



2023

# Design and Construction Standards Manual



Division of Campus Planning,  
Infrastructure, and Facilities

Effective July 2023

## CHAPTER 3 – SAFETY AND SECURITY

Safety and security equipment as described in this chapter cannot be removed from the project requirements as a result of Value Engineering.

### 3.1 FALL PROTECTION

Passive or active fall protection systems must be installed on roofs and other locations such as mezzanines where the fall distance to the next lower level is greater than 30 inches whenever feasible.

Passive fall protection shall be provided on exterior grounds where one grade is more than 30 inches above an adjacent grade and they are connected by a vertical or near-vertical slope. Landscaping shall not be permitted to guard a fall hazard area unless approved by EHS.

Where mechanical equipment is installed on roofs, it should be located inside penthouses, behind screens, within a parapet wall of sufficient height, or behind permanent guardrails, when possible. If mechanical equipment is not located behind or within an enclosure, and is located within 15 feet of an unguarded edge, the edge shall be guarded in accordance with 304.10 of the Virginia Mechanical Code.

1. Passive fall protection systems
  - a. Parapet wall height at least 39" from the walking/working surface
  - b. OSHA-compliant guardrails
    - i. Top rail: 42" +/- 3" from ground/walking surface and withstands 200 lb. of force applied in an outward and downward direction.
    - ii. Mid-rail: approximately halfway between top rail and ground (about 21") from ground/walking surface and withstands 150 lb. of force applied in an outward and downward direction.
      1. If vertical, intermediate members (e.g., balusters) are installed between the top rail and walking/working surface, they shall not be more than 19" apart.
      2. Other structural members, such as additional mid-rails or architectural panels, shall not have an opening more than 19" apart.
    - iii. Toe-boards installed where materials can fall off of the elevated walking/working surface onto personnel below. They should be 3-1/2" in height, and no more than 1/4" above the walking/working surface, and withstand 50 lb. of force applied in an outward direction.
  - c. Standard guardrails
    - i. Penetrating (roof): Permanently mounted

- ii. Non-penetrating (roof): Free-standing
  - d. Low-profile (reduced visibility) guardrails (setback, curved)
    - i. Penetrating (roof): Permanently mounted
    - ii. Non-penetrating (roof): Free-standing
  - e. Collapsible guardrails
    - i. Penetrating (roof): Permanently mounted
    - ii. Non-penetrating (roof): Free-standing
  - f. Temporary guardrails
    - i. Penetrating (roof), install or store as needed: Permanently mounted, low-profile base plates installed on roof, temporarily add rails when accessing roof
    - ii. Non-penetrating (roof), install or store as needed
      - 1. Clamp to parapet wall
      - 2. Install base or mount to wall or short parapets
      - 3. Free-standing
- 2. Active fall protection systems
  - a. Where passive fall protection systems are not feasible, permanent anchor points that are specifically designed for fall arrest and meet OSHA requirements shall be provided.
    - i. Bollards or anchor points designed to withstand 5,000 lb. per attached person
    - ii. Travel restraint systems with 100% tie-off
    - iii. Horizontal life lines
  - b. Where permanent anchor points are not feasible, mobile anchor points as approved by CPIF and EHS shall be provided.
    - i. Designed for permanent, long-term installation
    - ii. Designed for temporary, short-term use
- 3. Skylights shall be sufficiently guarded in accordance with 29 CFR 1910.28(b)(3)(i).

### **3.1.1 Elevated Walking/Working Surface Access**

- 1. Stairway and door access to roofs and other elevated working or accessible storage surfaces is preferred over fixed ladders, roof hatches, or temporary means of access (e.g., extension ladders).
- 2. Handrails shall be provided for stairways per Table D2 of 29 CFR 1910.28(b)(11).
- 3. Handrails shall be provided for exterior stairs associated with walkways in accordance with 1910.28(b)(11), or the VCC, whichever is more restrictive.
- 4. Roof hatches shall have guardrails on each side.
  - a. A self-closing swing gate shall be provided at the access point.

- b. Grab-rails shall be provided at the roof level if they are not integral with the roof hatch system.
- 5. Mezzanines shall have the designated load rating posted. Mezzanines shall have guardrails and swing gates for fall protection.
- 6. Fixed ladders
  - a. New fixed ladders, that extend more than 24 feet above a lower level, must have a personal fall arrest system or a ladder safety system installed.
  - b. Ladder Safety Systems selected shall be consistent with existing systems installed on campus, or as approved by Engineering Services and EHS.
  - c. Cages or wells are no longer permitted on new installations after November 19, 2018, or on existing installations after November 18, 2036.
  - d. Fixed ladders must have a swing gate or be offset at the point of access to prevent falls.

### **3.1.2 Floors/Ramps**

Flooring must have a dynamic coefficient of friction (DCOF) of at least 0.42. Some applications may require a higher DCOF depending on use, expected traffic and wear, contaminants, maintenance, and manufacturer guidelines. The use of floor coatings to achieve this coefficient of friction is permitted, but not preferred.

Entryway walk-off systems shall be provided at all regularly used, exterior-to-interior entrances and entrances from covered parking garages. Walk-off carpet tiles or recessed mat/grate systems are preferred in lieu of removable roll-out mats.

## **3.2 SAFETY EQUIPMENT NOT REQUIRED BY CODE**

Safety equipment, including fire detection, fire alarm, and fire suppression systems, which are not required by code, but are provided at the University's option in buildings and structures shall be installed in accordance with the code and shall operate as designed. Work that is planned as a complete system, but requires phased construction to provide a complete system is acceptable. It is also acceptable to provide non-required, fully functional "partial systems" to certain areas (e.g., storage spaces) which will improve safety. However, incomplete systems which are not designed in accordance with the code, non-functional systems, and abandoned life safety systems are not acceptable because such systems may be perceived as code-compliant systems and may result in life safety or fire hazards to adjacent areas.

### 3.2.1 Fan Guarding

To prevent access to fan blades, all industrial ventilation fans shall have guards with openings that are 0.5-inch wide or less.

