

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

Includes the following sections:

- 28 05 00 Common Work Results for Electronic Safety and Security
- 28 05 13 Conductors and Cables for Electric Safety and Security
- 28 05 26 Grounding and Bonding for Electronic Safety and Security
- 28 05 28 Pathways for Electronic Safety and Security
- 28 13 00 Access Control and Alarm Systems
- 28 23 00 Visual Surveillance
- 28 31 00 Fire Detection and Alarm

COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY	28 05 00
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For more information, refer to the University's Standard Specification Section 28 05 00 Common Work Results for Electronic Safety and Security.

CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY	28 05 13
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For more information, refer to the University's Standard Specification Section 28 05 13 Conductors and Cables for Electric Safety and Security.

GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY	28 05 26
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For more information, refer to the University's Standard Specification Section 28 05 26 Grounding and Bonding for Electronic Safety and Security.

PATHWAYS FOR ELECTRONIC SAFETY AND SECURITY	28 05 28
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For more information, refer to the University's Standard Specification Section 28 05 28 Pathways for Electronic Safety and Security.

ACCESS CONTROL AND ALARM SYSTEMS	28 13 00
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For more information, refer to the University's Standard Specification Section 28 13 00 Access Control and Alarm Systems.

VISUAL SURVEILLANCE	28 23 00
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For more information, refer to the University's Standard Specification Section 28 23 00 Visual Surveillance.

FIRE DETECTION AND ALARM

28 31 00

Refer to the University's Standard Specification Section 28 31 00 Fire Detection Alarm and Section 28 08 00 Commissioning Electronic Safety Security. The specifications shall be modified by the Design Professional to meet project requirements. Electronic copies (Word documents) are available, contact the University's Representative.

Section 28 05 00

Common Work Results For Electronic Safety and Security

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Section includes, but is not necessarily limited to:
 - 1. Common standards and procedures for the Electronic Safety and Security Work.
 - 2. Design, engineer and provide complete, all means of support, suspension, attachment, fastening, bracing, and restraint (hereinafter "support") of the Work of this Division. Provide engineering of such support by parties licensed to perform work of this type in the Project jurisdiction.
- B. Provisions of this Section apply to Electronic Safety and Security Work, including the following Sections:
 - 1. Section 28 05 13 – Conductors and Cables for Electronic Safety and Security
 - 2. Section 28 05 26 – Grounding and Bonding For Electronic Safety And Security
 - 3. Section 28 05 28 – Pathways for Electronic Safety And Security
 - 4. Section 28 13 00 – Access Control and Alarm Systems
 - 5. Section 28 23 00 – Visual Surveillance

1.2 REFERENCES

- A. Usage in accordance with Section 01 42 19 - Reference Standards.
- B. Conform to the applicable portions of the following standards agencies:
 - 1. American National Standards Institute (ANSI)
 - a. ANSI C39.1 (1981; R 1992) Requirements for Electrical Analog Indicating Instruments
 - 2. ASTM International (ASTM)
 - a. ASTM A 123/A 123M (2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - b. ASTM B 32 (2004) Solder Metal
 - 3. Electronic Industries Alliance (EIA)
 - a. EIA ANSI/EIA/TIA-232-F (2002) Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
 - 4. Institute of Electrical And Electronics Engineers (IEEE)
 - a. IEEE 142 (2007) Recommended Practice for Grounding of Industrial and Commercial Power Systems - IEEE Green Book.
 - b. IEEE C2 (2012) National Electrical Safety Code.
 - c. IEEE C62.41.1 (2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits.
 - d. IEEE C62.41.2 (2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
 - 5. National Electrical Manufacturers Association (NEMA)
 - a. NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. NEMA ICS 1 (2000; R 2005; R 2008) Standard for Industrial Control
 - c. NEMA ICS 2 (2000) Industrial Controls and Systems: Controllers, Contactors, and Overload Relays Rated Not More than 2000 Volts AC or

- 750 Volts DC
- 6.
 - d. NEMA ICS 6 (1993; R 2001) Industrial Control and Systems: Enclosures
 - Underwriters Laboratories (UL)
 - a. UL 294 (1999; Rev thru Oct 2001) Access Control System Units
 - b. UL 365 Standard for Police Station Connected Burglar Alarm Units and Systems.
 - c. UL 636 (1996; Rev thru Mar 2001) Holdup Alarm Units and Systems
 - d. UL 639 (1997; Rev thru Sep 2002) Intrusion Detection Units
 - e. UL 681 (1999; Rev thru Jan 2001) Installation and Classification of Burglar and Holdup Alarm Systems
 - f. UL 796 (1999; Rev thru Dec 2003) Printed-Wiring Boards (1982 issue or latest revision).
 - g. UL 1037 (1999; Rev thru Sep 1999) Antitheft Alarms and Devices
 - h. UL 1076 (1995; Rev thru Feb 1999) Proprietary Burglar Alarm Units and Systems
 - i. UL 1610 (1998; Rev Aug 2001) Central-Station Burglar-Alarm Units
 - 7. U.S. National Archives and Records Administration (NARA)
 - a. 21 CFR 1020 Performance Standards for Ionizing Radiation Emitting Products
 - b. 47 CFR 15 Radio Frequency Devices

1.3 DEFINITIONS

- A. See also Section 01 42 10 - Abbreviations, Symbols, and Definitions, and Section 27 05 00 – Common Work Results for Communications.
- B. General Abbreviations used in these specifications. Refer additionally to the abbreviations list appearing on the Drawings.
 - 1. ACAS Access Control and Alarm System.
 - 2. ADA Americans With Disabilities Act.
 - 3. AFC Above Finished Ceiling.
 - 4. AFF Above the Finished Floor.
 - 5. BLDG Building
 - 6. CAT Category
 - 7. CL Centerline
 - 8. DIV Division
 - 9. (E) Existing
 - 10. FBO Furnished By University
 - 11. HR Home Run
 - 12. ID Inside Diameter
 - 13. IDS Intrusion Detection System
 - 14. LAN Local Area Network
 - 15. MAX Maximum
 - 16. NIC Not In Contract.
 - 17. NRTL Nationally Recognized Testing Laboratory
 - 18. NVR Network Video Recorder
 - 19. OD Outside Diameter
 - 20. OFE University Furnished Equipment.
 - 21. PSRH Project Standard Receptacle Height.
 - 22. PSSH Project Standard Switch Height.
 - 23. POE Power over Ethernet
 - 24. TYP Typical
 - 25. UON Unless Otherwise Noted.
 - 26. VMS Video Management System

Omit if Access Control not in Scope

- A. [Definitions of Terms:
 - 1. As defined in Section 28 13 00 – Access Control and Alarm Systems.]

1.4 SYSTEM PERFORMANCE REQUIREMENTS

Adjust to match scope

- A. [The fully configured access control panels provided under the work of this project in conjunction with devices installed under the work of this project, shall enable the access control and intrusion detection functions as defined in Section 28 13 00 – Access Control and Alarm Systems.
- B. The video surveillance system installed under the work of this Project shall enable viewing and recording images on the University's VMS/NVR system as defined in Section 28 23 00 – Visual Surveillance.]

1.5 SUBMITTALS

- A. Comply with Section 01 33 23 – Shop Drawings, Product Data and Samples and the following.
 - 1. Submit all materials for review arranged in same order as Specifications, individually referenced to Specification Section, Paragraph and Contract Drawing number. Conform in every detail as applies to each referencing Section.
 - 2. Provide electronic submittals in the electronic format defined by Division 1.
 - 3. Make each specified submittal as a coordinated package complete with all information specified herein. Incomplete or uncoordinated submittals will be returned with no review action.
- B. Contractor and Key Personnel Experience.
 - 1. A minimum of 30 days prior to installation, submit documentation of the experience of the Electronic Safety and Security contractor(s) and of their key personnel.
 - 2. Qualifications shall be provided for:
 - a. the Electronic Safety and Security contractor(s).
 - b. the Electronic Safety and Security installers,
 - c. and the supervisor(s) (if different from the installers).
 - 3. Refer to Quality Assurance paragraph in this section for complete requirements.
- C. Progress Schedule: Comply with Section 01 31 13 - Project Coordination.
- D. Manufacturer's Product Data:
 - 1. Manufacturer's Product Data Sheets. Collate in sequence of List of Materials:
 - 2. Data sheet for each item in each Electronic Security Section, including all accessories, clearly marked for proposed product required for the Project, to including but not limited to the following where required by the Project scope:
 - a. Common Work
 - i. *Power Supplies*
 - ii. *UPS's*
 - iii. *Switches*
 - iv. *Relays*

- v. *Batteries*
- vi. *Tamper resistant security fasteners*
- vii. *Terminal blocks*
- viii. *End-of-Line Resistors.*
- b. Wiring
 - i. *Cabling of each type used on the project.*
- c. Racks and Cabinets (where provided under the work of Division 28).
- d. Electronic Security Systems Pathway
 - i. *Raceway*
 - ii. *Raceway connectors*
 - iii. *Gutter*
 - iv. *Terminal Cans, Pull Boxes, Device Boxes*
 - v. *Enclosures*
 - vi. *Means of support*
- e. Access Control and Intrusion Device Field Devices
 - i. *Door position sensors*
 - ii. *Duress alarm components,*
 - iii. *Request to exit devices*
 - iv. *Card readers*
 - v. *Card stock*
 - vi. *Vehicle readers*
 - vii. *Motion detectors,*
 - viii. *Glass break sensors,*
 - ix. *Key pad controllers*
 - x. *Local alarm devices/sounders, including key cores and sleeves*
- f. Headend and Building Level Access Control Electronics
 - i. *DGP and complete daughter card components required to complete the work of the project.*
- g. Visual Surveillance Devices
 - i. *Cameras*
 - ii. *NVR Camera Licenses*
 - iii. *Line extenders (where permitted),*
 - iv. *PoE injectors.*

3. Material Safety Data Sheet, where applies.

4. List of Materials Schedule. For each item, include:

- a. Referencing Specification Section
- b. Referencing Paragraph
- c. Referencing Drawing, if specified only on plans
- d. Manufacturer.
- e. Model number.
- f. Listing, including name of Nationally Recognized Testing Laboratory.
- g. Precede each submittal book with a summary schedule, with columns for each item above and rows for each item submitted.
 - i. *Example:*

Specification Section	Paragraph	Contract Drawing Reference	Manufacturer	Model No.	NRTL Listed
28 05 00	2.03C		XYZ	123	Y
28 13 00	2.07A1		AAA	34-56	Y
		TY2.01	ZZY	456	Y

- E. Functional description, provide
1. A system description, including analysis and calculations used in sizing equipment required.
 2. Description to show how the equipment shall operate as a system to meet the performance requirements. The following information shall be supplied as a minimum:
 - a. Description of site equipment and its configuration
 - b. Protocol description
 3. Startup operations
 4. System expansion capability and method of implementation
 5. System power requirements and UPS sizing
- F. Field (Installation) and Shop Drawings: Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Collate in sequence at least the following plans:
1. Drawing index/symbol sheet.
 2. Floor plans. At scale of Contract Documents. Show:
 - a. Device locations, type and circuit number(s).
 - b. Mounting height.
 - c. Conduit size.
 - d. Rough-in.
 - e. Wire type.
 - f. Wire fill.
 - g. Termination rooms, including BDF and IDF Closets where use of these spaces are indicated on the Bid Documents
 3. Sections/Elevations: At scale of Contract Documents:
 - a. Mounting location reference.
 - b. Terminal cabinets.
 - c. Power Supplies and UPS.
 - d. Electrical power receptacles required for the work of this Section.
 - e. Block wiring terminations
 - f. Clearances
 - g. Backboard Wire and Cable Management
 - h. Copper cable patch panels.
 - i. Rack layouts.
 4. Enlarged plans. At scale of Contract Documents or larger as required for trade coordination. Show:
 - a. Refer to "floor plans" above.
 - b. Architectural features.
 - c. Rack cabinets.
 - d. Clearances required by applicable Code.
 - e. Terminal panels and backboard mounted power supplies
 - f. Terminal blocks
 - g. Electrical and Mechanical panels, including panel boards, EMS and fire alarm, and mechanical systems in vicinity of the work of these Sections.
 5. System Conduit Riser Drawing. Submit drawings that clearly and completely indicate the function of each Electronic Safety and Security component. Indicate termination points of devices, and interconnections required for system operation. Indicate interconnection between modules and devices. Show:

- a. Terminal cabinets.
 - b. Coordination with floor plans.
 - c. Wire runs not shown on floor plans.
 - d. Wire type.
 - e. Wire number
 - f. Wire fill.
6. Single line diagram of Electronic Security and Safety Systems. Indicate the relationship of integrated components on one diagram and show power source, system controls, impedance matches; plus number, size, identification, and maximum lengths of interconnecting wires.
- a. Show at least:
 - i. *Equipment: Function, make, model.*
 - ii. *Rack number.*
 - b. Grounding and bonding scheme
 - c. Terminal cabinets.
 - d. Coordination with floor plans.
 - e. Wire runs not shown on floor plans.
 - f. Wire fill.
 - g. Wire numbers assigned uniquely to each wire/cable.
 - h. Wire type.
 - i. Signal Type
 - j. Signal operating level or voltage (for non-optical communications).
 - k. Shield condition at both ends (float, ground, location of ground) for non-optical communications.
7. Equipment rack elevations: All racks scaled at 1-1/2" equals 1 foot, or larger.
- a. Show Equipment:
 - i. *Function.*
 - ii. *Make.*
 - iii. *Model.*

Include where rack installation included in scope of work

8. [Rack wiring drawings: For each rack, show:
- a. Power strip: Receptacles, circuiting.
 - b. Equipment.
 - c. Grounding.
 - d. Wiring, all systems.
 - e. Wiring harness scheme.]
9. Mounting details:
- a. Specific details of restraints including anchor bolts submitted under the Section 28 05 28 – Pathways for Electronic Safety and Security for mounting and maximum loading at each location, showing compliance and coordination with Code and the project Architectural, Structural and Mechanical Documents.
 - b. Stamped and signed by an Engineer licensed in the Project jurisdiction for work of this type.
 - i. *Submit an accompanying engineering analysis stamped and signed by an Engineer licensed in California for work of this type, indicating that the Equipment Enclosure System will comply with California Building Code for the Project Seismic Zone when loaded with the weight of the equipment submitted.*
 - ii. *Show calculations on drawings or in bound volume for review by Authorities having jurisdiction.*

- c. Show loads, type and strength of connections, sizes, dimensions, materials, etc.
 - d. Provide details for:
 - i. *Equipment Rack anchorage.*
 - ii. *Wall Mounted Racks and Enclosures.*
 - iii. *Cable Runway and Cable Tray*
 - iv. *Monitors, cameras or other Electronic Safety and Security Equipment with total weight, including housing and support brackets weighing 20 pounds or more.*
 - v. *Camera mounting at all conditions required by the project, including, flush, surface, pendant, corner or parapet as applies.*
10. Installation details
- a. Terminal cabinets: Draw elevations of terminal blocks corresponding to the Single Line Diagram.
 - b. Firestopping.
 - c. Details of flexible raceway connections to be made to vibrating equipment
 - d. Details of J-Box and sealant application for the typical conditions listed in Section 27 05 48 – Noise and Vibration Controls for Communications Systems.
 - e. California Access Compliance Manual and Americans with Disabilities Act (ADA) compliance.
11. Fabrication details
- a. Receptacles.
 - b. Panels.
 - c. Special mounting provisions
 - d. Legends/engraving details. Half or full size:
12. Schedules of Application
- a. An itemized list of all items of equipment to be fitted with flexible electrical connections.
 - b. Catalog cuts of the products to be applied as J-Box mastic and Acoustical Sealant, and a schedule of rooms to receive application of mastic and sealant at J-Boxes.
- G. Pre-Functional Test plan
1. Project Site Pre-Functional Test Reports:
- a. Schedule: Submit test reports in timely manner relative to Project schedule such that the University's Representative may conduct verification of submitted test data without delay of scheduled progress.
 - b. Project Site test report: Submit following system completion and prior to and as condition precedent to Acceptance Review and Testing of the Work of this Section.
 - c. Content: Include at least:
 - i. *Time and date of test.*
 - ii. *Personnel conducting test.*
 - iii. *Test equipment, including serial and date of calibration.*
 - iv. *Test object.*
 - v. *Procedure used.*
 - vi. *Results of test*
 - vii. *Numerical or graphical presentation.*
 - viii. *Electronic file in format and media directed by the University's Representative.*

- d. Submit pre-functional testing report.
2. Following submission of Prefunctional Test Reports, refer additionally to the requirements of Part 3 of this Section and of the individual Electronic Safety and Security Sections for requirement to conduct functional testing session in presence of University's Representative.

1.6 QUALITY ASSURANCE

- A. Procedures: In accordance with Section 01 45 00 - Quality Control.

Omit selected sections of the following paragraphs if no access control scope in Project

B. General Qualifications

1. Installer's Qualifications
 - a. Prior to installation, submit data of the installer's experience and qualifications. Show that the installer who will perform the work has a minimum of 2 years experience successfully installing Electronic Safety and Security Systems of the same type and design as specified herein. Include the names, locations, and points of contact, including telephone numbers, of at least two installations of the same type and design as specified herein where the installer has installed such systems.
 - b. Indicate the type of each system, including a summary written description and certify that each system has performed satisfactorily in the manner intended for a period of not less than 12 months.
2. [Instructor's Qualifications
 - a. Access control training to be provided by ACAS Manufacturer personnel. Contractor provided training will not be accepted in lieu of manufacturer provided training.
 - b. Prior to installation, submit data of the instructor's experience and qualifications. Show that the instructor, who will train operating and maintenance personnel, has received a minimum of 24 hours of IDS and access control training from a technical organization such as the National Burglar and Fire Alarm Association, and 2 years experience in the installation of IDS and access control of the type specified.
3. Access Control Systems Contractor and Installation Personnel
 - a. Contracting firm(s) and installation personnel installing the Software House C-Cure access control systems specified under the work of Division 28 shall be Factory Authorized dealers in the specified products. The Contractor for the work of Section 28 13 00, including all wiring for the work of that section shall hold a Software House Authorized Integrator status, including all persons installing or making contact with the work of that Section, including wiring, termination, labeling, testing or trouble shooting of the installed DGP's, card readers, end-of-line resistors and/or field devices.
 - b. Installation personnel of the Authorized Integrator installing the Software House C-Cure access control systems specified under the work of Division 28 shall have received factory training to install and program the specified hardware, including the manufacturer's Advanced Installer class for C-Cure 9000 installation and shall hold a current certificate for same from the manufacturer. Contractor to provide copies of the installer certificates prior to commencing work on site.]

Omit the following for small projects less the \$15,000 in construction cost

- C. [Designated Supervisor: Provide a designated supervisor present and in responsible charge in the fabrication shop and on the Project Site during all phases of installation and testing of the Work of this Section. This supervisor shall be the same individual through the execution of the Work unless illness, loss of personnel, or other circumstances reasonably beyond the control of the Contractor intervene.]
- D. Reference Documents: At all times when the work is in progress, maintain at the workplace, fabrication shop or Project Site as applies.
 - 1. A copy of the conformed design team prepared Bid Set.
 - 2. A complete set of the latest stamped, actioned submittals of record.
 - 3. A complete set of manufacturer's original operation, instruction and service manuals for each equipment item.
- E. Test Equipment
 - 1. Requirements:
 - a. Maintain and operate test equipment at the fabrication shop and the job site for both routine and Acceptance Testing of the Work of this Section.
 - b. Maintain test equipment at the job site while work is in progress from installation of equipment racks until University Acceptance of this Work; thereafter remove all of this test equipment from the job site.
 - c. Unless otherwise indicated, test equipment shall remain property of the Contractor.
 - d. Provide all required test cables, jigs and adapters.
 - e. Provide equipment with traceable calibration, with calibration date not greater than one year prior to the date of the use of the equipment to perform the specified testing.
 - 2. Equipment: Specified in individual Sections.

1.7 REGULATORY REQUIREMENTS

- A. Regulations Applicable: Including but not limited to those defined in Section 01 41 00 - Regulatory Requirements.
 - 1. Nothing in the Contract Documents shall be construed to permit Work not conforming to applicable laws, ordinances, rules, or regulations.
 - 2. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the University's Representative. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.
- B. Refer elsewhere in this Section for reference Standards applicable to work of the Project.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Procedures:
 - 1. In accordance with Section 01 60 00 – Product Requirements and as specified in the individual Electronic Safety and Security Systems sections.
 - 2. General
 - a. Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for cabling and equipment placed in storage.

1.9 ENVIRONMENTAL REQUIREMENTS

Amend to match the expected jobsite conditions

- A. [Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, non-condensing.
- B. Active components shall installed indoors be rated for operation under ambient conditions of 32 to 100 degrees F and in the range of 0 to 95 percent relative humidity, non-condensing]

1.10 SEQUENCING

Edit to match Project Requirements

- A. [Comply with Section 01 10 00 - Summary and Section 01 32 16 – Progress Schedules and the following:
 - 1.

1.11 OPERATING AND MAINTENANCE DATA

- A. Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance of custom parts and assemblies, and for any products submitted as substitution of the design basis products as a part of the Electronic Safety and Security system. Precede the manuals with a systems narrative specific to this Project, outlining the major systems functionality, the major systems components, and identifying which manuals document the performance of which subsystems.
 - 1. Submit operations and maintenance data in accordance with Section 01 78 30 - Guarantees Bonds Service and Maintenance Contracts and as specified herein not later than 2 months prior to the date of beneficial occupancy.
- B. Spare Parts
 - 1. In addition to the requirements of Section 01 78 30 - Guarantees Bonds Service and Maintenance Contracts, provide a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking.

1.12 PROJECT RECORD DOCUMENTS

- A. Comply with 01 77 00 - Closeout Procedure, and the following.
 - 1. Record Drawings
 - a. Content
 - i. *Provide a least as required for the Shop and Installation Drawings defined elsewhere in this Section.*
 - ii. *Contractor shall be responsible for updating building and Electronic Safety and Security plans to reflect as-built conditions.*
 - iii. *Indicate actual work on Drawings; indicate actual products used, replace vendor neutral nomenclature used in bid set with makes and models of actual installed devices.*
 - b. CAD

- i. Use a computer aided drafting (CAD) system in the preparation of record drawings for this Project. CAD system shall produce files in AutoCAD® .DWG format, latest release at time of Project bid closure. Campus Standard, no substitution permitted.
 - ii. Except where prohibited by Contract, University's Representative will furnish CAD backgrounds in AutoCAD® .DWG format, for use by the Contractor in preparing Record Drawings.
 - iii. Electronic copy of Record Drawings: Provide electronic copies of each drawing file in the format noted above. Submit on in the format required by Division 1.
- c. Reproducibles: As specified in Division 1.

1.13 CLOSEOUT

- A. Punch List: Perform any and all remedial work, at no claim for additional cost or time. Where required, retest and submit Test Report. Notify the University's Representative of completion of Punch List.
- B. Portable Equipment: Furnish all portable equipment and spares to the University's Representative, along with complete documentation of the materials presented. Where applicable, furnish portable equipment in the original manufacturer's packing.
- C. Operating and Maintenance Data: Install framed operating and maintenance instructions. Submit Manuals.
- D. Project Record Documents: Submit print and digital copies. Digital files shall be in AutoCAD .dwg format, latest release at time of Project bidding.
- E. Keys: If applicable, replace construction locks with permanent locks. Provide 5 sets of keys to the University's Representative.
- F. Instruction: Conduct specified instruction.
- G. Warranty: Submit Warranty dated to run from date of Substantial Completion of the Project.

1.14 WARRANTY SERVICE

- A. In addition to provisions of 01 78 30 - Guarantees Bonds Service and Maintenance Contracts, provide the following.

Edit the requirements to match the Project scope

1. Response Time:
 - a. Provide a technician who is both familiar with the work at the Project Site and, for Access Control Systems issues, is one of the Contractor's C-Cure factory certified staff, on the job site within 24 hours after receipt of a notice of non-emergency malfunction.
 - b. Contractor to respond to calls within 2 hours and provide a technician who is both familiar with the work at the Project Site and, for Access Control Systems issues, is one of the Contractor's C-Cure factory certified staff, on the job site within 4 hours after receipt of a notice of an emergency malfunction, unless the problem has already been resolved

- remotely. An emergency malfunction is defined as one causing one or more access controlled gate(s) or door openings to a secured area to be rendered either inaccessible or unsecured.
- c. The malfunctioning ACAS or Visual Surveillance System shall be restored to proper operating condition after one (1) calendar day.]
 - d. Provide the University's Representative with telephone number attended 8 hours a day, 7 days a week, to be called in the event of a malfunction.
2. Materials installed during warranty service to match or exceed specification of products originally installed for the specified function.
- B. Provide all additional Warranties as defined in each Electronic Safety and Security Systems Section.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Standard Products
- 1. Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section. All components must be of new condition, used or reconditioned products will not be accepted.
 - a. Alternative Qualifications. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished. Contractor submittal of subject of Alternative Qualifications shall incorporate in their submittal a written description of the installation in a comparable condition to that of the work of the Project and shall provide a telephone contact number for an Owner's representative able to discuss the satisfactory performance of the components being submitted.
- B. Material and Equipment Manufacturing Date
- 1. Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.
 - 2. Unless recycled content is specified, provide new materials.
- C. Where a particular material, device, piece of equipment or system is specified directly, the current manufacturer's specification for the same shall be considered to be a part of these specifications, as if completely contained herein in every detail.
- D. Each material, device or piece of equipment shall comply with all of the manufacturer's current published specifications for that item.
- E. Provide quantity as shown on Contract Drawings, or as otherwise indicated.

- F. Provide all auxiliary and incidental materials and equipment necessary for the operation and protection of the Work of this Section as if specified in full herein.
- G. In the event the specified product is no longer in manufacture, provide the manufacturer's latest design/model of equivalent functionality, permanently labeled with the manufacturer's name, model number and serial number.
- H. Where products are of similar type or use, provide products of the same manufacturer, unless otherwise indicated.
- I. All devices provided under the Work of this Section which are connected to the Project electrical system shall be listed by a Nationally Recognized Testing Laboratory, and shall be so labeled.
- J. Components
 - 1. NRTL certified. Cabling and interconnecting hardware and components for Electronic Safety and Security systems shall be NRTL or third party independent testing laboratory certified, and shall comply with NFPA 70 and conform to the requirements specified herein.
 - 2. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, submit proof of such compliance.
 - a. The label or listing by the specified organization will be acceptable evidence of compliance.
 - b. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the University's Representative.
 - c. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.
- K. Enclosures:
 - 1. Provide steel frames and enclosures designed and wired to eliminate all induced currents.
 - 2. Make bolted connections with self-locking devices.
 - 3. All enclosures should be appropriate to environment of installation – refer to the requirements of Section 28 05 28 – Pathways for Electronic Safety and Security.
- L. Finishes: Any item or component of the Work of this Section which is visible shall comply with the following.
 - 1. Finishes noted or scheduled on the Contract Drawings take precedence.
 - 2. Where design location requires that products, materials or equipment are visible to the public, no manufacturer's logos larger than 1/2 inch shall be visible. Unless otherwise noted or directed, neatly remove or permanently paint out such logos.
 - 3. Where finishes are not noted or otherwise defined in the Contract Documents, submit manufacturer's standard finish samples for selection by the University's Representative.

2.2 LABELING

- A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
- B. Unless otherwise indicated, provide black text on a white background.
- C. Shall be preprinted or computer printed type. Hand written labels are not acceptable.

- D. Manufacturers
 - 1. Brother P-Touch
 - 2. Brady
 - 3. Or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine existing conditions before starting work. Submit conflicts in a timely manner for resolution

3.2 GENERAL

- A. Conform to UL 681, UL 1037, and UL 1076, the appropriate installation manual and the requirements of each specification section for each equipment type, whichever is most restrictive. Components within the system shall be configured with appropriate "service points" to pinpoint system trouble in less than 20 minutes.

3.3 PREPARATION

- A. Prepare and sequence the work to minimize disruption to each room environment and any existing Electronic Safety and Security systems.
- B. Protection: Cover all computers, electronic equipment, desks, chairs, furniture and other articles when working at ceiling level and/or performing dust producing tasks.

3.4 LABELING

- A. Field devices: Each Electronic Security System initiating device and each annunciating device shall be labeled with the assigned C-Cure ID.
 - 1. The ID shall incorporate the device abbreviation, the architectural door number and a sequential number assigned to each device of the same type occurring at the door opening in the form Door Number - Device Abbreviation – Sequential Number - .
 - a. Example: One LA at door number 101A: 101A-LA-1.
 - b. Example: Two DO's at door 121: 121-DO-1, 121-DO-2.
 - 2. Apply label to an unobtrusive spot on the device, cut to minimum practical size before applying.
- B. Panels. Attach to the interior of each control a panel clear plastic holder in this holder place a laser printed list of the door and card reader relay points zone numbers and other signals that may be transmitted to the central station, the type of device, exactly what the alarm and restoral signals indicate. This list shall be typed on 8-½" x 11" paper provide a copy of these list(s) in Microsoft Word on electronic media format delivered to the University's Representative.

3.5 REPAIR AND RESTORATION

- A. Where working in spaces occupied by the University, return to their original positions any furniture or articles relocated to perform the work.

3.6 CLEANING

- A. Where working in spaces occupied by the University:
 - 1. Immediately after completing work within each space, clean up and remove all materials, scrap and dust.
 - 2. All scrap material in work area shall be picked up and removed from the building at the end of each day. See also Division 1 for additional requirements.
 - 3. All dust resulting from work performed shall be vacuumed up daily.
 - 4. All scrap material shall be removed from Campus and disposed of in an authorized disposal site. Refer to Section 01 74 19 - Construction Waste Management and Disposal.

3.7 SYSTEMS PERFORMANCE TESTING AND ADJUSTING PROCEDURES

- A. General Procedures
 - 1. It shall be the responsibility of the Security Contractor to demonstrate to the University's Representative that the security system is complete and functional as per these specifications. For intrusion detection field devices test shall ensure that the requisite degree of intrusion detection is provided.
 - 2. Acceptance testing shall be scheduled by the Security Contractor through established project channels
 - 3. Furnish all necessary instruments and equipment required for conducting tests.
- B. Device Level Tests
 - 1. Initially, test each sensor and subsystem component individually.
 - 2. Test all wire for shorts, open circuits, or grounding.
 - 3. Immediately correct any defective work
- C. Systems Tests.
 - 1. When the function of each component within a particular subsystem such as each sensor within a particular zone is verified, certify that subsystem of the entire Electronic Safety and Security System is satisfactorily meeting required specifications. Test each subsystem similarly until each detection zone has been certified.
 - 2. When subsystem certification is complete, test entire integrated system to ensure that subsystem elements are compatible and function as a complete system. Integrated system test shall be accomplished in linear fashion, end-to-end, and shall verify that each simulated intrusion performed within each detection zone produces an appropriate alarm or signal.
 - 3. Integrated system test shall also verify that alarm is correctly annunciated at the terminal block associated with the field devices,
- D. Contractor Testing
 - 1. Provide for approval, not later than 30 days prior to formal inspection and test, a detailed operational test plan of how each component, subsystem, and entire Electronic Safety and Security System will be tested.

2. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% tested and approved. Submit prior to request for final payment.
3. Test each individual circuit and device for proper operation in the presence of telecommunications personnel. Correct all failures and retest at contractors expense to verify corrections. Correct as built drawings, O & M manuals, programming sheets and system programming to reflect the University's final occupancy room numbers.
4. Provide University's Acceptance Form with a check box associated with each card reader and input point. A check mark in the box will indicate that each point has been correctly installed and that communication between the controller and the server has been established. This form shall be completed prior to University acceptance of the system.

3.8 COMMISSIONING AND ACCEPTANCE

- A. General:
 1. Upon completion of the work, remove excess debris, materials, equipment, apparatus, tools and similar items. Leave the premises clean, neat and orderly.
- B. Results Expected:
 1. Electronic Security Systems shall be complete and ready for use.
 2. Testing, start-up and cleaning work shall be complete.
 3. Maintenance Materials: Special tools for proper operation and maintenance of the equipment provided under this Specification shall be delivered to the University.
- C. Inspections
 1. There shall be three phases of commissioning inspections:
 - a. Rough-in inspection
 - b. Above-ceiling inspection (after cables are placed)
 - c. Final inspection and testing
 2. The Contractor shall verify that the installation and materials used have been inspected before they are enclosed within building features, or otherwise hidden from view. The Contractor shall bear costs associated with uncovering or exposing installations or features that have not been inspected and approved.
- D. Rough-in inspection. Once electrical rough-in and pathways have been installed, but prior to walls and ceilings being installed, the Contractor shall request of the University's Representative, in writing, for the official rough-in inspection to take place. The University's Representative will then schedule a time to be on-site to conduct this inspection.
 1. At a minimum, the University's Representative will evaluate the following items:
 - a. Accurate location and height above finished floor for all outlet boxes.
 - b. Accurate dimensions (particularly depth) of all outlet boxes and diameter of in-wall conduit serving outlet boxes.
 - c. Gutter size, location and clearance.
 - d. Location and size of all other electronic security systems conduits or pathways.
 - e. Location, spacing and clearance of and around electronic security systems racks and wall-mounted equipment.
 - f. That electronic security systems hard wired power and power receptacles, where installed under the work of this project, meet the design requirements.

2. The University's Representative is then to issue a written report to the Contractor identifying all items which currently do not meet the construction document requirements. All items are to be resolved prior to walls and ceilings being closed up. This report is not necessarily all-inclusive; should issues be discovered later in the project, the Contractor is still responsible for corrections/repairs.
- E. Above-ceiling and Camera Placement Inspection
1. Once all electronic security systems cabling has been installed and properly supported and suspended light fixtures hung, but prior to the installation of ceiling tiles/material, contractor shall request of the University's Representative, in writing, for the official above-ceiling and final camera placement inspection. The University's Representative will then schedule a time to be on-site to conduct this inspection.
 - a. Prior to the walk, the Contractor is to apply colored tape indicating proposed camera installation locations for field review.
 2. At a minimum, the University's Representative will evaluate the following items:
 - a. That the camera locations can provide the required field of view.
 - b. That all items from the previous inspection have been corrected.
 - c. That electronic security systems cabling is routed correctly and adequately supported.
 - d. That electronic security systems cabling is not painted or over-sprayed.
 - e. That the installed electronic security systems cabling matches what was specified/submitted.
 - f. That there are no kinks, splices, or other damage to the installed electronic security systems cabling.
 - g. That all field devices are properly supported, oriented and labeled.
 - h. That all penetrations through fire-rated walls are properly firestopped, including fire blocking materials installed in the annular spaces; and that the firestops are properly labeled.
 3. The University's Representative is then to issue a written report to the Contractor identifying all items which currently do not meet the construction document requirements. This report is not necessarily all-inclusive; should issues be discovered later in the project, the appropriate communications subcontractor is still responsible for corrections/repairs.
- F. Acceptance Review and Testing Procedures
1. The University's Representative will witness formal Acceptance Tests after receipt of written certification that all prior Punch List work is complete and that Contractor's functionality tests have been completed and that system is ready for final inspection. This request shall be made 3 weeks before substantial completion. The University's Representative will then schedule a time to be on-site to conduct this inspection.
 2. The Contractor shall provide the following for the acceptance testing.
 - a. Personnel: Provide services of the designated supervisor, ACAS manufacturer representative and additional manufacturer qualified technicians familiar with work of this Project. Provide quantity of technicians as required to comply with Project Schedule.
 - b. All tools appropriate for performance of adjustment of and corrections to this Work. Include spare wire and connectors and specified tooling for application.
 - c. Ladders, scaffolding and/or lifts as required to access high devices.
 - d. All test equipment.
 - e. Complete set of latest stamped, actioned submittals of record for reference.

- f. Complete set of Test Reports.
- g. Complete set of manufacturer's original operation, instruction and service manuals for each equipment item for reference.
- 3. The Contractor shall execute the test plan required in Submittals section and as approved and/or modified by the University's Representative. The testing must demonstrate complete operation of all systems and equipment, including any portable equipment.
- 4. These procedures may be performed at any hour of the day or night as required by the University's Representative to comply with the Project Schedule and avoid conflict with University staff or student activities. Provide all specified personnel and equipment at any time without claim for additional cost or time.
- 5. At a minimum, the University's Representative will check the following items:
 - a. Mechanical/Physical Installation.
 - i. *That all items from the previous inspections have been corrected.*
 - ii. *That all electronic security systems equipment and cabling terminal rooms is installed per the contract documents, including all required terminal blocks, pull boxes, termination resistors and electronic security systems grounding.*
 - iii. *All other items necessary to guarantee contract documents are met and complete and functioning communications systems are installed.*
 - iv. *All cables and electronic security systems field devices and pathway are properly labeled.*
 - v. *All penetrations through fire-rated walls are properly fire-stopped, including fire blocking materials installed in the annular spaces; and that the firestops are properly labeled.*
 - b. Functionality Demonstration
 - i. *Demonstrate functionality of each installed device is consistent with the read range, sensitivity and immunity to false alarms as specified by the device manufacturer.*
 - ii. *Functional demonstration to also include, but not limited to the following active components and all related items installed under the work of the project:*
 - (1) *Batteries*
 - (2) *Cameras*
 - (3) *Card readers*
 - (4) *Door position sensors*
 - (5) *Duress alarm components*
 - (6) *Electrified hinges*
 - (7) *Electrified latches*
 - (8) *Electrified strikes*
 - (9) *Glass break sensors*
 - (10) *Key pad controllers*
 - (11) *Local alarm devices*
 - (12) *Motion detectors*
 - (13) *Power supplies*
 - (14) *Relays*
 - (15) *Request to exit devices*

- (16) Servers
- (17) Switches
- (18) UPS devices

- 6. Access Control Infrastructure:
 - a. Demonstrate that operation of each opening, including access controlled doors and gates. Refer to the System Performance Requirements and Schedule of Programmatic Outcomes by Door Opening in Section 28 13 00 – Access Control and Alarm Systems is in full conformance with the specified functionality, including each C-Cure status item associated with the scheduled UCSC Door Class.
 - 7. Door Position, Window and Hatch Switches
 - a. Demonstrate functionality of each device. Demonstrate that operation of each monitored door by 1/2" or less from the fully closed position causes the position switch to change state.
 - 8. Uninterrupted Power Systems:
 - a. Disconnect normal power service. Demonstrate that the system remains in full operation for the specified time.
- G. Adjust: As directed by the University's Representative.

3.9 POST ACCEPTANCE TEST REMEDIATION

- A. Temporary Equipment: Provide and operate, without claim for additional cost or time, temporary equipment and/or systems to provide reasonably equivalent function, as determined by the University's Representative, in place of the Work of this Section which is incomplete or found not in conformance with the Contract Documents as of seven (7) days prior to the scheduled completion date. Provide such temporary equipment until Acceptance of the Work of this Section. Thereafter, remove such temporary equipment.
- B. Correct:
 - 1. In timely manner, correct identified Work of this Section which is incomplete or found not in conformance with the Contract Documents to comply with the Contract Documents, as reasonably determined by the University's Representative.
 - 2. Conduct additional tests to in the presence of the University's representative to demonstrate that system conforms to the Contract Documents.

END OF SECTION 28 05 00

Section 28 05 13

CONDUCTORS AND CABLES FOR ELECTRIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Defines wiring standards for work of Electronic Safety and Security Systems

The Division 27 references below assume that Structured Cabling systems conforming to current UCSC ITS standards are being specified in Division 27. If not, preserve the equivalent language in this Section.

- B. Related Work Under Other Sections
1. [Section 27 10 00 – Structured Cabling, Basic Materials & Methods
 - a. Defines standards and methods for termination of IP-based cabling used for IP cameras and IP work area outlets necessary to support access control systems installed under the work of Division 28.
 2. Section 27 15 00 – Communications Horizontal Cabling
 - a. Defines materials and execution standards for installation of TIA/ANSI standard category media installed under the work of Division 27 to provide work area outlets for final connection by the work of Division 28 to cameras and IP alarm system panels.]
 3. Section 28 05 00 – Common Work Results for Electronic Safety and Security.
 4. Section 28 05 26 – Grounding and Bonding For Electronic Safety And Security
 5. Section 28 05 28 – Pathways for Electronic Safety And Security
 6. Section 28 13 00 – Access Control and Alarm Systems

1.2 SUBMITTALS

- A. Refer to the requirements of Section 01 33 23 – Shop Drawings, Product Data and Samples and Section 28 05 00 – Common Work Results for Electronic Safety and Security.

1.3 REFERENCES:

- A. Usage: In accordance with Division 1.
- B. American Society For Testing and Materials (ASTM)
1. ASTM A228/A228M-02 Steel Wire, Music Spring Quality.
 2. ASTM D 709(2001) Laminated Thermosetting Materials
- C. Federal Communications Commission (FCC)
1. The Code of Federal Regulations, Title 47, Telecommunications, Chapter 1 - FCC Part 68 (1982 issue or latest revision) (47 CFR 68) .
- D. Institute of Electrical and Electronic Engineers
1. IEEE 383-2003 Standard for Qualifying Class 1E Electric Cables and Field Splices for Nuclear Power Generating Stations
 2. IEEE 100-00 The Authoritative Dictionary of IEEE Standards Terms
- E. Insulated Cable Engineers Association (ICEA)
1. ICEA S-56-434 (1983, 5th Ed.) Reaffirmed October 18, 1991 Polyolefin Insulated Communication Cables for Outdoor Use.
 2. ANSI/ICEA S-83-596-2011 Indoor Optical Fiber Cables

3. ANSI/ICEA S-84-608-2010 Telecommunications Cable, Filled Polyolefin Insulated Copper Conductor
4. ANSI/ICEA S-86-634-2011 Buried Distribution & Service Wire, Filled Polyolefin Insulated, Copper Conductor.
5. ANSI/ICEA S-87-640-2011 Fiber Optic Outside Plant Communications Cable
6. ICEA S-102-700-2004 – ICEA Standard For Category 6 Individually Unshielded Twisted Pair Indoor Cables (With Or Without An Overall Shield) For Use In Communications Wiring Systems Technical Requirements
7. ICEA S-103-701-2011 Riser Cables Technical Requirements
- F. National Electrical Manufacturers Association (NEMA)
 1. NEMA WC 63.1(2000) Twisted Pair Premise Voice and Data Communications Cables
- G. National Fire Protection Association (NFPA)
 1. NFPA 70 National Electrical Code
- H. Telecommunications Industry Association (ANSI/TIA)
 1. ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises
 2. ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard, 2009
 3. ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunication Cabling and Components Standard, published 2009
 4. ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard, published 2008, including errata issued in October, 2008.
 5. ANSI/TIA 569-C (2012) Telecommunications Pathways and Spaces
 6. ANSI/TIA-606-B (2012) Administration Standard Telecommunications Infrastructure
 7. ANSI- J-STD-607-B (2011) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- I. Underwriters Laboratories, Inc. (UL)
 1. UL 444(2002; Bul. 2002, 2003) Communications Cables
 2. UL 910(1998) Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air
 3. UL 1286(1999; R 2004) Office Furnishings
 4. UL 1581 Reference Standard for Electrical Wires, Cables, and Flexible Cords. Oct. 2001
 5. UL 1666(2000; R 2002) Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
 6. UL 1863(2000; R 2004) Communications Circuit Accessories
 7. UL 969 (1995; R 201) Marking and Labeling Systems

1.4 DELIVERY, STORAGE AND HANDLING

- A. Comply with requirements of Division 1, Section 27 05 00 – Common Work Results for Communications and the following:
- B. Shipping Conditions:
 1. All cable shall be shipped on reels or manufacturer supplied “handy boxes”.
 2. The diameter of the drum shall be at least 13 times the diameter of the cable.
 3. The reels shall be substantial and so constructed as to prevent damage during shipment and handling.
 4. Secure the outer end of the cable to the reel head so as to prevent the cable from becoming loose in transit.
 5. Project the inner end of the cable into a slot in the side of the reel, or into a housing on the inner slot of the drum, in such a manner and with sufficient length to make it available for testing.

