type may vary if recommended by the system manufacturer for compatibility with system warranty or design.
- 7.15. All fire alarm system wiring will be installed in a dedicated raceway. Raceway may be EMT, RMC, FMC, LFMC (flexible type limited by NEC), and surface raceway (only in areas where not subject to damage).
- 7.16. Ground fire alarm equipment, conductors, and cable shields per NFPA and manufacturer.
- 7.17. Notification Devices
 - 7.17.1. Fire alarm horns shall be 85 dBA output at ten (10) feet. Horns will be Wheelock NH or AH series or equal.
 - 7.17.2. Fire alarm strobe flash rate to be one flash per second with low current design. Strobes will be Wheelock RSS series or equal. Strobes with adjustable candela levels from 15 to 110 shall be specified.
 - 7.17.3. Synchronized strobes are required where more than one strobe is visible from any location, including corridors. Where synchronized strobes are used, use appropriate control module based on manufacturer's recommendations, such as Wheelock SM, DSM or equal.
 - 7.17.4. Alarm speakers will be Wheelock series ET or equal.
 - 7.17.5. Only speakers or horns will be used unless approved otherwise by the PM in which case all code requirements must still be met.
- 7.18. Before partial occupancy, on all fire alarm installations or modification, manufacturer shall provide a written satisfactory completion of the required test outlined in NFPA 72.