## 3.3 EMERGENCY AID SPECIALTIES

Install a sufficient number of automatic external defibrillators (AEDs) to provide a 3-minute response time. Place AEDs in central locations in buildings.

Provide AEDs (typically one per floor) to:

1. Service public areas such as lobbies, hallways, entryways, high visibility pedestrian collection points, areas of high pedestrian concentration, areas of frequent large populations;
2. Be visible to the pedestrian public by locating cabinets in line of sight paths;
3. Be equipped with signage adequate to reasonably alert the public of AED locations;
4. Be placed in areas where service technicians can gain access without specialized permissions, access cards, or in restricted research areas without prior approval of the VT Rescue Squad; and
5. Be placed on walls or contained within a recessed cabinet without potential to be covered by furniture, wall decorations, or equipment.

The location of defibrillators shall be coordinated and approved by Virginia Tech Rescue Squad.

AEDs purchased for Virginia Tech shall be the Zoll AED 3 model automatic external defibrillator. The product package shall include the AED, battery, pads (universal or separate adult and pediatric sets), a quick response AED prep kit, a wall-mounted protective cabinet with alarm, and wall signage.

## 3.4 EXTERIOR ACCESS

A Knox Box shall be placed on the exterior of the building. The Knox Box shall be Knox-Vault (Series 4400, P/N 4441, silver finish, recess mount, 6" depth with a dual lock key). Mount unit 6 feet above finish grade and locate near the building's front entrance, typically by the fire panel. The exact location shall be determined by the fire department. The Knox Box should have the appropriate keys inside upon completion and opening of the building. Knox Boxes may be furnished by Virginia Tech.

For Blacksburg campus locations, one lock shall be keyed to CPIF and the other to the Blacksburg Volunteer Fire Department.



### 3.5 DOORS AND WINDOWS

Doors and windows have the following safety requirements:

1. Exterior doors, stairwell doors, and hallway doors:
  - a. All egress double doors shall not have the potential to be chained. When viewing from the outside, the left-hand door shall not have a handle, only the right side may have a handle. On the inside, panic/push bars shall have no gap behind (between bar and glass, or bar and door).
  - b. These doors should provide unfettered egress, but should also make it not possible to lock them from the outside.
  - c. The inside should have push bars (not handles). The outside should have only one of the two door sets with handles to open (alleviates the chaining of handle to handle). The locks should be set to the store room function.
  - d. In addition, caution should be used that nothing else in the area of the doors provides a means of locking/chaining them from the outside or inside.
2. All interior classroom doors, conference rooms, and offices shall have a manual lock on the inside.
3. Interior glass:
  - a. Interior glass that would allow access to classroom or office space shall be covered with an impact-resistant coating. This would include large windows viewing into occupied spaces from corridors, as well as windows on access doors that could be broken out to access interior locking mechanisms.
  - b. The coating or window film selection should meet the requirements set in ANSI Z97.1-2015 standard.
  - c. Interior window shades are recommended for interior glass walls for securing in place. Open view and open concept areas separated by glass limit occupant ability to secure in place during a campus incident.

### 3.6 EXTERIOR LIGHTING

1. OUP and VTPD shall be consulted on the design and color temperature of all exterior lighting.
  - a. Exterior lamps shall be LED.
  - b. Neon and/or cold cathode lighting systems are not permitted for use in exterior lighting systems.
2. Exterior light sources should be of a white source.
  - a. The color rendering index (CRI) is important for normal pedestrians and the natural and perceived surveillance of the building.

- b. In addition, any future plans for surveillance cameras shall require white light sources for color imaging (i.e., color video surveillance cameras require a much higher CRI).
  - c. The CRI of white sources goes from 80 up.
3. Where outdoor light fixtures are provided, shielded outdoor light fixtures shall meet one of the following requirements:
  - a. Fixtures shall be fully shielded so that no light rays are emitted by the installed fixture above the horizontal plane.
  - b. Fixtures shall be constructed so that no more than two percent of the total luminaire lumens in the zone of 90 to 180 degrees vertical angle is permitted, if the related output of the luminaire is greater than 3200 lumens.
4. With exterior lighting, the lighting recommendations for pathways and parking lots are referenced in the ANSI/IES RP-8-18 standard. Parking lot area lighting and sidewalk area lighting shall be addressed to ensure sufficient lighting to meet the recommendations. Coordinate parking lot lighting requirements with the Virginia Tech Police Department (VTPD) and the VT PM.
5. For roadway and parking lot signage and pedestrian “Hokie” lighting, see DCSM sections 4.5 and 4.8.14.7.

### **3.7 ELECTRONIC SAFETY AND SECURITY**

#### **3.7.1 Access Control**

Electronic access (Hokie Passport) is required on all of the exterior doors. Infrastructure should be included regardless. See DCSM section 5.7.4 for requirements for electronic door access control.

#### **3.7.2 Video Surveillance**

1. Buildings shall have all necessary infrastructure and exterior features for the placement of surveillance cameras. All sides of buildings shall be included in the surveillance camera design layout. Exterior camera placement typically includes rooftop locations to provide maximum coverage of the area under surveillance.
2. Exact locations of surveillance cameras shall be coordinated with and approval obtained from VTPD and the specialty contractor for cameras. Coverage required for sites and the placement of cameras will vary. The vendor shall provide assistance during the design phase.
3. For exterior camera placement, the A/E shall incorporate the following:
  - a. Provide 360-degree exterior coverage.
  - b. Provide coverage of crosswalks, intersections, and major roadways. Complement existing coverage.

- c. Provide coverage of areas with higher concentrations of people (common areas and areas with enough space for people to gather together).
- d. Provide coverage of ingress and egress points from a lower viewing angle; typical placement would be above a portal or on the side of a building.
- e. Provide coverage of high value assets.
- f. Provide coverage of loading dock areas for asset protection and intrusion prevention.
4. Exterior camera placements can be supplemented with cameras mounted on new blue light phone placements, if those are part of the project.
5. For interior camera placement, the A/E shall incorporate the following:
  - a. Provide coverage of areas with higher concentrations of people (common areas and areas with enough space for people to gather together).
  - b. Provide coverage of high value assets.
  - c. A security camera shall be installed in all elevator cabs.
6. The infrastructure for surveillance cameras shall be installed in the hallways and stairwells for future camera installations.