6. The inner end shall be fastened so as to prevent the cable from becoming loose during installation. End seals shall be applied to each of the cables to prevent moisture from entering the cable.
- C. Storage:
1. Do not roll or store cable reels without an appropriate underlay.
 2. Retain factory cable protection until installation. Supplement with heavy gauge plastic sheeting if factory protective membrane is pierced prior to installation. Tape ends and seams water and dust tight.
 3. The reels with cable shall be suitable for outside storage conditions when the temperature ranges from minus 40 degrees C to plus 65 degrees C, with relative humidity from 0 to 100 percent.
 4. Protect cable reels from physical damage from site construction vehicles or from settling into the soil.
 5. Equipment, other than outside plant rated cable protected with fully watertight cable caps, to be delivered and placed in storage, suitably protected from the weather, humidity and temperature variation, dirt and dust, or other contaminants.
- D. Handling
1. Cabling other than outside plant cabling exposed to standing water or other liquids at any time during storage, delivery or placement shall be replaced at no expense to the University.
 2. Cut ends of outside plant rated cabling or portions of outside plant rated cable with a damaged jacket shall not be exposed to standing water or other liquids at any time during storage, delivery or placement. Where such conditions occur, the University's representative may require that the cable be replaced at no cost to the University.

1.5 SEQUENCING

- A. Coordinate the installation of the horizontal cabling with the other work of this Project, or Projects simultaneously in progress in each building of the project. The Contractor shall ensure that construction and preparation of the rooms and spaces in which the work of this Section are to be installed are sufficiently complete before beginning work.
- B. Removal, replacement and re-installation of materials and equipment required to permit the completion or correction of other building trade work that is the work of this Project shall be done at no cost to the University or impact to the project schedule.

Include the next two subsections where work of the Project has no Division 27 spec and relies on this Section to install station cabling supporting the TCP/IP cameras and/or DGP uplink signaling.

1.6 Category rated cable PERFORMANCE STANDARDS

- A. Horizontal (Station) Category 6 Copper Cabling – Permanent Link
 1. Testing shall commence while the University's equipment in the area of service is operational and creating worst case emissions associated with its operation while in good working order. Every effort shall be made to include worst case influence on the materials install shall be taken.
 2. In accordance with the field test specifications defined in ANSI/TIA-568-C.2 "Commercial Balanced Twisted-Pair Telecommunications Cabling and Components Standard", every horizontal station cabling link in the project shall be tested for:

- a. Wire Map
 - b. Length
 - c. Insertion Loss
 - d. NEXT Loss
 - e. PS NEXT Loss
 - f. ACR-F Loss
 - g. PS ACR-F Loss
 - h. Return Loss
 - i. Propagation Delay
 - j. Delay Skew
3. Using the listed Category 6 cable test set, test installed cabling using Permanent Link procedure and submit report demonstrating that the link meets the following parameters:

Frequency (MHz)	Insertion Loss	NEXT (Worst pair to pair)	Power Sum NEXT	ELFEXT (Worst pair to pair)	Power Sum ELFEXT	Return Loss
1.0	2.0	79.3	77.3	72.8	69.8	20.0
4.0	3.8	70.3	68.3	60.7	57.7	23.6
10.0	5.9	64.3	62.3	52.8	49.8	26.0
16.0	7.5	61.3	59.3	48.7	45.7	26.0
20.0	8.4	59.8	57.8	46.7	43.7	26.0
31.3	10.6	56.9	54.9	42.9	39.9	25.0
62.5	15.3	52.4	50.4	36.8	33.8	23.5
100.0	19.7	49.3	47.3	32.8	29.8	22.5
150.0	24.7	48.7	44.7	29.3	26.3	21.6
200.0	29	44.8	42.8	26.8	23.8	21.0
250.0	32.6	43.3	41.3	24.8	21.8	20.5

- a. Each permanent link shall demonstrate a positive PSACR beyond 350 MHz to meet and exceed the bandwidth requirements of TIA-568-C.2 Category 6 standards. Each permanent link shall demonstrate 2 dB of cross talk headroom over TIA-568-C.2 Category 6 standard for NEXT, PSNEXT, ELFEXT and PSELFEXT bit error rate.
4. Report whether tested link passes or fails
 5. Note exceptions to required Category standards. Remedy and retest

1.7 Category rated cable TESTING

A. General

1. In addition to the tests detailed in this specification section, the contractor shall notify the University's Representative of any additional tests that are deemed necessary to guarantee a fully functional system. The contractor shall carry out and record any additional measurement results at no additional charge
2. Test and report on each intermediate cabling segment separately, including station cabling, horizontal distribution (each segment, if multiple) and telecommunications room wiring.
3. Test each end to end cable link.

4. Submit machine-generated documentation and raw data of all test results on Contractor-provided, and University's Representative approved, forms; and in electronic format approved by the University's Representative.
 5. Provide machine-generated data on an appropriate disk media (CD-ROM CD-R format) to be transferred to the University's computers.
 - a. Where the machine-generated documentation requires use of a proprietary computer program to view the data, provide the University with 1 licensed copy of the software.
 6. Provide registered testing software used for the actual tests to the University for review of test data.
- B. Test Equipment:
1. Test systems using at least one (1) each of the following test measurement devices or their functional equivalents:
 - a. Level III field testers as defined in ANSI/TIA-1152 - Fluke DX-1800, Agilent or equal.
 - i. *The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table 4 of ANSI/TIA-1152 (Table 4 in this TIA document also specifies the accuracy requirements for the Channel configuration).*
 - ii. *The RJ45 test plug shall fall within the values specified in ANSI/TIA-568-C Annex C for NEXT, FEXT and Return Loss.*
 - iii. *The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.*
 - b. Site portable communications systems (walkie-talkie, cell phone or similar).
 - c. Any other items of equipment or materials required to demonstrate conformance with the Contract Documents.
- C. Station Wiring, General
1. Test station wire only after all pairs of station wire in a work area have been terminated at both ends, and no work of this Section or other Sections may cause physical disturbance to the wiring.
 2. Correct any and all transpositions found. Retest.
 3. If any conductor in a station wire tests either open or short, then the entire station wire is to be removed, replaced, and re-tested.
- D. Inside Category 6 Cabling.
1. Using the listed Category 6 cable test set, test and submit report on the parameters specified for Category 6 cabling in this Section. Report whether tested link passes or fails the Category 6 standards. Cables must pass TIA Permanent Link Certification for the cable type being installed. A "Marginal" test result will not be accepted.
 2. Note exceptions to required Category standards. Remedy and retest.]

PART 2 - PRODUCTS

2.1 NON-CATEGORY RATED CABLING

A. General

1. Where not otherwise specified or indicated, conform to manufacturers most stringent recommendations with respect to pair count, gage, conductor construction and shielding for indicated run length.
2. Conform to Code requirements with respect to acceptable jacket construction for each application and condition. Provide NEC/CEC CMP listed cable construction at plenum at environmental air and underfloor applications.
3. Analog Video Cabling, Copper Coax and Related. Provide cable with electrical conductors of soft drawn annealed copper, bare or tinned, solid or concentric stranded as applies, conductivity not less than 98% of pure copper. Comply with applicable Code for insulation, jacket, marking and listing for applicable use.
4. Manufacturers:
 - a. Alpha
 - b. Belden
 - c. Commscope/Isotec
 - d. West Penn
 - e. or equal.

B. Card Reader Cabling

1. Construction:
 - a. Conform to Code requirements with respect to acceptable jacket construction for each application and condition
 - b. 4 pair
 - c. 22 ga. minimum
 - d. Overall foil shield with drain wire.
 - e. Manufacturers:
 - i. *Belden*
 - ii. *Alpha*
 - iii. *Commscope/Isotec*
 - iv. *West Penn*
 - v. *or equal.*

Omit where work of the Project has no Division 27 spec and relies on this Section to install station cabling.

f. [Manufacturers, Alternate Construction:

- i. *Provide Category 6 cabling as specified in Section 27 15 00.]*

C. Release Button, Door Switch

1. 2 stranded conductors, 22-18 gauge minimum
2. Manufacturers:
 - a. Belden 8442, 8461, 5300UE, 5500UE, 6300UE, 6500UE
 - b. Alpha
 - c. Commscope/Isotec
 - d. West Penn
 - e. or equal.

D. Request to Exit, Motion Detector, Glass Break

1. 4 stranded conductors, 22-18 gauge minimum

2. Manufacturers:
 - a. Belden 5302UE, 5502UE, 6302UE, 6502UE
 - b. Alpha
 - c. Commscope/Isotec
 - d. West Penn
 - e. or equal.
- E. Combination dual detector
 1. 6 stranded conductors, 22-18 gauge minimum
 2. Manufacturers:
 - a. Belden 5304UE, 5504UE, 6304UE, 6504UE
 - b. Alpha
 - c. Commscope/Isotec
 - d. West Penn
 - e. or equal.
- F. Lock Power and General Low Voltage Power, Indoor Applications
 1. 2 stranded conductors, 16-18 gauge minimum. Size to exceed manufacturer's minimum recommendations for voltage drop for required run lengths.
 2. Manufacturers:
 - a. Belden 5300UE, 5200UE, 6300UE, 6200UE
 - b. Alpha
 - c. Commscope/Isotec
 - d. West Penn
 - e. or equal.
- G. RS-232 Cabling
 1. At least 2-3 pairs, actual pair count as required by interface.
 2. 22 gauge minimum, paired construction.
 3. Overall foil shield with drain wire
 4. Manufacturers:
 - a. Belden 9855, 89855
 - b. Alpha
 - c. Commscope/Isotec
 - d. West Penn
 - e. or equal.
- H. RS-485 Cabling
 1. At least 2 pairs, or as required by interface.
 2. 18 gauge minimum, paired construction.
 3. Overall foil and braid shield with drain wire
 4. Manufacturers:
 - a. Belden 9842, 82842
 - b. Alpha
 - c. Commscope/Isotec
 - d. West Penn
 - e. or equal.
- I. Control Cabling, Underground, in ducts
 1. As specified for the applications above with waterblocking construction consisting of two ply tape designed to swell on exposure to water.
 2. Jacket is sunlight and moisture resistant
 3. NEC CM or CL3 listed or better. Transition to listed cabling type within 50 feet of entering building.

4. Manufacturer listed for underground application subject to extended exposure to standing water.
 5. Manufacturer:
 - a. West Penn Aquaseal
 - b. Alpha
 - c. Belden
 - d. Commscope/Isotec
 - e. or equal.
- J. Cable, Precision Video:
1. Drawing Reference: PVideo.
 2. Description: 100% sweep tested (0.01 to 100 MHz) double braided shield solid center conductor 75 ohms coaxial precision video cable.
 3. Performance:
 - a. Cable Type: Coaxial precision video.
 - b. Center Conductor AWG: At least twenty (20) bare copper. Copper clad steel center conductors not acceptable. Increase gauge for longer runs as recommended by camera manufacturer.
 - c. Jacket
 - i. *Underground: Flooded, waterblocked. Suitable for continuous immersion in water.*
 - ii. *Riser and General Applications:*
 - iii. *Underfloor and in environmental airspace: Plenum*
 - d. Insulation: Polyethylene.
 - e. Shield: Tinned copper double braid, 95% coverage.
 - f. Nominal Impedance: 75 ohms.
 - g. Velocity of Propagation: at least 66%.
 - h. Maximum Attenuation Per 100':
 - i. *1 MHz: 0.25 dB*
 - ii. *4.5 MHz: 0.45 dB.*
 - iii. *10 MHz: 0.78 dB.*
 4. Jacket: Polyethylene.
 5. Diameter: 0.305" maximum.
 6. Manufacturers
 - a. Interior Application
 - i. *Belden 8281A, 8281B, 543945, 643948*
 - ii. *Commscope/Isotek IR201V59*
 - iii. *West Penn*
 - iv. *or equal*
 - b. Underground Outside Plant, as for above with flooded jacket, at least NEC CM rating.
 - i. *Belden 5339W5*
 - ii. *Commscope/Isotek*
 - iii. *West Penn*
 - iv. *or equal*
 - c. Siamese cabling with specified coaxial cable and integral camera control cabling:
 - i. *Belden*
 - ii. *Commscope/Isotek*
 - iii. *West Penn*

iv. *or equal*

Include the next subsection where work of the Project has no Division 27 spec and relies on this Section to install station cabling.

2.2 STRUCTURED CABLING

A. General

1. Provide horizontal cable in compliance with NFPA 70 and performance characteristics in accordance with TIA/EIA-568-C
2. UCSC has established an installed product set for the campus IT systems. It is the intention of UCSC ITS to continue the use of the established product set to match existing. The first-named product in these specifications is the basis for the design. Substitutions which are equal in quality, utility, and appearance to those specified must be submitted and meet all requirements of Division 01 specification section 01 25 00 Substitution Procedures.

B. Definitions

1. Keystone Opening: A communications industry standard rectangular opening in a wall plate or patch panel having nominal dimensions of 0.58" wide and .76" high and designed to securely mount industry standard keystone jacks.

C. Intervendor compatibility

1. Keystone Jack Compatibility test.
 - a. Any jack or panel system proposed as meeting the keystone compatibility requirements of this specification shall be able to interchangeably mount or mount in (as applies) Leviton Quickport series components.
 - b. Systems exhibiting excess play, inability to insert, inability to remove, damage to the plate or jack or occupying excessive area behind the plate opening will not be accepted.

D. Copper Cabling, Category Rated Data/Voice

1. General
 - a. Provide horizontal cable in compliance with NFPA 70 and performance characteristics in accordance with ANSI/TIA-568-C
2. High Speed, EIA/TIA Category Cabling
 - a. Drawing Reference: ** UTP6-4, where ** denotes cable count
 - b. Construction:
 - i. *Provide horizontal copper cable in accordance with:*
 - (1) *ANSI/TIA-568-B.2*
 - (2) *UL 444*
 - (3) *NEMA WC 66 (Performance Standard for Category 6 and Category 7 100 Ohm Shielded and Unshielded Twisted Pair)*
 - (4) *ICEA S-90-661*
 - ii. *UTP (unshielded twisted pair),*
 - iii. *100 ohm impedance*
 - iv. *No shield in the sheath.*
 - v. *Jacket*
 - (1) *Color: Blue unless otherwise indicated.*

- (2) Provide communications general purpose (CM or CMG), communications plenum (CMP) or communications riser (CMR) rated cabling in accordance with NFPA 70.
- (3) Type CMP and CMR may be substituted for type CM or CMG and type CMP may be substituted for type CMR in accordance with NFPA 70.

c. Certification

- i. Warranted by the manufacturer to provide Category 6 performance when installed in accordance with applicable ANSI/TIA standards and when terminated with the jacks supplied by the Contractor for this Project.

d. Minimum Performance

- i. Assembly electrically meets or exceeds ANSI/TIA 568-C.2 Category 6 performance standards and the following:

FQ = Frequency (MHz) / TIA = TIA Spec / PG = Product Guarantee					
	RL (dB)	NEXT (dB)	PSNEXT (dB)	ACRF (dB)	LCL/TCL
FQ	TIA / PG	TIA / PG	TIA / PG	TIA / PG	PG
1	20.00 / 20.00	74.30 / 76.30	72.30 / 74.30	67.80 / 67.80	40.00
4	23.00 / 23.00	65.30 / 67.30	63.30 / 65.30	55.80 / 55.80	40.00
10	25.00 / 25.00	59.30 / 61.30	57.30 / 59.30	47.80 / 47.80	40.00
16	25.00 / 25.00	56.20 / 58.30	54.20 / 56.30	43.70 / 43.70	38.00
20	25.00 / 25.00	54.80 / 56.80	41.80 / 54.80	41.80 / 41.80	37.00
31.25	23.60 / 23.60	51.90 / 53.90	49.90 / 51.90	37.90 / 37.90	35.10
62.5	21.50 / 21.50	47.40 / 49.40	45.40 / 47.40	31.90 / 31.90	32.00
100	20.10 / 20.10	44.30 / 46.30	42.30 / 44.30	27.80 / 27.80	30.00
150	18.90 / 18.90	41.70 / 43.70	39.70 / 41.70	24.30 / 24.30	28.20
200	18.00 / 18.00	39.80 / 41.80	37.80 / 39.80	21.80 / 21.70	27.00
250	17.30 / 17.30	38.30 / 40.30	36.30 / 38.30	19.80 / 19.80	26.00
300	— / 16.80*	— / 39.10*	— / 37.10*	— / 18.30*	25.20
350	— / 16.30*	— / 38.20*	— / 36.20*	— / 16.90*	24.60*
400	— / 15.90*	— / 37.30*	— / 35.30*	— / 15.80*	24.00*
450	— / 15.50*	— / 36.50*	— / 34.50*	— / 14.70*	23.50*
500	— / 15.20*	— / 35.80*	— / 33.80*	— / 13.80*	23.00*
	IL (dB/100 m)	ACR (dB/100 m)	PSACR (dB/100 m)	PSACRF (dB/100 m)	EL TCTL
FQ	TIA / PG	TIA / PG	TIA / PG	TIA / PG	PG
1	2.00 / 2.00	72.20 / 74.30	70.30 / 72.30	64.80 / 64.80	35.00
4	3.80 / 3.80	61.50 / 63.50	59.50 / 61.50	52.80 / 52.80	23.00
10	6.00 / 6.00	53.40 / 55.40	51.30 / 53.40	44.80 / 44.80	15.00
16	7.60 / 7.60	48.80 / 50.70	46.70 / 48.70	40.70 / 40.70	10.90
20	8.50 / 8.50	46.40 / 48.40	44.30 / 46.40	38.80 / 38.80	9.00
31.25	10.70 / 10.70	41.40 / 43.30	39.20 / 41.30	37.90 / 34.90	—
62.50	15.40 / 15.40	32.40 / 34.00	30.00 / 32.00	28.90 / 28.90	—
100	19.80 / 19.80	25.20 / 26.60	22.50 / 24.60	24.80 / 24.80	—
150	24.70 / 24.60	16.90 / 19.10	14.90 / 17.10	21.30 / 21.30	—
200	29.00 / 29.00	10.80 / 12.90	8.80 / 10.90	18.80 / 18.70	—

250	32.80 / 32.80	7.30 / 7.50	3.50 / 5.50	16.80 / 16.80	—
300	— / 36.40*	— / 2.70*	— / —	— / 15.30*	—
350	— / 39.80*	— / -1.60*	— / —	13.90 / 13.90*	—
400	— / 43.00*	— / -5.70*	— / —	12.80 / 12.80*	—
450	— / 46.00*	— / -9.50*	— / —	— / 11.70*	—
500	— / 48.90*	— / -13.10*	— / —	10.80 / 10.80*	—

e. Technical Data - Physical

- i. *Conductor:* 23 AWG Bare Copper
- ii. *Conductor diameter - in.:* 0.022"
- iii. *Insulated conductor dia.-in.:* 0.039"
- iv. *Cable diameter - in.:* 0.21"
- v. *Nom. cable wt.-lb./kft.:* 22
- vi. *Max. installation tension - lb.:* 25
- vii. *Min. bend radius - in.:* 1.00
- viii. *Color Code:*
 - (1) *Pair-1: White/Blue* Blue
 - (2) *Pair-2: White/Orange* Orange
 - (3) *Pair-3: White/Green* Green
 - (4) *Pair-4: White/Brown* Brown
- ix. *Temperature Rating (degrees C)*
 - (1) *Installation:* 0 to +50
 - (2) *Operation:* -20 to +75
- x. *Mutual Capacitance:* 5.1 nF/100 m max.
- xi. *DC Resistance:* 9.38 Ohms/100 m max.
- xii. *Skew:* 45 ns/100 m max.
- xiii. *Pair to Ground Unbalance:* 330 pF/100 m max.
- xiv. *Velocity of Propagation:* 69% nom.
- xv. *DC Resistance unbalance:* 5% max.

3. Manufacturers:

- a. Berk-Tek LANmark-6
- b. General Cable
- c. or equal

E. High Speed, Category 6 Cabling, Plenum Rated

- 1. Drawing Reference: ** UTP6-4P, where ** denotes cable count
- 2. Construction:
 - a. As for non-plenum, with fire retardant overall jacket construction.
 - b. National Safety Agency – UL or ETL listed, NEC compliant for plenum installation - CMP.
- 3. Manufacturers
 - a. As for non-plenum Cat. 6, plenum construction.
- 4. Minimum Performance
 - a. Category 6 CMP, where FQ = Frequency (MHz), TIA = TIA Spec, PG = Manufacturer's Product Guarantee

	RL (dB)	NEXT (dB)	PSNEXT (dB)	ACRF (dB)	LCL/TCL
FQ	TIA / PG	TIA / PG	TIA / PG	TIA / PG	PG
1	20.00 / 20.00	74.30 / 76.30	72.30 / 74.30	67.80 / 67.80	40.00
4	23.00 / 23.00	65.30 / 67.30	63.30 / 65.30	55.80 / 55.80	40.00

10	25.00 / 25.00	59.30 / 61.30	57.30 / 59.30	47.80 / 47.80	40.00
16	25.00 / 25.00	56.20 / 58.30	54.20 / 56.30	43.70 / 43.70	38.00
20	25.00 / 25.00	54.80 / 56.80	41.80 / 54.80	41.80 / 41.80	37.00
31.25	23.60 / 23.60	51.90 / 53.90	49.90 / 51.90	37.90 / 37.90	35.10
62.5	21.50 / 21.50	47.40 / 49.40	45.40 / 47.40	31.90 / 31.90	32.00
100	20.10 / 20.10	44.30 / 46.30	42.30 / 44.30	27.80 / 27.80	30.00
150	18.90 / 18.90	41.70 / 43.70	39.70 / 41.70	24.30 / 24.30	28.20
200	18.00 / 18.00	39.80 / 41.80	37.80 / 39.80	21.80 / 21.70	27.00
250	17.30 / 17.30	38.30 / 40.30	36.30 / 38.30	19.80 / 19.80	26.00
300	— / 16.80*	— / 39.10*	— / 37.10*	— / 18.30*	25.20
350	— / 16.30*	— / 38.20*	— / 36.20*	— / 16.90*	24.60*
400	— / 15.90*	— / 37.30*	— / 35.30*	— / 15.80*	24.00*
450	— / 15.50*	— / 36.50*	— / 34.50*	— / 14.70*	23.50*
500	— / 15.20*	— / 35.80*	— / 33.80*	— / 13.80*	23.00*
	IL (dB/100 m)	ACR (dB/100 m)	PSACR (dB/100 m)	PSACRF (dB/100 m)	EL TCTL
FQ	TIA / PG	TIA / PG	TIA / PG	TIA / PG	PG
1	2.00 / 2.00	72.20 / 74.30	70.30 / 72.30	64.80 / 64.80	35.00
4	3.80 / 3.80	61.50 / 63.50	59.50 / 61.50	52.80 / 52.80	23.00
10	6.00 / 6.00	53.40 / 55.40	51.30 / 53.40	44.80 / 44.80	15.00
16	7.60 / 7.60	48.80 / 50.70	46.70 / 48.70	40.70 / 40.70	10.90
20	8.50 / 8.50	46.40 / 48.40	44.30 / 46.40	38.80 / 38.80	9.00
31.25	10.70 / 10.70	41.40 / 43.30	39.20 / 41.30	37.90 / 34.90	—
62.50	15.40 / 15.40	32.40 / 34.00	30.00 / 32.00	28.90 / 28.90	—
100	19.80 / 19.80	25.20 / 26.60	22.50 / 24.60	24.80 / 24.80	—
150	24.70 / 24.60	16.90 / 19.10	14.90 / 17.10	21.30 / 21.30	—
200	29.00 / 29.00	10.80 / 12.90	8.80 / 10.90	18.80 / 18.70	—
250	32.80 / 32.80	7.30 / 7.50	3.50 / 5.50	16.80 / 16.80	—
300	— / 36.40*	— / 2.70*	— / —	— / 15.30*	—
350	— / 39.80*	— / -1.60*	— / —	13.90 / 13.90*	—
400	— / 43.00*	— / -5.70*	— / —	12.80 / 12.80*	—
450	— / 46.00*	— / -9.50*	— / —	— / 11.70*	—
500	— / 48.90*	— / -13.10*	— / —	10.80 / 10.80*	—

5. Technical Data - Physical
- a. Conductor: 23 AWG Bare Copper
 - b. Conductor diameter - in.: 0.023"
 - c. Insulated conductor dia.-in.: 0.041"
 - d. Cable diameter - in. 0.22"
 - e. Nom. cable wt.-lb./kft. 29
 - f. Max. installation tension - lb.: 25
 - g. Min. bend radius - in. 1.00
 - h. Color Code
 - i. Pair-1 White/Blue Blue
 - ii. Pair-2 White/Orange Orange
 - iii. Pair-3 White/Green Green

	iv.	<i>Pair-4 White/Brown Brown</i>
	i.	<u>Temperature Rating (degrees C)</u>
	i.	<i>Installation 0 to +50</i>
	ii.	<i>Operation -20 to +75</i>
6.		Electrical
	a.	<u>Mutual Capacitance 5.2 nF/100 m max.</u>
	i.	<i>DC Resistance: 9.38 Ohms/100 m max.</i>
	ii.	<i>Skew: 45 ns/100 m max.</i>
	b.	<u>Pair to Ground Unbalance: 330 pF/100 m max.</u>
	c.	<u>Velocity of Propagation: 67% nom.</u>
	d.	<u>DC Resistance unbalance: 5% max.</u>
7.		Manufacturers:
	a.	<u>Berk-Tek LANmark-6</u>
	b.	<u>General Cable</u>
	c.	<u>or equal</u>

F. Work Area Outlets

1. Data Jacks Performance Requirements, General
 - a. Jack
 - i. *Construction:*
 - (1) *Industry standard keystone construction.*
 - (2) *Performance - The jack shall meet or exceed the following standards.*
 - (3) *TIA/EIA 568C.1*
 - ii. *UL listed*
 - iii. *Physical - The modular jacks shall meet the following physical requirements.*
 - iv. *Connector-insulation displacement connectors accepting 22 and 24 gauge AWG solid conductor wire.*
 - v. *Wired to meet EIA 568C.1 and T568B Color Code*
 - vi. *Color:*
 - (1) *Jacks: Blue.*
 - (2) *Blank jack cover: To match plate.*
 - vii. *"C6" or equivalent molded on face of jack.*
 - viii. *Mechanical - The modular jacks shall meet the following mechanical requirements*
 - ix. *Plug insertion - minimum 750 plug insertions*
 - b. Blank connector modules.
 - i. *Features.*
 - (1) *Snaps into faceplate, fills blank openings.*
 - c. Manufacturers – Jacks, subject to keystone interchangeability requirement:
 - i. *Leviton eXtreme 6+ Connector*
 - ii. *Panduit Mini-com TX6*
 - iii. *or equal.*
 - d. Manufacturers - Blank Module.
 - i. *Leviton SnapIn Blank Module*
 - ii. *Panduit Mini-com Blank Module*
 - iii. *or equal.*

2. Telecommunications Outlets, Copper Jacks, Wall Mount, Flush
 - a. Drawing Reference(s):
 - i. *MMP4*
 - ii. *MMP6*
 - b. Assembly. Provide complete telecommunications outlet assembly, including but not limited to:
 - i. *Faceplate with industry standard keystone openings*
 - ii. *Blank connector modules at faceplate openings not filled with connector modules.*
 - iii. *Labels and label holders.*
 - iv. Faceplate Features:
 - (1) *Single gang.*
 - (2) *Front Loading*
 - (3) *Openings for up to 4 keystone jack connector modules – MMP4, up to 6 openings – MMP6.*
 - (4) *At wall mount locations calling for 4 jacks or fewer, provide with flat faced openings for jacks relative to the place of the faceplate, oriented along the long edge of the place.*
 - (5) *At other jack locations, including wall mount locations with more than 4 jacks, inside floor boxes or above ceiling, provide with flat face faceplates.*
 - v. *Label holders with space to label the plate number and the number of each jack.*
 - vi. *Color: To match electrical receptacles and switch plates mounted on same wall,*
 - c. Manufacturers - flat plates, subject to keystone interchangeability requirement:
 - i. *Leviton Quickport Multimedia MOS Single Gang Wall Plates and Adapters.*
 - ii. *Panduit Mini-com Classic Series*
 - iii. *or equal*
3. MultiMedia Surface Mount Box
 - a. Drawing Reference (s):
 - i. ** MMSB, where * represents the number of Category connectors of the type specified elsewhere herein.*
 - b. Biscuit Box
 - c. Features Functions
 - i. *Surface mount enclosure holds terminated station cabling with Category connectors parallel to face of mounting surface.*
 - ii. *Mechanically fastened to enclosure surface.*
 - iii. *2 part assembly includes fixed mounting base plate and removable cover over terminations*
 - d. Manufacturers:
 - i. *Leviton Quickport Surface Mount Boxes*
 - ii. *Panduit*
 - iii. *Or equal.*

- G. Data Patch Panels, Keystone, Rack Mounted
1. Drawing Reference: ***CXPPK, or CXPP, where *** refers to port count and X to Category rating of ports.
 2. Functions/Features:
 - a. 19" EIA rack mountable.
 - b. At least 24 ports per EIA rack unit (1.75").
 - c. Industry standard keystone openings in steel plate
 - d. arranged in rows on steel panel,
 - e. jacks on front,
 - f. terminations on rear.
 - g. Port identifier label space on front.
 - h. Fill each opening with Category 6 keystone jacks as specified herein above. Coordinate jack selection with patch panel construction to ensure that jack width behind the panel does not prevent fully loading panel.
 - i. Integral cable management bar at rear.
 3. Manufacturer
 - a. Leviton QuickPort High Density Multimedia Patch Panels with Management Bar
 - b. Panduit Netkey
 - c. Hubbell Xcelerator Series Panels
 - d. Molex EZ Patch
 - e. Suttle SE-2504 and SE-2504-48 Patch Panels
 - f. AMP
 - g. ADC/Krone
 - h. Ortronics
 - i. or equal.]

2.3 CABLE TERMINATION DEVICES AND RELATED, NON-CATEGORY RATED

- A. Screw type or Tubular Clamp Barrier Blocks:
1. Buchanan 125, 0625 Series.
 2. Electrovert equivalent.
 3. TRW Cinch 140, 141, 142 Series.
 4. Weidmuller
 5. Pass & Seymour/Legrand equivalent.
 6. Phoenix
 7. or equal.
- B. Tubular Clamp Barrier Blocks, High Density, Switch Block Section
1. Drawing Reference: TB15.
 2. Features/Functions
 - a. Paired screw terminals on opposite sides of insulating base.
 - b. TB15 Base mounts to DIN rail, providing space beneath TB15 to dress field and source cabling.
 - c. Terminates range of wire gages used by project – at least 30 gage to 10 gage.
 - d. High density:
 - i. *At least 33 pairs of connections per foot for 12 and smaller gage terminations,*
 - ii. *At least 16 pairs of connections per foot for 10 gage terminations.*
 - e. Switch Block Section permits load, such as field devices, to be separated from monitoring panel for testing independent of source then restored

- without disturbing field wiring terminations.
 - f. Rated at least fifteen (15) amperes at 300V AC/DC
 - 3. Approvals
 - a. UL
 - 4. Manufacturers:
 - a. Allen Bradley Isolation Switch Blocks,
 - i. 1492-H7 for 30 to 12 gage
 - ii. 1492-CE9 for 10 gage.
 - b. Tyco Buchanan 0135 Series.
 - c. WECO Electrical Connectors
 - d. Altech
 - e. Curtis Industries
 - f. Electrovert
 - g. Weidmuller
 - h. Pass & Seymour/Legrand
 - i. Phoenix
 - j. or equal.
- C. Video connector, BNC type, 75 ohms, cord, crimp applied. Coordinate with cable.
 - 1. Amp.
 - 2. Amphenol.
 - 3. Augat/LRC Products
 - 4. Canare.
 - 5. Kings.
 - 6. RFI/Celltronics.
 - 7. Trompeter.
 - 8. or equal.

2.4 PATCH CORDS

- A. Category 6 Patch Cords
 - 1. Reference: Cat 6 Patch Cords
 - 2. Features/Function/Construction:
 - a. Manufactured product – field/contractor assembled patch cords not acceptable.
 - b. Manufacturer certified to exceed EIA/TIA 568 C.1 Category 6 performance and construction standards.
 - c. Snagless Boot Covers
 - d. Color: Green, Aqua or Turquoise, unless directed otherwise by the University's Representative. In no event the color of the supplied voice patch cabling match that used by the University furnished data systems patch cords
 - 3. Length: As required to meet function
 - 4. Quantity: As required to meet function
 - 5. Manufacturers:
 - a. Belden
 - b. Belkin
 - c. Leviton
 - d. Systemax/Commscope
 - e. AMP
 - f. Hubbell

- g. Siemon
- h. Or equal.

2.5 ELECTRONIC SECURITY SYSTEMS CABLING LABELS, INTERIOR

- A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
- B. Shall be preprinted or computer printed type. Hand written labels are not acceptable.
- C. Provide vinyl substrate with a white printing area and black print. If cable jacket is white, provide cable label with printing area that is any other color than white, preferably orange or yellow – so that the labels are easily distinguishable.
- D. Shall be flexible vinyl or other substrates to apply easy and flex as cables are bent.
- E. Shall use aggressive adhesives that stay attached even to the most difficult to adhere to jacketing.
- F. Manufacturers:
 - 1. Brady
 - 2. Brother
 - 3. Panduit
 - 4. Or equal.

2.6 ELECTRONIC SECURITY SYSTEMS CABLE LABELS, OUTSIDE PLANT

- A. Cable Tags in Manholes, Handholes, and Vaults
 - 1. Provide tags for communications cable or wire located in manholes, handholes, and vaults.
 - a. The tags shall be polyethylene.
 - b. Machine printed - Do not provide handwritten letters.
 - 2. Polyethylene Cable Tags
 - a. Provide tags of polyethylene that have an average tensile strength of 22.4 MPa (3250 pounds per square inch) 3250 pounds per square inch; and that are two millimeter (0.08 inch) 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 77 degrees C 170 degrees F.
 - b. Provide 1.3 mm (0.05 inch) 0.05 inch (minimum) thick black polyethylene tag holder.
 - c. Provide a one-piece nylon, self-locking tie at each end of the cable tag.
 - d. Ties shall have a minimum loop tensile strength of 778.75 N (175 pounds) 175 pounds. The cable tags shall have black block letters, numbers, and symbols 25 mm (one inch) one inch high on a yellow background.
 - e. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.
 - 3. Manufacturers:
 - a. Panduit
 - b. Brady
 - c. or equal.

PART 3 - EXECUTION

3.1 WIRING CLASSIFICATION AND RELATED

- A. Audio Signal Wiring Classification:
 - 1. Type A-1: Microphone level wiring less than -30 dBu, 20 Hz to 20 kHz.
 - 2. Type A-2: Line level wiring -30 dBu to +24 dBu, 20 Hz to 20 kHz.
 - 3. Type A-3: Loudspeaker level or circuit wiring greater than +24 dBu, from 20 Hz to 20 kHz.
- B. Video and Related Signal Wiring Classification:
 - 1. Type V-1: Baseband and composite video wiring 1 volt peak-to-peak into 75 ohms, 0 to 10.0 MHz.
 - 2. Type V-2: Synchronization and switching pulse wiring 4 volts peak-to-peak into 75 ohms, 15.62 to 15.75 kHz.
 - 3. Type V-3: Color subcarrier wiring 0 to 4 volts peak-to-peak into 75 ohms, 3.57 to 4.43 MHz.
 - 4. Type V-4: MATV system wiring 0.1 to 1000 microVolts peak-to-peak into 50 or 75 ohms, 47 to 890 MHz.
- C. Control Signal Wiring Classifications:
 - 1. Type C-1: DC control wiring 0 to 50 volts.
 - 2. Type C-2: Synchronous control or data wiring 0 to 40 volts, peak-to-peak.
 - 3. Type C-3: AC control wiring 0 to 48 volts, 60 Hz.
- D. Additional Wiring Classifications:
 - 1. Type M-1: DC power wiring 0 to 48 volts.
 - 2. Type M-2: AC power wiring greater than 50 volts, 60 Hz.
 - 3. Wiring Combinations:
- E. Except as indicated herein, conduit, wireways and cable bundles shall contain only wiring of a single classification. The following combinations are acceptable in conduit, or cable harnesses. Additional acceptable combinations may be indicated on the Drawings.
 - 1. Types A-1, C-1, and M-1.
 - 2. Types A-2, C-1, C-2, and M-1, runs less than 20 feet.
 - 3. Types A-2, C-1, and M-1.
 - 4. Types A-3, C-1, C-2, and M-1.
 - 5. Types A-2, V-1, and V-3.
 - 6. Types V-1, V-2, V-3, and C-1.
 - 7. Types M-2 and C-3.

3.2 WIRING PRACTICE, NON CATEGORY RATED CABLING

- A. All wiring of Division 28 to be installed in raceway except above accessible ceilings.
 - 1. Separate raceway systems, including backboxes and conduit, shall be provided for to electromagnetically isolate electric lock and door motor operators, local door alarms and other similarly powered sources of electro-magnetic noise from door position switches, card reader, door release buttons, duress alarms and similar low power, electromagnetic noise sensitive applications. Refer to Wiring Classification and Related above and comply.

2. Minimum conduit size for multiple conductor runs shall be $\frac{3}{4}$ ". In each control panel 2 empty $\frac{3}{4}$ " conduits shall be installed for future use. These conduits shall be routed to an accessible area above the ceiling or to a location approved by University. Run circuits for AC separate from circuits using DC. Each supervisory/data loop shall be run separately from any other supervisory/data loops they shall not be permitted to share the same conduit. From security alarm control panel provide one $\frac{3}{4}$ " conduit to nearest telephone backboard or panel location for tie-in to University furnished central station. Provide min 1" conduit to each card access or exterior door, unless otherwise shown or scheduled on the plans
 3. Conduits including flexible metal and armored cable shall terminate in the sensor or device enclosure.
 4. Ends of conduit shall be fitted with insulated bushings. Exposed conductors at ends of conduits external to sensors and devices are not acceptable.
 5. Refer to additional requirements in Section 28 05 28 - Pathways For Electronic Safety And Security.
- B. All field wiring shall run continuous from device to device no splices shall be permitted except at specified terminal blocks installed in lockable termination cabinets.
1. The use of wire nuts and crimp type connectors shall not be permitted.
 2. Where shielded wire is used it shall be connected to an earth ground at the panel. Tin terminated shield drain wires and insulate with heat shrinkable tubing.
 3. Dress, lace or harness all wire and cable to prevent mechanical stress on electrical connections. No wire or cable shall be supported by a connection point.
 4. Provide service loops where harnesses of different classes cross, or where hinged panels are to be interconnected.
 5. Security alarm conductor terminations in control panels, termination cabinets, junction boxes and annunciator panels to be made on specified terminal strips with a separate point for each conductor.
 - a. All such strips to be number identified as shown in wiring diagram attached to inside of door of control panel.
 - b. Connect wiring neatly to terminals strips.
 - c. Set up termination of cabling so that section of the system may be isolated or shorted out for servicing.
- C. No control panel shall be mounted where is not readily accessible the highest connection point shall not be above 6'6" nor shall the bottom of the panel be below 30".
- D. All necessary interconnections, services, and adjustments required for a complete and operable system shall be provided. All installation work must be done in accordance with the safety requirements set forth in the general requirements of ANSI C2 and NFPA 70.
- E. Coordinate insulation displacement (quick connect) terminal devices with wire size and type. Comply with manufacturer's recommendations. Make connections with automatic impact type tooling set to recommended force.
- F. Security alarm conductor terminations in control panels and termination panels to be made on terminal strips with a separate point for each conductor. All such strips to be number or labeled identified as shown in wiring diagram attached to inside of door of control panel. Connect wiring neatly to terminals strips. Bundle with nylon cable straps. Set up termination of cabling so that sections of the system may be isolated or shorted out for servicing.

- G. Mount end-of-line resistor for each circuit at the device. Glass break devices may be grouped orderly to a zone. Do not allow glassbreak zones to cover more than one side of the building without approval from University. Connect glass break detectors to C-Cure DGP panel and provide programming of campus C-Cure database to enable remote reset.
- H. Correct unacceptable wiring conditions including but not limited to:
 - 1. Deformed, brittle or cracked insulation.
 - 2. Torn or worn cable jacket.
 - 3. Excessively scored cable jackets.
 - 4. Insulation shrunken or stripped further than 1/8" away from the actual point of connection within a connector, or on a punch block.
 - 5. Ungrommeted, unbushed, or uninsulated wire or cable entries.
 - 6. Deformation or improper radius of wire or cable.

3.3 UNDERGROUND WIRING PRACTICE

- A. General
 - 1. Provide safety barriers and flag persons for all open manholes and pullboxes that are located in areas accessible to the public.
 - 2. Provide traffic control in accordance with the requirements of Division 1.
 - 3. Conform to OSHA guidelines when accessing manholes and handholes, inclusive of the requirement for air sampling. Provide continuous measurements. Provide the University's Representative with contractor maintained logs of air samples taken at most two hours apart.
 - 4. Provide sufficient personnel to permit one individual to remain above the surface at all times, in visual contact with persons in manholes and similar. Provide the observer with a appropriate means of obtaining assistance.
 - 5. Provide ladders for access to manholes. Do not permit workers to use cables or splice cases as ladders.
 - 6. Install a 3/8" nylon pullrope with all underground cables placed by this project.
- B. Cable Pulling
 - 1. Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before pulling cables.
 - 2. Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation.
 - 3. Use flexible cable feeds to convey cables through manhole opening and into duct runs.
 - 4. Accumulate cable slack at each manhole or junction box where space permits by training cable around the interior to form one complete loop.
 - 5. Maintain minimum allowable bending radii in forming such loops.
 - 6. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into outdoor pedestals or other enclosures.
 - 7. Cable with tape shield shall have a bending radius not less than 12 times the overall diameter of the completed cable.
 - 8. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.
- C. Cables in Manholes, Pull boxes and Handholes.
 - 1. Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths.
 - 2. Form cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators.

3. In existing manholes and handholes where new ducts are to be terminated or where new cables are to be installed, locate the existing installation of cables, cable supports and grounding as required for a uniform installation with cables carefully arranged and supported.
 4. Where underground cable splices are called for on the plans, support cable splices in underground structures by racks on each side of the splice.
 5. Located splices to prevent cyclic bending in the spliced sheath.
 6. Install cables at middle and bottom of cable racks, leaving top space opening or future cables, except as otherwise indicated for existing installations.
- D. Service Loop at Building Entry
1. For outside plant entering a communications room, provide at least 20 feet of cable in excess of the minimum required to reach terminal device by a dressed route. Form into a storage loop, typically around the perimeter of the backboard and fix in place as directed by the University's Representative.