### 3.8 COMMUNICATIONS

When required by the current adopted version of the VUSBC, all occupiable structures shall have a distributed antenna system (DAS) as needed in the building for police, fire, and rescue personnel and it shall be monitored by the fire alarm system.

Regardless of whether a DAS is required per code, the A/E shall design a complete system for the building during the schematic and preliminary design phases. This should include, at a minimum, the locations of the interior and exterior antennas, major cable pathways, interior amplifier(s), and battery backup(s). Coordinate locations and design elements with the VT PM and the distributed antenna system vendor as part of the design.

For emergency preparedness signage, provide ADA-compliant locations and install 2" × 2" posters under plexiglass. This signage will be provided by the Office of Emergency Management (OEM). OEM signage locations shall be considered when laying out floor plans.

#### 3.8.1 Mass Notification System

1. Emergency notification system: The location of message boards and/or addressable fire annunciator system shall be approved and closely coordinated with the OEM. Emergency message boards should be located in both classrooms and common spaces. The Contractor shall provide and install conduit and power t



o the approved locations. Virginia Tech Network Infrastructure & Services (NI&S) shall provide the data cable and message boards.

2. Fire alarm annunciators with public address systems/speakers are required.
3. VT Alert message boards: In buildings with annunciators capable of providing VT Alerts, message boards are to be located in suitable common spaces providing redundant delivery of emergency messages. Coordinate message board locations with VTPD and the VT PM.

### **3.8.2 Emergency Telephone and Enclosures**

1. A number of “push-to-talk” emergency phones may be located within the project limits. Infrastructure shall be designed to provide for emergency phone usage.
2. It is recommended that emergency callbox(s) be placed outside of the building.
3. The number and location of the phones is determined by OEM and the VTPD. The physical requirements for the infrastructure to support the phones are found in the following specifications and the drawing below.
4. For placement of blue boxes (interior emergency phones), the A/E shall incorporate the following:
  - a. Each floor shall have emergency phones. Exact number depends on floor plan and floor square footage and shall be coordinated with the VT PM and VTPD.
  - b. Phones shall be located along paths of egress to exits and stairwells. Longer floors or hallways may require additional boxes.
  - c. Phones shall be visible, but not located in areas where heavy traffic would lead to accidental activation.
  - d. Exact locations for phones shall be coordinated with and approval obtained from VTPD.
5. For placement of blue light phones (exterior emergency phones), the A/E shall incorporate the following:
  - a. Phones shall be placed in projects to supplement the overall deployment. The A/E shall review the campus map for placement locations.
  - b. Phones shall be located in primary travel paths for pedestrians.
  - c. All new phone installations shall include camera placement capability.
6. Any emergency phones removed during a construction project shall be replaced as close as possible to the original location. Changes to the location or quantity of emergency phones within the structure should be approved by OEM and VTPD.

7. Equipment and materials used shall be standard components that are manufactured and available for purchase as standard replacement parts as long as the product is commercially available from the manufacturer.

### **3.8.2.1 Quality Assurance**

1. All tower installation, configurations, setup, program and related work shall be performed by electronic technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.
2. The tower shall be warrantied against any defects in material and workmanship under normal use for a period of five years from date of installation, provided that manufacturer receives a completed "installation certification" certifying the date on which the system has been installed. An installation certification card shall be enclosed with every unit. In the event that no installation certification is received by manufacturer, the five years will commence on the date of shipment by the manufacturer.
3. The blue light and faceplate light shall be warrantied against any defects in material and workmanship under normal use for a period of 24 months from date of installation, provided that manufacturer receives a completed "installation certification" certifying the date on which the system has been installed. An installation certification card shall be enclosed with every unit. In the event that no installation certification is received by manufacturer, the 24 months will commence on the date of shipment by the manufacturer.

### **3.8.2.2 Certifications and Standards**

1. The tower as an assembly shall be certified to UL Standard 60950-1. The basis of design for the tower shall be Talk-A-Phone model: ETP-MT.
2. The included LED blue light (the basis of design for the LED blue light shall be Talk-A-Phone model: ETP-EL or ETP-EL12/24) shall be certified to:
  - a. UL Standard 1598
  - b. CSA Standard C22.2 No. 250.0

### **3.8.2.3 Products**

The tower shall consist of a highly vandal-resistant free-standing steel emergency phone tower mount with an integrated flashing LED blue light. Have an integrated LED faceplate light, mounted directly above the phone faceplate.

#### **3.8.2.3.1 Hardware**

1. The tower shall:
  - a. Be constructed of 0.25" thick steel and weigh approximately 300 lb.

- b. Measure:
  - i. Tower only: 10" W × 8" D × 108" H, with a 0.5" radius on each corner.
  - ii. Tower and blue light: 10" W × 8" D × 114" H.
- c. Utilize a high-gloss, multi-coat, corrosion-inhibitive coating that shall be applied to withstand prolonged exposure to hard environments.
  - i. Tower shall be sandblasted to SSPC-SP 6 standards before a 2-3 mil layer of rust-inhibitive primer is applied.
  - ii. Tower shall be hand sanded for smoothness before a second 2-3 mil layer of primer is applied.
  - iii. Tower shall have a 2-3 mil layer of dark bronze color coat applied.
  - iv. Tower shall have a 1-2 mil layer of clear coat applied.
- 2. The tower base plate shall:
  - a. Be 2.0" above the tower base.
  - b. Be constructed of 0.75" thick A36 structural steel.
  - c. Have a 4" diameter center hole for wiring access.
  - d. Have four 1" holes for anchor bolt attachment.
- 3. The tower wiring access opening shall:
  - a. Measure 9" H × 6.75" W.
  - b. Be located 15" above the base of the tower.
  - c. Have a flush cover plate that shall:
    - i. Be constructed of 0.25" thick steel.
    - ii. Be held in place by two 1/4"-20 countersunk, tamper-resistant spanner screws.
- 4. The tower shall have an opening in the front to accommodate flush mounting an emergency phone. The phone opening shall:
  - a. Measure 10" H × 6.75" W.
  - b. Have six self-clinching #10-24 stainless steel threaded nuts to mount the emergency phone.
- 5. Directly below the tower phone opening, the tower shall have a section with a 30-degree downward slope from rear to front, spanning the depth of the phone opening to the full tower depth.
- 6. The tower shall have the word "EMERGENCY" emblazoned on all four sides in 3.25" high reflective white letters. Custom lettering, sizes and colors are available.
- 7. The tower blue light shall:
  - a. Be mounted at the top of the tower with three #10-24 tamper-resistant spanner screws.

- b. Have a polycarbonate refractor lens assembly with a prismatic pattern to increase visibility at greater distances.

#### **3.8.2.3.2      Functionality**

1. Blue Light
  - a. The LED blue light shall remain lit at all times.
  - b. The blue light shall automatically flash 78 times per minute when triggered by the emergency phone.
  - c. The blue light shall have an illumination rating of 209 lumens (peak).
  - d. The blue light shall retain 70% of its initial output intensity after 50,000 hours of operation.
2. Faceplate Light
  - a. The faceplate light shall remain lit at all times.
  - b. The faceplate light shall have a concealed, ultra-bright LED design.
  - c. The faceplate light LEDs shall have no less than 50,000-hour lifetime.

#### **3.8.2.3.3      Power Requirements**

The tower shall be powered by one of the following power sources:

1. 12 VDC – Nominal: 9 watts
2. 24 VDC – Nominal: 9 watts
3. 24 VAC – Nominal: 9 watts
4. 120 VAC – Nominal: 9 watts

#### **3.8.2.3.4      Manufactured Units**

The basis of design for the tower shall be a Talk-A-Phone ETP-MT emergency telephone tower to match existing equipment specified by VTPD and OUP.

#### **3.8.2.4      Installation**

1. The Contractor shall carefully follow instructions in documentation provided by the manufacturer to ensure all steps have been taken to provide a reliable, easy-to-operate system.
2. All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation.
3. The tower mounting shall be per manufacturer's specification.
4. Provide and install all necessary conduit pathway and infrastructure as noted in the drawing attached.
5. Telecommunications cabling to be installed by NI&S under separate contract.

6. Power to the telephone tower is to be provided by the Contractor under separate contract. Contractor shall consult tower manufacturer's recommendations for power requirements.
7. Conduit pathways including service/pull boxes locations are to be designed by the Contractor during site plan coordination.
8. Conduit pathway shall be installed in accordance with the conduit pathway installation detail in the VT Design Standard Detail Library.

### **3.9 LABORATORY EMERGENCY SAFETY APPLIANCES**

For additional laboratory design requirements, see DCSM section 5.18.

1. Eyewashes
  - a. Unobstructed access to an eyewash within 10 seconds is required in every laboratory where corrosive substances are present as is stated in 29 CFR 1910.151(c). Unobstructed is defined for this purpose as not being inside or outside of a door that can be locked or that would otherwise inhibit access, such as a door with an inward swing or one without a crash bar. Unobstructed also means that no stairs, step-ups, etc., will need to be traversed in order to get to the eyewash or safety shower.
  - b. The design and installation of all eyewashes must meet ANSI Z358.1-2014. Counter-mounted eyewashes must be installed within 6 inches of the front of the counter for hands free access.
  - c. Portable eyewash stations are not allowed without EHS review and approval.
  - d. Every new or renovated laboratory must include a plumbed eyewash installation.
  - e. Standalone eyewash stations or combination eyewash/shower stations must be plumbed to a drain in order to facilitate use and weekly testing (flushing) of the eyewash.
2. Safety showers
  - a. Where the potential for contact with corrosive materials exists, a safety shower must be installed within 10 unobstructed seconds.
  - b. Safety showers must be installed in accordance with ANSI Z358.1. Where new buildings are designed or labs are renovated, ANSI Z358.1-2009 requires a water-mixing valve for tempered or a tepid supply of rinsing fluid.
  - c. Any new building with more than 15 safety showers in it shall utilize a central tepid water system with dedicated mixing valves and circulating pumps. Individual mixing valves at each shower in this situation are not an acceptable alternative.



3. Flow rates for all new eyewashes and showers shall be tested as part of the renovation or construction process. Flow rate data shall be provided to EHS prior to project turnover.
4. Flow rates for eyewashes and safety showers shall conform to a functional test involving the fixture(s) on the floor that is farthest from the water supply. In accordance with ANSI standard Z358.1, flow rates for all new construction and major renovations shall be measured at 20 GPM. Existing eyewashes and safety showers shall have a minimum flow rate of 12 GPM.
5. See DCSM section 6.6.8 for floor drain requirements
6. Portable fire extinguishers: A portable fire extinguisher, suitable for use in the laboratory and around chemicals used therein, must be mounted in each laboratory. At minimum, a 10-pound ABC extinguisher will be required. Signage must also be displayed at the extinguishers. See DCSM section 3.10.5 for fire extinguisher cabinet requirements.

### **3.10 FIRE PROTECTION SYSTEMS**

Provide the information required in the fire systems drawing checklists for each design phase submittal. The requirements pertain to all projects which are constructed on state property, regardless of funding source.

#### **3.10.1 Fire Safety Systems**

The design of fire suppression systems (sprinkler systems/standpipes, alternate automatic suppression systems, fire pumps), fire detection and fire alarm systems, smoke control systems, access control systems and applied fire-resistant materials shall comply with the submittal requirements outlined in DCSM section 2.7.5.9 and the fire systems checklists for each design phase submittal. The requirements pertain to all projects which are constructed on state property, regardless of funding source.

#### **3.10.2 Fire Safety Review of Shop Drawings**

Shop drawings for the following building systems shall be reviewed and approved prior to the work being installed:

1. Fire suppression systems (sprinklers/standpipes, alternate automatic suppression systems, fire pumps): shop drawings prepared by a certified engineering technician, NICET Level III or IV, reviewed and approved as indicated below.