3.4 SPLICING, NON-CATEGORY RATED CABLING

- A. All wire and cable shall be continuous and splice-free for the entire length of run between designated connections or terminations.
1. At designated splices, maintain conductor color code across all splices.
 - a. All shielded cables shall be insulated. Do not permit shields to contact conduit, raceway, boxes, panels or equipment enclosures.
 - b. Within buildings, make splices only in designated terminal cabinets and/or on designated equipment backboards.

3.5 PULLING IN

- A. Verify that all raceway has been de-burred and properly joined, coupled, and terminated prior to installation of cables. Verify that all raceway is clear of foreign matter and substances prior to installation of wire or cable.
- B. Inspect all conduit bends to verify proper radius. Comply with Code for minimum permissible radius and maximum permissible deformation.
- C. Apply a chemically inert lubricant to all wire and cable prior to pulling in conduit. Do not subject wire and cable to tension greater than that recommended by the manufacturer. Use multi-spool rollers where cable is pulled in place around bends. Do not pull reverse bends.
- D. Provide a box loop for all wire and cable routed through junction boxes or distribution panels. Cable loops and bends shall not be bent at a radius greater than that recommended by the manufacturer.
- E. Field Device Wiring
1. Wire each device as a home run from the device the terminal block
 2. Loop or Zone wiring not acceptable unless addressable devices are specified and provided. Wire all potential monitoring and signaling points (each pin) of each field device and alarm sensor, including internal tamper sensors.
 3. At electric strikes and electric locks, provide end-of-line resistors, diodes or MOV's where device does not already include such components. Document where such devices have been added on As-Built drawings.
- F. Card Reader Wiring
1. Verify that the slack loops called for on the plans are provided.

3.6 CEILING TILE

- A. Ceiling tile shall be removed as necessary for the cable installation and put back in place without damaging or soiling any of the tiles or supporting framework.
- B. Ceiling tile shall be handled so no fingerprints or marks are left on the tiles, and the tiles are not damaged in any way.
- C. The Contractor is responsible for the cost of repair or replacement of any tile or ceiling tile support/framework hardware that is damaged or soiled by the Contractor.

3.7 SUPPORT

- A. Support: Provide support for all cabling. Conform to the most restrictive of the California Electric Code and Section 28 05 28 Pathways for Electronic Safety and Security. Provide support for all cabling. Conform to the restrictions of the California Electric Code and Section 27 05 29. Secure all wire and cable run vertically for continuous distances greater than thirty (30) feet. Secure robust non-coaxial cables with screw-flange nylon cable ties or similar devices appropriate to weight of cable. For all other cables, provide symmetrical conforming nonmetallic bushings or woven cable grips appropriate to weight of cable.
- B. Separation from sources of Electromagnetic Interference: Conform with the requirements of ANSI/TIA-569-C, 9.3 Pathway Separation from EMI sources. Secure all wire and cable run vertically for continuous distances greater than thirty (30) feet. Secure robust non-coaxial cables with screw-flange nylon cable ties or similar devices appropriate to weight of cable. For all other cables, provide symmetrical conforming nonmetallic bushings or woven cable grips appropriate to weight of cable.

Include the next subsection where work of the Project has no Division 27 spec and relies on this Section to install station cabling supporting the TCP/IP cameras and/or DGP uplink signaling.

3.8 WIRING PRACTICE, CATEGORY RATED CABLING USED IN TCP/IP APPLICATIONS

- A. Signal Polarity and Color Code Convention
 - 1. Category 6 Station Wire, RJ45 - Per EIA/TIA-568, designation T568B
- B. Station Cable Installation And Termination Procedures
 - 1. General:
 - a. All cable runs shall be installed per manufacturer's installation instructions.
 - b. Cable installation is "home-run" between the jack termination of the cable at the faceplate to the patch panel jack termination in its assigned IDF (TR).
 - i. *Each cable shall be installed without any splices.*
 - ii. *Each cable shall be installed without intermediate termination points unless approved by the University's Representative.*
 - 2. Run Lengths:
 - a. Station, Horizontal and IDF Links, Copper:

- i. *The total length of any horizontal station cable from jack termination of the cable at the WAO faceplate to the patch panel jack termination in its assigned IDF (TR) shall not exceed ninety meters (90m) - two hundred ninety-five feet (295') - unless approved by the University's Representative.*
- C. WAO Horizontal Cable Placement
1. No cable shall run unsupported by conduit, cable tray, hangers, or other specified support for distances greater than five feet (5').
 2. No cable shall be attached to the suspended ceiling structure or laid directly on the ceiling tiles or hard lid as a means of support, and the bottom of a cable or cable bundle shall be minimum of six inches (6") above the ceiling tile grid.
 3. No cable or cable bundle shall be supported by or attached by any means to fire sprinkler heads, delivery system hardware, environmental sensor system hardware, or the exterior of any conduit, ladder rack, or cable tray. Cable shall be supported by systems specifically installed for cable support.
 4. Where cable being installed is not enclosed in conduit or cable tray, cross all electrical power circuit transport at right angles.
 5. Where discontinuity of cable trays or conduit pathway occurs that causes cable or cable bundle to sag vertically three inches (3") or more, support the cable or cable bundle over the discontinuity using hangers, brackets, hooks, rings, and other applicable supporting devices specified in Section 27 05 29 - Hangers and Supports for Communications Systems.
 6. During placement of cable runs, do not exceed manufacturer's maximum pulling tension or minimum bend radius limits.
 7. Do not bundle cables in cable trays.
 8. Do bundle two (2) or more cables with plenum-rated Velcro ties that are snug but which do not deform the cable geometry as follows:
 - a. Whenever cables in cable trays leave the cable tray and enter/exit distribution conduit.
 - b. Wherever cables enter a TR. Maintain bundling within the TR.
 9. Manage slack to avoid excess cable or kinking.
 10. Pull new pulling string through all conduits while placing new horizontal cable. Leave a pulling string in the utilized conduits for future use.
 11. Do not roll or store cable reels without an appropriate underlay.
 12. Cables with jackets that are chaffed, burned, have exposed internal conductor insulation, or have any bare copper (shiners) shall be replaced.
 13. After cable installation is complete, tested, and, if necessary, repairs made, install all required fire stopping. The University Representative or his/her designate will not accept the installation as completed until all required fire stopping has been installed and accepted as complete. See Section 27 05 33 – Conduits and Backboxes For Communications Systems.
 14. Any horizontal cable installed, then removed for any reason, shall not be reused.
 15. Bundle voice cross-connect cables separately from horizontal WAO cables. Do not mix with horizontal WAO cables.
 16. Test cable as for station cabling.
- D. Termination
1. Comply with the following:
 - a. Termination of wiring at the station outlet:
 - i. *All data and voice station cable shall be terminated at the individual receptacle modules in accordance with EIA/TIA-568-C.*
 - ii. *Termination shall not untwist more than 1/2 inch of cable maximum from the manufactured condition.*

- iii. *Service loop at WAO*
 - (1) *Copper. Provide slack, which is to be no less than 2.5" and no greater than 5.0", in the station cable at the station outlet end. This is to allow the Work Area Outlet to be removed from the outlet box and visually inspected without leaving so much wire in the box that it might become accidentally damaged during installation.*
- iv. *Termination of wiring at existing station outlets:*
 - (1) *Install in data and voice inserts in place of existing blank insert in existing faceplate.*
 - (2) *Install new labels and label holders.*
- b. Termination of copper station wiring at the Telecommunications Room
 - i. *For the installation/layout of station cable within the Communications Rooms, see detail on drawings.*
 - ii. *Install one (1) 48-port patch panel for every 48 WAO cables.*
 - iii. *Mount patch panels per the Project drawings.*
 - iv. *Each patch panel shall have a 2RU horizontal manager (WMP) placed both above and below the panel.*
 - v. *Horizontal cables are to be routed neatly on overhead cable runway to equipment racks; exit cable runway into equipment rack vertical cable management and proceed to the patch panels.*
 - vi. *Cable termination.*
 - (1) *Cables on the left side of the patch panel shall enter from the left side vertical cable manager. Cables on the right side of the patch panel shall enter from the right side vertical cable manager. Cables shall not cross the center line of the patch panel.*
 - (2) *Terminate cables using the 8-pin jack, T568-B four (4) pair termination standard and comply with manufacturer's termination practices, specifications, instructions, and recommendations.*
- E. Testing, Verification, Adjustments and Acceptance
 - 1. Comply with the requirements of Part 1 of this Section and the following:
 - a. After submittal of test result documentation and the associated as-built drawings, the University's Representative shall randomly pick five percent (5%) of the submitted cable plant installation for re-test.
 - b. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of the representative shall repeat 100% testing at no cost to the University.

3.9 LABELING

- A. Label each end of each cable to indicate its terminal point.
- B. Non category rated cabling and category cabling used for non-TCP/IP applications
 - 1. For field devices, use the device label assigned per the requirements of Section 28 05 00 - Common Work Results for Electronic Safety and Security.

Include the next paragraph where work of the Project has no Division 27 spec and relies on this Section to install station cabling supporting the TCP/IP cameras and/or DGP uplink signaling.

- C. [Category rated cabling used in TCP/IP applications]
 - 1. Label placement: Attach a label to both ends of each cable six inches (6") from the cables termination at WAO and TR patch panel port.
 - 2. Label content and format, both ends of cable shall be XXX - YZZZ where:
 - a. XXX = the 3-digit building number which is the last 3 digits of the facility asset designator - a 4-digit number called a CAAN number.
 - b. Y = the floor number - use zero (0) for basement.
 - c. ZZZ = the WAO jack number the cable is terminated on - 001 through 999.
 - d. Example: 195-2001 = Building 195, (2) second floor, (001) first jack on the second floor.]
 - 3. All labels shall be machine created labels. Hand labeling is not acceptable.

3.10 REMOVAL OF ABANDONED CABLING

- A. The California Electrical Code (CEC) requires all unused cable intended for future use to be terminated and labeled for such use. Any other unused cable is considered abandoned including cable abandoned due to installation of new cabling under the work of this Project.
- B. Abandoned cable must be removed and disposed of, per CEC 770.53(A) & 770.53(B) (fiber) and 800.52(B), 800.53(A) & 800.53(B) (copper). Similar requirements are elsewhere in the CEC for other types of cable.
Refer to Division1 regarding means and methods to be employed in the disposal of construction waste materials including material subject to recycling such as abandoned copper cabling.

3.11 AS-BUILT DRAWINGS

- A. Comply with Division 1 and Section 28 05 00 – Common Work Results for Electronic Security and Safety.

END OF SECTION 28 05 13

Section 28 05 26

Grounding and Bonding For Electronic Safety and Security

PART 1 - GENERAL

1.1 SCOPE OF WORK

The Division 26 and 27 references below assume that the Communications work installed in accordance with UCSC ITS masterspecs are being installed in parallel with the Division 28 ESS scope. Alter as necessary to indicate where equivalent scope is being specified.

- A. Section includes grounding and bonding of Electronic Safety and Security Work, including but not limited to:
 - 1. Electronic Safety and Security Raceways
 - 2. Cable Shields
 - 3. [Electronic Safety and Security Cabinets and Enclosures.]
- B. Related Work Under Other Sections
 - 1. [Section 26 05 26 – Grounding & Bonding for Electrical Systems]
 - 2. [Section 27 05 26 – Grounding and Bonding For Communications Systems]
 - 3. Section 28 05 00 – Common Work Results for Electronic Safety and Security
 - 4. Section 28 05 13 – Conductors and Cables for Electronic Safety and Security
 - 5. Section 28 05 28 – Pathway for Electronic Safety and Security

1.2 SYSTEM DESCRIPTION

- A. Provide Electronic Safety and Security Grounding System as described herein and indicated on drawings.
- B. Except as otherwise indicated, the complete Electronic Safety and Security installation including the racks, cabinets, panels, cable tray, runway, lightning protectors cable shields and splice cases provided under the work of this project shall be completely and effectively grounded in accordance with all Code and Standards requirements, whether or not such connections are specifically shown or specified.

1.3 RESISTANCE:

- A. Resistance from the farthest ground bus through the ground electrode to earth shall not exceed 5 Ohms or the requirements of ANSI-J-STD-607-B-2011, whichever is more restrictive.
- B. Resistance from Electronic Safety and Security Rack Buss ground to Ufer ground must remain less than or equal to the electrical ground presented at A/C outlet for electronic equipment in the communications rack.

1.4 REFERENCES

- A. American National Standards Institute (ANSI)
 - 1. ANSI/TIA/-606-B-2012, Administration Standard Telecommunications Infrastructure.
 - 2. ANSI-J-STD-607-B-2011 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
- B. ASTM INTERNATIONAL (ASTM)

- C. 1. ASTM B3 (2013) Standard Specification for Soft or Annealed Copper Wire
- IEEE
- 1. IEEE C135.30 (1988) Standard for Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction
- 2. IEEE 81 (2012) Guide for Measuring Earth
- D. Underwriters Laboratories (UL)
- 1. UL 467 (1993); R 2004 Grounding and Bonding Equipment

1.5 SUBMITTALS

- A. Conform with the requirements of Section 01 33 23 - Shop Drawings, Product Data and Samples and Section 27 05 00 - Common Work Results for Communications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Equal products by the following manufacturers will be considered providing that all features of the specified product are provided:
 - 1. Ground Bushings, Connectors, Jumpers and Bus:
 - a. O-Z/Gedney.
 - b. Thomas & Betts Corp.
 - c. Or equal.
 - 2. Compression Connector Lug
 - a. Panduit
 - b. Harger Lightning & Grounding
 - c. Or equal.
 - 3. Telecommunications Ground Bus Bar
 - a. Panduit
 - b. Harger Lightning & Grounding
 - c. or equal.
 - 4. Rack and Cabinet Grounding
 - a. Panduit Structured Ground Kit
 - b. Harger Lightning & Grounding
 - c. or equal.

2.2 GROUND CONDUCTORS

- A. General purpose insulated: UL listed and code sized copper conductor, with dual rated THHN/THWN insulation, color identified green.
- B. Cable jacket marking:
- C. Must be legible and shall contain the following information:
 - a. Manufacturer's name
 - b. Copper conductor gauge
 - c. UL listing
 - d. Cable jacket shall be green with black lettering
- D. Telecommunications Bonding Backbone Cable: 3/0 AWG THHN/THWN CU - Must be UL listed.
 - a. Manufacturer:
 - b. General Cable

- c. Harger Lightning & Grounding
- d. equal.
- E. Bonding pigtails: Insulated copper conductor, identified green, sized per code, and provided with termination screw or lug. Provide solid conductors for #10 AWG or smaller and stranded conductors for #8 AWG or larger.
- F. Bonding Conductors sized at 2 kcmil per linear foot of conductor length up to a size of 3/0 AWG ground wire.

2.3 COMPRESSION CONNECTOR LUG

- A. Description
 1. Long-barrel compression lugs shall be used on all ground wire.
 2. Copper alloy body.
 3. Provide lug size to match conductor being terminated.
 4. Provide 2 hole pattern lugs.
 5. Provide each lug with silicon bronze hardware, including 2 bolts, 2 split lock washers and 2 nuts.
- B. Manufacturer:
 1. Panduit
 2. Harger Lightning & Grounding GECLBxxx (xxx depending on Cable Size)
 3. or equal.

2.4 INSULATED GROUNDING BUSHINGS

- A. Plated malleable iron or steel body with 150 degree Centigrade molded plastic insulating throat and lay-in grounding lug.

2.5 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS, OR SPLICES

- A. Where required by the Drawings or Specifications, grounding conductors shall be spliced together, connected to ground rods or connected to structural steel using exothermic welds or high pressure compression type connectors.
 1. Exothermic welds shall be used for cable-to-cable and cable-to-ground rod and for cable to structural steel surfaces. Exothermic weld kits shall be as manufactured by Harger Lightning & Grounding, Cadweld, Thermoweld or equal. Each particular type of weld shall use a kit unique to that type of weld.
 2. High-pressure compression type connectors shall be used for cable-to-cable and cable-to-ground rod connections. Connections shall be as manufactured by Thomas & Betts #53000 series, Burndy "Hy-Ground" or equal.

2.6 EXTRA FLEXIBLE, FLAT BONDING JUMPERS

- A. Two Hole Tinned Flat Braided Copper Ground Straps, 6 Gauge equivalent, 12" long with crimped lugs on each end and ¼"-20 mounting hardware.
 1. Manufacturer:
 - a. Harger GS12094122C3/8
 - b. or equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide Grounding and Bonding according to the most restrictive requirements of:
 - 1. ANSI-J-STD-607-B-2011.
 - 2. California Electrical Code Article 250 and references therein.
 - 3. California Electrical Code Article 800.
- B. In the event of conflicting requirements, National Electrical Code requirements shall prevail.
- C. Point of Connection
 - 1. Under Work of this Section, ground to the building Telecommunications Grounding System as installed under the work of Division 27 at the TMGB
- D. Ground And Bonding Conductor Installation
 - 1. All lug connections to the ground bars and opposite end shall use Antioxidant Joint Compound.
 - 2. Unless otherwise noted, all bonding and ground wires on electronic security systems and communications systems cable trays and runways shall be routed on the outer edge of the cable trays and runways.
- E. Mechanical Connections
 - 1. Make connections bare metal to bare metal.
 - 2. Where required, remove paint to bare metal, make grounding or bonding connection, and touch up paint.
 - 3. Torque threaded fasteners to manufacturer's recommended values.
- F. Compression Connections
 - 1. Make compression connections with the lug or fitting manufacturer's recommended tooling, with the tooling set to the recommended force and stroke.
- G. Electronic Safety and Security Raceways and Sleeves
 - 1. Bond metallic raceway and sleeves to the Telecommunications Ground Busbar at the Telecommunications Room that serves the related Electronic Safety and Security systems.
 - 2. Where a metallic raceway connects 2 or more Telecommunications Rooms, bond to the Telecommunications Ground Busbar at each.
- H. Cable Shields
 - 1. Comply with California Electrical Code Article 800.
- I. Protector Fields
 - 1. Comply with California Electrical Code Article 800.
- J. Electronic Safety and Security cabinets and enclosures
 - 1. Bond to the Communications Ground Busbar at the Communications Room.

3.2 LABELING

- A. Provide labeling according to the requirements of:
 - 1. ANSI/TIA/EIA-606-A.
 - 2. Section 28 05 13 – Conductors and Cables for Electronic Safety and Security

END OF SECTION 28 05 26

Section 28 05 28

Pathways For Electronic Safety and Security

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Provide electronic security systems pathways as specified in this Section and as shown diagrammatically on the plans. Contractor to design complete Electronic Safety and Security pathway system including provision:
 - 1. Rigid steel conduit and fittings.
 - 2. Intermediate metal conduit and fittings.
 - 3. Electrical metallic tubing and fittings.
 - 4. Non-metallic raceway and fittings.
 - 5. Flexible metallic conduit and fittings.
 - 6. Liquidtight flexible metallic conduit and fittings.
 - 7. [Underground duct and structure]
 - 8. Miscellaneous conduit fittings and products.
 - 9. Junction Boxes
 - 10. Hinged cover enclosures.
 - 11. Pullboxes and Terminal Cabinets.
 - 12. Wireway
 - 13. Strut supports
 - 14. Beam clamps
 - 15. Concrete Fasteners
 - 16. Touch-Up Materials
 - 17. Conduit supports.
 - 18. Equipment supports.
 - 19. Fastening hardware
- B. At Hazardous Occupancies, installation conforms to the requirements of California Electric Code for Class and Division rating of spaces.

1.2 RELATED WORK IN OTHER SECTIONS

- A. Related work: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.
 - 1. [Section 01 71 23 – Field Engineering.]
 - 2. Section 28 05 00 – Common Work Results for Electronic Safety and Security
 - 3. Section 28 05 13 – Conductors and Cables for Electronic Safety and Security
 - 4. Section 28 05 26 – Grounding and Bonding for Electronic Safety and Security
 - 5. Section 28 13 00 – Access Control and Alarm Systems

1.3 SYSTEM DESCRIPTION

- A. Provide devices specified in this Section and related Sections for support of electronic safety equipment specified for this Project.
- B. Provide support systems that are adequate for the weight of equipment, conduit and wiring to be supported.

1.4 SEISMIC DESIGN REQUIREMENTS

- A. Identify each item requiring seismic restraint installation in accordance with CBC Chapter 16A. Include floor mounted items weighing more than 400 pounds and wall mounted or suspended items weighing more than 20 pounds.
- B. Supports for such items, including racks, conduit, cable trays and similar shall be provided support, bracing, and anchorage, designed by the Contractor in accordance with the following criteria:
 - 1. Design to resist seismic forces in accordance with CBC Chapter 16A.
 - 2. Minimum Design Parameters - As defined for the Building, with respect to Occupancy Category, Site Classification, Seismic Design Category, Importance Factor, Spectral Acceleration and SDI.

The Electronic Security System design should always conform to the standards of execution and code of reference typically established for the Project and stated on the cover sheets of the drawing set. Include the following texts only on projects where no Architectural drawings are being prepared (example: a standalone security upgrade

- a. *[If not defined for this Project, conform with at least Seismic Importance Factor 1.25 Table 11.5-1 of ASCE-705, or latest edition.]*

1.5 REFERENCES

- A. Usage: In accordance with Section 01 41 00 – Regulatory Requirements.

The AASHTO references below are required when underground electronic security duct placement is required.

- B. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. AASHTO M-306 Standard Specification For Drainage, Sewer, Utility, And Related Castings
- C. American Institute Of Steel Construction (AISC)
 - 1. AISC 325 (2005) Steel Construction Manual
 - 2. American National Standards Institute (ANSI)
 - a. ANSI C80.1 1994 Rigid Steel Conduit - Zinc Coated
 - b. ANSI C80.3 1991 Electrical Metallic Tubing - Zinc Coated
- D. American Society For Testing and Materials (ASTM)
 - 1. ASTM A123/A123M-02 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - 2. ASTM A153/A153M-04 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 3. ASTM B633-98e1 Specification for Electro-deposited Coatings of Zinc on Iron and Steel.
 - 4. ASTM A653/A653M-04a Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

The Caltrans references below are required when underground electronic security duct placement is required.

- E. *[California Department of Transportation*
 - 1. *Standard Specifications, 2010 Edition, 86 Electrical Systems*
 - a. *Materials only. Refer to this Section, Related Sections and the plans for means of execution.]*
- F. National Electrical Manufacturers Association (NEMA)

1. NEMA 250-2003 Enclosures for Electrical Equipment (1000 Volts Maximum)
 2. NEMA FB 1 (ANSI/NEMA FB 1-2003) Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
 3. FB 2.102000 Selection and Installation Guidelines For Fittings For Use With Non-Flexible Metallic Conduit Or Tubing (Rigid Metal Conduit, Intermediate Metal Conduit, And Electrical Metallic Tubing).
 4. FB 2.202000 Selection and Installation Guidelines for Fittings for use with Flexible Electrical Conduit and Cable
 5. NEMA ICS 6 1988 (Rev. 1) Enclosures for Industrial Control and Systems
 6. NEMA OS 3-2002 Selection and Installation Guidelines for Electrical Outlet Boxes.
 7. NEMA RN 1-1998 Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 8. NEMA TC 7 2000 Smooth Wall Coilable Polyethylene Electrical Plastic Duct
 9. NEMA TC 13 2000 Electrical Nonmetallic Tubing (ENT).
 10. NEMA TC 14 1984(R 1986) Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings
- G. Underwriters Laboratories, Inc. (UL)
1. UL 1 2000 Flexible Metal Conduit
 2. UL 6 2004 Electrical Rigid Metal Conduit - Steel
 3. UL 50 (1995; R 1999, Bul. 2001) Enclosures for Electrical Equipment
 4. UL 360 1986 (Bul. 1991) (R 1993) Liquid-Tight Flexible Steel Conduit
 5. UL 514A 1991 (R 2004) Metallic Outlet Boxes
 6. UL 514B 1989 (R 2004) Conduit, Tubing and Cable Fittings
 7. UL 514C 1996 (R 2000) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
 8. UL 651 1989 (R 1989) (Bul. 1993) Schedule 40 and 80 Rigid PVC Conduit.
 9. UL 797 1993 (R 2004) Electrical Metallic Tubing - Steel
 10. UL 1242 1983 (R1993) (Bul. 1993) Intermediate Metal Conduit.
 11. UL 1286(1999; R 2001, Bul. 2002) Office Furnishings
 12. UL 1479 Fire Tests of Through Penetration Firestops
 13. UL Fire Resistance Directories

1.6 DEFINITIONS

- A. Exposed. Visible to the public following completion of the project. Not concealed.
- B. Concealed. Fully enclosed in finished construction, and not visible to the public. Examples include installation above finished ceiling or within a wall cavity.

1.7 SUBMITTALS

- A. Conform with the requirements of Section 01 33 23 – Shop Drawings, Product Data and Samples and Section 28 05 00 - Common Work Results for Electronic Safety and Security.
 1. As part of the project submittals, the contractor to provide engineered shop drawings indicating the proposed design for mounting all work of this Division as defined under the Seismic Design Requirements and defined elsewhere in this Section, inclusive of mounting systems, equipment mounted at the exterior, inclusive of its effective wind load under the range of conditions expected.
 - a. Shop drawings to be accompanied by anchorage calculations indicating that it shall remain attached to the mounting surface after experiencing forces in conformance with California Code of Regulations, Title 24, California Building Code, edition as referenced in Division 1 and as

- b. shown on the Architectural Plans
Structural Calculations shall be prepared and signed by a California Registered Structural Engineer. Specify proof loads for drilled-in anchors, if used.

1.8 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new and unused, and of current manufacturer.
- B. Only products and applications listed in this Section may be used on the project unless otherwise submitted and approved by the University's Representative.

PART 2 - PRODUCTS

Pathway construction throughout the majority of the UC Santa Cruz campus requires conventional materials. Refer to the most recent edition of the PP&C Division 26 raceway standard to conform with its latest requirements. At the present time, PP & C does not permit the use of setscrew fittings for EMT construction. Note that due to severe salt water exposure at the Marine Science Campus, pathways installed at the exterior of buildings on that site utilize 316 stainless steel and/or nonmetallic pathway.

2.1 GENERAL

- A. Provide the following types of conduit systems listed by their commonly used generic name.

2.2 RACEWAY

- A. Manufacturers:
1. Raceway:
 - a. Allied Tube and Conduit Co.
 - b. Triangle PWC, Inc.
 - c. Western Tube and Conduit Corp.
 - d. Spring City Electrical Manufacturing Co.
 - e. Occidental Coating Co. (OCAL).
 - f. Alflex Corp.
 - g. American Flexible Metal Conduit Co.
 - h. Anaconda.
 - i. Or equal.

Stainless steel only applies for work installed at the exterior at the Marine Science campus.

2. *[Stainless Steel Raceway and Fittings*
 - a. Constructed of Type 316 Stainless Steel with either EMT, IMC type stainless steel fittings.
 - b. Approvals
 - c. UL6A
 - d. Manufacturers
 - i. Calbrite
 - ii. Allied Tube and Conduit
 - iii. Or equal.]

3. Fittings:
 - a. Appleton Electric Co.
 - b. OZ/Gedney.
 - c. Thomas & Betts Corp.
 - d. Spring City Electrical Manufacturing Co.
 - e. Occidental Coating Co. (OCAL).
 - f. Carlou.
 - g. or equal.

- B. Rigid Steel Conduit.
 1. Drawing and Spec Reference: RSC.
 2. Construction:
 - a. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and UL 6.

Select compression type for severe exposure conditions, otherwise use standard.

 - b. [Standard threaded] [Compression Type] couplings locknuts, bushings, and elbows: Only materials of steel or malleable iron are acceptable. Locknuts shall be bonding type with sharp edges for digging into the metal wall of an enclosure.
 - c. Three piece couplings: Electroplated, cast malleable iron.
 - d. Insulating bushings: Threaded polypropylene or thermosetting phenolic rated 150 degree C minimum.
 - e. Insulated grounding bushings: Threaded cast malleable iron body with insulated throat and steel "lay-in" ground lug with compression screw.
 - f. Insulated metallic bushings: Threaded cast malleable iron body with plastic insulated throat rated 150 degrees C.
 - a. All fittings and connectors shall be threaded.

- C. Coated Rigid Steel Conduit:
 1. Drawing and Spec Reference: CRSC.
 2. Conduit: Full weight, threaded, hot-dip galvanized steel, conforming to ANSI C80.1 and NEMA RN-1 with nominal 40 mil thermoplastic vinyl coating, heat fused and bonded to the exterior of the conduit.
 3. Fittings:
 - a. Conduit couplings and connectors shall be as specified for galvanized rigid steel conduit and shall be factory PVC coated with an insulating jacket equivalent to that of the coated material.
 - b. Fittings over-sleeve to extend 1 conduit diameter or 1-1/2" beyond fitting, whichever is less.
 4. Performance:
 - a. Tensile Strength: 3500 psi.
 5. Approvals:
 - a. NEMA RN1 (Type 40 - 40 mils thick)
 - b. CalTrans Type 2
 6. Manufacturers:
 - a. Plastibond by RobRoy Industries.
 - b. Occal-40 by Occidental Coating Company.
 - c. KorKap by Plastic Applicators.
 - d. Ocal-Blue
 - e. or equal.

- D. Intermediate Metal Conduit
 - 1. Drawing Reference: IMC
 - 2. Conduit: Hot dip galvanized steel meeting the requirements of CEC Article 345 and conforming to ANSI C80.6 and UL 1242.

Select compression type for severe exposure conditions, otherwise use standard.

- 3. Fittings: *[Standard threaded][Compression Type]* couplings, connector and bushing shall be as specified for galvanized rigid steel conduit. Integral retractable type IMC couplings are also acceptable.
- E. Electrical Metallic Tubing.
 - 1. Drawing and Spec Reference: EMT.
 - 2. Conduit: Shall be formed of cold rolled strip steel, electrical resistance welded continuously along the longitudinal seam and hot dip galvanized after fabrication. Conduit shall conform to ANSI C80.3 specifications and shall meet UL classifications.
 - 3. Raintight compression couplings: Electroplate steel or cast malleable iron; UL listed raintight and concrete tight, using gland and ring compression type construction.
 - 4. Raintight compression connectors: Electroplated steel or cast malleable iron, UL listed raintight and concrete tight, with insulated throat, using gland and ring compression type construction.
 - 5. Use of set-screw couplings and connectors is not permitted.
- F. Flexible Conduit:
 - 1. Drawing Reference: FLEX
 - 2. Construction:
 - a. Flexible steel, zinc coated on both inside and outside by hot-dipping process.
 - b. Interlocking spirally wound continuous steel strip.
 - c. 3/4" minimum size.
 - 3. Fittings: Compression type connectors shall be of the single screw clamp variety with steel or cast malleable iron bodies and threaded male hubs with insulated throats. Exception: Pressure cast screw-in connectors shall be acceptable for fixture connection in suspended ceilings and cut-in outlet boxes within existing furred walls.
 - 4. Approvals:
 - a. UL 1
- G. Liquidtight Flexible Metallic Conduit
 - 1. Drawing Reference: Liquidtight
 - 2. Conduit: Shall be fabricated in continuous lengths from galvanized steel strips, interlocking spirally wound, covered with extruded liquidtight jacket of polyvinyl chloride (PVC) and conforming to UL 360. Provide conduit with a continuous copper-bonding conductor wound spirally between the convolutions.
 - 3. Fittings: Compression type connector body and gland nut shall be of cadmium plated steel or cast malleable iron, with tapered, male, threaded hub; insulated throat and neoprene "O" ring gasket recessed into the face of the stop nut. The clamping gland shall be of molded nylon with an integral brass push-in ferrule.

2.3 DUCTBANK CONSTRUCTION

- A. PVC Conduit
 - 1. Drawing and Spec Reference: PVC.
 - 2. Construction:
 - a. 4" trade diameter, unless otherwise noted.

- b. Poly-vinyl chloride.
- c. Schedule by Application
 - i. *Straight segments, Schedule 40.*
 - ii. *Flat elbows, Schedule 40.*
 - iii. *Vertical elbows sweep up to grade, Schedule 80.*
 - iv. *Above grade, Schedule 80.*
- d. Elbows.
 - i. *Where innerduct liner is scheduled – CRSC.*
 - ii. *Elsewhere, Schedule 80.*
 - iii. *90° C rated.*
 - iv. *Solvent welded joints, joints by pipe manufacturer.*
- e. Application.

Conform with the latest PP&C master specs for underground Ductbank installation. UCSC typically concrete encases underground ductbank.

- i. Soil Backfill/Direct Burial
 - (1) *RUS Type II, Type C or Type DB*
 - (2) *Schedule 40.*
- ii. Concrete Encasement:
 - (1) *PVC Type DB-120,*
 - (2) *RUS Type I, Type B ohim him him r Type EB*
 - (3) *Any meeting Soil Backfill/Direct Burial.*
- iii. Boring
 - (1) *HDPE.*
 - (2) *RUS Type Flexible Plastic.*
- f. Performance:
 - i. *Tensile Strength: 7,000 psi at 73.4° F.*
 - ii. *Flexural Strength: 11,000 psi.*
 - iii. *Compressive Strength: 8,600 psi.*
- g. Approvals:
 - i. *RUS Listed for Telephone Cable Installation 5-99 Edition, or latest release thereof.*
 - ii. *NEMA TC-2, PVC Type EPC-40 and EPC-80.*
 - iii. *NEMA TC-3.*
 - iv. *NEMA TC14 Fiberglass Conduit.*
 - v. *UL 514 fittings.*
 - vi. *UL 651.*
 - vii. *ANSI C33.91.*
- h. Manufacturers:
 - i. RUS Listed:

Manufacturer	RUS Listed for	Manufacturer Part Number
Allwire, Inc.	Flexible plastic	ALLDUCT
American Pipe & Plastics	Plastic	Type B, C, and D
	Plastic	Type EB and DB

	Plastic	PVC Multi-Duct (2,3,4 and 6-way)
Americon International	Flexible plastic	HDPE Duct
	Plastic	PVC Type C
Apache Plastics, Inc.	Plastic	Type EB and Type DB
ARMCO	Plastic	Smooth-Cor Type B and Type C
Arnco	Flexible plastic	HDPE Conduit
Bay Plastics, Inc.	Plastic	Type B and Type C
Bristolpipe	Plastic	Type B, C, and D
	Plastic	Type EB and Type DB
Can-Tex	Plastic	Type EB and Type DB
	Plastic	Type B, C, and D
Carlton	Plastic	Type EB and Type DB
	Plastic	Type B, C, and D
	Plastic	Multi-Gard
Certain-Teed Products Corp.	Plastic	Type EB and Type DB
CIBA-GEIGY	Fiberglass	T & D Conduit
Condux International, Inc.	Concrete	Condux
	Plastic	Type EB and Type DB
CSR Polypipe	Flexible plastic	HDPE Duct
Dura-line	Flexible plastic	HDPE Duct
Eagle Pacific Industries, Inc.	Plastic	Type EB and Type DB
	Flexible plastic	HDPE Coiled Duct
Endot Industries	Flexible plastic	HDPE Duct
Freedom Plastics, Inc.	Plastic	Type C
Hercules, Inc.	Flexible plastic	Corflo plastic conduit
Hurlbut Plastic Pipe	Plastic	Type C
Ingomar Plastic Pipe	Plastic	Type B and Type C

J-M Manufacturing Company	Plastic	Types C, EB, and DB
Kyova	Plastic	Type EB and Type DB
LCP National Plastics, Inc.	Plastic	Type EB and Type DB
	Plastic	Type B and Type C
Northern Pipe Products	Plastic	Type B, C, and D
OMNI	Flexible plastic	HDPE Duct
Petroflex	Flexible plastic	HDPE Duct
	Flexible plastic	Corrugated HDPE Duct
Phillips Products Co., Inc.	Flexible plastic	Drisccon 3200
Phone Ducs	Plastic	Multiple plastic conduit (4, 6, & 9 Way)
PLEXCO	Flexible plastic	PLEXCO Duct
PWPipe	Plastic	Type EB and Type DB
Pyramid Industries, Inc.	Plastic	Type EB and Type DM
	Flexible plastic	HDPE Conduit
Quail Plastics	Plastic	Type EB and Type DB
Queen City Plastics	Plastic	Type EB and Type DB
River City Plastics	Plastic	Type EB and Type DB
Sedco	Plastic	Type EB and Type DB
Southern Pipe, Inc.	Plastic	PVC Types EB, DB, and Sch. 40
Tamaqua Cable Products	Flexible plastic	HDPE Duct
Tridyn Industries	Plastic	Type EB and Type DB
Vassallo Industries	Plastic	Type B and Type C
Wesflex	Flexible plastic	Flex-Con

i. or equal

- B. Fiberglass Conduit
 - 1. Drawing Reference: Fiberglass

2. Construction:
 - a. Trade Standard Sizes
 - b. Meets NEMA TC 14
 - c. Complete system of joints and threaded steel conduit couplers
3. Manufacturers:
 - a. TVC Communication/Vikimatic Fiberglass Conduit
 - b. Champion Fiberglass
 - c. FRE Composite
 - d. or equal.

2.4 MISCELLANEOUS CONDUIT FITTINGS AND PRODUCTS

- A. General
 1. UL 514B.
 2. Listed in UL Electrical Construction Materials List.
- B. Conduit Fittings, Insulated Throat Grounding Bushings
 1. Description
 - a. Threaded for Rigid Steel Conduit and Intermediate Metal Conduit.
 - b. UL Listed for use with copper conductors.
 - c. Thermoplastic insulated liner for 105 degrees Celsius.
 - d. Body of malleable iron, zinc plated; or die cast zinc.
 2. Manufacturer
 - a. Thomas & Betts (Steel City) BG-801 Series
 - b. O-Z/Gedney
 - c. or equal.
- C. Watertight conduit entrance seals: Steel or cast malleable iron bodies and pressure clamps with PVC sleeve, neoprene sealing grommets and PVC coated steel pressure rings. Fittings shall be supplied with neoprene sealing rings between the body and PVC sleeve.
- D. Watertight cable sealing bushings: One piece, compression molded sealing ring with PVC coated steel pressure disks, stainless steel sealing screws and zinc plated cast malleable iron locking collar.
- E. Expansion fittings: Multi-piece unit comprised of a hot dip galvanized malleable iron or steel body and outside pressure bussing designed to allow a maximum of 4" conduit movement (2" in either direction). Furnish with external braid tinned copper bonding jumper. Unit shall be UL listed for wet or dry locations.
- F. Expansion/deflection couplings: Multi-piece unit comprised of a neoprene sleeve with internal flexible tinned copper braid attached to bronze end couplings with stainless steel bands. Coupling shall accommodate .75-inch deflection, expansion, or contraction in any direction, and allow 30-degree angular deflections. Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber jacket and stainless steel jacket clamps. Unit shall comply with UL467 and UL514.
 1. Manufacturer:
 - a. OZ/Gedney Type DX
 - b. Steel City Type EDF
 - c. or equal.
- G. Standard products not herein specified:
 1. Submit for review a listing of standard electrical conduit hardware and fittings not herein specified prior to use or installation, i.e. locknuts, bushings, etc.

2. Listing shall include manufacturers name, part numbers, and a written description of the item indicating type of material and construction.
 3. Miscellaneous components shall be equal in quality, material, and construction to similar items herein specified.
- H. Hazardous area fittings: UL listed for the application.

2.5 JUNCTION AND DEVICE BOXES

A. Junction and Device Boxes

1. Drawing References: As shown on Symbol Schedule
2. Construction:
 - a. Concealed/Flush Mounted:
 - i. *One or two piece welded knockout boxes. UL 514A, cadmium or zinc-coated 1.25 oz/sq. ft., if ferrous metal.*
 - ii. *Pressed sheet steel, for flush indoor locations.*
 - iii. *UL 514C approved if non-metallic.*
 - iv. *At hollow masonry, tile walls and plaster walls, provide with device rings as required.*
 - v. *Exterior: Where installed in hazardous locations or exposed to corrosive atmosphere, rain or spray, boxes shall be corrosion resistant cast metal with threaded entrances, removable covers, gaskets, and corrosion resistant screws.*
 - b. Surface mounted:
 - i. *Conform to the Junction and/or PullBox construction scheduled on the Plans. Where construction not otherwise scheduled or noted on the plans, conform to the following:*
 - (1) *Junction boxes with knockouts are not to be used for surface mounted locations or exposed locations.*
 - (2) *Cast iron with threaded hubs and mounting lugs.*
 - ii. *Exterior: Where installed in hazardous locations or exposed to corrosive atmosphere, rain or spray, boxes shall be corrosion resistant cast metal with threaded entrances, removable covers, gaskets, and corrosion resistant screws.*
 - c. Concrete floor embedded:
 - i. *Cast iron concrete pour boxes with screwed brass cover, unless otherwise noted.*
 - ii. *Cadmium plated screw cover attachment at least 6" on center.*
 - d. If size not otherwise noted, at least 4S (4" square) by 2-1/8" deep, or Code minimum size, whichever is larger.
 - i. *Wherever 4S is indicated, contractor may at their option substitute 4-11/16" or 5" (5S) square boxes while maintaining the minimum depth required by these specifications and the drawings.*
 - ii. *At recessed masonry wall installations, provide gangable masonry boxes.*
 - e. Provide complete with approved type of connectors and required accessories, including attachment lugs or hangers. Provide raised device covers as required to accept scheduled device.
3. Approvals.
 - a. UL 514A
4. Manufacturers:

- a. Interior, flush:
 - i. *Steel City.*
 - ii. *Bowers*
 - iii. *Randl Industries, Inc. (5S Boxes).*
 - iv. *or equal.*
- b. Interior, flush 5S Boxes
 - i. *Randl, Inc. 5 Square Telecommunications Boxes*
 - ii. *or equal.*
- c. Surface mount or exterior, exposed with cover of same construction.
 - i. *Appleton*
 - ii. *Pyle-National*
 - iii. *or equal.*
- d. Other conditions:
 - i. *Any meeting approvals and requirements.*

2.6 CABINETS AND ENCLOSURES

A. Terminal Cabinets:

- 1. Drawing Reference: As Scheduled.
- 2. Construction:
 - a. All security system enclosures to be equipped with tamper detection.
 - b. All enclosures should be appropriate to the environment.
 - i. Interior:
 - (1) *Zinc Coated Sheet Steel, code gauge with standard concentric knockouts for conduit terminations.*
 - (2) *NEMA 250 Type 1, unless otherwise noted. Refer to plans and schedules.*
 - ii. External enclosures:
 - (1) *NEMA 250 Type - As Scheduled, not less than NEMA 3R.*

Stainless steel Type 316 only applies for work installed at the exterior at the Marine Science Campus and similar campus settings.