2. Fire detection and fire alarm systems: shop drawings prepared by a certified engineering technician, NICET Level III or IV, reviewed and approved as indicated below.
3. Smoke control systems designed by the licensed engineer, shop drawings reviewed and approved by the A/E of record, then reviewed and approved by the UBO.
4. Applied fire-resistant materials: product data and details prepared by the Contractor, as may be required by specific projects.
5. Access control must be coordinated with fire systems by the A/E.

The licensed professional engineer is responsible for the overall design of the fire protection systems, evaluating the building-specific conditions and preparing the analysis, calculations, design, and documents. When complete, the final documents display the signed, dated seal of the responsible professional engineer. Refer to DCSM section 2.7.5.9.

The certified engineering technician, certified to NICET Level III or IV, prepares the working plans as defined by NFPA 13, supplemental calculations, and material submittals based upon the engineer's design, for the engineer's review and approval. The professional engineer does not affix his/her professional seal to the shop drawings.

### **3.10.2.1 A/E Shop Drawing Final Approval**

When the design of fire suppression, fire detection and fire alarm, smoke control, access control systems or applied fire-resistant materials provided in the initial working drawings submittal is determined to be complete and code compliant by the UBO, then the building permit shall stipulate that the shop drawings and submittal data shall be reviewed and approved by the A/E of record.

The A/E shall include a stipulation on the working drawings and in the technical specification that the Contractor shall bid and install the fire protection system as shown in the documents. Designs modified from the UBO-approved working drawings, shall be submitted to the UBO for review and approval as described in DCSM section 3.10.2.

### **3.10.3 Protection During Construction**

In renovation projects where the building is to remain occupied during construction, the following measures shall be included in the Contract Documents:

All existing fire protection systems shall remain operational during construction. If temporary shutdown is necessary, the system shall be returned to operational condition as soon as possible and no later than the end of each working day prior to the Contractor leaving the job site. The Contractor is to notify the SFMO prior to any necessary shutdowns. Any necessary shutdowns shall not affect other areas not involved with this construction project.

All operational standpipes are to be maintained at all times.

Sprinkler systems in areas being renovated shall be operational when the Contractor leaves the site each day. A fire watch shall be provided at all times that a sprinkler system is inactive.

### **3.10.4 Spray Fireproofing Design and Specification**

#### **3.10.4.1 General**

1. Final Construction Documents shall clearly show locations, rating and type of spray fireproofing on the drawings, on typical and special details, and in the specifications.
2. The spray fireproofing applicator shall be qualified and/or licensed on the manufacturer product.
3. Proof of qualification and/or licensure shall be submitted to the University.
4. At the intersection of structural steel members with different thicknesses of spray fireproofing, provide spray fireproofing equal to the greater thickness on all members for a distance of 2' minimum from the intersection of the members.
5. Spray fireproofing shall meet or exceed the fire rating on all clips, hangers, light gauge framing, support sleeves and other attachments covered at the area of attachment to a structural member.
6. Mark new spray fireproofing with fire rating and material type in all accessible locations at 16' intervals.

#### **3.10.4.2 Testing Requirements**

All spray fireproofing shall be tested after installation according to manufacturer's requirements.

The University shall arrange and pay for services for field and laboratory tests and reports. The Contractor shall schedule the tests while the material is accessible. If additional tests are required as a result of non-compliance with the specifications, the additional tests and reports shall be paid for by the Contractor.

#### **3.10.4.3 Removal and Replacement**

The A/E, in consultation with the University, shall verify early in the design phase with the UBO the original purpose of any fireproofing material to be removed or replaced and what, if anything, must be done to restore the fire-resistive characteristics.

Plans and specifications shall be submitted to the UBO, including any final construction documents, amendments/addenda, or change orders which may relate to the fire-resistive characteristics of the structure. On every submittal, indicate construction date, original and present uses, height in floors and feet, whether the building is sprinklered, and any other information that may assist the UBO in his/her determination.

If sprayed-on ACM is to be replaced, copies of the specifications for the intended replacement material shall be submitted to the UBO for review.

Independent testing laboratory reports shall be sent through the A/E to the UBO.

#### **3.10.4.4 Identification of Spray-Applied Fire-Resistive Materials (SFRM)**

New and replaced SFRM material shall be identified at 16' intervals in accessible locations with label providing the following information:

1. Fire-rated assembly design number from listing agency.
2. Hourly rating.
3. Material type and designation.

#### **3.10.5 Fire Extinguisher Cabinets**

1. Fire extinguisher cabinets shall be incorporated into all projects. All fire extinguishers shall be installed in red, code-acceptable cabinets.
2. Fire extinguisher cabinet doors shall not be equipped with any type of lock. Only roller latches, or something providing an equivalent level of function shall be used. Access without a key is required for extinguisher inspection.

3. Fire extinguisher cabinets that are located in hallways or would be considered a protruding object per ADA requirements shall be either semi-recessed or fully recessed.

### **3.10.6 Fire Extinguishers**

Contract specifications shall identify the extinguisher type and size, and note that the extinguishers shall be provided, inspected and appropriately tagged with the inspection date, and installed by the Contractor.

In general, all fire extinguishers shall be serviceable, 10-pound ABC type unless there is a special hazard present. If there is a special hazard present, then the fire extinguisher shall be listed for that specific hazard.

Permanent fire hoses are not acceptable for installation on campus.

### **3.10.7 Fire Alarm Systems**

#### **3.10.7.1 Overview**

This section provides Virginia Tech's standards for the design and installation of fire alarm systems and equipment in new construction, retrofit of new systems into existing buildings, and modifications to existing systems. All new university buildings shall be equipped with a fire alarm system with voice alarm capabilities meeting or exceeding these standards and applicable codes.

Over the years, Virginia Tech has developed a technologically advanced campus-wide fire alarm system through the standardization and integration of each new individual building system. These standards require that each new system installed by or for Virginia Tech within the boundaries of Montgomery County have the proper technology to be fully compatible with the campus fire alarm network and that each be fully integrated as a node on the same, thereby providing the level of fire protection the University desires.

In applying these standards to the design of a new system, designers are expected to follow everything listed without exception.

To determine the level of protection appropriate for a given type of building, several risk factors were considered. These were:

1. Building size – both the height and total area.
2. Building use – how the building is used and what hazards are present.
3. Occupant load – number of people occupying the building.
4. Type of construction – combustible, non-combustible, fire protected, etc.
5. Sprinkler protection – whether or not the building will be sprinklered.



A voice fire alarm system provides a public address function by use of the control panel microphone. This can effectively be used to communicate to all of the building's occupants for any type of emergency, even when building evacuation is not needed.

### 3.10.7.2 Design Phase Procedural Requirements

1. In designing Virginia Tech fire alarm systems, nothing in these standards shall be construed to allow anything less than full compliance with minimum legal requirements of the applicable codes and standards as established in the current edition of the VUSBC. Any discrepancies found should be brought to the immediate attention of the University.
2. The latest adopted edition of NFPA 72 shall be used for all new fire alarm systems. A code modification may be required from the UBO for required systems where the referenced edition in the VUSBC is not the most recent edition. The modification request is the responsibility of the University.
3. The communications protocol for the campus fire alarm network is proprietary to Johnson Controls. No other manufacturer's equipment can be properly integrated into the network, and provide the two-way communication needed for monitoring and control of the existing systems. Therefore, all fire alarm equipment shall be listed as compatible with Johnson Controls. All suppression release (including kitchen grease hoods and server rooms) shall be by Johnson Controls.
4. As part of their service to the University, Johnson Controls provides a high level of engineering support to the A/E for the design of our new systems. The A/E is required to contact the Roanoke branch office of Johnson Controls for their assistance for every project. We rely heavily on input by Johnson Controls to assure compliance with codes and university standards, and for proper integration of new systems into the campus network. The A/E shall send Johnson Controls a copy of the set of preliminary design documents submitted to the University's internal review team.
5. Johnson Controls shall assist the A/E and the University by:
  - a. Providing Johnson Controls specifications to the A/E for their use.
  - b. Meeting with A/E and University to go over basic system design issues.
  - c. Reviewing working drawing design documents to assure system equipment is properly specified, and located within the building in compliance with codes and university standards.
  - d. Analyzing existing equipment impacted by any new installation to ensure that it can work properly with the new equipment.

- e. Inspecting and testing new systems to help assure that the complete system is installed properly and performs in a manner compliant with code. Johnson Controls will send the CAD drawing files they have prepared showing final device locations to EHS.
6. Provisions need to be made to update the campus fire alarm network when new systems are added. The TrueSite Workstation (TSW) in the Fire Protection Manager's office, the TSW in the Student Affairs Fire Protection maintenance office, and the appropriate Network Display Units necessary for sending the signals to the Central Station monitoring, must be reprogrammed to include building address, point label, etc., as needed to add the new system to the network.
7. The University's room numbering must be used to program the labels for the points in the control panel, and not the construction document numbers.

### **3.10.7.3 General Design Standards**

1. All equipment shall be manufactured by Johnson Controls.
2. Control and Annunciator Panels
  - a. All displays and annunciators shall be touchscreen alarm displays.
  - b. Location of control panel – The fire alarm control panel (FACP) shall be located at the primary entry point to be used by the local fire department or in an electrical room. If the FACP is located in an electrical room, a remote command center shall be provided at the primary entry point to be used by the local fire department. The University will provide this information to the A/E after consultation with the local fire department.
  - c. Remote annunciator panels shall only be used where two or more fire department response points are clearly identified. Otherwise, the main control panel or remote command center is all that is needed.
  - d. The FACP shall be used to control pre-action sprinkler systems. The panel must be UL listed or FM approved for this function.
  - e. Maximum mounting height of FACP shall be 75 inches above finished floor to the top of the 4100 panel.
  - f. Max limitation on power supplies – The design load placed on the power supply shall not exceed sixty percent of the power supply capacity.
  - g. Individual signal circuits shall not exceed sixty percent of the card capacity. For voice systems this assumes that all speakers are tapped at their maximum wattage, which is currently 2 watts.

- h. Location of secondary panels – All secondary panels for the fire alarm system shall be located either in electrical closets or in public spaces where they are readily accessible.
  - i. All batteries associated with the fire alarm system shall be no more than three months old (based on the date code on the battery) at the time of system acceptance.
  - j. Batteries serving the FACP but installed in separate cabinets shall be located adjacent to the FACP and no higher than 3 feet above the floor.
  - k. Emergency power – Where a generator is present, the FACP and all secondary panels shall be tied to the emergency circuit, and batteries shall also be provided, sized per NFPA 72 requirements. Where there is no generator, batteries shall be provided and sized per NFPA 72 requirements as the secondary power source.
  - l. If smoke control or stairwell pressurization systems are being installed, the FACP shall provide a manual means of activating and disabling these systems. Switches shall be clearly labeled as to the specific system they control.
  - m. If a building has stairwell pressurization fans and has emergency power generators, pressurization fans shall be on emergency power.
  - n. Degree of point reporting – All initiating devices shall be reported individually to the TSW and NDUs.
  - o. Network node – The panel shall be configured as a node on the campus Johnson Controls 4190 fire alarm network.
3. Initiating Devices
- a. Location of pull stations – Locations for pull stations shall be per code and pull stations shall be provided as if the building were not equipped throughout with an automatic sprinkler system. The exceptions in the code shall not be used. All pull stations must be listed for the environmental conditions for the area of installation.
  - b. All pull stations shall be single action.
  - c. Addressable initiating devices – All devices shall be addressable-type devices. All initiating devices must be listed for the environmental conditions for the area of installation.
  - d. Duct detectors – Unless required by code, are not to be installed on any air handling equipment. When duct detectors are installed the detector must be accessible for maintenance and a remote LED shall be placed on a wall or ceiling in public area where it will be readily visible and will not be obstructed by furniture, and shall be located as close as possible to

the air handling unit (AHU). Signage shall be provided indicating the AHU served. Do not provide test switches.