- (2) [NEMA 250 Type - NEMA 4X.]
 - c. Rear wall dimensions not less than those scheduled.
 - d. Finish: Manufacturer's standard gray baked enamel finish.
 - e. Covers: Trim fitted, continuous hinged steel door, flush catch – lockable and keyed to match. Screw fastened doors not acceptable.
 - i. *Door face to be not less than 95% of panel interior dimensions.*
 - f. Provide with 3/4" fire retardant treated ply backboard.
 - 3. Mounting:
 - a. Flush cabinets shall be furnished with concealed trim clamps and shall be not less than 4 inches deep.
 - b. Surface cabinets shall be furnished with screw cover trim, flush hinged door and shall not be less than 6 inches deep.
 - 4. Manufacturers:
 - a. B-Line Electrical Enclosures
 - b. Circle AW Products.

- c. Hammond
- d. Henessey.
- e. Hoffman.
- f. Myers Electric Products
- g. Rittal.
- h. or equal.

2.7 WIREWAY

Note that UCSC Physical Security does not accept nonmetallic "finger" wireway at electronic security backboards in lieu of the steel wireway (gutter) specified here.

- A. Lay-In Wireway
 - 1. Drawing Reference: Gutter
 - 2. Features/Functions/Construction
 - a. NEMA Type 1, unless otherwise noted.
 - b. ANSI 61 Gray polyester powder finish inside and outside.
 - c. Screw fastened cover completely removable to provide complete access to interior.
 - d. 6"x6" cross-section minimum, size for 30% fill maximum
 - 3. Approvals
 - a. UL 870
 - b. NEMA Type 1
 - 4. Manufacturers
 - a. Hoffman Lay-In Type 1 Wireway
 - b. Square D
 - c. Circle AW
 - d. or equal

2.8 THROUGH PENETRATION SEALING SYSTEMS

Conform with current PP & C master specs four through penetration sealant systems. UCSC ITS requires that communications cabling including cabling placed for Division 28 security cameras be placed using re-enterable through penetration sealant system equivalent to STI EZ-Path.

- A. Through Penetration Sealant Assembly, Re-Enterable (Zero Maintenance)
 - 1. Drawing Reference: TPSR and as required at all new through penetrations through rated partitions.
 - 2. Application
 - a. Provide at all locations where open wire communications cabling penetrates fire-rated assemblies in basket tray, cable tray or supported by J-hooks. Zero-maintenance firestop assemblies shall be used when the pathway on one or both sides of the wall, ceiling or floor is open, such as J-hooks or cable tray.
 - b. Communications conduit sleeves through a single fire-rated wall shall not be used. For these applications, a zero-maintenance firestop assembly is required.
 - 3. Functions
 - a. Cables passing through fire-rated floors or walls shall pass through fire-rated assemblies which can be used by the University's technical staff to

- add and remove cabling without having to apply or remove putty fill, backing or similar compounds to maintain the necessary fire rating.
- b. Through penetration system to feature either automatic self-adjustment mechanisms, or integral mechanical adjustment mechanisms to permit the University's staff to adapt the assembly to the fill condition without need for supplementary or disposable materials. The assembly shall contain a self-contained sealing system which shall automatically adjust to the installed cable loading and shall permit cables to be installed, removed or retrofitted without the need to adjust, remove or reinstall firestop material.
 - c. Assemblies shall have an F Rating and T Rating equal to the rating of the barrier in which the device is installed, where such is performance is required by Code.
 - d. Assembly size and quantity shall be determined as follows:
 - i. *For round openings, the fill ratio of cabling-to-opening-size shall not exceed 40%, or as dictated by the manufacturer, whichever is more stringent.*
 - ii. *For rectangular openings, the fill ratio of cabling-to-opening size shall not exceed 50%, or as dictated by the manufacturer, whichever is more stringent.*
 - iii. *Include in the cabling cross-sectional area enough spare capacity to accommodate 50% growth. Upon commissioning, if adequate spare capacity is not observed, the contractor shall install additional assemblies at their own cost to provide such spare capacity*
4. Approvals:
 - a. California State Fire Marshal.
 - b. Tested to UL 1479
 - c. UL 2043
5. Manufacturers - Select for application:
 - a. Specified Technologies Inc. EZ-Path Fire Rated Pathway
 - b. Wiremold FlameStopper
 - c. Hilti CP 653 Speedsleeve
 - d. or equal.
- B. Firestopping for Conduits and Other Closed Pathways
- 1. Approvals: California State Fire Marshal
 - 2. Tested to UL 1479 or ASTM E814.
 - 3. Manufacturers:
 - a. Specified Technologies, Inc.
 - b. 3M
 - c. or equal.

2.9 SUPPORTING DEVICES

- A. General
 - 1. Supports to be sized to suit load and selected to match mounting conditions
- B. Manufacturers
 - 1. Equal products by the following manufacturers will be considered providing that all features of the specified product are provided:
 - a. Concrete fasteners:
 - i. *Phillips "Red-Head".*

- ii. *Remington.*
 - iii. *Ramset.*
 - iv. *Hilti*
 - v. *Simpson Strong-Tie*
 - vi. *or equal.*
 - b. Concrete inserts and construction channel:
 - i. *Unistrut Corp.*
 - ii. *GS Metals "Globe Strut."*
 - iii. *Thomas & Betts "Kindorf" Corp.*
 - iv. *Or equal.*
 - c. Conduit straps:
 - i. *O-Z/Gedney.*
 - ii. *Erico "Caddy" Fastening Products.*
 - iii. *Thomas & Betts "Kindorf" Corp.*
 - iv. *Or equal.*
 - d. Beam Clamps
 - i. *Cooper B-Line*
 - ii. *SuperStrut*
 - iii. *Unistrut*
 - iv. *or equal*
 - e. Aircraft Cable Sway Braces
 - i. *Mason Industries*
 - ii. *M.W. Sausse/Vibrex*
 - iii. *Loos & Company, Inc.*
 - iv. *or equal.*
- C. Concrete Fasteners
 - 1. Provide expansion-shield type concrete anchors.
 - 2. Provide powder driven concrete fasteners with washers. Obtain approval by University's Representative prior to use.
- D. Concrete Inserts
 - 1. Provide pressed galvanized steel, concrete spot insert, with oval slot capable of accepting square or rectangular support nuts of ¼ inch to ½ inch diameter thread for rod support.
- E. Aircraft cable sway braces
 - 1. Steel rope sized to meet load.
- F. Construction Channel:
 - 1. Construction:
 - a. 1-5/8" square galvanized channel formed from U.S.S.G No. 12 or 0.109 inch cold formed steel with 17/32-inch diameter bolt holes, and 1-1/2 inch on center in the base of the channel.
 - b. 10 foot sections.
 - 2. All supporting materials by same manufacturer.
- G. Beam Clamps
 - 1. Malleable iron electro-galvanized steel beam clamps selected to match building structural steel members.
- H. Conduit Straps
 - 1. One hole strap, steel or malleable iron, with malleable iron clamp-back spacer for surface mounted wall and ceiling applications.
 - a. Use malleable strap with spacers for exterior and wet locations.

- b. Use steel strap without spacers for interior locations.
- 2. Steel channel conduit strap for support from construction channel.
- 3. Steel conduit hanger for pendant support with threaded rod
- 4. Steel wire conduit support strap for support from independent #12 gauge hanger wires.
- I. Threaded rods, couplings, screws and nuts:
 - 1. Electrolytically coated with zinc, 2 oz. zinc per square foot of surface, ASTM A123 or A153.
- J. Miscellaneous Parts
 - 1. Hot dipped galvanized after fabrication; after cutting, de-burring and hole drilling. Coated with zinc, 2 oz. zinc per square foot of surface, ASTM A123 or A153.
- K. Exterior/Wet Service Application
 - 1. Electronic security systems hangers or supports in wet areas or areas exposed to outside air including but not limited to building exterior, Tank Farm, AH-1 Mechanical Room, Greenhouse Interior or similar, shall be need to be suitably corrosion resistant, constructed of either 316 stainless steel or non-metallic
 - 2. Manufacturers:
 - a. Cooper Industries
 - b. Champion Fiberglass
 - c. Enduro Composites
 - d. Seasafe
 - e. Or equal.
- L. Paint/Tape for Touch-up:
 - 1. Zinc: CRC "Zinc-It", Glyptal, Enterprise Galvanizing "Galambra", or equal.

2.10 CABLE HANGERS

- A. Ceiling Hung J-Hooks
 - 1. Drawing Reference(s):
 - a. WMJ
 - b. ACJ
 - 2. Features/Functions/Construction
 - a. Specifically intended to carry the load of up to 50 communications cables without applying excess forces to cables at bottom of bundle.
 - b. Integral broad bottom edge to spread cable load with flat bottom and provide a minimum of 1-5/8 inch cable bearing surface.
 - c. Integral hanger rod attachment hardware at top.
 - d. Load rated for application.
 - e. Incorporates smooth 90-degree radiused edges to prevent snagging cable jackets on installation.
 - f. Designed so the mounting hardware is recessed to prevent cable damage.
 - g. Integral mechanical cable latch retainer to provide containment of cables within the hook. The retainer shall be removable and reusable.
 - h. Suitable for direct attachment to walls, hanger rods, beam flanges, purlins, strut, floor posts, etc. to meet job conditions.
 - i. Multi-tiered cable hooks to be used where required to provide separate cabling compartments, or where additional capacity is needed.
 - j. Finishes:
 - k. Cable hooks for non-corrosive areas shall be pre-galvanized steel, ASTM A653. Where additional strength is required, cable hooks shall be

- I. spring steel with a zinc-plated finish, ASTM B633, SC3.
Cable hooks for corrosive areas shall be stainless steel, AISI Type 304.
- 3. Manufacturer
 - a. Cooper B-Line series BCH21, BCH32, BCH64
 - b. Caddy/Erico CableCat
 - c. or equal.

The next subsections only applies when the electronic security system includes underground work.

2.11 UNDERGROUND STRUCTURE AND PATHWAY

- A. *Fittings*
 - 1. *Couplings, adapters, transition fittings, etc., shall be molded PVC, slip on, solvent weld type conforming to NEMA TC3 for Schedule 40 or 80 and NEMA TC 9 for type EB or DB.*
 - 2. *Fitting Types*
 - a. Expansion Fittings, 12", Metallic:
 - b. Function: At road or bridge expansion joints requiring up to 12" of expansion compensation.
 - c. Construction
 - i. Steel, hot dip galvanized.
 - ii. Nylon wear bushings
 - iii. O-ring seal
 - iv. Bonding jumper
 - d. Manufacturers:
 - i. O-Z Gedney Type AX, Type AX-8, and Type EX fittings with Type BJ Bonding Jumper.
 - ii. TVC/Vikimatic VB0285X series.
 - iii. Or Equal.
 - 3. *Expansion Fittings, 6", Non-metallic:*
 - a. Function: At road or bridge expansion joints requiring up to 6" of expansion compensation.
 - b. Construction
 - i. Fiberglass
 - ii. Provide bonding jumper.
 - c. Manufacturers:
 - i. TVC Communications HW or Extra Heavy Wall Expansion Joint.
 - ii. Vikimatic
 - iii. FRE Composites, Inc.
 - iv. Or Equal.
 - 4. *Caps, Underground Conduit Stubs*
 - a. Provide at each location indicated for future expansion.
 - b. Wateright.
 - c. Manufacturers:
 - i. Carlon E985N
 - ii. Vikimatic
 - iii. or equal by manufacturers listed in this Section for underground ductbank construction.

B. *Underground Structures*

1. *Vaults, PullBoxes and Manholes, Precast, General*

a. *Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes, boxes and handholes.*

b. *Construction*

i. *General*

- (1) Castings shall be free from warp and blow holes that may impair strength or appearance.
- (2) Structures shall be precast to the design and details indicated, precast monolithically and placed as a unit, or structures may be assembled in sections, designed and produced by the manufacturer in accordance with the requirements specified.
- (3) Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.
- (4) Structure top and wall shall be of a uniform thickness of not less than 4 inches except at knockouts.
- (5) The minimum concrete cover for reinforcing steel shall be 2 inches.
- (6) All steel, except reinforcing steel, shall be hot dip galvanized after fabrication.
- (7) Knockouts & Windows
 - (a) Thin-walled knock-out panels designed for future duct bank entrances are permitted.
 - (b) Sides of precast windows shall be a minimum of 4 inches from the inside surface of adjacent walls, floors, or ceilings.
 - (c) Form of the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope.
 - (d) Provide welded wire-fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes.
 - (e) Provide additional reinforcing steel comprised of at least 2 No. 4 bars around window openings.
- (8) Extension Rings
 - (a) Provide extension rings as-required to extend from finished grade to communications utilities.
- (9) Bottom and Drain Sumps
 - (a) Provide solid concrete bottom surface.
 - (b) Provide drain sumps for precast structures a minimum of 12 inches in diameter and 4 inches deep.

c. *Joints:*

- i. Provide tongue-and-groove or shiplap joints on mating edges of precast components.
 - ii. Design joints to firmly interlock adjoining components and to provide waterproof junctions, and adequate shear transfer.
 - iii. Seal joints watertight using preformed plastic strip conforming to AASHTO M198, Type B.
 - d. Frames and Covers
 - i. Covers to match across all utilities.
 - ii. Provide fiber composite lids at pedestrian rated covers, H-20 steel slip resistant covers otherwise.
 - iii. Labeling
 - (1) Provide labeling as follows:
 - (a) "Communications"
 - (b) University's Manhole or Vault No, as shown on drawings or provided to Contractor prior to vault order placement.
 - (2) Labeling shall be:
 - (a) Cast in concrete lids
 - (b) Written in weld on steel lids
 - (c) Alternatively, for pedestrian grade vault lids and for the vault number only, provide ½" tall, 1/8" min. thickness lamacoid label, rivet attached to box top in recess area below surface of lid.
 - e. Pulling-In-Irons
 - i. Steel bars bent in the form indicated and cast in the walls and floors.
 - ii. Install a pulling-in iron in the wall opposite each duct line entrance at walls, not less than 6 inches above or below, and opposite the conduits entering the manhole.
 - iii. Pulling-in irons shall project into the manhole approximately 4 inches, or be cast in a pocket. Iron shall be hot-dipped galvanized after fabrication.
 - f. Cable Racks and Arms
 - i. Provide nonmetallic cable racks:
 - (1) Vaults and pullboxes. Minimum two (2), at each vault face 24 inches or longer, at least one (1) each face otherwise.
 - (2) Manholes. Provide AT&T standard arrangement of cable racks at each manhole
 - (a) Provide two nonmetallic cable racks arms - minimum 12" arms – for each cable rack provided at each manhole or vault as required above.
- 2. Underground Pull Boxes and Vaults, Concrete with Diamond Plate Steel or Concrete Lids
 - a. Drawing and Specification References:
 - i. PB1P
 - ii. PB1T

- iii. PB2P
- iv. PB2T
- v. PB3T
- b. Minimum Size (inches)
 - i. PB1: 12x18
 - ii. PB2: 24x36
 - iii. PB3: 36x60
 - iv. Provide scheduled or larger size.
 - v. Provide extension rings as required to meet required depth.
- c. Minimum Load Performance:
 - i. PB*P – where * is the vault size: Manufacturer's Parkway/Pedestrian Box/Lid or using Polymer Concrete Box lid meeting ANSI/SCTE 77-2007 Tier 8.
 - ii. PB*T – where * is the vault size: Per AASHTO H-22. See options described in plans and Part 3 for Contractors Option to use Polymer Concrete Vaults at specific dirt road/path conditions where indicated on the plans. Refer below for specification of Polymer Concrete Vaults.
- d. Lid Construction:
 - i. As scheduled on the plans and in the schedule of applications in Part 3.
 - ii. Labeling "Communications" in addition to the vault number identified by the University.
- e. Solid Bottom, with sump as indicated on the plans.
- f. Sidewall Duct Entries with bell end fittings.
- g. Cover Components
 - i. PB1 and PB2 Size: One piece construction
 - ii. PB3 Size: Two piece hinged lids with torsion spring lifters.
- h. Manufacturers:
 - i. Oldcastle Precast
 - ii. Brooks Products
 - (1) 1P & 1T: 5 Series and extension rings as required
 - (2) 2P & 2T: 67 Series and extension rings as required
 - (3) 3T: 400 Series with 11C Type Lid.
 - iii. Jensen PreCast
 - (1) PB1P: P9 with FL9D lid, P9BA base and extension rings as required.
 - (2) PB1T P9 with P9-61 lid, P9BA base and extension rings as required
 - (3) PB2P: P36 with FL36D cover, P36BA base and extension rings as required
 - (4) PB2T: P36 with P36-61D lid, P36BA base and extension rings as required
 - (5) PB3T: 35TA
 - iv. Utility Vault Company, Inc./Oldcastle Precast
 - (1) PB3T: PTS-3660, with H-20-44 loading cover, with 3660-06 and 3660-12 extensions as required.

- v. Associated Concrete Products
 - vi. Forni Corporation.
 - vii. Or equal.
3. *Manhole/Maintenance Hole*
- a. Drawing and Specification Reference:
 - i. MH: Maintenance Hole, 8'-6" feet long by 4'-6" wide minimum inside dimensions, 6'-6" clear interior height.
 - b. Minimum Load Performance: AASHTO H-22.
 - c. Construction:
 - i. AT&T Reference Specification PTS-65 for overall size and shape.
 - (1) Arrange duct bank entry per 2004 BICSI Customer Owner Outside Plant Manual, Basic A Splayed Duct Entries, not AT&T standard Basic A center window.
 - (2) Provide non-metallic racking and cable support arms, not AT&T standard metallic arms.
 - (3) Increase wall thickness where indicated installation depth exceeds rating of PTS-65 assembly.
 - (4) Provide extension rings as required to meet required depth.
 - ii. Ladder
 - (1) Provide 1 ladder per maintenance hole
 - (2) Steel, hooks to rungs at top of maintenance hold neck, long enough to reach bottom of maintenance hole.
 - d. Labeling
 - i. Labeling "Communications" in addition to the manhole number identified by the University.
 - e. Manufacturers
 - i. Jensen PreCast PTS65 Manhole with ladder, with cover with nameplate "Communications", and with extension rings as required.
 - ii. OldCastle/Utility Vault Company, Inc.
 - iii. Teichert Precast Products
 - iv. Associated Concrete Products
 - v. Forni Corporation.
 - vi. Or equal.
4. *Underground Pull Boxes and Vaults, Polymer Concrete*
- a. Drawing and Specification References – where the option to use of composite vault assemblies is indicated on the plans and per Part 3 of these specifications
 - i. PB1P
 - ii. PB1T
 - iii. PB2P
 - iv. PB2T
 - v. PB3T
 - b. Minimum Size
 - i. As scheduled on the drawings. Provide scheduled or larger size.

- c. Cover Components
 - i. PB1 and PB2 Size: One piece construction
 - ii. PB3 Size: Two piece hinged lids with torsion spring lifters.
 - d. Construction:
 - i. Polymer concrete cover and body.
 - e. Labeling
 - i. Labeling "Communications" in addition to the vault number identified by the University.
 - f. Sidewall Duct Entries with bell end fittings.
 - g. Solid bottom with sump as indicated on the plans.
 - h. Minimum Load Performance:
 - i. PB*P – where * is the vault size: ANSI/SCTE 77-2007 Tier 8.
 - ii. PB*T – where * is the vault size: At indicated dirt roads, per ANSI/SCTE 77-2007 Tier 22.
 - i. Manufacturers
 - i. Armorcast Polymer Concrete Vaults
 - ii. Oldcastle Enclosure Solutions H-Series
 - iii. New Basis
 - iv. Quazite
 - v. Hubbell Power Systems
 - vi. Or equal.
- C. *Miscellaneous Underground Products*
- 1. *Cable Warning Tape*
 - a. Provide
 - i. 6 inches wide minimum.
 - ii. 5 mil plastic.
 - iii. Metallic backing at least 10 feet o.c.
 - iv. 1 mil metallic foil core.
 - v. Orange in color
 - vi. Suitable for buried applications.
 - vii. Continuously imprinted with the words "WARNING - COMMUNICATIONS CABLE BELOW" or similar at not more than 48 inch intervals.
 - b. Manufacturers:
 - i. Carlon Telecom Systems.
 - ii. Monarch Duct & Conduit
 - iii. Vikimatic
 - iv. Or equal.
 - 2. *Pull Rope*
 - a. At least 3/8 inch diameter polyethylene or 3/8" min width woven aramid fiber pulltape.
 - b. 200 pound minimum strength.
 - c. Manufacturers:
 - i. Arnco Dandy-Line
 - ii. Carlon Telecom Systems.
 - iii. Fibertek Pull-line
 - iv. Monarch Duct & Conduit
 - v. Vikimatic

- vi. Any length marked tape listed elsewhere herein below constructed as a pulltape.
 - vii. Or equal.
3. *Length Marked Tape*
- a. Provide 1/2 inch flat tape with sequential markings in whole feet.
 - b. Manufacturers:
 - i. Carlon Telecom Systems.
 - ii. Greenlee
 - iii. Fibertek Pulltape or Tracertape
 - iv. Vikimatic
 - v. Or equal.
4. *Conduit Plugs*
- a. Provide universal blank duct plug type, with eye for tying rope and tape.
 - b. Manufacturers:
 - i. Carlon Telecom Systems Universal Blank Duct Plugs, Simplex, Triplex and Quadplex Duct Plugs
 - ii. Condux International, Inc.
 - iii. Monarch Duct & Conduit Duct Plugs and Multistep Cap Ends
 - iv. GS Industries of Bassett, LLC Expandable Watertight Plugs
 - v. Or equal.
5. *Conduit Spacer, Trench*
- a. Construction
 - i. Non-metallic.
 - ii. Sized to snap around conduits as shown on Drawings.
 - iii. Interlocking.
 - b. Manufacturers:
 - i. Underground Devices Wunpeece.
 - ii. GS Industries of Bassett, LLC Underground Products Spacer System.
 - iii. Armorcast Products Company
 - iv. Carlon Snap-Loc Spacers
 - v. or equal
6. *Pulling In Irons*
- a. 7/8" Diameter
 - i. 6" exposed length minimum after embedment
 - ii. RUS approved
 - b. Manufacturer
 - i. Cooper Power Systems
 - ii. Or equal by listed vault or maintenance hole manufacturer
 - iii. Or equal.
7. *Cable Racks & Supports*
- a. Construction:
 - i. Steel
 - ii. 12" minimum rack arms
 - iii. Snap into vertical strut sections provided with new manhole, pullboxes and vaults, or into University's existing vaults, where indicated.
 - b. Approvals

- i. RUS
- ii. NEMA
- c. Manufacturers:
 - i. As manufactured by the listed vaults and manhole manufacturers listed herein above.]

PART 3 - EXECUTION

3.1 GENERAL

- A. The University's Representative reserves the right to request additional supports where in their sole opinion said supports are required. Any additional supports shall be installed at no additional cost to the University.

3.2 EXAMINATION

- A. Thoroughly examine site conditions for acceptance of supporting device installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.3 PREPARATION

- A. Coordinate size, shape and location of concrete pads required for equipment installation with the work of the other trades
- B. Lay out support devices to maintain headroom, neat mechanical appearance and to support the equipment loads.
- C. Where shown on the Drawings or Specifications, install freestanding Electronic Safety and Security equipment on concrete pads.

3.4 CONDUIT APPLICATION

General: Install the following types of conduits and fittings in the locations listed, unless otherwise noted in the drawings:

The following is required only where work includes underground electronic security duct installation

- 1. [Underground Ductbanks, Concrete Encased
 - a. PVC]
- 2. Exterior, Exposed:
 - a. Type RSC for applications up to 8 feet AFF or to first pull box, whichever is first, applications subject to physical abuse or for applications greater than 4" diameter.
 - b. EMT acceptable in all other applications not noted above up to 4", where used in conjunction with specified Raintight (compression) couplers.

Replace the above application standards for work at Marine Science Campus and use the following

- c. [Type 316 Stainless Steel with either watertight EMT or IMC type stainless steel fittings. Provide non-metallic or 316 SS supports.]
- 3. Interior, Exposed, Wet and Damp Locations:
 - a. Type CRSC.

4. Interior, Hazardous Locations
 - a. Type RSC
 - b. Type IMC, where permitted by the CEC.
5. Interior, exposed or concealed, dry locations:
 - a. RSC, if subject to physical abuse.
 - b. EMT, if not subject to physical abuse.
6. Interior, concealed, damp locations, including in masonry walls.
 - a. RSC
7. Embedded in Concrete
 - a. RSC or rigid non-metallic conduit.
 - b. PVC Type Schedule 40.
8. Transition from walls, floor boxes and monuments to open plan furniture systems:
 - a. Liquidtight

The next two subsections only apply when the electronic security system includes underground work.

3.5 UNDERGROUND VAULT APPLICATION

Condition	Acceptable vault construction standard		
	AASHTO H-20	ANSI /SCTE 77 2007 Tier 22	Pedestrian/Parkway ANSI /SCTE 77 2007 Tier 8
<i>Pedestrian pathways.</i>	Yes	Yes	Yes
<i>At unpaved roads subject to infrequent vehicle traffic.</i>	Yes	Yes	No
<i>At paved roads and at paved surfaces ordinarily exposed to motor vehicle traffic.</i>	Yes	No	No

3.6 UNDERGROUND CONSTRUCTION

- A. *Duct and Conduit Placement.*
 1. *Duct lines shall have a continuous slope downward toward underground structures and away from buildings with a minimum pitch of 3 inches in 100 feet.*
 2. *Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes.*
 3. *Excavate trenches along straight lines from structure to structure before ducts are laid or structure constructed so the elevation can be adjusted, if necessary, to avoid unseen obstruction.*
 4. *Except at conduit risers, accomplish changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, by long sweep bends having a minimum radius of curvature of 25 feet. Sweep bends may be made up of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 18 inches for use with conduits of less than 3 inches in diameter and a minimum radius of 36 inches for ducts of 3 inches in diameter and larger.*

5. *Short-radius manufactured 90-degree duct bends may be used only for building, pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 450 mm 18 inches for ducts of less than 80 mm 3 inch diameter, and 900 mm 36 inches for ducts 80 mm 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 7.6 m 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used.*
- B. *Duct Bank.*
1. *Duct Entrance Arrangement - Conform to Table 3.33 and applicable arrangement diagrams 3.67-3.74 of 2004 BISCO Customer Owned Outside Plant Design Manual.*
 2. *Terminate conduits in end-bells where duct lines enter underground structures.*
 3. *Stagger conduit joints by rows and layers to strengthen the duct bank.*
 4. *Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers and top spacers to provide a completely enclosed and locked-in duct bank. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of duct bank. Before pouring concrete or backfilling, as applies, anchor duct bank assemblies to prevent the assemblies from floating. Anchoring shall be done by driving reinforcing rods adjacent to every other duct spacer assembly and attaching the rod to the spacer assembly.*
 5. *Partially Completed Duct Banks. Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud, sand and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 2 feet back into the envelope and a minimum of 2 feet beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 inches from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 1 foot apart. Restrain reinforcing assembly from moving during concrete pouring.*
 6. *As each section of a duct line is completed from structure to structure, for conduit sizes 3 inches and larger draw a flexible testing mandrel approximately 12 inches long with a diameter less than the diameter of the conduit through a conduit. After which, draw a stiff bristle brush having the same diameter of the conduit through the conduit, until conduit is clear of particles of earth, sand, and gravel; then immediately install end plugs. For conduit sizes less than 3 inches, draw a stiff bristle brush through the conduit, until conduit is clear of particles of earth, sand, and gravel; then immediately install end plugs.*
 7. *Field cuts requiring tapers shall be made with proper tools and match factory tapers.*
 8. *Joints shall be staggered at least 6 inches vertically. Plastic Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.*
 9. *A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape.*
 10. *Unless otherwise noted, exterior communications conduit runs shall be buried a minimum of 24" below finished grade or as required to conform to local utility requirements.*
 11. *Refer to the details in the plans for additional depth required for PDS communications duct construction.*

12. *Where new trenching is required, backfill and compaction requirements shall be as defined Division 33.*
 13. *Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.*
 14. *Provide concrete encasement of all communications duct runs. Construct underground duct lines of individual conduits encased in concrete. Do not mix different kinds of conduit in any one duct bank. Ducts shall not be smaller than shown. The concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover for ducts, 8" minimum at PDS conduits. Separate conduits by a minimum concrete thickness of 2 inches, except separate light and power conduits from communications conduits by a minimum concrete thickness of 4 inches. The top of the concrete encasement shall not be less than 18 inches below grade except that under roads and pavement concrete be a minimum of 24 inches below grade.*
 - a. *Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. Submit proposed bonding method for approval in accordance with the detail drawing portion of the submittals.*
- C. *Where conduit runs under existing roads, cut and patch the pavement as indicated on the Civil Plans.*
- D. *Conduit Plugs and Pull Rope. New conduit indicated as being unused or empty shall be provided with plugs on each end. Plugs shall contain a weephole or screen to allow water drainage. Provide a 3/8 inch nylon pull rope having 3 feet of slack at each end of unused or empty conduits.*
- E. *Manhole Placement and Connections*
1. *In unpaved areas, the top of new manhole covers shall be approximately 1/2 inch above the finished grade.*
 2. *Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level.*
 3. *All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole.*
 4. *Duct lines entering precast concrete manholes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell.*
 5. *A cast metal grille-type sump frame and cover shall be installed over the manhole sump.*
 6. *Connections to Existing Manholes. For duct line connections to existing structures, break the structure wall out to the dimensions required and preserve steel in the structure wall. Cut steel and bend out to tie into the reinforcing of the duct line encasement. Chip out the structure wall to form a key for the duct line encasement. Grout new bell end entries watertight to the formed opening.*
- F. *Mark locations of future provision underground raceways by pre-cast reinforced concrete pullbox set flush in ground with stamped brass disk identification plate tied to conduit end with "Ty-Wrap", "Quick-Wrap" or equal.*

- G. *In existing facilities underground construction, the Contractor shall promptly repair any indicated utility lines or systems damaged by Contractor operations. Damage to lines or systems not indicated, which are caused by Contractor operations, shall be brought to the immediate attention of the University's Representative. If the Contractor is advised in writing of the location of a non-indicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In any event, the Contractor shall immediately notify the University's Representative of any such damage.*
- H. *At twelve inches below grade, place specified warning tape continuously.]*

3.7 MOUNTING AND INSTALLATION – DEVICE BOXES

- A. Conform to the more restrictive of NEMA OS 3-2002 and the following.
- B. Provide backboxes at all Electronic Safety and Security systems devices. Installation of device plates directly to wall surface without use of a backbox, unless specifically directed on plans, is unacceptable.
- C. Install boxes at each device, and outlet, and where indicated on the Drawings, complying with CEC. Coordinate box installation with conductor/cable and raceway installation. Coordinate box installation with other trades so that boxes will remain accessible. Outlet boxes shall not be installed back-to-back. Maintain minimum 24" separation between outlet boxes on opposite sides of rated walls, and minimum 6" separation in nonrated walls. Provide knockout closures to cap unused knockout holes where blanks have been removed.
- D. Align boxes plumb with floor and surrounding construction. At door frames, locate 4" from frame. Verify placement with University's Representative details to ensure that box clears all trim, etc.
- E. Support and fasten boxes securely. At stud walls use rigid bar hangers, attached to hanger with stud and nut.
- F. At existing locations, provide cutting, patching and finishing as required to maintain or restore finishes so that resulting installation is integrated into the Architectural decor of the particular location.
- G. Mounting Height: the mounting height of a wall-mounted outlet box is defined as the height from the finished floor to the horizontal center line of the cover plate.
- H. Mount outlet boxes with the long axis vertical. Three or more gang boxes shall be mounted with the long axis horizontal.
- I. Install wiring jacks and outlet devices only in boxes which are clean; free from excess building materials, dirt, and debris.
- J. Install wiring jacks and outlet devices after wiring work is complete.

3.8 TERMINAL CABINETS, JUNCTION BOXES AND PULL BOXES

- A. General
 - 1. Thoroughly examine site conditions for acceptance of cabinets and enclosures installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

- B. Where termination cabinets are used they shall be installed in or on walls. Each termination cabinet shall have a hinged cover with a lock installed flush with the cover. These locks shall be keyed alike. Each termination cabinet shall be marked with a sign with the words "Sec. Termination Cabinet" attached to the front cover. This sign shall be constructed from red laminated plastic with 1/4" white engraved letters.
 - 1. The distance between pull boxes shall not exceed 150 feet or more than two 90 degree bends.
 - 2. Install exposed junction or pull boxes only in unfinished spaces, unless indicated otherwise on the Drawings.
- C. Set cabinets and enclosures plumb and symmetrical with building lines. Furnish and install all construction channel bolts, angles, etc. required to mount all equipment furnished under this Section of the Specifications.
- D. Cabinets and enclosures shall be anchored and braced to withstand seismic forces calculated in accordance with standards in this Section.
- E. "Train" interior wiring, bundle and clamp using specified plastic wire wraps. Separate power and signal wiring.
- F. Replace doors or trim exhibiting dents, bends, warps or poor fit that may impede ready access, security or integrity.
- G. Terminate conduit in cabinet with lock nut and grounding bushing.
- H. Cleaning
 - 1. Touch-up paint any marks, blemishes or other finish damage suffered during installation.
 - 2. Vacuum clean cabinet on completion of installation.

3.9 SUPPORT

- A. Provide supports for raceways as specified in this Section.
- B. All raceways installed in exposed dry locations shall be grouped in a like arrangement and supported by means of conduit straps, wall brackets or trapeze hangers in accordance with Code and the requirements of this Section. Fasten all hangers from the building structural system.
- C. Provide supports and mounting attachments per the most restrictive of Code and the following Install no more than one coupling or device between supports.

Raceway Size (inches)	No of cables in run	Location	Support Spacing (feet)	
			RSC	EMT
Horizontal Runs				
1/2, 3/4	1-2	Flat Ceiling Wall Runs	5	5
1/2, 3/4	1-2	Where Access Limited To Building Structure	7	7
1/2, 3/4	3≥	Any Location	7	7
1≥	1-2	Flat Ceiling Or Wall	6	6
1≥	1-2	Where Access Limited To Building Structure	10	10
1≥	3≥	Any Locations	10	10
Any	Any	Concealed	10	10
Vertical Runs				
1/2, 3/4	Any	Exposed	7	7
1, 1.25	Any	Exposed	8	8
1.5 or ≥	Any	Exposed	10	10

- D. The University's Representative reserves the right to request additional supports where in their sole opinion said supports are required. Any additional supports shall be installed at no additional cost to the University.

3.10 SUPPORT INSTALLATION

- A. Furnish and install supporting devices as noted throughout the Electronic Safety and Security Systems work.
- B. Electronic Safety and Security device and conduit supports shall be independent of all other system supports that are not structural elements of the building, unless otherwise noted.
- C. Fasten hanger rods, conduit clamps, outlet and junction boxes to building structure using powder actuated tools, precast inserts, expansion anchors, preset inserts or beam clamps.
- D. Use powder actuated tools, self-drilling anchors, expansion anchor, or preset inserts on concrete surfaces.
- E. Use sheet metal screws in sheet metal studs and wood screws in wood construction.
- F. Do not fasten supports to piping, ductwork, mechanical equipment, conduit, or acoustical ceiling suspension wires.
- G. Do not drill structural steel members unless first approved in writing by the University's Representative.
- H. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- I. Install surface-mounted cabinets with minimum of four anchors. Provide additional support backing in stud walls prior to sheet rocking as required to adequately support cabinets and panels.
- J. Bridge studs top and bottom with channels to support flush mounted cabinets and panelboards in stud walls.

3.11 ERECTION OF METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS "Structural Welding Code."

3.12 WOOD SUPPORTS

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

3.13 RACEWAY INSTALLATION, GENERAL

- A. Raceway runs are shown schematically – Contractor to provide design and implementation of complete pathway system. Install concealed unless specifically shown otherwise. Supports, pull boxes, junction boxes and similar generally not indicated. Provide where designated in addition to those required by the Contractor's design.

- B. All raceway in new construction shall be run concealed, unless exposed construction is called for on the plans. Bring to the University Representatives any field conditions requiring exposed electronic security systems pathway and receive direction prior to proceeding.
 - 1. Conduit entries to device backboxes shall be made from the rear or side where concealed by architectural finish materials and shall not be exposed to public view and/or tampering.
 - 2. Install exposed conduit and raceway parallel and perpendicular to nearby surfaces or exposed structural members, and follow the surface contours. Level and square conduit and raceway runs.
- C. Comply with the most restrictive of the CEC, manufacturer's instructions and these specifications.
- D. Provide escutcheon plates for all through wall conduit stubs.
- E. All ends of conduits shall be cut square, reamed and fitted with insulated bushing.
- F. Raceways shall be secured in place and protected to prevent damage to the work during construction. Open ends of raceways shall be taped or capped after installation to prevent entry of dirt and debris during construction prior to pulling wire. Installation of raceways shall be complete and shall be blown-out and swabbed clear of water and trash prior to pulling wire.
- G. Raceway runs shall be mechanically and electrically continuous between all each equipment rack and utility demarcation point, receptacle and/or surface raceway strip, as applies.
- H. Each conduit shall enter and be securely connected to a cabinet, junction box, pull box, or outlet by means of a locknut on the outside and a bushing on the inside or by means of a liquid-tight, threaded, self-locking, cold-weld type wedge adapter.
- I. Conduit connections to enclosures will not interfere with components inside enclosure such as batteries, circuit boards, locking mechanisms etc.
- J. Conduit to be connected to enclosures via knockouts from factory. Additional penetrations are not permitted.
- K. Bends

- 1. All bends or elbows shall have a minimum radius as follows:

Conduit Size (INCHES)	MIN. RADIUS (INCHES)
3/4	8
1	12
1-1/4	18
2	24
2-1/2	24
3	30
3-1/2	30
4	30
5	36
6	42

- a. Use factory elbows or machine bends for conduit bends 1-1/4" and larger.
- 2. Make bends and offsets so the inside diameter is not effectively reduced. Make bends in parallel or banked runs from the same center line so that the bends are parallel.
- 3. Install at least one (1) 3/8", 200 pound strength nylon pull cord in all empty raceways.

4. Raceways crossing building expansion joints or in straight runs exceeding 100 feet shall be provided with UL listed expansion fittings.
 5. Install conduit seals and drains to prevent accumulated moisture in conduits from entering Electronic Safety and Security Systems enclosures.
 6. Rigid metal conduit shall be installed for applications not otherwise specified herein. Rigid metal conduit shall be secured to metal enclosures using hub fittings. Insulated bushings or fittings shall be installed at connections to cabinets and boxes. Terminate stub-ups not attached to enclosures with an insulated throat grounding bushing. Commercial pipe joint compound shall be applied to the male threads on threaded joints and fittings. Connections shall be wrench tight, and where subject to ground water rain or spray shall be watertight.
- L. Do not install conduit in concrete slabs unless specifically directed by University's Representative. Embedded conduits in concrete slab walls, and columns shall be installed in center third between upper and lower layers of reinforcing steel as directed by the University's Representative. Space conduits 8" on center except at cabinet locations where slab thickness shall be increased as directed by the University's Representative.
- M. All conduits to be kept 12" away from steam or hot water lines. Install horizontal conduit and raceway runs below water and steam piping.
- N. Conduit dropping down to equipment shall be as straight as possible without any offsets, parallel or perpendicular to walls, ceilings and other building features.
- O. Conduit installed on any equipment shall be run symmetrical with the equipment and in such a manner as to:
1. not to be exposed to damage;
 2. not interfere with access to components of the equipment that will interfere with maintenance operation or;
 3. not to be in a manner that the University deems detrimental to its operation.
- P. Whenever an installation such as that listed occurs, the Contractor shall make all necessary changes at no additional cost to the University.
- Q. All cut ends of conduit, scratches, tool marks, etc. on any metallic raceway installed in the ground or on the exterior of the building shall be treated with two coats of specified Touch Up Paint/Tape.
- R. Exposed conduit and metallic surface raceway installed in finished spaces shall be painted to match surrounding surfaces using paint and methods directed by the University's Representative.
- S. All raceways stubbing up into equipment or racks shall be sealed. Raceways with conductors shall be plugged with duct-seal. Spare raceways shall be capped. Prevent foreign matter from entering conduit and raceway; use temporary closure protection. Replace conduits containing concrete, varnish or other foreign material.
- T. Complete installation of conduit and raceway runs before starting installation of cables/wires within conduit and raceway.
- U. Use specified conduit and raceway fittings that are of types compatible with the associated conduit and raceway and suitable for the use and location. Join and terminate conduit and raceway with fittings designed and approved for the purpose of the conduit and raceway system and make up tight.
- V. Where chase nipples are used, align the raceway and coupling square to the box and tighten the chase nipple so no threads are exposed.
- W. Horizontal pathway runs, where required and permitted, shall be installed as close to ceiling or ceiling beams as practical.

- X. Pathway connected to wall outlets shall be run in such a manner that they will not cross water, steam or waste pipes or radiator branches.
- Y. Pathway shall not be run through beams, purlins or columns except where permission is granted by University's Representative in writing.
- Z. Bond installed metallic raceway in accordance with the requirements of the CEC.

3.14 RACEWAY FOR ACCESS CONTROL AND INTRUSION DETECTION SYSTEMS

- A. Refer to general requirements herein above.
- B. Access control and intrusion detection systems shall be installed in entirely in raceway below ceiling line in pathway size for 30% fill maximum, including:
 - 1. Rough-in for the field devices as detailed and scheduled on the plans.
 - 2. Pull cabinets located at regular intervals in the building, sized to accommodate the access control and intrusion detection cabling. Locate pull cans outside of public view.
 - a. Size raceway between pull cabinets to accommodate fill of field devices, not to exceed 30% fill.
 - b. Coordinate backbox size to ensure that pathway connections to enclosures shall not interfere with components installed inside enclosure including batteries, circuit boards, locking mechanisms, etc. Undersized enclosures exhibiting interference with installed components to be replaced by the Contractor at no expense to the University.
 - c. Pathway including flexible metal and armored cable shall terminate in the sensor or device enclosure.
 - d. Ends of conduit shall be fitted with insulated bushings. Provide continuous complete non-flexible pathways, from device, including pull boxes for all field devices. Leaving exposed conductors at ends of conduits external to sensors and devices not acceptable except above accessible ceiling line.
 - 3. Mounting field devices to the cover of surface mounted junction boxes is unacceptable and will be replaced at no cost to the University.

3.15 HAZARDOUS LOCATIONS

- A. Use rigid steel conduit only.
- B. Install UL listed sealing fittings that prevent passage of explosive vapors in accordance with the manufacturers written instructions. Locate fittings at suitable, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank coverplate having a finish similar to that of adjacent plates or surfaces.
- C. Install raceway sealing fittings at the following points and elsewhere as indicated:
 - 1. Where conduits enter or leave hazardous locations.

3.16 REUSE OF EXISTING CONDUIT

- A. General
 - 1. Existing conduit is to be used as a pathway only where so shown on the drawings.