- e. For locations with an installed smoke or heat detector that would be affected by adverse environmental conditions or where maintenance on the detector would be problematic, aspirating early warning smoke detectors shall be used as an alternative to spot detectors.
  - f. Heat detectors and combination smoke/heat detectors:
    - i. Install a combination smoke/heat detector in the following locations:
      - 1. Mechanical rooms
      - 2. Sprinkler riser rooms
      - 3. Areas deemed necessary by the VT PM and VT Engineering during the preliminary design phase, such as areas with water pipes (domestic or fire sprinkler).
    - ii. Heat detectors and combination smoke/heat detectors shall be programmed to provide a non-latching supervisory trouble signal for low temperatures at 40 °F.
      - 1. The supervisory trouble signal shall be programmed to report the low temperature reading.
      - 2. The signal shall be programmed to clear when temperatures rise above the 40 °F threshold.
4. Notification Devices
- a. Strobes shall be installed in conformance with NFPA 72. Strobes must be listed for the environmental conditions for the area of installation.
  - b. Ceiling mounted strobes are acceptable.
  - c. Location of strobes – All public spaces listed above for detection; and also, classrooms, bathrooms, laboratories, assembly spaces, conference rooms, shops with high ambient noise levels, mechanical rooms and other areas as required by the VUSBC. Placement shall be made with consideration of ambient light levels.
  - d. Synchronization of strobes – Strobes shall be synchronized and all strobes shall be the addressable type.
  - e. A/V unit mounting heights are dictated by the requirements for the strobe, not the speaker.
  - f. All speakers shall be tapped at their maximum capacity, which is currently 2 watts.
  - g. Ceiling mounted speakers are preferred.

5. Circuits and wiring
  - a. Class B circuits shall be used.
  - b. Conduit vs. cable – For new construction, wire in conduit or EMT that is dedicated to the fire alarm system shall be used. For retrofit installations, the use of cable will be acceptable, but it must be installed in locations where it will be protected by building construction (above ceilings, in cable trays, chases, within walls, etc.) as long as the installation complies with the NEC.
  - c. Conduit shall be a minimum of 3/4-inch.
  - d. No conduit or EMT shall be run in or below slabs.
  - e. Wiremold may be used in retrofit installations, but only when it is in the project's scope.
  - f. All wire routed underground shall be listed for direct burial and be installed in conduit.
6. Interface with other fire protection systems and VT Alerts
  - a. Mass Notification – To ensure the emergency notification to all members of the university community, the equipment necessary to connect to the university emergency communication system (VT Alerts) shall be provided and installed to the building fire alarm panel. This will include two Ethernet ports installed in the building fire alarm panel.
  - b. Where the building contains other fire related systems, such as sprinklers, hood suppression, fire door hold-open devices, etc., these systems shall be connected to the new FACP and monitored for alarms, trouble, or supervisory conditions.
  - c. The A/E shall coordinate the sprinkler and fire alarm design to help assure that the number of flow, tamper, and pressure switches are identified as accurately as possible in the working drawing design.
  - d. Where a fire pump is present, a “pump running” condition shall be treated as a supervisory condition, and not an alarm.
  - e. Where dry-pipe valves are installed in buildings not normally occupied, where loss of heat in the room could go undetected, a means for monitoring the temperature of the sprinkler riser room shall be installed and programmed to provide a supervisory signal to the fire alarm panel.
  - f. A supervised tamper switch is required on all exterior post indicator valves on fire protection water supply lines. These valves are typically installed 40 feet from the building, which will require underground circuit be provided to the switch.



- g. Every tamper and flow switch shall be individually addressed, regardless of their proximity to other devices.
- 7. Miscellaneous
  - a. Consideration shall be given to any room within the building that may be subject to wash-down cleaning.
  - b. Devices shall be listed for conditions.

### **3.10.7.4 Building-Specific Design Standards**

- 1. Definitions of University Building Categories
  - a. Class 1 – Academic, administrative, assembly and research buildings (multi-story with elevator), or otherwise classified as such as needed to address specific safety concerns
  - b. Class 2 – Residential buildings, all dormitories, and special purpose housing
- 2. Class 1 Building Specifications
  - a. Panel model – 4100ES or the latest version of this level of panel. Note that at present, the 4100ES is the only panel listed for use as a panel to control fire suppression systems, such as pre-action sprinkler systems. When a building has a pre-action sprinkler system in it, the 4100ES must be used.
  - b. Type of audible devices – All notification audible devices shall be speakers.
  - c. Addressable audible devices – When addressable speakers become available from Johnson Controls, they are to be used.
  - d. Addressable strobes – Strobes shall be the addressable type.
  - e. Level of automatic detection – For non-sprinklered buildings, public area smoke detection shall be provided. This will include areas such as lobbies, hallways, reception areas, areas above every floor landing in all stairwells, elevator lobbies, and similar spaces. Auditoriums shall be addressed on a case-by-case basis with University consultation.
  - f. Specific areas that require heat detection in non-sprinklered buildings – mechanical equipment rooms; attics and crawl spaces built with combustible construction; chemical storage rooms, shop areas used for welding, woodworking, painting, etc.; or any other area with a hazard that warrants heat detection as determined by the University.
  - g. Specific areas that require smoke detection in non-sprinklered buildings – NI&S communication closets; large electrical rooms containing either distribution transformers or switchgear;

transformer vaults; at the FACP; storage rooms which are greater than 100 square feet, open into a space without smoke detection, and are neither sprinklered or enclosed by fire-rated construction.

- h. Laboratories involving hazardous operations must be evaluated for the need for automatic detection (either heat or smoke) on a case-by-case basis.
  - i. Specific areas that require smoke detection in sprinklered buildings – elevator lobbies, transformer vaults, NI&S communication closets, at the FACP.
  - j. Elevator machine rooms – In general, smoke detectors shall be installed in these rooms, however, if the ambient conditions in the room are such that a smoke detector would result in nuisance alarms, another appropriate detector may be used with the university's concurrence.
3. Class 2 Building Specifications
- a. All provisions for Class 1 systems shall apply, unless otherwise modified here.
  - b. All sleeping rooms shall be equipped with system smoke detectors with addressable speakers programmed to function as a single station detector. This will satisfy the code requirement for single station detectors. If the detector is still in an alarm condition at the end of 60 seconds, the system shall sound a general alarm.
  - c. All detectors within a suite shall be programmed to operate the addressable speakers simultaneously.
  - d. In addition to the public spaces listed for Class I buildings, strobes shall be installed in all suite living rooms, and in all bedrooms designed specifically to accommodate the disabled. Strobes shall be 110 candelas in these bedrooms.
  - e. Heat detectors shall be installed in all residence hall student lounge kitchen areas and in locations where steam may be present.
  - f. All pull stations shall be equipped with alarmed covers to prevent vandalism. The basis of design for pull station covers shall be Lexan Stopper II.