2. Prior to beginning work involving the use of an existing conduit, the Contractor shall consult with the University's Representative in order to establish whether or not the conduit contains active service.
 3. If no active service exists within the conduit, all cable is to be removed, and work is to proceed.
 4. If active service does exist within the conduit and it has been determined that service needs to be disrupted, then work on that conduit shall not proceed until a schedule of service outage has been established by University's Representative. Once given direction to proceed, the Contractor shall within the time period of one (1) working day; remove the old cable, install, terminate and test the new cables, and notify the University's Representative the work using the specific conduit has been completed. The University's Representative shall be responsible for the disconnection and reconnecting of the active service cross-connects within the terminal closet(s).
- B. Conduit preparation procedure:
1. Remove existing wires and cables (if any).
 2. Run a mandrel $\frac{1}{2}$ " smaller than the inside diameter of the conduit through the conduit receiving new wires and cables.
 3. If the specified size mandrel will not pass through the existing conduit, start with a smaller size mandrel and increase mandrel size until the specified sized mandrel will pass.
 4. Run a wire brush and clean rag with an outside diameter $\frac{1}{8}$ " larger than the inside of the conduit through the conduit receiving new wires and cables.
 5. Repeat above until conduit is clean and materials detrimental to the wire and cables to be installed no longer exit conduit with the clean rag.

3.17 WIREWAY INSTALLATION

- A. Install complete wireway system at electronic security systems backboards, including track, cover plate, device boxes, inside and outside elbows, splice plates, T's, transitions and extension rings and end caps as required.
1. Gutter at backboard indicated security electronics termination points sized for 30% fill maximum, to terminate the raceway arriving from the pull cabinets and directly from the field devices pathway systems.
 2. Steel wireway/gutter and terminal cabinets to be provided at backboards of indicated termination rooms to full enclose the electronic security systems access control and alarm systems wiring, terminal devices, and terminal blocks used to terminate the field wiring installed under the work of this contract as described elsewhere herein.
- B. Any existing surface raceway and/or exposed cabling along the indicated pathway of the raceway to be installed shall be removed prior to the installation of the new raceway. If the existing cabling contains active service, then Contractor shall consult with the University's Representative as to how best maintain the existing service before proceeding with the work.
- C. Provide and install the proper factory fabricated corners, support clips, end connectors, etc. as required.
- D. Corners and joints are to be cut neatly and finished using connector components of specified system. Where components are not available using specified system, to meet requirements of drawings, provide cleanly mitered joints, EMT and/or surface backboxes specified elsewhere herein.

- E. All installed surface raceway shall be inspected for marks, scratches, gaps between sections or improper fitting of connector parts. All such damage shall be repaired to the University's Representatives satisfaction, or the raceway shall be removed and replaced.
- F. Remove sharp corners and edges prior to installation of cable.
- G. Attachment of raceway to walls, floors, and partitions:
 - 1. Attach raceway to the supporting surface with mechanical fasteners applied to building structure per the most restrictive of manufacturer's directions, Code, or these provisions.
 - 2. All surface raceway shall be installed so that its edges are parallel to the vertical or horizontal edge of the surface on which they are mounted. All surface raceway, found not to be installed in this manner, shall be removed and re-installed correctly.
 - 3. Surface raceway shall be secured at 2'-0" intervals (2 spaced screws for 2" and wider raceways) with wood screws into wooden framing or self-drilling wall anchors (ITWBildex "Heavy Duty E-Z Toggle", no known equal) into sheetrock or plastic inserts with pre-assembled drive screw for concrete (ITT-HOLUB "HI-DRIVE" nail anchors, no known equal) Powder (explosive charge) driven anchors are not acceptable. The use of adhesives as the sole means for fastening to any surface is not allowed.
 - 4. Screws used in fastening surface raceway shall be no less than 3/4" in length.
 - 5. The proper support clips, as called for by the manufacturer, for securing surface raceway to walls or floors are to be used per the manufacturer's instructions.

3.18 PENETRATIONS

- A. Gypsum Wall Board Penetrations: Provide circular penetrations maximum 1/8" inch larger than outer diameter of conduit being used. On both sides of the wall fill space between conduit and wall with joint compound, depth to match gypsum board thickness.
- B. As specified elsewhere herein, install UL listed fire-stop system whenever a raceway penetrates a firewall in conformance with the manufacturer's directions, the published systems assembly requirements, CBC Section 709 and 710 and CEC 300-21, whichever is the most restrictive. At cable tray penetrations, provide pillow type removable fire stop per CBC Section 709 and 710, the published systems assembly requirements and the manufacturer's directions, whichever is the most restrictive.
- C. All Electronic Safety and Security systems conduit openings in walls and floors are the responsibility of the Contractor. Install sleeves shown on the drawings when the concrete is poured. Any openings required after the concrete has set maybe core drilled.

3.19 THROUGH PENETRATIONS SEALANT SYSTEMS

- A. At a minimum, follow all manufacturer instructions. In case of discrepancy between manufacturer and contractor requirements, the more stringent shall apply. In the case of conflicting instructions, report any discrepancy to the University's Representative in a timely fashion so as not to impact the construction timeline.
- B. Application: Through Penetration Sealant Assemblies, Re-enterable
 - 1. Zero-maintenance firestop assemblies shall be used when the pathway on one or both sides of the wall, ceiling or floor is open, such as J-hooks or cable tray.
 - 2. Communications cable tray or ladder rack shall not be continued through a fire-rated wall. Stop the tray or ladder rack, install multiple zero- maintenance firestop assemblies as needed, and continue the tray or ladder rack on the other side. Ensure grounding of the cable tray is continuous through the wall.

3. Electronic security system conduit sleeves through a single fire-rated wall shall not be used. For these applications, a zero-maintenance firestop assembly is required.
- C. Application: Firestopping for Conduits and Other Closed Pathways
1. Firestopping is required for all fire-rated penetrations where an electronic security system conduit or other closed pathway penetrates one or more membranes of a fire-rated wall floor or ceiling.
 2. Close and firestop abandoned penetrations and penetrations through fire-and smoke-rated construction.
 3. Required for all electronic security system outlets located on fire-rated walls. Systems shall be UL CLIV tested.
- D. For all penetrations for electronic security system openings through fire-rated walls, floors and ceilings, install the same manufacturer's product for that type of penetration throughout the project.
- E. Coordinate with all other trades prior to installation:
1. To ensure that through penetration firestop systems are installed according to specified requirements.
 2. To ensure that sizing of openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems is appropriate.
- F. All penetrations through fire-rated building structures (walls, ceilings and floors) shall be sealed with an appropriate firestop system that at least matches the fire rating of the structure. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire-rated structure).
1. Any penetrating item i.e., riser slots, cables, conduit, cable tray, and raceways, etc. shall be properly firestopped.
 2. Through penetrations shall be sealed on both sides of the structure.
 3. Electronic security system outlet back-boxes installed in fire-rated walls shall be completely enclosed in an appropriate firestopping assembly within the wall.
 4. Conduit sleeves shall not be used for penetrating fire-rated floors, ceilings and walls. A zero-maintenance firestop assembly shall be used instead.
- G. Verify the locations of all fire-rated walls prior to installation.
- H. Firestopping assemblies must make a gas, smoke and water tight seal when activated in a fire.
- I. Multiple cable bundles planned to penetrate a fire-rated wall and entering the same space within 10 feet of each other shall be consolidated in to a single penetration, unless one or both penetrations are membrane penetrations.
- J. Ambient Conditions:
1. Do not install firestopping products when ambient or substrate temperatures are outside the limitations recommended by the manufacturer.
 2. Do not install firestopping products when substrates are wet due to rain, frost, condensation, or other causes.
 3. Maintain the minimum temperature before, during, and for a minimum 3 days after installation of materials.
- K. Schedule installation of firestopping after completion of the penetrating item (e.g., conduit) installation but prior to the covering or concealing of openings.
- L. Before beginning installation:
1. Examine and clean the affected surfaces, as they shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellants, and any other substances that may inhibit optimum adhesion.
 2. Provide masking and temporary covering to protect adjacent surfaces.
 3. Do not proceed until unsatisfactory conditions have been corrected.
- M. After installation:

1. Remove equipment, materials, and debris, leaving area in undamaged, clean condition.
 2. Clean all surfaces adjacent to sealed openings to be free of excess firestopping materials and soiling as work progresses.
 3. Do not cover installed firestopping assemblies until inspected by the University's Representative.
- N. All firestop systems (including the cabling through them) and identification labels shall be installed prior to the University Representative's above-ceiling inspection.
- O. Labeling
1. At all firestop locations, install a permanent label near the firestop on each side of the wall, ceiling or floor. Labels shall be pre-printed and include:
 - a. Manufacturer of the firestop.
 - b. Name of product and UL System Number.
 - c. Name of installer and company name
 - d. Date of installation.
 - e. Rating of the wall/system (F and T ratings).
 2. One location may have multiple labels (e.g. for a firestop in the annular space around a conduit penetration and a firestop within the conduit around the cables).
 3. Labels shall not be painted over or otherwise obscured or defaced.

3.20 ACCESS PANELS

- A. Where security work is concealed by walls or ceilings, or is inaccessible, provide an access panel to provide access for service and maintenance.
- B. Security work located above ceilings is considered accessible if the ceiling is the accessible type and is arranged for access to the equipment.
- C. Fire rated access panels shall be provided in fire barriers, with ratings to match the construction fire rating.
- D. Access doors providing access to equipment access doors shall allow for service and maintenance of the intended equipment.
- E. Installation of access panels is specified under another Division [insert Division].

END OF SECTION 28 05 28

Section 28 13 00

ACCESS CONTROL AND ALARM SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. Section includes (but is not necessarily limited to) provision of a complete access control system, including but not limited to:

1. Access Control and Alarm System.

a. Work of this Project extends the University of California, Santa Cruz's existing Tyco Software House C-Cure access control system to control and monitor the openings of this Project designated to receive access control. The Access Control and Alarm System (ACAS) shall include intelligent field control panels, communication devices, card readers/keypads, biometric access control stations, cards, I/O boards, power supplies, conduit, raceways, enclosures, mounting hardware, and all other equipment as indicated on the contract drawings and as specified herein. All material shall be the manufacturer's standard catalog products.

b. Scope of work includes provision of ACAS panels, readers and field devices at the following facilities:

List the facilities served by the work of this Project.

i. []

c. Input and output points.

i. As indicated on the plans, work of this project installs new Card Readers at selected locations.

ii. As indicated on the plans, work of this project interfaces the ACAS to:

Edit the following to reflect conditions found on the work of this Project.

(1) [Door position switches.

(2) Local door alarms

(3) Electric locks and electric strikes

(4) Door hardware with integral REX button functionality.

(5) Request to exit devices

(6) Intelligent gate controllers and gate position switches

(7) Elevator controls]

2. The Access Control and Alarm System shall utilize existing access control servers operated by the University of California, Santa Cruz by integrating with the existing campus wide Access Control System database. Integration with the ACAS and bringing it to operational status requires the following major steps:

a. Install and integrate Access Control and related security hardware at the Project site.

b. Configure local access panels and ACAS Server computer system to communicate with one another.

c. Program the University's ACAS database reflect the University's authorized access control users associated with the devices installed under the work of this project as described elsewhere in this Section.

d. Connect between existing host system and the access controllers, and related hardware installed under the work of this project over the University's Campus network including through structured cabling installed under the work of Division 27 of this project.

- e. Test security system communication and operation.
 - f. Train operators.
- B. Related Work in Other Sections:

The Division 27 references below assume that Structured Cabling systems conforming to current UCSC ITS standards are being specified in Division 27. If not, preserve the equivalent language in this Section. Review the remainder of the references for applicability to the current project.

- 1. Section 08 11 13 – Hollow Metal Doors and Frames
 - 2. Section 08 71 00 – Door Hardware
 - 3. [Section 14 20 00 – Elevators]
 - 4. [Section 27 10 00 – Structured Cabling, Basic Materials & Methods
 - a. Defines standards and methods for termination of IP-based cabling used IP work area outlets necessary to support access control systems installed under the work of Division 28.
 - 5. Section 27 15 00 – Communications Horizontal Cabling
 - a. Defines materials and execution standards for installation of TIA/ANSI standard category media installed under the work of Division 27 to provide work area outlets for final connection by the work of Division 28 to IP alarm system panels.
 - 6. Section 28 05 00 – Common Work Results for Electronic Safety and Security
 - 7. Section 28 05 13 – Conductors and Cables for Electronic Safety and Security
 - 8. Section 28 05 26 – Grounding and Bonding for Electronic Safety and Security
 - 9. Section 28 05 28 – Pathways for Electronic Safety and Security
 - 10. Section 32 31 00 – Fences and Gates
- C. Related Work by Others
- 1. By University
 - a. Existing UCSC Tyco Software House C-Cure brand database access control server and smartcard enabled database at the campus Emergency Response Center.
 - b. IBM PC type workstations running Windows 7 or later to be used in monitoring and configuring the system installed by the work of this Section.
 - c. Software and systems to backup the access control system installed under the work of this Project.

1.2 SUBMITTALS

- A. Refer to the requirements of Section 01 33 23 – Shop Drawings, Product Data and Samples and Section 28 05 00 – Common Work Results for Electronic Safety and Security.

1.3 QUALITY ASSURANCE

- A. General:
 - 1. Conform to Section 28 05 00 - Common Work Results For Electronic Safety and Security and Standards stipulated in the work of the Section from which this Section is referenced.
 - 2. The manufacturers of all hardware and software components employed in the system shall be established vendors to the access control/security monitoring industry for no less than five (5) years.
 - 3. The security system integrator shall have been regularly engaged in the installation and maintenance of integrated access control systems similar in size and scope to that outlined herein for a period of no less than five (5) years.
 - 4. The security system integrator shall supply information attesting to the fact that their firm is an authorized product dealer for the system proposed.

5. The security system integrator shall supply information attesting to the fact that their installation and service technicians are competent factory trained personnel capable of maintaining the system and providing reasonable service time.
 6. The security system integrator shall provide a minimum of three (3) references whose systems are of similar complexity and have been installed and maintained by the security system integrator in the last five (5) years.
 7. There shall be a local representative and factory authorized local service organization that shall carry a complete stock of parts and provide maintenance for these systems. Local shall be defined as an area in a 25 mile radius of installed location
- B. Standards Agencies. Additionally, conform to the applicable portions of the following standards defined in 28 05 00 – Common Work Results for Electronic Safety and Security.

1.4 DEFINITIONS

- A. Definitions of Terms: The following definitions and conditions apply to each of the respective parameters and the measurements of those parameters, unless specifically stated otherwise:
1. ACAS. Access Control and Alarm Systems. The integrated system installed by the work of this Contract comprising the access control system, intrusion detection system and panic/duress alarms, including both central processing hardware and the remote field devices.
 2. Access Group: A logical group of card readers (terminals) which may be connected to one or more controllers and that represent a collection of readers for which a particular cardholder may have access privileges.
 3. Access Mode: The mode of operation in which the ACAS shall only annunciate tamper and trouble conditions at a monitored point. Alarm conditions shall not be annunciated in this mode. This is referred to as “alarm shunting.”
 4. Acknowledge: The action taken by an ACAS operator to indicate that he/she is aware of a specific alarm or tamper state.
 5. Advisory: A message provided by the ACAS to the operator to inform him/her of a condition as reported by the ACAS.
 6. Active mode: That in which some type of signal is continuously sent across the link, resulting in simple link breaks being readily detected.
 7. Alarm: A change of state as detected by the ACAS indicating that it has detected a condition that its sensors were designed to identify.
 8. Armed. State of operating in a secure mode. For a given device, when in armed condition the failure of the device to operate in a prescribed manner associated with secure state operations causes an alarm state to be generated at the central alarm monitoring panel or screen, and if a local sounder/door alarm is shown, causes sounder to activate.
 9. Audit Trail: A sequential record of system activity used to reconstruct and review a series of system events.
 10. Badge: The physical card, carried by the cardholder used to gain access through a portal by presentation to a card reader.
 11. Boolean: An expression that results in a value of either TRUE or FALSE.
 12. Cardholder: A person who is a member of the cardholder database who may have been issued a valid badge.
 13. Card Reader: A device usually located at access points, designed to decode the information contained on or within a badge for the purposes of making an access decision or for identity verification.
 14. Clear: The action taken by an ACAS operator to remove an alarm from the alarms queue after it has been acknowledged and, if required, responded to.

15. Disable: A system command that intentionally places a device or system out of service, typically for maintenance.
16. Download: Refers to the transfer of system configuration information from the server to the memory of the controllers. This includes information such as badge records and access rights.
17. Dry Contact: A voltage free electrical contact.
18. DGP. Data Gathering Panel. Intelligent access control and alarm systems panel connected to the ACAS network and to card readers, access control and intrusion detection field devices as specified elsewhere in this Section.
19. Element: As used in this section means a constituent part of a complex signal such as an AC or DC voltage or current, AC phase, or frequency duration.
20. Elevator/Cabinet Control: Elevators and cabinets are readers associated with a set of output points and an optional set of input points. The field controller interfaces with elevators and cabinets using output points to enable car-call buttons or unlock cabinet doors and input points to monitor their status. The controller may grant access to a floor or cabinet door when a badge is presented at a reader installed in the elevator cab. The elevator/cabinet access control allows the operator to assign cardholder access to various elevators, floors, cabinets, and doors in a facility using access group definition.
21. Events: Events are sequences of system commands or actions that may be activated at a pre-defined time or on an as-needed basis. Events can be activated and deactivated either manually or automatically.
22. Facility Code: A coded number, in addition to the individual card number stored within each card key, which uniquely identifies the facility at which the card is valid. This feature prevents cards from one facility being used at another facility with a similar access control system.
23. Fail-safe: For system electronics, the capability to monitor system functions and report an alarm when a failure is detected in a critical system function. For door hardware, hardware which on loss of electrical power ceases to restrict movement through the affected door opening. Contrast with fail-secure.
24. Fail-secure: For door hardware, hardware which on loss of electrical power continues to restrict movement through the affected door opening from the unsecure side to the secure side. Contrast with fail-safe.
25. Guard Tour: A sequence of transactions that, when performed within a specified time frame, ensures that your facility is being properly monitored by security personnel. The main purpose of a tour is to confirm and record that an area has been physically visited. It provides real time monitoring of guard activities - reporting if a guard arrives early or late to designated tour stations. Guard Tour stations can either be readers or input points. Tours can be selected randomly or may be specified at regular time intervals.
26. Input Point: Electrical contacts that open or close to inform the system of a change of state.
27. Intruder: An animate object at least 1220 mm 48 inches in height, 34 kg 75 pounds in weight and 4 cubic feet in volume, moving through the protected zones or portals at a velocity of 30 to 3000 mm 0.1 to 10 feet per second.
28. Line Supervision: The process of monitoring an electrical circuit via electrical and software systems to verify the electrical integrity of the supervised circuit.
29. Loop: A number of terminals connected in series in a continuous circuit that starts and ends at the controller.
30. Monitoring: The process of maintaining a vigilant watch over a system element or point and taking appropriate action in response to system activity.
31. Offline: A condition in which a controller is not in communication with the server. In the offline mode, the controller continues to make access decisions and process alarms according to the information stored at its local database.

32. Output Point: Control external devices such as signals, relays, LEDs, control modules, etc.
33. Panel: See Controller.
34. Password: A combination of numbers and/or letters unique to each ACAS operator.
35. Polling: Terminals are interrogated at regular intervals by the controller to establish and verify communications with other equipment and exchange data if necessary.
36. Port: A connection that provides a means of communication between devices.
37. Priority: The relative importance of system events.
38. Reset: A command or feedback signal that indicates that a monitored point has returned to its normal state having previously been at the alarm or trouble state.
39. REX. Request to Exit. With a magnetic lock, a photo-optical device that breaks the current to the lock on detecting a person approaching from the secure side as required by Code and NFPA 101 while signaling the ACAS panel that the exit detected by the door switch was preceded by an approach to the door from the secure side. With non-magnetic locks, a REX performs the same signaling function for the ACAS panel, but no alteration of the lock power is required as the electric lock is intrinsically safe. UCSC does not employ tradition photo-optical REX devices, but instead uses door hardware with integral micro-switches triggered by mechanical motion to provide equivalent notification to the ACAS panel that the door position switch signal was preceded by an action by a person operating the door hardware located on the secure side of the opening.
40. RTE. Request to Enter. In C-Cure's current programming interface, a field device providing REX functionality is labeled RTE.
41. Secure Mode: The normal state of an alarm input point. A change of state in this mode shall indicate an alarm, or that it has transferred to the trouble or tamper state.
42. Secured Area: A physical location within the facility to which one or more card readers control access.
43. Secure Side. With respect to a door, the side on which the assets to be protected lie. At exterior doors, this is generally the interior face. Refer to the architectural plans, including the exiting plan, the door hardware schedules and specifications to confirm which face is the Secure Side.
44. Sensor zone: A geographic position for which an intrusion must be identified and displayed and may be the combination of multiple detection devices.
45. Server: The main computer in the system. The server runs the ACAS software, stores database information, and communicates with the field controllers and operator workstation terminals.
46. Service: The process that performs specific system functions and operates in the background without user intervention.
47. Soft Alarm: Soft alarms and their addresses are created by the system during installation rather than hardwired to an actual input point.
48. Tamper: A condition within the circuitry of a monitored point, which indicates that the electrical integrity of that sensing circuit has been compromised.
49. Terminal: Terminals provide additional reader interfaces, input points or output points to the ACAS.
50. Time Zone: A user-defined period made up of days of the week and hours of the day during which events such as Valid Card Grants and Input/Output linking events may occur.
51. Transaction: Indicate some form of system activity. It may include items such as access requests and general system messages.

52. Trouble: A condition within the circuitry of a monitored point, which indicates that an equipment malfunction, single break, single fault and/or a wire-to-wire short exists.
53. Unsecure Side. With respect to a door, the exposed side opposite the side on which the assets to be protected lie. At exterior doors, this is generally the exterior face.
54. User-Definable: An attribute of an ACAS function, which may be easily tailored by an operator without extensive computer programming knowledge or experience.
55. Workstation: A personal computer connected to the main Access Control and Alarm System (ACAS) server computer via local area network connections for the purpose of operating the system and responding to alarms.

1.5 QUALITY ASSURANCE

- A. ACAS Quality Assurance
 1. The ACAS shall be tested and listed by Underwriters Laboratories (UL) for UL 294 for Access Control System Units.
 2. The ACAS shall be tested and listed by Underwriters Laboratories (UL) for UL 1076 for Proprietary Alarm Units
- B. Installing Contractor Qualifications
 1. Conform with the requirements of Section 28 05 00 – Common Work Results for Electronic Safety and Security.

1.6 UNINTERRUPTIBLE POWER

- A. System Power and Functionality during Loss of Power
 1. Power supply for door locks shall be provided by the work of this Section.
 2. Power supply shall be 120-volts, 60 Hz supplied from the building's emergency power system. DC power for all system supervisory and control functions shall be provided by the control panel's power supply.
 3. The system shall be electrically supervised against power loss, short and open wiring faults in the detection and alarm circuits. A malfunction shall cause the system to function as follows:
 - a. Common trouble will be annunciated at the local panel as well as the alarm receiver the owner's designated central station receiver
 4. Provide UPS and supplemental battery subsystems sufficient to sustain system operations of the components indicated:
 - a. 4 hours for DGP.
 - b. 4 hours for field devices, including operation of electric door hardware and monitoring functions.

Review the conditions that apply to this project and edit the following subsection as required. Review the Physical Security and University Project Representatives the requirement to support destination dispatch control or similar advanced elevator functionality control.

1.7 SYSTEM PERFORMANCE REQUIREMENTS:

- A. General Description - Access Control and Alarms Processing System
 1. The University's Access Control and Alarms Processing System (ACAS) is a Commercial Off The Shelf (COTS) system that having a powerful, flexible, multi-function and object-oriented security and event management system featuring a variety of customizable interfaces for maintaining the system and for monitoring the desired secure sites. The ACAS shall provide an option to display these management and monitoring interfaces in the native languages of the people using the system.

2. The University's ACAS provides extensive information management capability using industry-standard programming interfaces. Clients will operate on University supplied personal computers with a Windows-based platform, and web clients will operate in a standard browser such as Internet Explorer and Mozilla Firefox.
 3. Field devices such as card readers, alarm inputs, control points, etc. shall be connected to fully distributed intelligent field controllers or directly through a Software Development Kit or Web Services, and be capable of operating without host computer intervention. All objects within the ACAS, i.e. doors, readers, time intervals, etc. shall be addressed by a unique name as opposed to point numbering or mnemonics. The ACAS shall have badge generation tools to create and manage badges using a graphical interface and convenient query features to manage large numbers of badges.
- B. Access Control and Alarm System - General Requirements:
1. UL Listed 1076 Proprietary Burglar Alarm Unit.
 - a. Designed by manufacturer to function as an Intrusion Detection System in addition to as an Access Control System.
 2. Provide for a separate supervised circuit to each monitored device.
 3. Monitor circuits at local ACAS Data Gathering Panels. Indicate at least:
 - a. Alarm on contact state change.
 - b. Trouble on short or open.
- C. Door Opening Operations. Assumes doors are in armed condition.
1. Doors with Card Reader on One Side
 - a. Presentation of valid card at unsecure side:
 - i. *Performs real-time lookup of card against current database to validate card status relative to door opening, day of week and time of day.*
 - ii. *Provides positive success visual feedback - green light or similar - to card holder*
 - iii. *Permits cardholder to operate door.*
 - iv. *Logs entry in access database, including at minimum card number, door number and timestamp*
 - v. *Shunts alarm generation for door open status for University selected variable period (adjustable over a range of at least 10 seconds to 1 minute adjustable through ACAS software).*
 - vi. *If double door opening, permits operation of second leaf during the University selected variable period without generating alarm.*
 - b. Presentation of invalid or unreadable card at unsecure side of door:
 - i. *Performs real-time lookup of card against current database to validate card status relative to door opening, day of week and time of day.*
 - ii. *Provides positive failed visual feedback - red light or similar - to card holder and denies operation of door.*
 - iii. *Logs entry in access database, including at minimum card number (if readable), door number and timestamp*
 - c. Approach to door opening from secure side
 - i. *Doors equipped with Request to Exit equivalent in handle/crash bar: If occupant signals intent to exit from secure side by mechanically operating door hardware, shunts generation of alarm on door operation for University selected variable period as for Card Readers above.*
 - ii. *Doors equipped with Release Button: On operating Release Button, shunts generation of alarm on door operation for University selected variable period as for Card Readers above.*

- b. Secure side
 - i. *Depressing door operator button causes the DGP to signal the door operator to initiate door opening after the associated electric lock mechanism has been released.*
 - (1) *In a double door, where the handle in an electric latch cannot be retracted remotely, this may include releasing an electric strike in the normally passive leaf of the opening.*
- D. Gate Operation
- 1. Presentation of valid card or vehicle emitter at unsecure side:
 - a. Performs real-time lookup of card against current database to validate card status relative to gate, day of week and time of day.
 - b. Provides positive success visual feedback - green light or similar - to card holder.
 - c. Signals gate controller to operate gate.
 - d. logs entry in access database, including at minimum card number, door number and timestamp
 - e. Shunts alarm generation for gate open status for University's Representative selected variable period (adjustable over a range of at least 30 seconds to 2 minutes).
 - 2. Presentation of invalid or unreadable card at unsecure side of gate:
 - a. Performs real-time lookup of card against current database to validate card status relative to gate, day of week and time of day.
 - b. Provides positive failed visual feedback - red light or similar - to card holder and denies operation of gate logs entry in access database, including at minimum card number (if readable), door number and timestamp
 - 3. Approach to gate from secure side
 - a. Detector loop or similar device detects presence of vehicle at exit point.
 - b. Receives signal from gate operator on action to operate Gate.
 - c. Shunts alarm generation for gate open status for University's Representative selected variable period (adjustable over a range of at least 30 seconds to 2 minutes).
 - 4. Detects forced operation of gate/operation of gate without use of valid card, remote release by Controller or in response to inductive loop detector or its functional equivalent.
 - a. Generates an alarm at the central control panel indicating gate location and condition
- E. Tamper Monitoring
- 1. Tampering with the DGP (removing its cover panel) or of other monitored electronic security system pullbox covers to be reported to the central ACAS monitoring station. Restoral events (replacement of cover) to similarly be reported to the central ACAS monitoring station.

1.8 COORDINATION

- A. Coordinate the work of this contract with the related work of at least the following parties:
 - 1. University Police Department
 - 2. UCSC Physical Security Staff
 - 3. University IT staff (ITS Department)

PART 2 - PRODUCTS

2.1 ACCESS CONTROL ALARM PROCESSING:

- A. Access Control and Alarm Processing System (ACAS).

1. Drawing References:
 - a. DGP* (Data Gathering Panel), where * represents the numbers of readers supported by the panel.
 - b. DGP*-RM (Data Gathering Panel, EIA 310D Rack Mount), where * represents the numbers of readers supported by the panel.
 - c. DGR – Card reader communications bus extender.
2. Minimum Features/Functions/Performance
 - a. DGP
 - i. *Processor and Memory*
 - (1) *The DGP's microprocessor shall be of sufficient speed and power to provide on-board AES 256-bit encryption without use of an external encryption device, while providing access decisions within 500 ms on a fully loaded system. The DGP shall have at least 2GB of on-board memory for cardholder and event storage. There shall be at least 16GB of on-board FLASH memory that shall be used for boot code and operating system code, and for memory backup.*
 - (2) *The DGP shall be able to locally store at least 500,000 card holders, using five cards/person and with 10 clearances/person, while also providing room for a transaction buffer of 10,000 alarms and events (minimum) in case communications to the host is lost.*
 - ii. *Memory Retention and Real Time Clock Backup*
 - (1) *The DGP must include automatic means to back up the system memory, including card holder records, configuration information, and alarm/event information, to onboard non-volatile flash memory in the event of AC power loss or Battery Low alarm. During the power interruption, the system's real time clock shall be backed up using a lithium coin cell battery such that the time is current when power is restored.*
 - iii. *Dual Ethernet Network Ports*
 - (1) *The DGP shall have two on-board 10/100/1Gb Ethernet ports, using standard RJ-45 connectors. The network ports must support full duplex communications. The DGP must provide visual LED indication of transmit and receive activity for the Ethernet communications port. DGPs that do not offer full duplex 1Gb connectivity will not be accepted.*
 - (2) *Secondary Communications*
 - (a) *Using the dual network ports, the DGP must support a primary network communications path and secondary communications path to the system server. Failover operation is described herein below.*
 - iv. *Field I/O Wiring Modules (Access Control Module)*

- (1) *The DGP shall provide terminations for field wiring through the use of modular boards (Access Control Modules). Each module shall support up to 8 readers and 8 doors, and a DGP may utilize either one or two Access Control Module, for a total of 16 readers. Refer to the drawings, scheduled reader count and the drawing references to establish the capacity required for the Project.*
 - (2) *Upgrades*
 - (a) *An eight-reader DGP shall be able to easily upgraded in the field to a 16-reader DGP, through the addition of a second Access Control Module board.*
 - (3) *USB Communications*
 - (a) *Communications from each Access Control Modules to the DGP's GCM (General Control Module) shall be made using a standard USB connection.*
- v. *Wireless Locksets*
- (1) *The DGP shall provide monitoring and control of up to 32 wireless locksets, using a local RS485 bus to interface to the wireless lockset hub network. The DGP shall support either the Schlage AD300 and AD400 series of locksets, or the ASSA ABLOY Aperio series of locksets. When Access Control Module I/O modules are used, the number of wireless locksets supported shall be reduced such that the overall reader count remains at 32 per DGP.*
- vi. *Power Requirements. The DGP shall be powered from a low voltage 12VDC power source, within a range of +/- 15%. 12VDC power is used to power the DGP electronics, plus, reader power and RS485 bus power.*
- (1) *Lock Power Management. In addition to system power, each Access Control Module I/O module shall be capable of managing and controlling lock power, such that separate individual fused relay boards or lock isolation relays shall not be required. Each Access Control Module shall provide two lock power inputs in addition to system power; each output relay on the Access Control Module shall be configurable via jumper to use lock power feed 1, lock power feed 2, or dry contact. Lock power feeds may be either 12VDC or 24VDC. All power feeds to outputs shall be power limited via resettable PTC devices.*
 - (2) *Power Requirements Design. The Contractor shall be responsible for calculating the overall power requirements for the DGP, including locking devices, readers, annunciators, and PIR exit devices. A power calculation spreadsheet shall be used to verify system power requirements, and a safety factor of 50% shall be used when sizing power supplies.*

- vii. *Wall Mount System Enclosure. The DGP shall be housed in a locking 18 gauge steel enclosure, suitable for wall mounting in accordance with UL 294. All cabinet locks shall be keyed alike. The cabinet shall be suitably sized to allow installation of the DGP and associated field wiring. The cabinet shall measure 25" in height by 22" in width and 5" in depth. There shall be a power indicator on the door which shall be visible when power is applied to the DGP. A single, Normally Closed (NC) tamper switch shall be incorporated into the door. There shall be at least 12 knockouts on the enclosure of various sizes to facilitate conduit and wire routing.*
 - (1) *Expansion. The wall mount enclosure shall be sized to accommodate up to two Access Control Module I/O boards.*
- viii. *Rack Mount System Enclosure. Alternatively, the DGP shall be able to be mounted in a standard 19" rack, using standard rack mounting hardware. A modular rack mounting arrangement shall be provided such that the General Control Module is housed in a separate rack enclosure that is 2U high (3.5"), while each Access Control Module is housed in a 4U enclosure (7" in height). Each rack enclosure will be made of 18 gauge galvanized steel, painted black. The enclosures shall be suitably sized to allow installation of the DGP and associated field wiring. A single, Normally Closed (NC) tamper switch shall be incorporated into the door.*
 - (1) *Tamper Switches. Each rack mount enclosure shall have its own NC tamper switch, incorporated into the body of the enclosure and activated whenever the cover is removed or partially removed.*
- ix. *Environmental Requirements*
 - (1) *The DGP shall be capable of operation in temperatures between 0° and 50° C (32° - 122° F), and within humidity levels between 5% and 95%, non-condensing.*
- x. *Reader Inputs*
 - (1) *The DGP shall provide for direct connection of up to 16 Wiegand read heads. The read heads connected to these ports shall conform to the industry standard Wiegand Output format and shall support multiple card technologies including contactless smart card, Wiegand, proximity, barium ferrite, bar code and biometrics. Wiegand readers directly connected to the DGP may reside up to 500 ft. from the DGP with the proper 18 AWG wiring. Wiegand reader inputs must be capable of receiving and decoding a bit stream of at least 256 bits.*

- (2) *LED Control. In addition to accepting card data from the read heads, the DGP shall control the LEDs at the reader, supporting industry standard 2-wire or 1-wire control. The DGP shall also provide a signal line to control an external beeper at the reader with an active low going signal. The LED control shall support three LEDs - red, amber and green. The System Server shall support the configuration of these LEDs such that certain LEDs shall illuminate or not illuminate or pulse to indicate various System status conditions. These LEDs shall indicate the following status conditions as a default:*
 - (a) *On-line Indication: Amber LED on steady*
 - (b) *Off-line Indication: Red LED on steady*
 - (c) *Card Accepted: Green LED pulses for door open time*
 - (d) *Card/PIN: Amber LED pulses to enter PIN. Subsequent red/green LEDs mimic card input*
 - (e) *Alarm Condition All LEDs pulse in alternating pattern*
 - (3) *Wiegand Keypad Support. The direct Wiegand reader ports shall support Wiegand readers with integrated Wiegand output keypads. The supported data format shall conform to industry standard 4 bit or 8 bit (4 bits plus 4 bits complemented) Wiegand keypad data.*
 - (4) *Power for Readers. The DGP shall provide +12VDC power for each reader, up to 1.5A each, on separate wiring terminals.*
 - (5) *Support for RS485 Readers, with Display/Keypad. The DGP shall support RS485 readers, to accommodate door control at distances greater than the 500 foot Wiegand distance limit. The DGP shall support up to 16 card readers, and can also be configured to use a mix of Wiegand readers, such that the overall reader count does not exceed 16.*
- xi. *Supervised Inputs*
- (1) *Twenty four (24) Class A Supervised inputs shall be provided on each Access Control Module, providing three inputs per reader. All supervised inputs in the system shall be field-configurable to accept either 1K, 5K or 10K ohm terminating resistor networks which may be configured to accept Normally Open (NO) or Normally Closed (NC) switches or contacts. Each EOL resistor network shall be configured such that the circuit reports unique messages for a secure circuit, alarm condition, and an open or shorted input (supervision alarm). Each input must also be capable of reading a non-supervised circuit.*
 - (2) *Each two-wire input must be able to be configured individually for its supervisory circuit type.*
 - (3) *Each two-wire input must be terminated on its own connector, and must not share a connector with another input.*

- (4) *The Monitoring Application Interface shall provide the current status of the inputs and shall log changes in input status. Supervised inputs shall be able to be taken offline for diagnostic purposes and each input shall support being linked directly to an output or to a system event. All input activations shall be reported to the Monitoring Application and stored in the Historical Journal on the System Server.*
- xii. *General Inputs. The DGP shall provide dedicated, normally-closed inputs for:*
- (1) *Enclosure Tamper. In a wall-mount cabinet, the tamper input on the GCM shall be pre-wired to the enclosure door to report opening of the door as a tamper event. In a rack-mount enclosure system, each enclosure's tamper switch shall be pre-wired to either the General Control Module or Access Control Module tamper input.*
 - (2) *Power Fail. A dedicated input shall be provided for a power failure alarm. When using an external DC power supply to power the unit, this input shall be wired to the power supply's alarm output*
 - (3) *Low Battery. A dedicated input shall be provided for a low battery alarm. When using external DC power supply to power the unit, this input shall be wired power supply's low battery alarm output*
- xiii. *Outputs. The DGP shall provide 16 separate outputs on each Access Control Module, configurable through on-board jumpers as either "wet-lock1" (power sourcing), "wet-lock2" (power sourcing) or as dry contact form C relays. The outputs shall be used to control door locks, local annunciators, and other output devices as required.*
- (1) *Output Protection and Power Ratings. Each output shall be individually protected with a PTC resettable fuse, transzorb and snubbers so that power can be directly provided to locking devices without damage to the DGP.*
 - (2) *When sourcing power to the outputs, one or both lock power inputs may be used. Outputs shall be able to provide at least 0.75A at 12VDC or 24VDC.*
 - (3) *Eight of the output relays shall be socketed, designed to control lock circuits, and shall be rated for 5.0A, 30VAC/DC when used as a dry contact control relay.*
 - (4) *The other eight relays shall be non-socketed, designed to control local door annunciator devices, and shall be rated for at least 1.0A at 30 VAC/30 VDC when used as a dry contact control relay.*
 - (5) *The DGP shall provide a LED for visual indication of each output's status.*
 - (6) *Each output must be terminated on its own connector, and must not share a connector with another output.*
 - (7) *The Monitoring Application Interface shall provide the current status of each output and shall allow the manual activation of each output individually or in user-defined groups for diagnostic purposes. All output activations shall be reported to the Monitoring Application and stored in the Historical Journal on the System Server.*

- (8) *Fire Alarm Interlock. Each lock output shall be capable of being controlled directly from a fire alarm input on the DGP board, based on a local dip switch setting for each output. When the fire alarm input is activated, the lock output shall be controlled to the door open state, if its fire alarm dip switch was enabled for that lock. Fire alarm control shall be hard-wired and not dependent on any software or firmware function to operate. Fire alarm functionality shall be tested and listed per UL.*
 - (a) *A separate fire alarm key switch latch input shall be provided. This input shall be used if manual intervention is required after a fire alarm before the locks are able to return to their normal (locked) condition. The Access Control Module shall have a key switch enable switch to enable this feature.*
- xiv. *Local Display*
 - (1) *The DGP shall include a local, on-board two line LCD for status and field diagnostic messages. Provide local switches on the DGP to set the LCD messaging and diagnostic modes.*
 - (2) *For normal operations, the LCD shall be configured to display status messages. For troubleshooting operations, the LCD shall be configured to display diagnostic messages for readers and card data, inputs, outputs, network ports and other connected devices.*
 - (3) *As a minimum, status messages shall include:*
 - (a) *Boot information*
 - (b) *Date and time*
 - (c) *Firmware version*
 - (d) *DGP status information.*
 - (e) *Configured power and measured power*
 - (f) *IP address and MAC address of DGP*
 - (g) *Host connectivity status*
 - (4) *The LCD shall also provide diagnostic information for:*
 - (a) *Cards/Readers – display raw card data, number of bits, reader number*
 - (b) *Inputs – display changes in input state*
 - (c) *Outputs – test each output in sequence*
 - (d) *Ethernet ports – test operation of the port*
- xv. *I/O Expansion. The DGP shall support input and output expansion, through the use of RS485-based input/output modules. Each Access Control Module module shall support up to 16 I8 modules, each providing eight supervised inputs, and up to 16 R8 eight-output form C relay modules. Form C relays shall be rated at 2A resistive and 1A inductive at 30VAC/DC.*
 - (1) *The DGP's wall mount enclosure shall be able to accommodate up to four modules mounted internally, without need for an external enclosure of any kind.*

- (2) *The DGP must provide, at least, eight RS-485 expansion ports. Each port must have LED indication of transmit and receive communications activity. End-of-line (EOL) termination resistors shall be provided for each port to satisfy RS-485 multi-drop requirements. The termination resistors must be selectable, by switch, to provide the possibility of a "Y" wiring arrangement.*
 - (3) *Each reader expansion bus must provide +12VDC power to its associated devices, through on-board power terminals. Each RM device may be powered from the DGP, or through a local +12VDC source.*
- xvi. *Wiring Connectors. All connectors shall be screw down type and pluggable, to facilitate field replacements and simplify testing. Connector spacing shall be such that connectors cannot be placed on the wrong wiring terminals.*
- xvii. *DGP Software*
- (1) *Firmware and OS. The DGP shall utilize a standard off the shelf Linux operating system, including kernel and base OS image. Firmware updates to the DGP shall include updates to the OS if applicable, including security patches. It shall not be necessary to independently manage updates to the OS outside of the access control application.*
- xviii. *Communications. The DGP shall utilize standard Ethernet network connectivity for communications, to the host server or to other network DGP's. DGP's shall be wired at any point on a Local Area Network (LAN)/Wide Area Network (WAN) via industry standard Ethernet utilizing the TCP/IP protocol. The DGPs shall be able to communicate back to the System database server through industry standard network switches and routers and shall not be required to reside on the same subnet as the System Server. Any activity or event within the DGP network shall be routed to any client workstation(s) on the network, regardless of the DGP that handles the activity. The System Server shall manage any message routing issues, thus isolating the subsystem applications from network-specific communication details.*
- (1) *The DGP to System Server communication, and DGP to DGP communication within the same cluster, shall include authentication and a minimum of 256 bit AES encryption.*
 - (2) *Upon losing and then restoring communications between the DGP and the System Server, database synchronization between the System Server database and the local database in each DGP shall be fast and efficient. When communications are restored, database synchronization shall occur immediately and without System Operator intervention. Any changes made to the System Server database while the DGP was off-line shall also be simultaneously downloaded to all required DGP databases.*
 - (3) *Protocols. Communication between the System Server and the DGP, and from DGP to DGP, is via TCP/IP only.*