#### **3.10.7.5 Acceptance Testing and Warranty Period**

1. As part of the final inspection and systems test, Johnson Controls will verify the candela rating of every strobe in its installed location, to ensure that the installing contractor has installed these devices per contract documents,

and per code. A copy of this report shall be provided to the University Fire Protection Manager.

2. Johnson Controls will measure the sound level and clarity of the alarm signal, in all areas of the building, to assure that the installed system produces the signal volume as required by code. All intervening room doors shall be shut during the test. A copy of this report shall be provided to the University Fire Protection Manager.
3. Johnson Controls will provide the University with a written statement verifying the successful completion of all required tests. This document will be required at the time of substantial completion, before a Certificate of Occupancy can be obtained for the building. A copy must also be provided to the SFMO.
4. During the one-year warranty period, one complete system test shall be provided and included as part of the initial purchase of the system. The test shall be performed during the eleventh month and shall be scheduled in coordination with the University Fire Protection Manager.
5. Any time the fire alarm system is inspected and/or tested, a copy of the inspection/test report shall be provided to the University Fire Protection Manager.

### **3.10.8 Fire Suppression Systems**

#### **3.10.8.1 General Duty Valves for Water-Based Fire Suppression Systems**

1. Sprinkler system control valves shall only be installed in corridors, stairwells, mechanical rooms, fire pump rooms and sprinkler valve rooms. The control valves shall be accessible with the use of no more than a six-foot stepladder.
2. Provide minimum of 24" × 24" access door for valves located above inaccessible ceiling types.
3. Control valves shall not be installed, above or below ceilings in classrooms, offices, conference rooms or any dormitory living quarters.
4. Drain valves shall only be installed in corridors, stairwells, mechanical rooms, fire pump rooms and sprinkler valve rooms and shall be easily accessible. The drain valves shall be accessible with the use of no more than a six-foot stepladder.
5. Drain valves shall not be installed, above or below ceilings, in classrooms, offices, conference rooms or in dormitory living quarters, or in any area requiring entry through a classroom, office, conference room or any dormitory living.

6. All drain valves discharge shall be piped to a drain capable of handling the discharge at full flow or to the exterior of the building.
  - a. Concrete splash blocks shall be installed below all sprinkler auxiliary drains. Splash blocks shall be placed with a slope draining away from the building and shall prevent erosion. Confirm placement with SID.
7. Inspector test valves (ITVs) shall only be installed in mechanical rooms, corridors, stairwells, fire pump rooms, sprinkler valve rooms and housekeeping closets and shall be easily accessible. The ITVs shall be accessible with the use of no more than a six-foot stepladder.
8. Inspector test valves shall not be installed, above or below ceilings, in classrooms, offices, conference rooms or in dormitory living quarters or in any area requiring entry through a classroom, office, conference room or any dormitory living quarters.
9. Inspector test valves discharge shall be piped to a drain capable of handling the discharge at full flow or to the exterior of the building.

#### **3.10.8.2 Identification for Fire Suppression Piping and Equipment**

1. Each control valve shall be supplied with signage indicating the area of the building that is served by the valve.
2. At all locations that inspector test valves or control valves are concealed above ceilings or behind access doors, a sign shall be provided on the ceiling below the valve or on the access door indicating the location of the valve.
3. Specifications shall indicate that following the completed installation, Virginia Tech Facilities Fire Protection Manager and their independent consultant will inspect and test all components of the installed sprinkler systems prior to final inspection and acceptance by the SFMO and report any deficiencies to the VT PM, the UBO and the SFMO.

#### **3.10.8.3 Water-Based Fire Suppression Systems**

1. In residential buildings, all control valves that are located in spaces accessible by the occupants of the building shall be provided with lockable tamper prevention devices and locks that shall be specified by the University.
2. In residential buildings, each fire department hose valve shall be provided with a lockable tamper prevention device and a lock.
3. No sprinkler heads from any manufacturer which incorporate a rubber O-ring shall be permitted to be installed in university buildings.

4. The stock of spare fire sprinklers shall correspond and the quantity be in proportion to the types and temperature ratings of the sprinklers in the property.
5. In residential buildings, provide concealed-type sprinkler heads in all occupiable rooms.

#### **3.10.8.4 Fire Suppression Hose Valves**

In addition to building code requirements, in buildings where the floor level of the highest story is located more than 24 feet above the lowest level of fire department access, all stairways that have an exterior exit shall be provided with standpipes and fire department hose valves on each intermediate level.

#### **3.10.8.5 Fire Suppression Sprinkler Systems**

1. Sprinkler system piping shall be steel; no plastic pipe shall be used.
2. In buildings with sprinklers, fire pumps and/or standpipes, separate water service for fire protection shall be provided, and shall not be through the domestic metered water service.
3. A digital set of as-built sprinkler system plans in AutoCAD format (see DCSM section 2.8.5) shall be provided to the VT PM and shall include information for every individual sprinkler head location which identifies the manufacturer, model, temperature rating and date of manufacture for the head that was actually installed. In addition, a digital summary shall also be provided to the VT PM which lists all the individual types of heads installed for the whole building, and the total number installed of each type. It is the responsibility of the sprinkler contractor to verify in the field that the inventory accurately represents the heads that were actually installed. Reliance solely on the approved shop drawings is not acceptable.

#### **3.10.8.6 Dry-Pipe Sprinkler Systems**

All dry sprinkler system piping shall be nitrogen-filled black steel pipes for dry-pipe sprinkler systems.