- (4) *The DGP shall support DHCP. Each DGP may be configured to accept an IP address and device name from local DHCP (Dynamic Host Configuration Protocol), WINS (Windows Internet Naming Service) or DNS (Domain Name System) servers.*
- (5) *The DGP shall have two 10/100/1000bT Ethernet (RJ-45) ports on-board and shall not require external devices to connect to the network.*
- (6) *Clustering*
 - (a) *The DGPs shall support peer-to-peer communications, without the need for host intervention. A cluster is a user-defined grouping of DGPs used to define peer-to-peer communications.*
 - (b) *Peer-to-peer communications within a cluster shall be used for input/output linking between DGP's, and for anti-passback control within a cluster.*
 - (c) *Each cluster has a master DGP. The master is the primary connection between the cluster and the System Server. Communication from the System Server to the master shall be through a TCP/IP supported physical medium.*
 - (d) *The other cluster DGP's are referred to as members. Member DGP's do not communicate directly to the System Server or to each other; rather their communication path to the System Server and to each other shall be through the master. Communication within a cluster is always through a TCP/IP supported physical medium.*
 - (e) *Each master DGP shall support an alternate Ethernet communications path to the System Server. In the event of a primary communications path failure, the master shall immediately attempt to utilize the secondary or alternate communications path. The alternate Ethernet path can be configured to use a different host IP address and subnet.*
- (7) *Polling. The DGPs shall support peer-to-peer communications, without the need for host intervention. Communication between the System Server and the DGP shall be asynchronous. The DGP shall not require any poll messages between the System Server and the DGP. Messages shall only be transmitted when required and messages can be initiated by any DGP or by the System Server. The DGP shall transmit a network heartbeat to the System Server to satisfy UL requirements.*
- (8) *AES Encryption and Key Management*

- (a) *The DGP to System Server communication, and DGP to DGP communication within the same cluster, shall include authentication and a minimum of 256-bit AES encryption. The DGP shall offer both default key management and custom key management.*
 - (b) *For a secure environment, the DGP must be able to accept and use a customer-supplied custom encryption key, supplied either from the host or from the DGP. The DGP must use a public key infrastructure (PKI) arrangement and certificates to authenticate keys between the host and the DGP. The DGP shall provide an on-board USB port to load a local encryption key.*
- (9) *Common System Services*
 - (a) *System Watchdog. The System Watchdog shall constantly monitor all internal processes and if it detects a problem, it shall reboot the DGP. A hardware watchdog shall also run and reboot the DGP if the system software fails to strobe it. The DGP's internal clock shall be updated by the DGP's real-time clock upon restart.*
 - (b) *Software Update Service. The system shall provide the ability to update the DGP firmware stored in FLASH remotely from the host, directly within the ACAS user interface. If the update image becomes corrupted, the DGP can fall back to an original boot image. The boot image shall restart the DGP and inform the host to re-send the update image. This feature allows the DGP firmware to be easily upgraded to add new features.*
- (10) *Event Handling Services. The DGP system firmware shall provide a service that will serve as a clearinghouse for all activities generated on a DGP. The System Server shall download a list of action definitions and a list of events to each DGP. The system software shall provide an interface for reporting activities or events in real time as they occur.*
- (11) *Event Linking. Event linking shall tie an activity on one DGP to the triggering of an action on the same or different DGP. The Server DGP shall support three types of event linking:*
 - (a) *Local Event Linking. When the source device and the target device are linked through an activity on the same DGP, local event linking shall occur.*

- (b) *Cluster Event Linking. When the source device and the target device being linked are on different DGP's in the same cluster, cluster event linking shall occur. The transmission of the action request from one DGP to another shall occur (routed through the master DGP) with no System Server intervention.*
 - (c) *Global Event Linking. When the source device and the target device being linked are on different clusters, global event linking shall occur. This cross-cluster linking will require that the action request be routed through the System Server. The event link definitions shall be created on the System Server and shall be downloaded to the appropriate DGP's. The System Server shall also insure that the event link definitions are valid and that there are no recursive links.*
- (12) *Action Scheduling. The system software shall provide an action scheduling service that will execute actions on devices residing on the same or other DGP's at a predefined time, frequency and time interval. The action definitions shall be the same System Server-defined actions utilized by event linking. The actions and the action schedule shall be defined by the System Server software and shall be downloaded to the appropriate DGP's.*
- (13) *Offline / Online Reporting. The system shall provide a mechanism to report activities to the System Server for display, reporting and archiving. If a System Server is not currently connected to the cluster of DGP's, the activity reports will be buffered until the System Server reconnects to the cluster. Should the user-configured, activity buffer limit be exceeded before the System Server reconnects, the first in first out rule shall apply. Provide a minimum of 10,000 events in the offline buffer.*
- (14) *Time Management Services. The system shall provide a service to manage user-defined time periods. These time periods shall be defined on the System Server and downloaded to all DGP's. The time management services shall also ensure that all DGP's have a synchronized time clock.*
- (15) *Access Control Functionality. The DGP shall perform basic access control operations with or without communications to a host server, including unlocking a door based on a valid credential, unlock based on a valid PIN, unlock based on card plus PIN, unlock based on schedule, unlock based on a pre-defined sequence or event, and unlock based on a manual action initiated by a system operator. In addition, the DGP shall be capable of the following:*

- (16) *Custom Defined Card Formats. The user shall be able to define custom card formats, up to 10 per DGP, and each format shall be able to be at least 256 bits in length. The user shall be able to define and use government card formats such as the 200-bit GSA format with HMAC.*
 - (17) *Elevator Control. The DGP shall be able to perform elevator control, using either inputs and outputs hard-wired to the elevator control system, or, using a network interface through the host server. Card readers may be located in the elevator lobbies or elevator cabs. Upon a valid card read, the DGP shall decide which floors the person is authorized for.*
 - (18) *Intrusion Zones. Doors on the DGP shall be able to be defined as intrusion zones that are armed and disarmed by various methods through a keypad/display reader.*
 - (19) *Inputs on the DGP shall be able to be defined as included in intrusion zones, and may be defined as 24-hour inputs, such as glass-break sensors, or as inputs that may be shunted during a time period, such as motion sensors.*
 - (20) *Double Swipe Custom Event. The DGP shall be capable of performing a pre-defined sequence of events if two duplicate card reads are seen within a certain period of time. It must be possible to select which personnel will activate the double swipe feature on each door.*
- xix. *Diagnostic Web Server. The Diagnostic Web Server shall generate real-time operational and diagnostic information on a DGP to be viewed by system installers, troubleshooters and tech support personnel from a standard web browser, such as Internet Explorer. This web server, residing on each DGP, shall answer requests from a standard web browser and shall generate and serve up HTML pages that indicate DGP status and diagnostic information.*
- (1) *Compatibility. The Diagnostic Server shall be compatible with standard browsers, such as Internet Explorer, Google Chrome and Mozilla Firefox.*
 - (2) *Functional Requirements. The Diagnostic Web Server shall query the appropriate DGP's to determine the following information and shall display it in an organized fashion to the user via a web browser.*
 - (3) *Total and Available Memory (RAM). The Diagnostic Web Server shall display the total amount of memory (in bytes) on the DGP and the amount of memory (in bytes) that is currently free.*
 - (4) *Current Time Information. The Diagnostic Web Server shall display the DGP's current time and time zone.*
 - (5) *Boot Time. The Diagnostic Web Server shall display the time at which the DGP was last rebooted.*
 - (6) *Firmware and Operating System Versions. The Diagnostic Web Server shall display the Firmware Version and build number and the operating system Version Number.*

- (7) *MAC and IP Address Information. The Diagnostic Web Server shall display the DGP's unique MAC Address as well as its IP Address.*
 - (8) *DGP Type (Cluster). The Diagnostic Web Server shall display the DGP type within the cluster – Master or Member.*
 - (9) *Connection Status. The Diagnostic Web Server shall display the DGP's current connection status with its parent (System Server or Master DGP).*
 - (10) *Parent Information. The Diagnostic Web Server shall display the hardware MAC and IP Addresses of its parent (System Server or Master DGP).*
 - (11) *Security. The Diagnostic Web Server shall support multiple simultaneous users and should have minimal impact on the normal operation of the DGP. The Diagnostic Web Server shall utilize a standard security scheme that requires a user to log in using a password that shall be set via the System Server or the iSTAR Configuration Utility (ICU).*
 - (12) *It shall be possible to disable the diagnostic web server if desired.*
 - (13) *Database Information*
 - (a) *The Diagnostic Web Server shall display all DGP database information, along with the number of records contained, the amount of memory (in bytes) utilized and the percentage of memory that each one consumes.*
 - (b) *Run-Time Diagnostics/Debug Information*
 - (14) *The user shall have the ability, via the web browser, to enable the output of real-time debugging information. This information shall be displayed on the browser. The information may also be output via the serial Debug Port of the DGP and can be viewed (and captured) by standard tools such as HyperTerminal.*
- xx. *Reader signal range extender.*
- (1) *Allows Weigand signaling to be extended to DGP at distances of up to 4000 feet.*
 - (2) *Provide in quantities as required to suit application.*
3. **Manufacturers**
- a. **ACAS Manufacturer**
 - i. *Tyco/Software House (Selected Item to match UCSC existing inventory).*
 - (1) *DGP2 or DGP4, Edge with daughter cards and accessories as required to provide the functionality described in these specifications and shown on the plans: iSTAR Edge. Provide with standard low-voltage power supply (not POE). Use integral door lock power supply in lieu of external supply. Provide with manufacturer's internal back-up battery.*
 - (2) *DGP8, with daughter cards and accessories as required to provide the functionality described in these specifications and shown on the plans. Provide with external power supply: USTAR008*

- (3) *DGP8-RM, rack mount version of DGP8, with daughter cards and accessories as required to provide the functionality described in these specifications and shown on the plans: Provide USTAR-ACM-4U*
- (4) *DGP16, with daughter cards and accessories as required to provide the functionality described in these specifications and shown on the plans. Provide with external power supply: USTAR016*
- (5) *DGR. Card reader range extender: RM-4E.*
- b. External Power Supply Manufacturer:
 - i. *For eight and 16 door iStar panels, specified above without internal power supplies*
 - (1) *Altronix (Selected Item to match UCSC existing inventory) with battery extenders as required to provide indicated Power Loss functionality.*

2.2 CARD READERS

- A. Access Card System
 - 1. Drawing Reference: CKP
 - 2. Technology - Cards & Card Reader:
 - a. HID iCLASS 13.56 MHz Contactless Smart Card.
 - 3. Minimum Features/Functions:
 - a. Integral keypad.
 - b. Typical Maximum Read Range
 - i. *iCLASS Card: 4.0 - 4.5" (10.2 - 11.4 cm)*
 - ii. *iCLASS Key/Tag: 1.0 - 2.0" (2.5 - 5.0 cm)*
 - iii. *MIFARE® Card (serial number only): 2-2.5" (2.5-6.4 cm)*
 - c. Dimensions
 - i. *3.3" x 4.8" x 0.95" (8.4 cm x 12.2 cm x 2.4 cm)*
 - d. Operating Temperature
 - i. *-40° to 150° F (-40° to 65° C)*
 - e. Operating Humidity
 - i. *5% to 95% relative humidity non-condensing*
 - f. Transmit Frequency
 - g. 13.56 MHz
 - h. Cable Distance
 - i. *Wiegand Interface 500ft (150 m) 22 AWg*
 - i. Card Compatibility
 - i. *13.56 MHz contactless smart cards*
 - (a) *ISO 15693 - read only; 2k bit (256 Byte), 16k bit (2k Byte) and 32k bit (4k Byte) iCLASS Credentials; serial number*
 - (b) *ISO 14443A – read only; MIFARE and DESFire® (serial number)*
 - (c) *ISO 14443B – read only; 2k bit (256 Byte), 16k bit (2k Byte) and 32k bit (4k Byte) iCLASS Credentials; serial number*
 - (d) *US Government PIV*
 - j. Card Reader Finish: Black, U.O.N.
 - 4. Manufacturer:
 - a. HID RPK40 Reader. Selected Item to match existing UCSC inventory.
 - b. No substitutions permitted.
- B. Vehicle Proximity Access System.

1. Drawing Reference: VR
 2. Features, Functions and Construction
 - a. 125 kHz Proximity system using same cards as used for building access control
 - b. Provide readers for low vehicle use (auto) at each location indicated "VR".
 - c. Minimum read range: ProxCard II Card - up to 24" (60.9 cm)
 - d. Dimensions: 11.8" x 11.8" x 1.0" (30.0 x 30.0 x 2.54 cm)
 - e. Cable distance:
 - i. Wiegand interface: 500 feet (152 m)
 - ii. RS-422 and RS-485: 4000 feet (1219 m)
 - f. Power supply: Configurable 12 or 24 VDC
 - g. Operating temperature: -22° to 150° F (-30° to 65° C)
 - h. Operating humidity: 0-95% relative humidity non-condensing
 3. Certifications
 - a. FCC Certification, United States
 4. Manufacturer:
 - a. HID MaxiProx 5375 Readers (Industry Standard Item) with Tyco RM-4 Wiegand signal extender
 - b. Or equal (no known equal).
- C. Pedestal, Vehicle Reader
1. Drawing Reference: None
 2. Functions/Features
 - a. Single height stanchion with arms mounted to accommodate drivers of both passenger vehicles.
 - b. Hollow 3" min. tube steel with escutcheon plate to cover bolted mounting to concrete base. Fittings on pedestal are designed to provide bolt pattern to mount specified and supplied VR assemblies. Signal cabling dresses through pole and concrete base to underground duct serving pedestal location. Contractor to engineer base size and depth as required to suit application.
 - c. Powder coat finish - color per University's Representative
 - d. Size to suit mounting location and distance from practical path of travel of cars and buses.
 - e. Provide plastic spacers as required and recommended by the VR manufacturer to maximize read range of installed VR system.
 3. Provides mounts for:
 - a. One HID MaxiProx Vehicle Reader Type VR as specified above, mounted at passenger vehicle height
 4. Manufacturers:
 - a. Custom by Paragon Metal Products based on manufacturer's Square Stanchion Style.
 - b. Custom by American Access Systems, Inc. (303-799-9757)
 - c. Or equal.

2.3 POWER PROTECTION

- A. Backboard mounted equipment
 1. Function:
 - a. Power supply with backup battery
 - b. Class 1 (115VAC Input)
 - c. Individually fused, Power Limited, Class 2 outputs - sized to meet worst case load and runtime while maintaining system operations.

- d. Unless otherwise indicated support operation of ACAS system for specified operational period following loss of power.
 - e. Battery is lead acid type of common commercial manufacture.
 - f. UL Listings: UL 294, UL603, UL 1069, UL1481 for application
 - g. Provide timer modules as required to supplement DGP control
 - h. Supervised fire alarm disconnect
 - i. Power supply and battery fully enclosed in steel NEMA enclosure with cam lock cover and conduit knockouts.
 - j. Thermal and short circuit protection with auto reset.
2. Manufacturers:
- a. Altronix AL Series (Design Basis)
 - b. Security Door Controls
 - c. Or equal.

2.4 ACCESS CONTROL AND ALARM SENSORS & FIELD DEVICES

A. General

- 1. Field devices to be selected to match condition of opening and/or space to be protected. The following specifications are minimum standards; Contractor to consult with listed manufacturers and select appropriate device and mounting means for unusual construction conditions.

B. Door Tamper Alarm Switch

- 1. Drawing Reference: DS
- 2. Construction and Features
 - a. UL Listed
 - b. Hermetically sealed magnetic reed switch. Dual biased high security switch assembly deters tampering. Reed shall be potted in the contact housing with a polyurethane based compound.
 - c. Magnet shall be made of Alnico V.
 - d. Steel Door Switches
 - i. *Contact and magnet housing shall snap-lock into a 1" dia. hole. Snap-lock insulation bushing for tight fit and maximum gap in steel.*
 - ii. *Housings shall be molded of flame retardant ABS plastic. Both contact and magnet plastic housings are constructed of one piece of thick-walled ABS plastic for maximum strength.*
 - iii. *Color of housings shall be off-white, grey or mahogany brown. Color to be selected by University's Representative.*
 - iv. *Designed for Use in Steel Doors*
 - v. *Operates in steel door and frame at gap up to:*
 - (1) 1" min., Steel Doors
 - (2) 2" Min, Wood Doors
 - vi. *Under Door Threshold switches. At all glass door assemblies with base lock plate, mount DS under door threshold. Provide necessary blocking and shimming and/or secondary magnets at recessed doors to bring magnet within specified gap.*
- 3. Manufacturer:
 - a. Steel Doors, 1"
 - i. *Sentrol 1076W. University standard - no substitutions permitted.*
 - b. Under threshold:
 - i. *Sentrol 1921 magnet and 1055 or 1075W Switch*
 - ii. *Or equal by Ademco.*

- C. Door Switch, Roll-up Doors and Coiling Grills
1. Drawing Reference: DU
 2. Function/Features:
 - a. Protects openings where door or gate travels in vertical plane.
 - b. Place door switches on slab at side of track or at top of frame at each end of rollup door or grill.
 - c. Fasten magnet to traveling door.
 - d. Switch connects to structure with armored cable connection.
 3. Manufacturer:
 - a. Sentrol 1982 Magnet and 2202A or 2205 switch with Manufacturer's Supplemental Mounting Brackets and Spacers as required. At panel/sectional doors Sentrol 2300 series.
 - b. Ademco
 - c. or equal.
- D. Gate Switch
1. Drawing Reference: GS
 2. Function/Features:
 - a. Monitors status of gate protected openings.
 - b. Fasten magnet to traveling/moving gate with tamperproof fasteners.
 - c. Switch connects to conduit and backbox infrastructure with armored cable connection.
 3. Manufacturer:
 - a. Sentrol 1982 Magnet and 2202A or 2205 switch with Manufacturer's Supplemental Mounting Brackets and Spacers as required. At panel/sectional gates, provide Sentrol 2300 series.
 - b. Ademco
 - c. or equal.
- E. Hatch Switch
1. Drawing Reference: HS
 2. Monitors state of roof hatches
 3. Fasten magnet to hatch door.
 4. Switch connects to structure at hatch opening with armored cable connection to serving junction box
 5. Manufacturer:
 - a. Sentrol 2500 series
 - b. Ademco.
 - c. or equal.
- F. Local Door Alarm, Interior
1. Drawing Reference: LA
 2. Functions/Features:
 - a. Provide door management alarms for local and remote monitoring and annunciation of the status of the doors (door prop/door held, door intrusion/door forced or secure)
 - b. The LA shall be capable of operating in a stand-alone configuration or with access control systems.
 - c. Local sounder (field selectable 96 or 103 dBA @ 3 feet) shall be used to indicate both door prop/door held and intrusion/door forced conditions after a user selectable quiet, or access, time (0 seconds - 90 minutes) has expired. Sounder shall be incorporated into the faceplate of the LA.
 - d. Form C (N/O or N/C) contacts shall be available for the following outputs:
 - i. Door Contact Status.

3. Manufacturers:
 - a. Alarm Controls Corporation EXP-1.
 - b. or equal (no known equal).

2.5 ACCESS CONTROL WIRING

- A. As specified in Section 28 05 13 – Conductors and Cables for Electronic Safety and Security.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall install all system components, including University furnished equipment, and appurtenances in accordance with the manufacturer's instructions, IEEE C2 and as shown and necessary to provide a fully functional system. The contractor shall furnish necessary interconnections, services, and adjustments required for a complete and operable system as specified and shown. Control signal, communications, and data transmission line grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.
- B. Provide mounting hardware as necessary to securely fasten ACAS hardware to the supporting structure or racks.
- C. Device Wiring and Communication Circuit Surge Protection
 1. All inputs shall be protected against surges induced on device wiring. Outputs shall be protected against surges induced on control and device wiring installed outdoors and as shown. All communications equipment shall be protected against surges induced on any communications circuit. All cables and conductors, except fiber optics, which serve as communications circuits from security console to field equipment, and between field equipment, shall have surge protection circuits installed at each end.
- D. Installation
 1. The contractor shall install the system in accordance with the standards for safety, NFPA 70, UL 681, UL 1037 and UL 1076, and the appropriate installation manual for each equipment type. Components within the system shall be configured with appropriate service points to pinpoint system trouble in less than 20 minutes.
 2. Flexible cords or cord connections shall not be used to supply power to any components of the system, except where specifically noted. All other electrical work shall be as specified in Division 26 and as shown.
 3. All circuit boards are to be mounted on "Stand-Offs". Circuit boards may not be affixed with double sided tape.
 4. No components of the security system are to be mounted on the interior door of the DGP enclosure. Where additional space is required, Contractor to place a supplemental NEMA enclosure adjacent to the DGP sized as required to accommodate the additional components.
 5. Perimeter Wireway: Refer to the requirements of Section 28 05 28 - Pathway for Electronic safety and Security regarding the requirement to wrap the backboard at electronic security system installation locations with steel wireway/gutter and terminal cabinets as necessary to fully enclose wiring and components associated with electronic security systems installation.
 6. Enclosure Penetrations

- a. Enclosure penetrations shall be from the bottom unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer, and in a manner that does not damage the cable. Locate penetrations to enclosures to ensure they will not interfere with components inside enclosure such as batteries, circuit boards, locking mechanisms etc.
7. Cold Galvanizing
 - a. Field welds and/or brazing on factory galvanized boxes, enclosures, conduits, etc., shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

3.2 CARD READERS

- A. Contractor to coordinate detail construction work in vicinity of card readers with work of other trades to ensure that specified read range of card readers is not compromised by the presence of large metal objects in the immediate vicinity of reader
- B. Securely fasten card reader to structure to prevent its movement during repeated usage.
- C. Unless otherwise indicated, card readers to be mounted to the nearest side of the door housing the door handle.

Where a Project Architect has established a Project standard device height, including through a Code Compliance detail sheet in the Architectural drawing set, conform the installed height of the card readers with the Project standard. In the absence of a Project Architectural device height standard, match to the Project light switch installation height. In the absence of either, include the following either in the specs or, preferably, the drawings.

- D. [Card reader mounting height to comply with the California Access Compliance Manual. Install with the centerline of devices at +45" AFF, unless otherwise noted.]
- E. Unless otherwise indicated, card readers should be mounted to flush mount backboxes. Mounting card readers on surface mounted boxes is unacceptable except where such installations are specifically called for in the plans.
- F. Contractor to further ensure that power supplies used with the readers meet or exceed card reader manufacturer minimum requirements for current and voltage stability.
- G. Exterior card reader installations must be equipped with the appropriate weather protection.

3.3 LOCAL ALARM

- A. Local Alarm (LA) assemblies to be mounted flush in wall, at the same height as card readers in the area of work, unless otherwise indicated on the plans. Coordinate the required backbox size with the work of 28 05 28 – Pathways for Electronic Safety and Security to ensure that installed backboxes incorporate specified local alarm assembly with University cylinder lock.
- B. Local Alarms to be wired to the DGP and not directly to electronic security door hardware other than the door lock power as described below. The intent is to permit the University to be able to bypass Local Alarms from the C-Cure programming interface as required.
 1. To achieve this, Contractor to extend the following points from the specified LA
 - a. To the DGP.
 - i. *Door Position Status Relay: Terminals 7 and 8*
 - ii. *Remote Bypass Relay: Terminals 9 and 10*
 - iii. *Bypass status, NC: Terminals 13 and 15*
 - b. To the Lock Power

- d. Pass codes according to the authorities and functions defined by the University's Representative.
- 2. In addition to standard door operation arming and alarming as described in Part 1 of this Specification Section, initial system programming to include the following features and functions:

Review with UCSC Physical Security the arming zones to be created through the work of the project and list below

- a. Arming Zones – At Least the Following:
 - i. []
- 3. Document the Initial Programming Requirements and Submit in accordance with Section 28 05 00 - Common Work Results For Electronic Safety and Security.
- B. At minimum, include allowance of post-opening programming time in the following quantities.
 - 1. In addition to providing the programming necessary to meet the functional requirements defined in Part 1 of this Section, Contractor to provide systems customization programming time as defined below in the following quantities:

Review with UCSC Physical Security the quantity of hours of post-opening programming to provide for this Project and list below.

- a. [10 hours].
- 2. Programming time is time spent by a trained systems programming developing the specific sequence of alarm events and response for this Project.
- 3. Programming time does not include installation of or correcting deficient installation of system components, coordination with the contractors, training the programmer in the programming of the system software or meeting with the University's Representative(s) to establish the functional requirements of the security system.
- 4. Programming time not used in initial systems configuration shall be available to the University for supplemental post-opening programming. Contractor to provide such post opening programming in a minimum of 4 hour blocks.
- 5. Contractor to provide University's Representative with daily timesheets of programming time spent in support of this Project on request"
- 6. Implement System Programming as defined above.
- C. Schedule of Programmatic Outcomes by Door Opening. For the indicated door openings, the Contractor should anticipate programming at least the minimum number of CCure features associated with the UCSC Standard Door Class as scheduled below.

Using the door number assigned by the Project Architect and appearing on the architect's plans (and reproduced on the electronic security drawings), the Door Opening Class Assignment cells in the table below should list which doors are scheduled to receive what type of monitoring and alarming. This is a key element of ensuring that the bidding contractors set aside sufficient funds in their bids and can be held responsible for completing the entirety of the programming required. Refer to the Section 28 00 00- Electronic Safety and Security Design Guide for additional detail in completing this Table.

UCSC Standard Door Class	Class 2	Class 3	Class 4	Class 5
Doors Opening Class Assignment	[Refer to the Design Guide]	[Refer to the Design Guide]	[Refer to the Design Guide]	[Refer to the Design Guide]
Card and PIN Reader	Yes	Yes		
Latch Bolt Monitoring				

UCSC Standard Door Class	Class 2	Class 3	Class 4	Class 5
Strike Position Monitoring				
Door Position Monitoring	Yes	Yes	Yes	Yes
Local Sounder	Yes	Yes	Yes	Yes
Always Locked	Yes		Yes	Yes
Locked/Unlocked on Schedule/Action		Yes		
Min. CCURE Programming to be performed by Contractor	Door Forced Open	Door Forced Open	Emergency Exit Open	Door Forced Open
	Door Forced Open Audio	Door Forced Open Audio	Emergency Exit Open Audio	Door Forced Open Audio
			Emergency Exit Secured Audio	Door Held Open
	Door Held Audio	Door Held Audio	Local Alarm Key Disarmed	Door Held Audio
			Local Alarm Key Disarmed Audio	
	Door Secured Audio	Door Secured Audio		Door Secured Audio
	DJP Tamper	DJP Tamper	Local Alarm Key Armed Audio	Local Alarm Key Disarmed
	DJP Tamper Audio	DJP Tamper Audio	Local Alarm Tamper	
			Local Alarm Tamper Audio	
	DJP Tamper Secure Audio	DJP Tamper Secure Audio	Local Alarm Tamper Display Map	
	Local Alarm Key Disarmed	Local Alarm Key Disarmed	Local Alarm Tamper Secure Audio	Local Alarm Tamper
				Local Alarm Tamper Audio
				Local Alarm Tamper Secure Audio
	Local Alarm Tamper	Local Alarm Tamper		
	Local Alarm Tamper Audio	Local Alarm Tamper Audio		
Local Alarm Tamper Secure Audio	Local Alarm Tamper Secure Audio			

1. For doors indicated to receive access control/IDS hardware but not assigned a class in the table above, Contractor to request written request of University's Representative for assignment to the appropriate Access Class.

Include the following where Opening Groups are required.

D. [Opening Groups

1. The following openings shall provide the monitoring functions as described above for their assigned class. Control of the openings shall be from a single card reader which when presented with a valid PIN at the card reader keypad shall simultaneously revert the state (i.e. from locked and armed to unlocked and disarmed) of all the listed openings.
 - a. 1

3.6 WIRING PRACTICE

- A. Comply with requirements of Sections 27 11 16 - Communications Cabinets, Racks, Frames and Enclosures and Section 28 05 13 – Conductors and Cables for Electronic Safety and Security
- B. At electric strikes and electric locks and all other monitored lines requiring same, provide end-of-line resistors, diodes or MOV's where device does not already include such components. Document where such devices have been added.

3.7 SYSTEM STARTUP

- A. Satisfaction of the requirements below does not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment. The Contractor shall not apply power to the system until after:
 1. System equipment items have been set up in accordance with manufacturer's instructions.
 2. A visual inspection of the system has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
 3. System wiring has been tested and verified as correctly connected.
 4. System grounding and transient protection systems have been verified as properly installed.
 5. Power supplies to be connected to the system have been verified as the correct voltage, phasing, and frequency.

3.8 IDS TESTING AND ADJUSTMENT

- A. Test shall ensure that the requisite degree of intrusion detection is provided. Initially, test each sensor and subsystem component individually. When the function of each component within a particular subsystem such as each sensor within a particular zone is verified, certify that subsystem of the entire IDS as satisfactorily meeting required specifications. Test each subsystem similarly until each detection zone has been certified. When subsystem certification is complete, test entire integrated system to ensure that subsystem elements are compatible and function as a complete system. Integrated system test shall be accomplished in linear fashion, end-to-end, and shall verify that each simulated intrusion performed within each detection zone produces an appropriate alarm or signal. Integrated system test shall also verify that alarm is correctly annunciated at the local annunciator unit (where a local annunciator is shown on the plans) and the central alarm reporting and display unit. Provide for approval, not later than 30 days prior to formal inspection and test, a detailed operational test plan of how each component, subsystem, and entire ACAS will be tested. When tests are complete and corrections made, submit a signed and dated certificate with a request for formal inspection and tests

3.9 SYSTEMS PERFORMANCE DEMONSTRATION AND ADJUSTING PROCEDURES

- A. Demonstrate functionality of each installed device. Refer to the requirements of Section 28 05 00 - Common Work Results for Electronic Safety and Security.

3.10 LABELING & NOMENCLATURE

- A. ACAS Nomenclature:
1. Installation to conform with the following UCSC standard C-Cure naming conventions:
 - a. ***Items in () are as applicable***
 2. Door Names:
 - a. Building (Floor) Door (#) (Description)
 - i. *Example: ERC 1st Floor Door 100.2 Interior Public Lobby Door*
 3. Door Forced Events:
 - a. Building (Floor) Door (#) (Description) Forced Open (Audio, Email)
 - i. *Example: Biomed 1st Floor Door 421 IT Room Forced Open Audio*
 4. Door Held Events:
 - a. Building (Floor) Door (#) (Description) Held Open (Audio, Email)
 - i. *Example: Com Basement Door 6 IDF Room Held Open Email*
 5. Door Secure Events:
 - a. Building (Floor) Door (#) (Description) Secure (Audio, Email)
 - i. *Example: Hay Barn Door 106 ITS Room Secure*
 6. Local Alarm Events:
 - a. Building (Floor) Door (#) (Description) Local Alarm Armed Email
 - b. Building (Floor) Door (#) (Description) Local Alarm Disarmed Email
 - i. *Example: Bowers 2nd Floor Door 2260 Gaming Lab Local Alarm Armed*
 7. Readers:
 - a. Building Door (#) Reader
 - i. *Example: Biomed Door 1314 Reader*
 8. Outputs:
 - a. Building Door (#) Lock
 - b. Building Door (#) Local Alarm Door Position Status
 - i. *Example: 250NB Door 321T Lock*
 9. Inputs:
 - a. Building Door (#) RTE
 - b. Building Door (#) DSM
 - c. Building Door (#) Local Alarm Bypass
 - d. Building Door (#) Local Alarm Tamper
 - i. *Example: McHenry Door 528B Local Alarm Bypass*
- B. Labeling
1. Refer to Section 28 05 13 – Conductors and Cables for Electronic Safety and Security for cable labeling standards.

3.11 WARRANTY PERIOD SERVICE & ADJUSTMENT

- A. Warranty Response
1. As specified in Section 28 05 00 – Common Work Results for Electronic Safety and Security.
- B. Maintenance Service
1. The contractor shall provide all services required and equipment necessary to maintain the entire ACAS in an operational state as specified for a period of one (1) year after formal written acceptance of the system, and shall provide all necessary material required for performing scheduled adjustments or other nonscheduled work.
- C. Description of Work

1. The adjustment and repair of ACAS includes computer equipment, contractor provided programming, software updates, signal transmission equipment, access control equipment, facility interfaces, and support equipment. Responsibility shall be limited to contractor installed equipment and programming. Provide the manufacturer's required adjustments, re-programming of deficient contractor programmed functions and other work as necessary.
- D. Personnel
1. Service personnel shall be qualified to accomplish all work promptly and satisfactorily and shall be provided from the Contractor's C-Cure factory certified staff. Provide proof that Service personnel have successfully completed the appropriate level of both hardware and software training offered by the system manufacturer. The University's Representative shall be advised in writing of the name of the designated service representative and of any change in personnel.
- E. Inspections
1. The contractor shall perform two inspections at six (6) month intervals or more often if required by the manufacturers. This work shall be performed during regular working hours, Monday through Friday, excluding Federal holidays. These inspections shall include:
 2. Visual checks and operational tests of the DGP's, field devices, power supplies, and electrical and mechanical controls.
 3. Clean system equipment, including interior and exterior surfaces.
 4. Perform diagnostics on all equipment.
 5. Check and calibrate each ACAS device, including field devices.
 6. Run system software and correct diagnosed problems.
 7. Resolve previous outstanding problems.

END OF SECTION 28 13 00

Section 28 23 00

VISUAL SURVEILLANCE

PART 1 - GENERAL

1.1 SCOPE

A. Section Includes (but is Not Necessarily Limited to):

Edit to reflect Project scope.

1. Video Surveillance System.
 - a. [Miniature fixed view indoor and self-illuminated TCP/IP outdoor dome cameras.]
 - b. Box format outdoor TCP/IP cameras with weather resistant housings.]
 - c. POE and Class 2 Powering of Cameras.
2. Video Management System Software Licenses
 - a. NVR licensing to enable recording of cameras installed under the work of this Project on University's existing NVR based VMS
 - b. Software Maintenance Agreement. Purchase of additional VMS SMA licenses to enable receipt of support for cameras installed under the work of this Project on University's existing NVR based VMS

B. Related Work in Other Sections:

1. Division 26
 - a. Power for the work of this Section.

The Division 27 references below assume that the Communications work installed in accordance with UCSC ITS masterspecs are being installed in parallel with the Division 28 ESS scope. Alter as necessary to indicate where equivalent scope is being specified.

2. [Section 27 11 16 - Communications Cabinets, Racks, Frames and Enclosures
 - a. Provides the racks the equipment of this Section is installed in.
 - b. Execution standards for wiring within racks and cabinets
 - c. Specifications for rack shelving and mounting hardware required by the work of this Section.
3. Section 27 14 00 – Communications Outdoor Cabling
 - a. OSP fiber cabling for pole mounted entry cameras.
4. Section 27 15 00 - Communications Horizontal Cabling
 - a. Specification of structured cabling to support the cameras installed under the work of this project.]
5. Section 28 05 00 - Common Work Results for Electronic Safety and Security
 - a. Submittals required of the work of this section.
 - b. Miscellaneous parts and execution standards for the work of this Section.
6. Section 28 05 13 - Conductors and Cables for Electronic Safety and Security
 - a. Cabling products and execution standards for the work of this Section.
7. Section 28 05 58
 - a. Provides raceway and backboxes for the work of this Section.

1.2 RELATED WORK BY OTHERS

- A. The University supplies the POE enabled Ethernet Switches and related building Ethernet networking hardware used to transmit the packets generated by the cameras installed under the work of this Project.
- B. The University maintains an existing standards based Genetec Network Video Recorder and NVR camera monitoring stations in the University's Emergency Response Center (ERC) and the communications systems upstream of the Project provide connectivity between the Project and ERC networks.
 - 1. Work of this Project provides Genetec camera licensing for the cameras installed under the work of this Project to enable their recording on University's existing Genetec NVR.
 - 2. Work of this Project further provides additions to the University's Genetec Software Maintenance Agreements for the cameras installed under the work of this Project to enable receipt of support from Genetec.

1.3 SUBMITTALS

- A. Refer to the requirements of Section 01 33 23 – Shop Drawings, Product Data and Samples and Section 28 05 00 – Common Work Results for Electronic Safety and Security.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. Video Surveillance Systems:
 - 1. Technical Performance:
 - a. TCP/IP: System demonstrates full conformance with 3rd party alarming and motion detection at remote monitoring headend using ONVIF Software (Open Network Video Interface Forum) Protocol.
 - b. IP Cameras: Meet Manufacturers performance specification.
 - 2. Functional Performance:
 - a. Monitor and Display
 - i. *Remote monitoring and reviewing of recorded images by persons using:*
 - (1) *University's Local and Wide Area Network.*
 - (2) *Local Area Network using cabling and network switching provided by the University and its Contractors.*
 - (3) *University furnished PC's equipped with compatible video cards.*

Adjust the text in the following paragraph to reflect whether the Project includes the work of new lighting under Division 26, or is for, example, a standalone electronic security systems upgrade project.

- ii. *Provide images suitable for making identification of persons and license plate capture under [existing available] lighting conditions [resulting from the work of this Project].*
 - b. Record

- i. Record video streams using University's existing standards based network video recorders.

The cameras specified herein are TCP/IP based and typically powered by POE network switches installed by the University (UCSC ITS). ITS standard provisioning in new and remodeled space is to supply its POE switches with a rack mount UPS, and where available, to connect them to emergency generators as part of its emergency systems support of the campus CruzAlert emergency notification system. The requirement to provide UPS is therefore limited to support of either legacy (unrenovated spaces, or where exterior cameras requiring high wattage power supplies (to support heaters or large IR emitters) are required by the work of the Project.

3. [Uninterrupted Power System: For systems deriving camera power from power supplies installed under the work of this Project, sustain system operation for 2 hours following loss of power].

1.5 COORDINATE

Adjust the coordination steps as outlined below to reflect the types of work required on this Project, including whether the work of this division or Division 27 installs the station cabling

- A. Other Trades
 1. Coordinate intended camera locations with the work of the Other Trades and the work of Section 28 05 28 – Pathways for Electronic Safety and Security to ensure field conditions do not result in obscuring the intended camera view(s).
 2. [Coordinate with the work of Division 27 to ensure that station cabling required for the work of this section has been installed and that the installation has been observed by the University's Representative as being in substantial conformance with the requirements of the Project before work of this section patches into it.]
- B. University
 1. Coordinate the scheduling of the Rough-in and Above Ceiling inspections required under Section 28 05 00 – Common Work Results for Electronic Safety and Security with the University's Representative.
 2. [Coordinate with the work of the University's ITS installation of network switches in the TR's of the project. UCSC ITS provisions network switches in TR's after the rough construction of the closet is complete and after the station cabling has passed performance testing as required in Division 27.]
 3. Coordinate the initial integration work of this Section with the University's operations of the existing VMS monitoring and recording systems to ensure the appropriateness of anticipated integration time slot(s) relative to other activities by the Emergency Response Center.

1.6 QUALITY ASSURANCE

- A. Test Equipment - provide for the purposes of quality assurance as described in Section 28 05 00 - Common Work Results for Electronic Safety and Security.
 1. Network Packet Analyzer: (Fluke, Wireshark)
 2. Waveform/Vector Monitor.
 3. Portable High Resolution Color Picture Monitor (Marshall Electronics, ToteVision or equal).

PART 2 - PRODUCTS

2.1 VIDEO SURVEILLANCE EQUIPMENT

A. General:

1. All equipment and materials used shall be standard components that are regularly manufactured and used in the manufacturer's CCTV system.
2. All systems and components shall have been thoroughly tested and proven in production use for at least 60 days prior to the installation of this system.
3. All CCTV active systems components shall be provided with the availability of a toll free, 24-hour technical assistance program from the manufacturer, which provides immediate technical assistance to the end user at no charge. Where supplied systems are only supported through dealer liaison with manufacturer, and the University's Representative desires to speak with the VMS manufacturer during Contractor troubleshooting of integration, Contractor to initiate call under VMS SMA expanded through work of Project on University's behalf.

Include the following for work being installed at the Marine Science Campus. See similar language in Section 28 05 28.

4. [Hardware installed outdoors shall be suitable for a continuous exposure to a marine atmosphere close to the ocean and subject to salt air and salt laden fog. Exterior enclosures and mounts shall be constructed of 316 stainless steel, aluminum or NEMA 4X non-metallic/fiberglass, with stainless steel fastening hardware.]

2.2 CAMERAS AND RELATED

A. Cameras, General

1. Cameras provided under the work of this Project shall be compatible with the Sony Toolbox software application used to administer cameras campuswide. Compatibility to include ability to make bulk settings changes as they are deployed to other cameras on the site including firmware updates, SSL changes and status monitoring of individual cameras.

B. TCP/IP Surveillance Indoor Dome Camera, Fixed, Miniature, General Purpose:

1. Drawing References:
 - a. CCTV Camera
2. Minimum Features, Functions, Performance, Construction
 - a. Camera:
 - i. *Image device 1/3 type progressive scan Sony Exmor CMOS sensor or technical equivalent.*
 - ii. *Indoor Camera: Minimum illumination required to produce a useable picture through the VMS system installed under the work of this project (with 1.2/View-Dynamic Range Off, Expanded Dynamic Range Noise Reduction On, Middle/VE OFF/AGC High/50 IRE[IP]):*
 - (1) *Color: 0.20 lux,*
 - (2) *Black and White: 0.10 lux*
 - iii. *Number of effective pixels: (H x V) 1.4 Megapixel (1329 x 1049)*
 - iv. *Electronic shutter speed: 1s to 1/10000s*
 - v. *Gain control: Auto (3 levels)*

- vi. *Exposure control Options Provided: Auto, EV Compensation, Auto Slow Shutter.*
- vii. *White balance mode: Auto, Preset, One-push WB, Manual*
- viii. *Lens type: Built-in Vari-focal lens*
- ix. *Zoom ratio: Optical 2.9X (x2 Digital Zoom)*
- x. *Horizontal viewing angle: 85.4 to 31.2 degrees*
- xi. *Focal length Range Provided: f=3.1 to 8.9 mm*
- xii. *F-number F1.2 (Wide), F2.1 (Tele)*
- xiii. *Minimum object distance 300 mm*
- xiv. *Powered focus: Yes*
- xv. *Powered zoom: Yes*
- b. Camera Features
 - i. *Day/Night Mode – camera automatically switches to Black and White in low light conditions*
 - ii. *Advanced Intelligent Video and Audio Analytic provided on board.*
 - iii. *Wide-Dynamic Range WDR technology enabled (130dB)*
 - iv. *Image enhancement: Visibility Enhancer optimizes contrast and makes the subject more visible, even in severe backlight or shadow conditions.*
 - v. *Noise reduction: Dynamic Noise Reduction) technology for clear images without motion blur under low illumination*
- c. Image
 - i. *Codec image sizes supported (H x V) 1280 x 1024, 1280 x 960, 1280 x 800, 1280 x 720, 1024 x 768, 1024 x 576, 800 x 480, 768 x 576, 720 x 576, 720 x 480, 704 x 576, 640 x 480, 640 x 368, 384 x 288, 320 x 240, 320 x 192 (H.264, MPEG-4, JPEG)*
 - ii. *Video compression formats provided: H.264, MPEG-4, JPEG*
 - iii. *Codec streaming capability: Dual streaming*
 - iv. *Maximum frame rates*
 - (1) *H.264: 20fps (1280 x 1024) / 30 fps (1280 x 720)*
 - (2) *MPEG-4: 25fps (1280 x 1024) / 30 fps (1280 x 720)*
 - (3) *JPEG: 30fps (1280 x 1024) / 30 fps (1280 x 720)*
- d. Audio
 - i. *Audio compression G.711/G.726*
- e. Scene Analytics
 - i. *Intelligent motion detection: Yes (with built-in Post Filter)*
 - ii. *Intelligent object detection: No*
 - iii. *Rule filter: Yes*
- f. Network
 - i. *Protocols IPv4, IPv6, TCP, UDP, ARP, ICMP, IGMP, HTTP, HTTPS, FTP (client/server), SMTP, DHCP, DNS, NTP, RTP/RTCP, RTSP, SNMP (MIB-2)*
 - ii. *ONVIF Software (Open Network Video Interface Forum) Protocol Support*
 - iii. *Number of direct remote clients supported 10*
 - iv. *Authentication: IEEE802.1X. Camera denies access to unauthorized users*
- g. Analog Video Output:
 - i. *Signal system NTSC / PAL*
 - ii. *Horizontal resolution 600 TV lines*
 - iii. *S/N ratio More than 50 dB*
- h. Interfaces Provided:

- i. Ethernet 10BASE-T / 100BASE-TX (RJ-45)
 - ii. Analog video output BNC x 1
 - iii. Analog monitor output Phono jack x 1
 - iv. Sensor input x 1
 - v. Alarm output x 2
 - vi. External microphone input Mini-jack (monaural), MIC IN/LINE IN: 2.5 V DC plug-in power
 - vii. Audio line output Mini-jack (monaural), Max output level: 1 Vrms
 - i. General
 - i. Nominal Weight 2 lb 3 oz
 - ii. Maximum Nominal Dimensions 5 5/8 x 4 3/4 inches
 - iii. Power requirements: PoE, AC 24 V, DC 12 V
 - j. Indoor Camera
 - i. Power consumption 8.0 W max. indoors,
 - ii. Starting temperature 32 to 122°F (0 to 50°C)
 - iii. Working temperature 23 to 122°F (-10 to 50°C)
 - iv. Storage temperature -4 to 140 °F (-20 to +60 °C)
 - k. Vandal resistance meets: IK10
 - l. Approvals
 - i. UL2044, FCC 15B Class A, IC Class A, IEC60950-1, EN55022(A)+EN55024+EN50130-4, VCCI Class A, C-Tick Class A
 - m. Mounting hardware: Contractor to select to suit application, with manufacturer accessory mounting plates, pipe mounts, pendant adapters, parapet mounts, corner mounts and backboxes as necessary to mount to rough-in conditions.
 - 3. Manufacturers:
 - a. Sony
 - i. Camera. SNC-EM601. University standard. No substitutions permitted
 - ii. Mounting Hardware:
 - (1) Indoor Wall Mount Bracket: UNIUMB1
 - (2) Gooseneck Wall Mount Bracket: UNIWMB4
 - (3) Pendant mount adapter: UNIMDPDH120. Additionally, provide threaded RSC type conduit in length to suit condition.
 - (4) In-Ceiling Mount Kit: YTICB600. Provide at ceiling flush mounting conditions.
 - b. Axis
 - c. Or equal.
 - C. TCP/IP Surveillance Indoor/Outdoor Dome Camera, Fixed, Miniature, General Purpose:
 - 1. Drawing References:
 - a. CCTV Camera, E
 - 2. Minimum Features, Functions, Performance, Construction
 - a. General:
 - i. Outdoor Type: Minidome IP Camera
 - ii. Camera Type: HD
 - b. Imager, Optics & Processing:
 - i. Image Device: 1/2.9-type progressive scan Exmor CMOS sensor
 - ii. Effective Pixels: Approx. 2.14 Megapixels

- iii. *Minimum Illumination:*
 - (1) *Color: 0.1 lx (F1.2, View-DR OFF, VE OFF, AGC ON, 1/30 s, 30 fps,*
 - (2) *B/W: 0 lx (IR LED ON)*
- iv. *Lens Type: Built-in varifocal lens*
- v. *Focal Length: f = 3.0 mm to 9.0 mm*
- vi. *F-Number: F1.2 (Wide) to F2.1 (Tele)*
- vii. *Compression Format: H.264 (High/Main/Baseline Profile), JPEG*
- viii. *Day Night: Yes (True D/N)*
- ix. *Wide-D: Yes*
- x. *Zoom Ratio:*
 - (1) *Optical zoom 3x*
 - (2) *Digital zoom 4x*
 - (3) *Total zoom 12x*
- xi. *Minimum Object Distance: 300 mm*
- xii. *White Balance Modes: ATW, ATW-PRO, Fluor., Merc., Sodium vapor, Metal halide lamp, White LED,*
- xiii. *One push WB, Manual*
- xiv. *Horizontal Viewing Angle: 105.2° to 35.4°*
- xv. *Exposure Control: Exposure compensation, AGC, Shutter speed, Iris*
- xvi. *Gain: Auto*
- c. *Image Specifications:*
 - i. *Image Size: 1920 x 1080, 1280 x 720, 1024 x 576, 720 x 576, 720 x 480, 704 x 576, 640 x 480, 640 x 360, 352 x 288, 320 x 184 (H.264, JPEG)*
 - ii. *Compression Format: H.264 (High/Main/Baseline Profile), JPEG*
 - iii. *Frame Rate: 30 fps*
- d. *Analog Video Output Specifications*
 - i. *Signal System: NTSC / PAL (selectable)*
 - ii. *S/N Ratio: More than 50 dB (Gain 0 dB)*
- e. *Interface Specifications*
 - i. *Network 10BASE-T / 100BASE-TX (RJ-45)*
- f. *General Specifications*
 - i. *Nominal Max Dimensions (W x H x D): 166 mm x 128 mm*
 - ii. *Power Requirements: IEEE802.3at compliant (PoE/PoE+ system)*
 - iii. *Power Consumption: Max. 17W (IEEE802.3at(PoE+));*
 - iv. *Max. 12.95W (IEEE802.3af(PoE));*
 - v. *Built-in heater*
 - vi. *Operating Temperature:*
 - (1) *-40°C to +50°C (heater enabled);*
 - (2) *-10°C to +50°C (heater disabled)*
 - vii. *Storage Temperature: -20 °C to +60 °C*
 - viii. *Storage Humidity: 20% to 95%*
 - ix. *Compression: H.264 or JPEG*
 - x. *FPS: variable up to 30*
 - xi. *Resolution: 2.1 megapixel/1080p*
 - xii. *Watts Max.: 17W (IEEE802.3at(PoE+)); Max. 12.95W (IEEE802.3af(PoE))*
 - xiii. *Network Specifications Detail:*

- (1) *Protocols IPv4, TCP, UDP, ARP, ICMP, IGMP, HTTP, DHCP, DNS, NTP, RTP/RTCP,*
- (2) *RTSPoverTCP, RTSPoverHTTP, SMTP, IPv6, HTTPS, SNMP (v1,2c,3), SSL. SSM (Source Specific Multimedia) is supported.*
- (3) *Number of Clients 20*
- (4) *Authentication IEEE 802.1X*
- g. Vandal resistance meets: IK10
- h. Approvals
 - i. *UL2044, FCC 15B Class A, IC Class A, IEC60950-1, EN55022(A)+EN55024+EN50130-4, VCCI Class A, C-Tick Class A*
- i. Where installed at exterior installation conditions, camera to have an IP66 rating and be manufacturer recommended for outdoor use. Outdoor cameras to be provisioned with integral IR illuminators.
- j. Mounting hardware: Contractor to select to suit application, with manufacturer accessory mounting plates, pipe mounts, pendant adapters, parapet mounts, corner mounts and backboxes as necessary to mount to rough-in conditions.
- 3. Manufacturers:
 - a. Sony
 - i. *Exterior Cameras: SNCEM632RC. University standard. No substitutions permitted.*
 - ii. *Mounting Hardware:*
 - (1) *Pole Mount: UNIPMA1.*
 - (2) *Corner Mount: UNICMA1*
 - (3) *In-Ceiling Mount Kit: YTICB45*
 - (4) *Exterior/Pole Mount Backbox: UNIWMBB1*
 - (5) *Gooseneck Wall Mount Bracket: UNIWMB4*
 - (6) *Pendent bracket: UNIMDB3*
 - (7) *Pendant mount adapter: UNIMDPDH180*
 - (8) *Weather Protector: SNCAWP602*
 - b. Axis
 - c. Or equal.

Provide where UCSC Physical Security has indicated a requirement for high resolution exterior coverage.

- D. [TCP/IP Surveillance Indoor/Outdoor Box Camera, Fixed, HD with Enclosure:
 - 1. Drawing References:
 - a. CCTV Camera, E HD
 - 2. Minimum Features, Functions, Performance, Construction – Camera
 - a. Camera Specifications:
 - i. *Camera Type: 1080p/60fps HD Fixed Camera*
 - ii. *Type: 1080p/60fps HD Fixed Camera*
 - iii. *Image Device: 1/2.9-type progressive scan Exmor CMOS sensor*
 - iv. *Effective Pixels: Approx. 2.14 Megapixels*
 - v. *Minimum Illumination: Color: 0.1 lx, B/W: 0.07 lx (F1.2, View-DR OFF, VE OFF, AGC ON, 1/30 s, 30 fps)*
 - vi. *Lens Mount: CS mount*

- vii. *Lens Type: Varifocal lens*
- viii. *Focal Length: $f=2.8\text{mm}$ to 8.0mm*
- ix. *F-Number: F1.2 (Wide) to F1.95 (Tele)*
- x. *Compression Format: JPEG / H.264*
- xi. *Day Night: Yes, true Day/Night*
- xii. *Wide-D: Yes*
- xiii. *Zoom Ratio: Optical zoom 3x*
- xiv. *Digital zoom: 4x*
- xv. *Total zoom: 12x*
- xvi. *Minimum Object Distance: 300 mm*
- xvii. *White Balance Mode: ATW, ATW-PRO, Fluorescent lamp, Mercury lamp, Sodium vapor lamp, Metal halide lamp*
- xviii. *White LED, One push WB, Manual*
- xix. *Horizontal Viewing Angle: 114.2° to 40.0°*
- xx. *Exposure Control: Exposure compensation, AGC, Shutter speed, Iris*
- xxi. *Gain: Auto (Max. limit value selectable)*
- b. Image Specifications:
 - i. *Image Size (H x V): 1920 x 1080, 1280 x 720, 1024 x 576, 720 x 576, 720 x 480, 704 x 576, 640 x 480, 640 x 360, 352 x 288, 320 x 184 (H.264, JPEG)*
 - ii. *Compression Format: H.264 or JPEG*
 - iii. *Frame Rate*
 - (1) *H.264: 60 fps (1280x1024)*
 - (2) *JPEG: 60 fps (1280x1024)*
- c. Analog Video Output Specifications:
 - i. *Signal System NTSC / PAL (selectable)*
 - ii. *Horizontal Resolution 600 TV lines (analog video)*
 - iii. *S/N Ratio More than 50 dB (Gain 0 dB)*
- d. Interface Specifications:
 - i. *Interface: Card Slot: SD card x1*
 - ii. *Network: 10BASE-T/100BASE-TX (RJ-45)*
 - iii. *I/O Port:*
 - (1) *Sensor input: x2, make contact, break contact*
 - (2) *Alarm output: x2, 24V AC/DC, 1 A (mechanical relay outputs electrically isolated from the camera)*
 - iv. *External Microphone Input: Mini jack (monaural)*
 - v. *Analog Video Output: BNC x1, 1.0 Vp-p, 75 ohms, unbalanced, sync, negative*
 - vi. *Audio Line Output: Mini jack (monaural), Maximum output level: 1 Vrms*
- e. Audio Specifications:
 - i. *Audio Compression G.711/G.726/AAC(16kHz,48kHz)*
- f. General Specifications:
 - i. *Weight: Approx. 1 lb 4 oz (565 g) with lens*
 - ii. *Camera Dimensions (W x H x D):*
 - (1) *2 7/8 inches x 2 1/2 inches x 5 3/4 inches (72 mm x 63 mm x 145 mm) not including the projecting parts*
 - (2) *2 7/8 inches x 2 1/2 inches x 7 7/8 inches (72 mm x 63 mm x 197 mm) with lens not including the projecting parts*
 - iii. *Finish White*

- iv. *Power Requirements: PoE system (IEEE 802.3af compliant), DC 12V, AC 24V*
 - v. *Power Consumption: 6.0 W max.*
 - vi. *Operating Temperature: 14° F to 122° F (-10° C to +50° C)*
 - vii. *Storage Temperature: -4 °F to +140 °F (-20 °C to +60 °C)*
 - viii. *Storage Humidity: 20% to 95%*
 - ix. *Compression: H.264 or JPEG*
 - x. *FPS: variable up to 60*
 - xi. *Resolution: 2.1 megapixel/1080p*
 - g. Network Protocols: IPv4, IPv6, TCP, UDP, ARP, ICMP, IGMP, HTTP, HTTPS, SMTP, DHCP, DNS, NTP, RTP/RTCP, RTSP, SNMP (MIB-2)
3. Minimum Features, Functions, Performance, Construction – Camera External Enclosure:
- a. General:
 - i. *Environmental housings shall be constructed from two extruded aluminum (.080-inch wall thickness, white finish) halves and two injection molded polycarbonate end caps.*
 - ii. *A clear polycarbonate viewing window shall be ultrasonically welded to the inside of the front end cap, creating a watertight seal.*
 - iii. *The top of the housing shall be hinged from the side to allow accessibility to the camera by one screw in each end cap.*
 - iv. *Camera adjustment or removal shall be provided via one screw located in the key hole slot on the aluminum camera sled.*
 - v. *A 25 VA heater is mounted to the inside of the bottom extrusion, directly behind the viewing window, for defogging and deicing.*
 - vi. *Four vent plugs (2 in front, 2 in rear) will create a positive airflow (front to rear) when the blower is in use.*
 - vii. *Two watertight strain relief plugs will be located at the rear of the housing for separate communication wiring and power cable entry.*
 - viii. *IP Rating: 54 minimum.*
 - ix. *Side hinges for ease of access when focusing and adjusting the camera.*
 - x. *High-strength steel wall/pole mount bracket included. Designed for mounting to a flat wall or round pole, larger than 3.5-inches in diameter.*
 - xi. *Tamper-resistant screws included to lock down the housing top included*
 - xii. *Accommodates maximum camera/lens combination length of 9.5".*
 - b. Minimum Environmental Range:
 - i. *Operating temperature: -20°F to 120°F*
 - ii. *Heater activates at: 50°F (+/-8°), deactivates at 80°F (+/-5°)*
 - iii. *Blower activates at: 110°F (+/-7°), deactivates at 80°F (+/-6°)*
 - iv. *Operating humidity: Up to 100%*
 - c. Enclosure Electrical:
 - i. *24VAC, 50/60 Hz 25 vA, 1.04 Amps for heater & blower*
4. Manufacturer
- a. Sony (University standard No substitutions permitted)
 - i. *Camera: SNCVB630.*
 - ii. *Enclosure: SNCUNIHB/1. Provide mounting bracket accessories as required by indicated mounting location and conditions of supporting surfaces.*

- b. Axis
- c. Or equal.]

2.3 POWER SUPPLIES

- A. Camera Power Supplies
 - 1. Drawing Reference: CAM PS
 - 2. Backboard mounted equipment
 - 3. Function:
 - a. Power supply.
 - b. Class 1 (115VAC Input)
 - c. Individually fused, Power Limited, Class 2 outputs - sized to meet worst case load while maintaining system operations.
 - d. UL Listings: UL 294, UL603, UL 1069, UL1481 for application
 - e. Power supply and battery fully enclosed in steel NEMA enclosure with cam lock cover and conduit knockouts.
 - f. Thermal and short circuit protection with auto reset.
 - 4. Manufacturers:
 - a. Altronix ALTV Series (Design Basis)
 - b. By camera manufacturer
 - c. or equal.

Refer to Part 1 of this spec section for a narrative of the conditions under which it may be necessary for this project to provide its own POE supplies independent of the POE Ethernet switches that UCSC ITS will ordinarily provide for each University project.

- B. [POE Power Supplies
 - 1. Drawing Reference: POE PS
 - 2. Backboard mounted equipment installs on DIN rails.
 - 3. Class 2 Voltage to suit POE device(s). Select for at least 50% safe headroom relative to attached load, cable gauge and run length/IR drop.
 - 4. Approvals:
 - a. UL 60950-1
 - b. UL 508
 - c. Over current protected outputs.
 - 5. Manufacturers
 - a. Lamda Electronics DPP Series with Altronix DP4 Power Distribution Modules.
 - b. Altronix
 - c. By POE Transceiver or Switch Manufacturer
 - d. or equal.]

PART 3 - EXECUTION

3.1 PROGRAMMING AND INSTALLATION

- A. Initial Systems Programming

1. Meet with University's Representative to establish functional requirements for surveillance systems, including but not limited to the following:
 - a. Camera Views
 - i. *Fixed views*
 - (1) *The target areas of useable coverage required for each camera are documented on the plans. The scheduled "View area upper bound distance" defines the minimum distance for which usable pictures will be provided. The scheduled lensing shown is calculated based on the mounting height, view area upper bound distance and the scheduled assumed CCD size. Contractor bears the responsibility to review the target image requirements relative to the system the Contractor proposes to provide and to adjust the lensing as necessary.*
 - (2) *Contractor to review the target for each camera at the Initial Systems Programming Meeting with the University's Representative and adjust the target view areas, and where required, the mounting location to provide the view currently required by the University's Representative.*
 - ii. *Pan-Tilt-Zoom Views*
 - (1) *As for Fixed Views above.*
 - (2) *In addition, review University's requirement for patrol views (continuous sweeping patterns followed by the cameras when not under operator control) and preset shots (pre-programmed views that the camera can rapidly switch between under program and manual control.*
 2. Document and submit in accordance with the requirements of Section 28 05 00.
 3. Provide initial systems programming in accordance with the preceding.
- B. Installation
1. General
 - a. Conform to the manufacturer's recommendations and instructions regarding:
 - i. *Camera mounting and adjustment.*
 - ii. *Power and video cable sizing for length of indicated run.*
 - b. Wiring Practice - Comply with requirements of Section 28 05 13 – Conductors and Cables for Electronic Safety and Security.
 2. Camera Installation
 - a. Pre-Installation Location Verification
 - i. *Locate the cameras in accordance with the plans and as required to provide the target images noted on the plans, except where modified through the pre-construction meeting described above. Coordinate with work of other trades as required by Part 1 of this Section.*
 - ii. *Do not place cameras where they will be subject to ready access or tampering from persons in public access areas of the sites.*

- (1) *Bring to the University's Representative attention through an RFI any proposed location that does not require a ladder or similar means of access from the public space.*
 - (2) *Obtain University's Representative's resolution of the RFI prior to proceeding with the installation.*
 - iii. *Mark the anticipated location(s) prior to placing rough-in and schedule the pre-installation job site pre rough-in walk as required under the work of 28 05 00 – Common Work Results for Electronic Security Systems with the University's Representative.*
 - iv. *Adjust camera locations as directed by the University's Representative following the pre rough-in walk.*
 - b. Secure cameras to structure so that they cannot be readily removed, including with use tools or by force.
 - i. *Cameras are to be mounted to flush mounted backboxes at fed through rear of camera body, except where surface mounting is explicitly called for.*
 - ii. *Where surface mounting is indicated, use knock-outs on side of camera housing to connect to conduit. Install backbox containing required structured cabling biscuit box at remote location hidden from view and secure cover with tamperproof fasteners.*
 - iii. *Select fastening means appropriate to the mounting surface and its underlying framing system and fasten securely to the structure and not to lightweight surface materials. Removal of cameras following successful fastening shall require use of tamper fastener tooling or application of destructive force. University's Representative reserves the right to request remounting of any camera not found to meet this standard at no additional cost.*
 - c. Where mounting to pipe mount indicated/or required by field conditions, select materials to maintain stability of camera image under environmental conditions associated with installation location, including wind load and potential for impact.
 - d. At exterior cameras, seal openings as directed by the manufacturer's instructions.
 - e. Apply manufacturer's recommended anti-graffiti coating to camera housings and domes.
 - f. Provide cameras with lensing as required to cover area of coverage indicated on the plans.
 - g. Adjust auto-iris systems at night to gain maximum depth of field under low light conditions.
 - h. Using a precision display portable video monitor and/or laptop, adjust each camera's angle and field of view as directed by the University's Representative.
 3. Power Supplies.
 - a. Unless otherwise directed, place camera supplies in the communications room closet to the camera(s) served by the equipment.
 - b. Submit proposed locations on communications room backboards for review by the University's Representative prior to installation.

- c. Correct installation conditions found to block access work of other Section.

3.2 LABELING

- A. Conform with the requirements of Section 28 05 13 – Conductors and Cables for Electric Safety and Security

3.3 SYSTEM STARTUP

- A. The Contractor shall not apply power to the CCTV system until the following items have been completed:
 1. CCTV system equipment items and NVR interface have been set up in accordance with manufacturer's instructions. Contractor to install and configure required VMS camera license(s) and SMA license(s) to University's server
 2. A visual inspection of the CCTV system has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
 3. System wiring has been tested and verified as correctly connected as indicated.
 4. All system grounding and transient protection systems have been verified as properly installed and connected as indicated.
 5. Power supplies to be connected to the CCTV system have been verified as the correct voltage, phasing, and frequency as indicated.
 6. Cameras are assigned correct University supplied IP address(es).
 7. Backlighting feature of camera(s) has been correctly enabled.
 8. Appropriate frame rates are configured.
 9. Low light functionality is configured.
 10. Password protection is applied to video stream using University supplied password.
- B. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.4 SYSTEMS PERFORMANCE TESTING AND ADJUSTING PROCEDURES

- A. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all site testing. The University's Representative will witness all performance verification and endurance testing. Written permission shall be obtained from the University's Representative before proceeding with the next phase of testing. Original copies of all data produced during performance verification and endurance testing shall be turned over to the University's Representative at the conclusion of each phase of testing prior to University's Representative approval of the test.
- B. Contractor's Field Testing.

1. The Contractor shall calibrate and test all equipment, verify system operation, place the integrated system in service, and test the integrated system. Ground rods installed by the Contractor shall be tested as specified in IEEE Std 142. The Contractor shall deliver a report describing results of functional tests, diagnostics, and calibrations including written certification to the University's Representative that the installed complete system has been calibrated, tested, and is ready to begin performance verification testing. The report shall also include a copy of the approved performance verification test procedure. In addition, the Contractor shall make a master video tape recording to DVD showing typical day and night views of each camera in the system and shall deliver the DVD with the report. Note any objects in the field of view that might produce highlights that could cause camera blinding. Note any objects in the field of view or anomalies in the terrain which may cause blind spots. Note if a camera cannot be aimed to cover the zone and exclude the rising or setting sun from the picture. Note night assessment capabilities and whether lights or vehicle headlights cause blooming or picture degradation. If any of the above conditions or other conditions exist that cause picture degradation or interfere with the camera field of view, the Contractor shall inform the University's Representative. The Contractor shall submit a letter certifying that the CCTV system is ready for performance verification testing. The field testing shall as a minimum include:
 - a. Verification that all cameras are aimed and focused properly and protective pre-installation film covers removed.
 - b. The Contractor shall conduct a walk test of the area covered by each camera to verify the field of view and framing of view.
 - c. Verification that cameras facing the direction of rising or setting sun are aimed sufficiently below the horizon so that the camera does not view the sun directly.
 - d. If vehicles are used in proximity of the assessment areas, verification of night assessment capabilities and determination if headlights cause blooming or picture degradation.
 - e. Verification that the integral tamper alarms are functioning.
 - f. When pan/tilt mounts are used in the system, verification that the limit stops have been set correctly. Verification of remote control of pan/tilt or zoom are operative and that the controls perform the desired function. If preposition controls are used, verification that all home positions have been set correctly, and have been tested for auto home function and correct home position. When dome camera mounts are used in the system, verify that all preset positions are correct and that the dome also operates correctly in a manual control from mode.
 2. The Contractor shall deliver a report describing results of functional tests, diagnostics, and calibrations including written certification to the University's Representative that the installed complete system has been calibrated, tested, and is ready to begin performance verification testing. The report shall also include a copy of the approved performance verification test procedure.
- C. Performance Verification Test

1. The Contractor shall demonstrate that the completed CCTV system complies with the contract requirements. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown. The performance verification test, as specified, shall not be started until receipt by the Contractor of written permission from the University's Representative, based on the Contractor's written report. This shall include certification of successful completion of Contractor Field Testing as specified in paragraph "Contractor's Field Testing," and upon successful completion of training as specified. The University's Representative may terminate testing at any time when the system fails to perform as specified. Upon successful completion of the performance verification test, the Contractor shall deliver test reports and other documentation as specified to the University's Representative
 2. Proof of Performance Demonstration
 - a. Camera Operation: Demonstrate that each camera:
 - i. *Produces images in conformance with specifications and as defined in the initial systems programming requirements.*
 - ii. *Includes correct camera number identification.*
 - iii. *Produces tamper alarm if disturbed.*
 - iv. PTZ Cameras:
 - (1) *At PTZ enabled cameras, provides "patrol" and pre-set shots in conformance with specifications and as defined in the initial systems programming requirements.*
 - (2) *Demonstrate that each responds appropriately to PTZ controls, where PTZ functionality is specified, from the University's VMS software installed on the University's PC's.*
 - b. Uninterrupted Power Systems: Disconnect normal power service. Demonstrate that the system remains in full operation for the specified time.
- D. University Evaluation
1. Following the above University Representative will provide a comprehensive assessment of the installation, using a form with fields similar to the following:

University Installation Inspection																												
Physical Installation Inspection							Configuration					Server and IT Closet																
Camera	Correct make & model	Placed as designed	Achieves security objective	unobstructed views	Secure mounting	Out of reach	In vandal or weather dome	Dome secured	Wires secured	Power supply secured	Conduit secured to structure	Correctly labeled	Camera visible in software	Correct IP address	Current license	Focused on objective	Clear focus	View framed properly	Adjusted to backlighting	Adequate frame rate	Low light functionality	Password protected	Wires properly routed and secured	Labeled and routed to correct port	Power supplies secured	Correct server and capacity	Connected to UPS	Secured facility

END OF SECTION 28 23 00

FIRE DETECTION AND ALARM

28 31 00

Refer to the University's Standard Specification Section 28 31 00 Fire Detection Alarm and Section 28 08 00 Commissioning Electronic Safety Security. The specifications shall be modified by the Design Professional to meet project requirements. Electronic copies (Word documents) are available, contact the University's Representative.

Fire alarm--all types of occupancies.

The following standard specification is intended to be edited according to the specifics of the project. Brackets [] and areas shaded in gray [e.g. format] indicate requirements that are optional depending upon the type of system being provided or per instructions associated with the [] and project requirements. Consult with University's Representative and campus stakeholders.

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The handling of such items will be decided by consultation between the University's Representative, Design and Construction Management, Facilities Management Alarms Department, and the UCSC Fire Prevention Services.

SECTION 28 31 00 FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 SUMMARY DESCRIPTION

- A. Design, build and provide a NFPA 72, current edition, code compliant complete manual and automatic addressable fire detection system and audible/visual alarm system, complete with connection to the Campus Central Dispatch via connection point indicated on Drawings.
- B. Contractor is advised that the drawings are diagrammatic in nature and are not intended to show all details. Contractor shall provide final design, achieve the University of California, Santa Cruz Deputy Campus Fire Marshal approval of the design, and to provide all miscellaneous parts and labor required to install a complete workable system that is approved by the UCSC DCFM for building occupancy. The UCSC DCFM (State Fire Marshal) is the Authority Having Jurisdiction. University's Representative will receive documents from and coordinate with Contractor to obtain approvals from the UCSC DCFM.
- C. Related Sections include the following:
 - 1. Fire-Stopping: Section [XX XX XX section number Title]
 - 2. Painting of Mechanical and Electrical Work: Section [XX XX XX section numbers Title]
 - 3. Conveying Systems/Elevators: Section [XX XX XX section number Title]
 - 4. Fire Protection/Automatic Sprinkler System: Section [XX XX XX section number Title]
 - 5. Conduit: Section [XX XX XX section number Title]
 - 6. Wire and Cable: Section [XX XX XX section number Title]
 - 7. Boxes: Section [XX XX XX section number Title]
 - 8. Cabinets and Enclosures: Section [XX XX XX section number Title]
 - 9. Electrical Identification: Section [XX XX XX section number Title]
 - 10. Building Automation and Control: Section [XX XX XX section number Title]
 - 11. Security Access Systems: Section [XX XX XX section number Title]
 - 12. Intrusion Detection Systems: Section [XX XX XX section number Title]
 - 13. Doors, Roll-Down Doors, Door Hardware: For door closers and holders with associated smoke detectors, electric door locks, and release devices that interface with the fire alarm system. Section [XX XX XX section number Title]
 - 14. Fire Smoke Dampers [XX XX XX section number Title]
 - 15. Telecommunications [XX XX XX section number Title]

1.2 DEFINITIONS

- A. Wherever mentioned in this specification or on the drawings the equipment, devices, and functions shall be as defined in Section 01 42 00 References and supplemented as follows:
 - 1. UCSC DCFM: University of California, Deputy Campus Fire Marshal.
 - 2. Emergency: An unsafe or intolerable condition requiring immediate correction.
 - 3. FACP: A Fire Alarm Control Panel, which processes alarm information and controls outputs.

4. Alarm Signal: A signal that indicates a state of emergency requiring immediate notification of the fire department and of the building occupants. These are signals such as the operation of a manual pull station, the activation of a water flow switch in a sprinkler system, the receipt of an alarm signal from a smoke detector that has gone through alarm verification, the receipt of an alarm signal from an elevator smoke detector or a computer room smoke detection panel, the operation of a heat detector, or the operation of a pressure switch in a fire suppression system caused by the flow of fire extinguishing agent (e.g. kitchen fire extinguishing system, CO₂, etc.).
5. Supervisory Signal: A signal that indicates the impairment of a fire protection system, which may prevent its normal use. These are signals from switches, such as a tamper switch; a low air pressure switch; a high air pressure switch; a generator phase reversal switch; a generator power failure switch; a generator running switch; a fire pump phase reversal switch; a fire pump loss of power switch; a fire pump running switch; or a duct smoke detector.
6. Trouble Signal: A signal that indicates that a fault, such as an open circuit or ground, has occurred in the fire alarm system or in a separate sub-system, whose control panel is monitored by the fire alarm system.
7. Multiplex System: A system in which multiple signals are transmitted via the same conduction path to a remote fire alarm control unit and fire alarm control panel, decoded and separated so that each signal will initiate the specified response.
8. Notification Appliance Circuit: A circuit to which notification appliances are connected to visually and audibly indicate an alarm signal.
9. Interface Device: An addressable device which interconnects hard wired systems or devices to a multiplex system.
10. Fire Alarm Power Boosters: Control panels that supply power to the notification appliances devices; and reports to and receives signals from the fire alarm control panel.
11. Master Fire Alarm Control Panel (MFACP): A master control panel having the features of a fire alarm control unit and to which all fire alarm control units are interconnected and report to. The panel has central processing, memory, input and output terminals, video display units (VDUs) and printers.
12. Class A Wiring: A circuit that is monitored for integrity such that a single break, a single wire-to-wire short, or a single loss of carrier condition will be indicated by a trouble signal on the FACP no matter where the break, short or loss of carrier condition occurs and will allow all functions of the affected circuit to remain operational. In accordance with NFPA 72, this would be Style 7 wiring for signaling line circuits.
13. Class B Wiring: A circuit that is monitored for integrity such that a single break, a single wire-to-wire short, or a single loss of carrier condition will be indicated by a trouble signal on the FACP no matter where the break, short or loss of carrier condition occurs, but which would prohibit devices beyond the fault, short or carrier loss from remaining operational. In accordance with NFPA 72, this would be Style 4 wiring for signaling line circuits, Style B for initiating device circuits, and Style Y for notification appliance circuits.
14. Signaling Line Circuit: A circuit to which any combination of circuit interfaces, control units, or transmitters are connected and over which multiple system input signals or output signals, or both, are carried.
15. Manual Pull Station: A fire alarm box as indicated in NFPA 72.
16. Tamper Switch: A valve monitor switch as indicated in NFPA 72.
17. Initiating Device: A system component that originates transmission of a change of state condition, which initiates an appropriate response via the fire alarm system.
18. Terminal Cabinet: A steel cabinet with locking, hinge-mounted door in which terminal strips are securely mounted. Minimum size is 200 mm x 200 mm (12 inch x 12 inch).
19. VAC: Volts Alternating Current.

1.3 PERFORMANCE REQUIREMENTS

- A. This specification establishes the requirements for the design and installation of a complete fire detection and alerting system as described in this Section and the Drawings.
- B. Scope of Work
 1. The scope of work includes, but is not limited to, provision of the following:

- a. Detailed design and preparation of shop drawings, to meet the intent of the design as indicated in the Drawings and these Specifications, and to meet the requirements of applicable codes and the UCSC DCFM. Drawings indicate preliminary design for the fire detection and alerting system, which must be followed as a guide, but responsibility for achieving a code-compliant and UCSC DCFM -approved fire detection and alerting system, including additional items not shown on the drawings or listed in these specifications, rests entirely with the Contractor.
 - b. Installation of the complete fire detection and alerting system after final approval by UCSC DCFM of the shop drawings and according to those shop drawings.
 - c. System software, database management utilities, firmware, and programming as required to provide a complete functioning interactive system
 - d. All necessary conduit and wiring associated with the fire detection and alerting system.
 - e. Smoke detectors, heat detectors, duct detectors, test switches, and manual pull stations.
 - f. Horns/speakers, strobes and remote lamps.
 - g. Remote annunciator panel(s).
 - h. Provision of auxiliary controls and switches including interposing control, monitor relays, and interconnection coordination for the operation of the following systems:
 - 1) Fan control, smoke/fire damper interface [Mechanical – Air Distribution]
 - 2) Sprinkler systems [Mechanical – Fire Protection Systems]
 - 3) Elevator recall [Architectural – Conveying Systems]
 - 4) Commissioning [Electrical and Mechanical]
 - 5) Door control [Architectural – Access Control CAAMS]
 - i. [Provision of a one way supervised voice communication system as a part of the audio evacuation system.]
 - j. [Provision of a two way supervised firefighter's telephone system.]
 - k. [Firefighter's fan control system.]
 - l. Permanent signs, labels, and operational instructions.
 - m. Systems and Equipment Startup and Testing
 - n. Commissioning
 - o. Training.
 - p. Record drawings.
2. The furnishing and installation of the following is prescribed in another Section but connection is prescribed in this Section.
 - a. Fire sprinkler alarm system flow switches, valve monitors and indicating valves.
 - b. [Elevator controller for recall.]
 - c. Door hold-open/closure devices without integral smoke detectors (coordinate with Section XX XX XX Hardware Specialties).
 - d. [Electric door locks control panel for override control.]
 - e. [Fire barrier roll down doors and shutters.]
 - f. [Fire pump controller to monitor status.]
 - g. [Fan control system for smoke management.]
 3. The installation of the following is prescribed in another Section but the furnishing and connection prescribed under this Section.
 - a. Duct mounted smoke detectors and test switches.
 - b. [Elevator cab mounted life safety system].
 - c. [Elevator cab mounted firefighter's phone jack].

C. Codes and Standards

1. Applicable Publications: Provide a system conforming to the requirements of the latest edition of the following publications including all amendments to these publications.
 - a. American Society for Testing and Materials (ASTM)
 - 1) E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
 - 2) E 119 Standard Test Methods for Fire Tests of Building Construction and Materials
 - b. American Society of Mechanical Engineers (ANSI/ASME):
 - 1) [A17.1 Safety Code for Elevators and Escalators]
 - 2) C62.41 Guide for Surge Voltages in Low Voltage A.C. Power Circuits

- c. Building Officials & Code Administrators International Inc. (BOCA): National Building Code.
 - d. National Fire Protection Association (NFPA):
 - 1) 70 National Electric Code (NEC)
 - 2) 72 National Fire Alarm Code
 - 3) 13 Standard for the Installation of Sprinkler Systems
 - 4) 20 Standard for the Installation of Centrifugal Fire Pumps
 - 5) 101 Life Safety Code
 - 6) 90A Standard for the Installation of Air Conditioning and Ventilating Systems
 - 7) 17 Dry Chemical Extinguishing System
2. State and Local Codes: Perform all work in accordance with the requirements of the latest issue of the following codes and standards, unless specifically directed otherwise in this specification in order to allow designs in excess of the code requirements. Applicable portions of current editions as adopted by the California State Fire Marshal of the publications listed below form a part of this Specification:
- a. California Code of Regulations, Title 24, Parts 2,3,4,9, and 12 [2007 Edition]
 - b. California Code of Regulations, Title 19
 - c. Safety Code for Elevators and Escalators (ANSI A17.1 [4] [7]) as amended by (DLCU) Director's Rule 21-97 (Revised).
 - d. Americans with Disabilities Act (ADA)
 - e. California Building Code, Part 2
 - f. California Electric Code, Part 3
 - g. California Mechanical Code, Part 4
 - h. California Fire Code, Part 9 [Current Adoption]
 - i.
3. EIA, IEEE, NEMA and ANSI standards pertaining to fire detection, alarm and communication systems.
4. Underwriters Laboratories UUKL listing: The fire alarm system shall be listed and meet the requirements for smoke control.
- D. Nameplates and Labeling
- 1. All fire alarm components shall be labeled. Identification tags shall be red, laminated plastic with engraved white lettering. Labels shall be mounted on panels with screws. Fire Alarm Account numbers will be issued by the University's Representative.
 - 2. Each FACP shall have a label placed on the front of the control panel indicating with 1/4 inch lettering stating: "ACCT. # # # #". The numbers shall indicate the account number.
 - 3. Each remote annunciation panel shall have a red laminated plastic identification label with 1/4 inch lettering stating "ACCT. # # # #". The numbers shall indicate the account number.
 - 4. Each fire alarm terminal box installed in or on a wall shall have a red laminated plastic identification label with 1/4 inch lettering stating "FIRE ALARM TERMINAL" on the front cover.
 - 5. Where terminal boxes are concealed in the ceiling, the box shall have a red laminated plastic identification label with 1/4 inch lettering stating "FIRE ALARM TERMINAL" attached to the front face of the box. A red laminated plastic identification label with 1/4 inch lettering stating "FIRE ALARM TERMINAL" shall be permanently attached to the ceiling T-bar grid at the access point or next to the access door nearest the terminal box.
 - 6. Fire/smoke dampers concealed in the ceiling area shall be Identified with a red laminated plastic identification label with 1/4 Inch lettering stating "FIRE/SMOKE DAMPER M:## s:### ZN ##" with the numbers indicating the point and zone number. The label shall be permanently attached to the ceiling T-bar grid at the access point or next to the access door nearest the fire/smoke damper.
 - 7. Duct detectors concealed in the ceiling shall be Identified with a red laminated plastic identification label with 1/4 inch lettering stating "DUCT DETECTOR M:## s:### ZN ##" with the numbers indicating the module, point and zone number. The label shall be permanently attached to the ceiling T-bar grid at the access point or next to the access door nearest the duct detector. Attach a similar label next to each remote test switch.
 - 8. Heat, smoke, products of combustion and addressable modules shall have red laminated plastic identification label with 1/4 inch lettering stating "[module, point, zone] M:## s:### ZN

with the numbers indicating the device. Label device and/or module in an unobtrusive location where not visible when the device/module is installed.

1.4 SYSTEM OPERATION – GENERAL REQUIREMENT

- A. Fire alarm functions: Activation of a pull station, sprinkler water flow or activation of an automatic sensing device for fire, temperature, flame, or smoke shall result in the following:
1. The appropriate zone or point will operate and transmit to the UC Santa Cruz Dispatch Center or other designated and UCSC DCFM approved central station.
 2. An audible and visual evacuation alarm signal will continuously sound a temporal 3-pulse signal until the system is silenced, reset or voice override is utilized.
- B. Auxiliary control functions: The fire alarm system shall, during certain alarm conditions, control the following types of equipment: Doors, fans, dampers, elevators, etc. Direct control from detector output contacts is not permissible unless the contacts are fully programmable from the FACP. As a minimum, the controls shall accomplish the following:
1. Automatically restore the signal to the controlled systems to normal operation after FACP is reset from alarm posture.
 2. If there are two or more fans of 20 HP or greater controlled directly from the FACP, then the fans shall stagger start with an appropriate delay between each start. The time delay and sequencing shall be incorporated into the ventilation controls or fan motor controllers by way of time-delay relays, etc. A 10-second delay between fan restart is recommended.
 3. [Phase I operation of elevator]
 4. Fan control
 - a. Environmental fans: FACP control shall have priority over all other interlocks and controls.
 - b. Dedicated fire safety fans: Shaft pressurization and other dedicated fire safety fans shall start and be controlled directly from the FACP.
 - (1) Manual override: Provide on-off-auto manual override switches with priority over local Hand-Off-Automatic (HOA), and other automatic control for all dedicated fire safety fans as identified above.
 - (2) Fan status:
 - (a) Provide contact point for positive feedback fan status at the FACP using a current sensor relay (provided in Division 23) located at the load side of the disconnect switch for all dedicated fire safety fans.
 - (b) Provide a green LED for run and a red LED for stop indication at FACP.
 - (c) Provide specific wiring diagrams for fan control.
 5. Drop all magnetically held doors.
- A. Supervisory functions
1. Supervise the 120 VAC circuits supplying the FACP.
 2. Supervise the alarm initiating circuits, building signaling circuits, and auxiliary control circuits, except the door circuits, against grounds, opens, and shorts.
 3. Any equipment trouble or malfunction or activation of a sprinkler system supervisory switch shall transmit a trouble signal.
 4. Upon application or reapplication of 120 VAC power, the fire alarm system shall automatically, without any operator intervention, initialize all circuitry and shall be in a normal operating condition. Systems which require operator intervention to reset manual controls following a 120 VAC restoration are not acceptable.

1.5 SYSTEM SEQUENCE OF OPERATION - DETAILED DESCRIPTION

- A. Signal Activation Sequence
1. Standard Responses Upon Activation: For all situations in Alarm Signal Activation Sequence paragraph standard response upon activation shall result in the following:
 - a. The FACP will go into alarm mode and the module, point, zone/deception in alarm will be annunciated at LCD displays.

- b. The appropriate zone will operate and transmit the alarm signal via two dedicated telephone lines to the UC Santa Cruz Dispatch Center [or other designated and UCSC DCFM approved central station].
 - c. An audible and visual evacuation alarm signal throughout the building will continuously sound a temporal 3-pulse signal until the system is silenced, reset or voice override is utilized.
 - d. Activate the following control functions:
 - 1) Door holder/releases shall activate on floor of alarm.
 - 2) [For high-rise facilities, initiate the smoke control sequence delineated in smoke report] [Except for high-rise facilities comply with applicable codes]
2. Pull station activation shall result in the following:
- a. All standard responses upon activation
3. Sprinkler water flow activation shall result in the following:
- a. All standard responses upon activation
 - b. Activate exterior water flow bell.
 - c. Waterflow bell shuts off when water stops flowing.
4. Duct Smoke Detectors for fan shut down or fire/smoke damper control
- a. The activation of any duct smoke detector shall cause the following to immediately happen:
 - 1) All actions in standard responses upon activation except [for -rise facilities, do not initiate the smoke control sequence delineated in smoke report] [except for high-rise facilities comply with applicable codes] above, and:
 - a) Shut down associated HVAC fan
 - b) Close associated fire/smoke damper.
 - c) Activate the remote indicator associated with the duct smoke detector.
5. [Area Smoke Detectors]
- a. [Elevator lobby or elevator] machine room smoke detector activation shall cause the following to immediately happen:
 - 1) All actions in standard responses upon activation except [For high-rise facilities], [except for high-rise facilities comply with applicable codes] do not initiate the smoke control sequence delineated in smoke report] above, and:
 - 2) [Shutdown of the elevator air-handler]
 - b. [Residential]
 - 1) Common Area Smoke Detectors: Activation of smoke detectors in the corridors, lobbies, storage rooms, electrical rooms and common spaces shall result in all actions in. Standard responses upon activation [except for high-rise facilities comply with applicable codes] above.
 - 2) Dwelling Unit Area Smoke Detectors: The detection of smoke by any addressable smoke detector within a dwelling unit shall not cause the fire alarm control panel to go into alarm mode, but shall cause the following to immediately happen:
 - a) Standard dwelling unit (non-handicap)
 - (1) Actuate the horn of all addressable smoke detectors within the dwelling.
 - (2) Annunciate a distinct supervisory signal at the Fire Alarm control panel and at the remote annunciator(s).
 - (3) Transmit the distinct supervisory signal to the UC Santa Cruz Dispatch Center.
 - b) Accessible (handicap) dwelling unit
 - (1) Actuate the horn of all addressable smoke detectors within the dwelling unit.
 - (2) Activate the strobe in the unit. The strobe(s) in the unit shall be powered and supervised by the building's power booster and controlled through an addressable control module.
 - (3) Annunciate a distinct supervisory signal at the Fire Alarm control panel and at the remote annunciator(s).

- (4) Transmit the distinct supervisory signal to UC Santa Cruz Dispatch Center via telephone lines to the Fire Alarm receivers.]
- c. Area smoke detector, heat detector, or flame detector activation anywhere in the facility shall cause the following to happen:
 - (1) Standard responses upon activation [for high-rise facilities comply with applicable codes].
- 6. Smoke Detector for the Release of Automatic Closing Fire Doors
 - a. Fire door release that includes smoke detectors protecting the affected door(s) shall have one or more smoke detectors located within 5 feet of the door opening and shall be in accordance with NFPA 72.
- 7. Fire suppression systems
 - a. The activation of any detection device associated with a fixed fire suppression system in the building shall cause the following to immediately happen:
 - 1) All actions standard responses upon activation above.

1.6 SUBMITTALS

- A. Conform to Section 01 XX XX Shop Drawings, Product Data and Samples and to the requirements of Section 01 XX XX Project Record Documents. All plans, calculations, and product data (including California State Fire Marshal approval sheets) shall be submitted as required by NFPA 72, current edition.
- B. Procedure
 - 1. The University's Representative will forward a copy of the Architectural backgrounds to the Contractor.
 - 2. Prepare and submit copies of shop drawings, catalog cut sheets, California State Fire Marshal (CSFM) listing sheets, and additional information required in this section, to the University's Representative for approval by UCSC DCFM and Alarm Shop.
 - 3. If the submittals are not approved in the second submittal, the contractor will be required to attend a meeting with the UCSC DCFM and Alarm Shop to discuss comments prior to the next submittal.
 - 4. Contractor shall not start any construction on the fire alarm system prior to approval of related submittals by the UCSC DCFM and Alarm Shop.
 - 5. Conform to Fire Alarm Plan Review Submittal Requirements - January 2008 and UCSC Fire Alarm Plan Submittal Intake Checklist at the end of this section and available on the UCSC DCFM web page: <http://safetyservices.UCSCavis.edu/ps/fp/fn> under Plan Review and Construction Inspections.
- C. Manufacturer's Product Data-Submit the following:
 - 1. Equipment schedule showing exact types, current CSFM listing, and quantity of all fire alarm devices.
 - 2. Technical data showing exact types of all fire alarm devices. Specific components on catalog cut sheets must be highlighted or otherwise identified. All equipment drawing alarm or supervisory current shall have documentation of the current draw clearly marked and highlighted in the submittal information.
 - 3. Technical information showing physical dimensions, weight, finish and mounting requirements.
- D. Shop Drawings
 - 1. Submit shop drawings as follows:
 - a. Drawn with AUTOCAD (latest version) to the same scale as the architectural drawings, showing device layout, raceway routing, conduit and wire size, wire identification numbers, room and floor identification numbers. These drawings shall be prepared by persons meeting the requirement of Quality Assurance paragraph. The drawings shall be stamped and signed by the contractor's engineer who shall be a licensed fire protection engineer or a licensed professional engineer in the state of California. Include the following:
 - b. Title Page

- 1) Title block showing the Installer's name, address, telephone number, license number, and NICET stamp.
- 2) Title block indicating project site address and University CAAN number, which shall be provided by the University's Representative.
- 3) Include an accurate legend of symbols for all fire alarm devices being installed. The legend must include the quantity and model number for each device.
- 4) Wire/circuit legend with circuit identification, color, gauge, wire type, number of conductors, etc.
- 5) A Materials Submittal cover sheet identifying all FACP equipment, model numbers, and quantities including the California State Fire Marshal listing numbers and expiration date for each component. The listing sheet shall be cross-referenced with and shall match the manufacturer's catalog data sheet.
- 6) Compliance Statements included on the Title Page:
 - c) "The fire alarm system shall conform to Article 760 of the California Electrical Code. Installation of the fire alarm system shall not be started until detailed drawings and specifications, including current California State Fire Marshal listing sheets for each component of the fire alarm system, have been approved by the California State Fire Marshal and the University Fire Department and the UCSC Alarm Shop.
 - d) A set of fire alarm shop drawings that are stamped approved by the UCSC DCFM shall be on the job site and used for installation. Any deviation from approved shop drawings, including substitution of devices, shall be submitted to University's Representative in accordance with Section 01 XX XX Substitution Procedures and approved in writing by the UCSC DCFM prior to installation.
 - e) Any discrepancies between the drawings and the code or recognized standards shall be brought to the attention of the University's Representative and the UCSC DCFM.
 - f) Upon completion of the installation of the fire alarm system, Contractor shall coordinate with other Work to test interconnections of the fire alarm system with other building systems and equipment. Once all functions indicated in the fire alarm system sequence of operations have been verified through testing by the installing contractor, an acceptance test must be performed in the presence of UCSC DCFM and UCSC Alarm Shop. The acceptance test must successfully demonstrate all functions required in the contract.
- 7) Fire smoke damper matrix.
 - g) damper location
 - h) area served
 - i) associated air handler unit
- c. Floor Plans
 - 1) The entire project area, room numbers and use for all rooms or spaces.
 - 2) All fire rated walls, clearly identified within the project area.
 - 3) Indicate all (new and existing) final fire alarm device outlet locations.
 - 4) Show size and route of cable and conduits.
 - 5) Wire identification: Information showing conductor types, sizes and quantities for each conduit run.
 - 6) Device address for all addressable devices; [module: point, zone ###.]
 - 7) Duct air velocity where each duct smoke detectors employing the use of sampling tubes is installed.
 - 8) Air handling systems supplying more than 2,000 cubic feet per minute.
- d. Schematic and Wiring Sheets
 - 1) Riser diagrams with FACP, terminal cabinets, raceway layout, circuit style and identification labels (format and designations in accordance with Performance Requirements – Nameplates and Labeling paragraph), riser conduit size, and all devices; horizontal and vertical lines shall be provided to illustrate floors and zones.
 - 2) Complete interior wiring diagrams for the fire alarm control panel and interior modules, cards and power supplies.

- 3) Point-to-point wiring diagrams showing interconnections between fire alarm control panels, terminal cabinets, annunciator panels, and fire alarm devices. All installed wiring (not factory wiring harnesses) shall be indicated. All variances from typical shall be illustrated in separate diagrams.
 - 4) Point-to-point wiring indicating interface connections to equipment supplied by other sections including but not limited to all HVAC control panels, fire/smoke dampers, field devices, relays, [elevators,] and other auxiliary control(s).
- e. Calculation Sheets
- 1) Alarm power requirements for all equipment in accordance with the voltage level conditions of notification devices described in Part 2 of this section.
 - 2) Supervisory power requirements for all equipment.
 - 3) Battery capacity calculations for all fire alarm control panels and auxiliary power supplies. Battery calculations shall include all electrical requirements of the entire fire alarm system, including the power consumption Calculation requirements in accordance with Part 2 of this section.
 - 4) Power supply rating justification showing power requirements for each of the system power supplies. Calculation requirements in accordance with Part 2 of this section.
 - 5) Voltage drop calculations for wiring runs indicating cumulative current draw and voltage drop from the panel to the last device in the loop. Calculation requirements as indicated in Part 2 of this section.
 - 6) Raceway size calculations showing percentage fill in accordance with this specification.
- f. Installation Detail Sheets
- 1) Detailed mounting installation diagrams of the control panel(s), remote annunciator(s), and audible silencing switch.
 - 2) Elevation drawing showing all fire alarm equipment enclosures and raceways on the walls where they will be installed. Panels must not be higher than 6 feet and system status displays should be at eye level (+60 inches above finished floor). No equipment or raceways may be located under a cabinet containing batteries.
 - 3) Front view of the control panel(s) and all annunciator panels.
 - 4) FACP, labels and labeling schemes for circuits, and field devices; nameplates and messages on the control panel(s) and annunciators shall be provided in actual size (see nameplate and labeling requirements in this section)
 - 5) Elevation details for manual pull stations and visual alarm signaling devices.
 - 6) Duct Smoke Detectors: Performance parameters and installation details for each detector, verifying that each detector is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 - 7) Ductwork Coordination Drawings: Plans, sections, and elevations of ducts, drawn to scale and coordinating the installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, the detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
 - 8) Voice/Alarm Signaling Service: Equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
 - 9) Details and listing numbers of through penetration fire stop systems.
 - 10) Details on support and anchorage of any fire alarm equipment weighing over 20 pounds.
 - 11) Dimensioned drawings of all raceways routing and crossover details showing accurately scaled layouts and spatial relationship to associated equipment and connections. These drawings shall be fully coordinated with other Work prior to submittal. Show relationship to adjacent surrounding structure. At the completion of the work, revise all shop drawings and other documentation to reflect any revisions.
- g. Schedule Sheets
- 1) Schedule of addressable circuits and corresponding circuit lengths
 - 2) Circuit schedules for horns, speakers, strobes, auxiliary controls.
 - 3) Functional response matrix identifying all system responses upon activation of each type of device.

- 4) Annunciator text messages and device address for each addressable device as delineated in the Annunciation Section.
- 5) Annunciation requirements: In an addressable system, each initiating device shall annunciate at the FACP [and remote annunciator] as a discrete point on an alphanumeric display. Provide descriptive alphanumeric program labels for each system-initiating device in accordance with the following format:
Zone/Module/Point/Device Type/Specific Information and/or Location (and special access notes)
- 6) Examples:
 - a) Zone 107, Module 33, Point 24, MPS, 4th Fl, C-Wing, corridor by Room 432
 - b) Zone 66, Module 1, Point 76, Duct Detector, 7th Fl, SF-2, in Mech Room 711
 - c) Zone 10, Module 33, Point 10, Water flow, 3rd Fl, Tower, in Stair No. 2

E. Qualification Data: For Installer. Refer to Quality Assurance article.

F. Testing & Commissioning Procedures:

1. Comply with the submittal requirements of Section XX XX XX Starting and Adjusting, Section XX XX XX Commissioning and Section XX XX XX Shop Drawings, Product Data and Samples.
2. In addition, prior to installation of any devices, submit the following for review and approval via the University's Representative to the University's Alarm Shop for review and for University's Representative approval:
 - a. A written acceptance test procedure (ATP), which shall include customized check-off sheets.
 - b. An electronic copy of the UC Santa Cruz Zone Sheet available from the University's Representative listing all circuits to identify the following:
 - 1) Account Number
 - 2) Building Name and physical address
 - 3) Device address (initiating only)
 - 4) Primary Telephone
 - 5) Secondary Telephone
 - 6) Annunciator Panel Location
 - 7) FACP Location
 - 8) Zone number (zones 000 through 010 reserved for University use.)
 - 9) Zone condition
 - 10) Zone Protected Area
 - 11) Manufacturer fixed labels (device type)
 - 12) Custom labels (conforming to UC Santa Cruz standard format)
 - c. A complete copy of panel programming.
 - d. A complete copy of the approved shop drawings with addresses to match the Zone Sheet.

G. Field quality-control test reports. See Quality Assurance article.

H. As-built Record Drawings

1. While the system installation is in progress, one additional set of shop drawings will be kept at the job site with the approved Alarm Zone Sheet. This set will be designated as the As-Built Record Drawings and will be updated regularly to reflect current as built information. These drawings shall reflect the following:
 - a. Changes as a result of final installation, testing, or a change to the system design.
 - b. An accurate depiction of risers, raceway, conduit, all wire runs, cable identification, conduit size, location of junction boxes, terminal boxes, sources of power, devices, sensors, equipment, controlled equipment (motor starters, fans, pumps, valves, dampers, etc.)
2. One set of as-built drawings can be replaced with a fresh updated set of drawings, but there shall never be more than one active set of as-built drawings.
3. The University's Representative and UCSC DCFM shall be given access to this set of as-built drawings at all times so that progress may be reviewed and copies can be made.

I. Record Documents

1. Comply with the requirements of Section **XX XX XX** Project Record Documents. .

J. Operation and Maintenance Manuals

1. Comply with the requirements of Section **XX XX XX** Close-Out Submittals.
2. Comply with NFPA 72, Appendix A, recommendations for University Representative's manual. Include abbreviated operating instructions for mounting at the FACP.
3. Submit operation and maintenance manuals including a brief description of the functions of and theory of operation of each system. Provide clear, concise and detailed operating instructions for all control functions giving the information required to properly operate the equipment and systems.
4. Include technical data sheets, floor plans showing locations of all devices and any other pertinent information such as schematics, parts lists, adjustments and troubleshooting procedures.
5. Include all working programs on compact disks, as well as a printed program listing with a license issued to the University (for on-site-system use) to modify and reproduce software documentation.

K. Final Completion Documentation

1. Approval and Acceptance: Provide the Record of Completion form according to NFPA 72 to University's Representative.
2. Record of Completion Documents: Provide the Permanent Records according to NFPA 72 to University's Representative.

1.7 QUALITY ASSURANCE

- A. The Contractor shall design, supervise, program, test, and commission the installed system and provide warranty service in accordance with NFPA 72. The Contractor's design shall complement the design provided by the qualified designer. A qualified designer as defined by NFPA 72 and shall have the proper training, education and experience.
- B. Manufacturer Qualifications: Equipment shall only be provided from firms regularly engaged in design and manufacture of fire detection, alarm and communications systems, components and accessories, of types, sizes, capacities and characteristics required, whose products have been in satisfactory use in similar service for not less than 5 years.
- C. Approved Equipment: Provide fire alarm materials, equipment and devices that have been constructed in accordance with the latest edition of the following publications from Underwriters Laboratories Inc. (UL), or Factory Mutual Engineering Corporation (FM). Materials shall be tested and listed and approved for fire protection service when so required by NFPA 72 or this specification.
 1. UL 228 - Door Holding Devices
 2. UL 464 - Audible Signal Appliances, Fifth Edition
 3. UL 864 - Control Units for Fire Protective Signaling Systems, Sixth Edition
 4. UL 1638 - Visual Signaling Appliances Standard
 5. UL 1971 - Signaling Devices for the Hearing Impaired
 6. UL Fire Protection Equipment Directory
 7. UL Electrical Construction Materials Directory
 8. FM P7825 Approval Guide
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Qualifications-Contractor shall meet the following qualifications, and shall submit proof within 10 days of the Notice to Proceed as described below:
 1. Qualified personnel shall include, but shall not be limited to, individuals with the following qualifications:

- a. Factory trained and certified.
 - b. National Institute for Certification in Engineering Technologies (NICET) fire alarm certified (Level III minimum or Level IV)
 - c. International Municipal Signal Association (IMSA) fire alarm certified.
 - d. Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.
 - e. A professional engineer, registered in the State of California.
2. Contractor must possess a C-10 Electrical State of California Contractor's License and have a minimum of 5 years experience in the business of installing fire alarm systems.
 3. Contractor shall have successfully completed similar local (Northern California) jobs in scope and nature, using the proposed product line, fire alarm panel, and equipment, in other buildings over the past 3 years. For new product lines, one system shall have been completed and in service for at least 1 year.
 4. Provide a list of at least 3 similar fire alarm projects valued at least at **[\$50,000.00]** performed by Contractor with its own forces within the last 3 years including for each project the following information:
 - a. Name, address and phone number of project representative for person or entity for which project was performed.
 - b. Date project was started.
 - c. Date project was completed.
 - d. The dollar amount for the project contract.
 - e. Description of work performed.
 5. Contractor shall be the manufacturer or a local authorized representative of the manufacturer with a proven track record of being responsive, providing accurate and complete submittals, meeting project schedules, and being prepared for system testing and acceptance.
 6. Contractor shall be able to provide a fully equipped and qualified factory-trained repair technician at the job site for any request for emergency services within the time stipulated under the Guarantee paragraph. This service shall be available 24 hours a day during the term of warranty.
 7. Contractor shall furnish evidence that the fire alarm equipment supplier has an experienced and effective service organization, which carries a stock of repair parts for the system to be furnished. The Contractor must be able to provide any replacement part on site within 48 hours during the warranty period. Should the Contractor fail to comply with the service requirements of this section, the University's Representative will then have the option to make the necessary repairs and back charge the Contractor without any loss of warranty or guarantee as provided by the Contract Documents.
 8. Contractor shall employ the services of a factory-authorized service representative who is factory-trained and certified to supervise the field assembly and connection of components, program, pre-test, test, adjust, and commission the system.

1.8 SEQUENCING AND SCHEDULING

- A. Existing Fire Alarm Equipment: Maintain fully operational until the new equipment has been tested and accepted by the University's Representative. As new equipment is installed, it shall be labeled "NOT IN SERVICE" until the new equipment is accepted. Once the new system is completed, tested, and accepted by the University's Representative it shall be placed in service and connected to the existing proprietary central station service. All new equipment shall have tags removed and the existing equipment shall be tagged "NOT IN SERVICE" until removed from the building.
- B. Equipment Removal: All existing equipment, wiring, junction boxes and conduit for the existing fire alarm system shall be removed after the installation of the new system has been accepted by the University Fire Marshal. All existing panels, other panels, manual pull stations, detectors or bells shall be
 1. Removed from the site and disposed of by the Contractor.
 2. All areas where existing devices were removed and not replaced shall be restored to match adjacent surfaces or repaired as indicated on the Drawings.
 3. **[Smoke detectors designated as hazardous waste shall be disposed of by University. Coordinate disposal with University's Representative.]**

- C. Interruption of Existing Fire Alarm Service: Do not interrupt fire alarm service to facilities occupied by University or others unless permitted under the following conditions and then only after arranging to provide temporary fire watch service according to requirements indicated:
 - 1. Notify the University's Representative in writing no fewer than 14 days in advance of proposed interruption of fire alarm service.
 - 2. Do not proceed with interruption of fire alarm service without the University Representative's written permission.
- D. Fire Watch: Where it is necessary to shut down existing fire alarm systems for switch-over purposes or any other reason that leaves the building unprotected, the Contractor shall provide a continuous UCSC DCFM approved fire watch during the shutdown.
 - 1. Fire watch personnel shall be trained in the use and operation of portable fire extinguishers, and instructed in how to contact the UC Santa Cruz Dispatch Center by either radio or telephone.
 - 2. Continuous rounds to cover all areas of the building are required every 30 minutes.
 - 3. An evacuation plan which includes a method to notify all occupants is required in occupied buildings.
 - 4. Maintain a log of the rounds and comprehensive notes.
 - 5. Provide a 30-day notice to the University's Representative and attend coordination meetings for fire watch approval.

1.9 GUARANTEE

- A. Refer to 01 78 00 Close-Out Submittals and Exhibit 19 Guarantee/Warranty form.
- B. Response time for emergency service shall be no longer than 2 hours from the time of notification. Response time for non-emergency service shall be no longer than 24 hours from the time of notification. These services shall be available 24 hours a day. University reserves the right to perform emergency service if Contractor does not meet response time and bill Contractor.
- C. Repairs or replacements shall be completed within 48 hours of notification. For all repairs that cannot be completed after the initial response, a written plan of correction shall be submitted to the University prior to leaving the premises.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The fire alarm control equipment shall consist of a system assembled as an approved unit of regularly manufactured components, by a single manufacturer for the purposes described elsewhere in this specification. The fire alarm control equipment must have a proven track record of service and reliability in projects of similar scope to this project. Interconnecting equipment that has not been listed for interconnection, or the creation of components or system into a nonstandard unit that is not normally available from the manufacturer, is not acceptable.
- B. Provide products by the following:
 - 1. Siemens: FireFinder XLS System

2.2 EXISTING FIRE ALARM SYSTEM

- A. Compatibility with Existing Equipment: Fire alarm system and components shall operate as an extension of an existing system.

2.3 SYSTEM SOFTWARE

- A. The CPU and Life Safety Software shall be the latest version listed by the CSFM. Time and date information will be included in all output messages.
- B. The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary. The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a non-

volatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory.

2.4 FIRE ALARM CONTROL PANELS (FACP)

A. General Description

1. Modular, power-limited design with electronic modules, UL 864 listed.
2. Equipped with a nonvolatile memory that requires no battery backup.
3. Addressable initiation devices that communicate device identity and status.
 - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at the FACP.
 - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
4. Addressable control circuits for operation of mechanical equipment.

B. Circuits

1. Signaling Line Circuits: NFPA 72, Class B.
 - a. System Layout: Install no more than 80 percent of maximum addressable device capacity on each signaling line circuit.
2. Notification-Appliance Circuits: NFPA 72, Class B.
3. Actuation of alarm notification appliances, [emergency voice communications,] annunciation, [smoke control,] [elevator recall,] [and actuation of suppression systems] shall occur within 10 seconds after the activation of an initiating device.
4. Electrical monitoring for the integrity of wiring external to the FACP for mechanical equipment shutdown and magnetic door-holding circuits is not required, provided a break in the circuit will cause doors to close and mechanical equipment to shut down. Locate addressable control module within 5 feet of control panel being controlled.

C. Smoke-Alarm Verification

1. An activated smoke detector shall automatically reset and then recheck the atmosphere following a 60-second waiting period.
2. The fire alarm system will not activate until detection is confirmed following the waiting period.
3. Activation of a second detector during the waiting period shall activate the alarm system immediately.
4. All area and duct smoke detectors shall be enabled with this feature.
5. Provide a disabling feature at the system keypad for system commissioning and University confidence testing.
6. Disabling this feature shall be accomplished via the keypad on a zone, or group of zones, basis.
7. Enable the feature following University and DCFM approval of the system.

D. Notification-Appliance Circuit: Operation shall sound in a temporal pattern, complying with ANSI S3.41.

1. The FACP shall support [speaker] horn and visual alarm circuits originating from FACP mounted hardware for each floor of the building.
 - a. Provide a schedule by performing circuit load calculations considering wire length, gauge, number of devices, and FACP specifications.
 - b. Do not use a single circuit for multiple floors; however, a number of circuits may be required for a single floor.
2. Visual notification circuits shall be synchronized per circuit at each floor's terminal cabinet.
3. No horn [speaker] or strobe circuit shall exceed 10 percent voltage loss measured at the end-of-line device. No strobe circuit shall exceed a 2.1-volt line loss measured at the end-of-line device with a 21-volt DC input at the fire alarm panel end of the circuit.
4. Calculate visual alarm (strobe) circuit capacity and line loss using the strobe's 20-volt DC ratings.
5. The FACP shall support independent door and [corridor damper] control circuits originating from FACP mounted hardware for each floor of the building.

E. [Elevator Controls

1. Heat detector operation shuts down elevator power by operating a shunt trip in a circuit breaker feeding the elevator through an addressable control module.
2. Activation of the heat detector or water flow will operate the building notification appliances and annunciator. Refer to Section 14 XX XX Elevator for additional requirements.]

F. Power Supply

1. General requirements: The FACP and Power Boosters shall have the following requirements:
 - a. All 24 VDC power supply shall be addressable Silent Knight model # 5895XL or Farenhyt RPS-1000/RPS-2000 power supply powered by 120-volt AC power, with a battery backup system regardless of the building's primary or alternate source of power; or equal (no known equal).
 - b. Power supply shall have a dedicated fused safety switch for this connection at the service entrance equipment. Paint the switch box red and identify it with FIRE ALARM SYSTEM POWER.
 - c. Surge Suppression: Install surge protection on normal ac power for the FACP and its accessories.
 - d. Install surge protectors recommended by FACP manufacturer. Install on all system wiring external to the building housing the FACP.
 - e. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module.
 - f. Secondary Power: 24-V dc supply system with batteries and automatic battery charger and an automatic transfer switch.
 - g. Batteries: Sized with 25 percent reserve capacity for future expansion.
 - h. 24-hour system backup capability plus 5 minutes of full alarm operation at the end of a 24-hour period.
 - i. Charger shall be able to restore batteries to full charge within 48 hours after a complete discharge.
 - j. No power supply shall be loaded to greater than 80 percent of its rated capacity. Rated capacity shall be calculated as the total load plus 25 percent future expansion.
2. Additional Requirements - FACP and Power Boosters
 - a. Fire Alarm Panel Control Panel
 - 1) The FACP shall supervise battery and charging system.
 - 2) The FACP shall include trouble annunciation of high/low voltage, shorted cell and open circuits.
 - 3) A means of disconnecting the 120 VAC feed to the FACP for maintenance shall be provided within the FACP or in a locked enclosure within 10 feet of the FACP.
 - b. Intelligent Power Supply
 - 1) Power supply shall have normally open trouble output contacts for monitoring by an external fire alarm system interface module.
 - 2) Power supply shall have supervised input circuit for external activation of alarm notification appliance circuits from fire alarm system interface module.
 - 3) If panel is not located in a locked or secured room, cabinet shall be provided with tamper switch on the door. Tamper switch shall be supervised by an external fire alarm system interface module. Opening of the door shall result in a trouble condition at the FACP.
3. Door Holder Auxiliary Power Supplies
 - a. All 24 VDC power supply shall be powered by 120-volt AC power system to supply all loads plus 25 percent future capacity.
 - b. Power supply shall only be loaded at 80 percent of its rated capacity. Apply this factor after adding the future capacity to the total load calculated above.
 - c. Door Holder Power Supply shall be configured to be de-energized upon loss of 120 VAC power to minimize 24 VDC battery supply requirements. Clearly indicate this function on the shop drawing battery calculations.
 - d. All door holders shall be on 120 VAC and powered by a 120 VAC electrical panel. The breaker shall be marked red and labeled. The door holder label shall identify the circuit.

- G. Alarm Silencing, Trouble, and Supervisory Alarm Reset: Manual reset at the FACP [and remote annunciators.] after initiating devices are restored to normal.
 - 1. Silencing-switch operation halts alarm operation of notification appliances and activates an alarm silence light. Display of identity of the alarm zone or device is retained.
 - 2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
 - 3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.
- H. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and control of changes in those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and make a printout of the final adjusted values on the system printer.
- I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, trouble, and supervisory signals to a remote alarm station through a digital alarm communicator transmitter and telephone lines.
- J. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.5 [VOICE COMMUNICATION SYSTEM

- A. Voice/Alarm Signaling Service: A central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided [in a separate cabinet located in the Fire Command Center] [as a special module that is part of the FACP].
 - 1. Notification-Appliance Circuits: NFPA 72, Class B.
 - 2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
 - 3. Preamplifiers, amplifiers, and tone generators requirements:
 - a. Audio amplifiers shall be sized to provide 1/2 Watt minimum speaker taps and as indicated on the Drawings.
 - b. Each audio amplifier shall have 50 percent minimum spare capacity when attached to the speakers necessary to meet audio requirements.
 - c. Automatically transfer to backup units, on primary equipment failure. FACP shall incorporate a spare automatic backup audio amplifier equal in size to the largest individual amplifier.]

2.6 [FIREFIGHTERS' TWO-WAY TELEPHONE COMMUNICATION SERVICE

- A. Dedicated, two-way, supervised, telephone voice communication links between the FACP, [the Fire Command Center,] and remote firefighters' telephone stations. Supervised telephone lines shall be connected to talk circuits by controls in a control module. Provide the following:
 - 1. Selective-talk type for use by firefighters.
 - 2. Controls to disconnect phones from talk circuits if too many phones are in use simultaneously.
 - 3. Audible Pulse and Tone Generator, and High-Intensity Lamp: When a remote telephone is activated, it causes audible signal to sound and high-intensity lamp to flash.
 - 4. Selector panel controls simultaneous operation of telephones in selected zones and permits up to six phones to be operated simultaneously. Indicate ground faults and open or shorted telephone lines on the panel front by individual LEDs.
 - 5. Provide [graphic] [liquid-crystal digital] display to indicate location of caller.
 - 6. Remote Telephone Cabinet: Flush or surface-mounted cabinet, as indicated, factory-standard red finish, with handset.
 - a. Install one-piece handset to cabinet with vandal-resistant armored cord. Silk-screened or engraved label on cabinet door, designating Fire Emergency Phone.

- b. With break-glass type door access lock.
- 7. Remote Telephone Jack Stations: Single-gang, stainless-steel-plate mounted plug, engraved Fire Emergency Phone.
- 8. Handsets: Provide [push-to-talk] type sets [with noise-canceling microphone]. Provide [Insert number] handsets stored in a cabinet [adjacent to the FACP] [in the Fire Command Center].]

2.7 MANUAL STATIONS

- A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. Mounted on recessed outlet box; if indicated as surface mounted, provide manufacturer's surface back box.
 - 1. Single action mechanism, pull lever type. With integral addressable module arranged to communicate status (normal, alarm, or trouble) to the FACP.
 - 2. Reset shall be accomplished with a lock and key.
 - 3. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm.

2.8 SMOKE DETECTORS/SENSORS

- A. General Description
 - 1. UL 268 listed, operating at 24-V dc, nominal.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
 - 3. When exposed back boxes are needed for interior work use round wire mold boxes of the appropriate size.
- B. Beam-Type Smoke Detector: Each detector shall consist of a single-ended transmitter/receiver, and shall have the following features.
 - 1. Remote test switch.
 - 2. Integrated sensitivity test.
- C. Addressable Duct Smoke Detectors
 - 1. UL 268A listed, operating at 24-V dc, nominal.
 - 2. Integral Addressable Module: Arranged to communicate detector status and sensitivity (normal, alarm, or trouble) to the FACP.
 - 3. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.
 - a. Weatherproof Duct Housing Enclosure: UL listed for use with the supplied detector. The enclosure shall comply with NEMA 250 requirements for Type 4X.
 - 4. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.
 - 5. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.
 - 6. Addressable analog or 2 wire type utilizing addressable component by other manufactures must be approved by the University's "Representative, University's Alarm Shop and UCSC DCFM.
 - 7. The devices shall include necessary sampling tube extensions.
 - 8. Install remote indicating light where indicated on the Drawings and where detector indicating lights are not readily visible.
 - a. Mount remote indicator lights adjacent to the unit, 4 to 6 feet above finished floor, the location must not obstruct area served.
 - b. Device shall be flush or semi-flush mounted with identifying nameplate.
 - c. Integral Visual-Indicating Light: LED type. Indicating [detector has operated] [and power-on] status.

2.9 HEAT DETECTORS

- A. General: UL 521 listed.

Preferably heat detectors shall be a rate of rise and fixed temperature low profile [addressable] type and

shall be ordinary temperature range in all areas except where located in a high ambient temperature area.

B. Heat Detector, Combination Type and Fixed-Temperature Type:

1. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

2.10 NOTIFICATION APPLIANCES

A. Description: Equipped for mounting as indicated on the Drawings and with screw terminals for system connections.

B. Bells: Electric vibrating, 120V under-dome type with provision for housing the operating mechanism behind the bell. Bells shall produce a sound-pressure level of 94 dBA, measured 10 feet from the bell. 10-Inch size, unless otherwise indicated. Bells are weatherproof where indicated.

C. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn in a three pulse temporal pattern. System Sensor, Wheelock, Gentex, or equal.

D. Visible Alarm Devices: Xenon strobe lights listed under UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word FIRE is engraved in minimum 1-inch-high letters on the lens. System Sensor, Wheelock, Gentex, or equal.

1. Strobe Leads: Factory connected to screw terminals.

E. Voice/Tone Speakers

1. UL 1480 listed.
2. High-Range Units (in noisy environments): Rated 2 to 15 W.
3. Low-Range Units (in quiet environments): Rated 1 to 2 W.
4. Mounting: Flush, semi recessed, or surface mounted; bi-directional as indicated.
5. Matching Transformers: Tap range matched to the acoustical environment of the speaker location.
6. Speakers located in rest rooms and similar enclosed areas where alarm threshold may be high should be tapped at 1/4 watt.
7. All settings other than 1/2 watt are identified on the drawings.
8. All systems shall be set at 25 Volt operation.
9. System Sensor, Wheelock, Gentex, or equal.

F. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly.

1. Speaker/strobes color shall be as approved by University's Representative and have sealed back, metal grill, with multiple wattage taps including 1/4, 1/2, 1 watt, and 2 watts, and multiple candela taps 15, 30, 75 or 110.
2. Install all speakers at the 1/2 watt setting unless indicated otherwise on the Drawings and with the candela setting as indicated on the Drawings.

2.11 SPRINKLER SYSTEM REMOTE INDICATORS

A. Tamper supervisory valve and water flow switches shall be provided by **Division 21 Section [21 XX XX Fire Suppression]**. Wiring and raceway from the switches to the fire alarm addressable interface modules and the final connection to the fire alarm system shall be provided and installed by this section.

B. The sprinkler electric bell shall be provided under this section and shall be 120V

2.12 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated on the Drawings and are complete with matching door plate.

1. Electromagnet: Requires no more than 3 W to develop 25-lbf (111-N) holding force.

2. Wall-Mounted Units: Flush mounted, unless otherwise indicated.
3. Rating: 120V
4. All new installations shall be 120 VAC powered door holders.

B. Material and Finish: Match door hardware.

2.13 REMOTE ANNUNCIATOR

- A. Description: Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACP, including acknowledging, silencing, resetting, and testing.
 1. Mounting: [Flush] [Surface] cabinet, NEMA 250, Class 1.
- B. Display Type and Functional Performance: Alphanumeric display same as the FACP. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.
- C. Provide alphanumeric type remote annunciator with 80 character LCD display. Mount annunciator(s) at locations determined by University's Representative and UCSC DCFM. Schedule Coordination site walk and plan review to determine the exact locations. Refer to plans as approved by UCSC DCFM for number and exact locations.

2.14 ADDRESSABLE INTERFACE MODULE

- A. Description: Microelectronic monitor module listed for use in providing a system address for listed alarm-initiating devices for wired applications with normally open contacts.
- B. Integral Relay: Capable of providing a direct signal [to the elevator controller to initiate elevator recall] [to a circuit-breaker shunt trip for power shutdown] [Insert other functions].
- C. Provide addressable interface modules to interface with non addressable initiating devices, installed in junction box adjacent to water flow, and tamper switches.

2.15 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Listed and labeled according to UL 632.
- B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP, and automatically captures one or two telephone lines and dials a preset number for a remote central station. When contact is made with the central station(s), the signal is transmitted. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is adequate to comply with NFPA 72 requirements.
- C. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.16 FIRE ALARM TERMINAL CABINETS AND AUXILIARY CABINETS

- A. Enclosures shall be NEMA Type 1 or Type 12. All panels shall be [surface or flush] mounted with hinged door and latch with lock. All locks shall match FACP key. Box and front shall be steel, painted to match wall in finished areas.
- B. Fire alarm terminal cabinet shall be labeled with a riveted or screwed laminated plastic nameplate indicating "FIRE ALARM TERMINAL CABINET" in 1/4 inch white letters on a red background.
- C. Provide a wire schematic similar to that specified inside the cabinet door. Also, provide a schedule identifying all end of line resistors for the zone and their respective locations.
- D. All end-of-line (EOL) devices shall be located in the terminal cabinet or the end of the corridor for the area served and labeled on the EOL device.
- E. Provide identified terminal blocks in all terminal cabinets and auxiliary control cabinets. These blocks shall be sized to accommodate wire from 18 gauge to 10 gauge.
- F. Backboards in the terminal cabinets shall be constructed of fire retardant treated 3/4 inch exterior grade plywood, painted white.

2.17 SPARES

- A. Provide FACP spare equipment for 5 percent (at least two each) spare fully operational [speaker], horn/strobe, smoke detectors, heat detectors, addressable input modules, addressable relay modules, manual pull stations, beam detectors, matching bases for each of the initiating devices, duct detector housing with function cards, and auxiliary control circuits.
 - B. Provide one spare expansion or isolation module.
 - C. Provide 25 percent spare capacity for FACP I/O points.
- 2.18 SMOKE/FIRE DAMPERS
- A. Dampers shall be as described in Division 21.
 - B. Interface relays shall be provided to operate 120VAC AC smoke dampers from the 24VDC fire alarm system.
 - C. Fire alarm relay contacts shall be rated at 10 amps; RIB Ribu 1c or equal.
 - 1. For RIB step down relay and relay wired in an energized state, interface relay shall be provided to operate a 120VAC smoke damper from 24 VDC fire alarm system. Fire alarm contacts shall be rated at 10amps. Mount in NEMA 1 enclosure in the proximity of the fire alarm terminal cabinet.
 - 2. The interposing relay shall be normally closed and the damper(s) powered open.
 - 3. Upon alarm, or AC power failure, the dampers shall close.
 - 4. Interposing relays shall be UL cross-listed with the FACP.
 - 5. Multiple fire/smoke dampers in a common area [per floor] shall have separate relay per floor at minimum.
- 2.19 WIRE AND CABLE
- A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760 and manufacturer's recommendations.
 - B. Non-Power-Limited Circuits: Stranded-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
 - 1. Low-Voltage Circuits: No. 16 AWG, minimum.
 - 2. Line-Voltage and notification Circuits: No. 12 AWG, minimum.
 - 3. [Multiconductor Armored Cable: NFPA 70 Type MC, copper conductors, TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, UL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.] Saddle grip connectors with lock nut are required. Can only be used in accessible areas. Seek University approval prior to including in design documents.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. The existing system shall remain operational at all times. Connecting to Existing Equipment: Verify that existing fire alarm system is operational before making changes or connections.
- B. Smoke or Heat Detector Spacing
 - 1. Smooth ceiling spacing shall not exceed 30 feet.
 - 2. Spacing of heat detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas, shall be determined according to Appendix A in NFPA 72.
 - 3. Spacing of heat detectors shall be determined based on guidelines and recommendations in NFPA 72.
- C. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of the duct.
- D. [Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.]

- E. Remote Status and Alarm Indicators: Install near each smoke detector that is not readily visible from normal viewing position.
- F. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- G. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling.
- H. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- I. FACP:
 - 1. Install in a secured and locked room (such as electrical room or fire control room) with an annunciator at building point of entry.
 - 2. Surface mount with tops of cabinets not more than 72 inches above the finished floor.
 - 3. Panels shall be installed in a conditioned space between 60 and 80 degrees F.
- J. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

3.2 WIRING INSTALLATION

- A. Wiring Method: Install wiring in metal raceway according to Section [26 XX XX] Raceways and Boxes.

- 1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.
- 2. [Multi Conductor Armored cable shall be installed in accessible non-concealed locations only.]
SEEK UNIVERSITY APPROVAL PRIOR TO INCLUDING IN DESIGN DOCUMENTS.

- B. Wiring Method

- 1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
- 2. Fire-Rated Cables: Use of 2-hour fire-rated fire alarm cables, NFPA 70 Types MI and CI, is not permitted.
- 3. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or raceway as signaling line circuits.
- 4. All wire shall be new, UL approved, marked, and brought to the job site in original packages.
- 5. Wire insulation shall be one of the types required by NEC. All wires shall be sized per NEC for the load serviced. Field wiring for initiation, supervision, and signal circuits shall be stranded conductor. All wire shall be approved for fire alarm installations.
- 6. Pig tailing and Tee tapping is prohibited for all system circuits, except door circuits and 120 VAC.
- 7. Addressable signaling line circuits may be Tee tapped only in the fire alarm terminal cabinet for the floor, which that circuit serves.
- 8. Fire alarm system shall be wired Class B, device to device, with no splicing unless approved by the University's Representative.
- 9. End of line resistors shall be located in the terminal cabinet or the end of the corridor or other unassigned (public) space for the zone served.
- 10. Splicing when approved shall be made with a terminal strip in a labeled fire alarm cabinet, which shall be easily accessible and marked clearly on shop drawings.
- 11. Colors shall match when possible and the conductors shall be mechanically secured to each other so that no stress is applied to the splice.
- 12. Aluminum wire and solid wire are not permitted unless recommended by the manufacturer. All wire and cable type to be used must be approved.
- 13. Wire pulls by powered mechanical means will not be permitted.
- 14. Conduit shall be thoroughly cleaned of all foreign material just prior to pulling the wire or cable.

15. Lubricants shall be compounds specifically prepared for cable pulling and shall not contain petroleum or other products, which will affect cable insulation.
 16. Wire that has scrapes, nicks, gouges, or crushed insulation shall not be used and must be removed.
 17. Do not run low voltage energy limited wiring in the same wire-ways with, or closely parallel to, high voltage and/or switched power wiring.
 18. Interposing relays shall be used for all switched power loads and shall be located such that the switched power conductors do not run in the same raceway as the interposing relay coil power or any other energy-limited low voltage conductors.
 19. All wiring shall be contained in metal conduit or raceways dedicated to fire alarm service.
 20. Conduit size shall be 3/4 inch minimum, except conduit up to 30 feet in length, from junction box to an individual device may be 1/2 inch. Surface mounted raceways shall be Wire mold #700 minimum, T&B, or equal (also see Section [26 XX XX, Basic Electrical Requirements]).
 21. No raceway shall be filled in excess of 40 percent. Contractor shall demonstrate by performing fill calculations showing that the designs comply with these criteria. [Exceptions are only allowed when use of existing wire ways is approved.]
 22. Provide 6 inch by 6 inch or larger junction boxes at all junctions where four or more conduits are combined. Use of extension rings to achieve adequate space for a device or junction is not allowed.
 23. The raceway system shall resemble a branch and tree configuration where the main run has limited offsets, and branch lines run perpendicular to the main run.
 - a. Each device shall be connected from a junction box on the main Fire Alarm (FA) raceway so that the main raceway does not pass through a device back box.
 - b. Branches shall be provided with sufficient junction boxes so that not more than three unassociated circuits pass through a device back box.
 24. All raceways shall run parallel or perpendicular to walls, floors, and ceilings.
 25. Raceways between FACP and terminal cabinets shall not be larger than 2-1/2 inches in diameter. Where additional capacity is needed, provided a second, third, or more raceways.
 26. As a minimum, provide a single 1-1/2 inch diameter raceway between the FACP and terminal cabinets, regardless of the wire fill.
 27. For surface-mounted raceway, runs shall be routed on walls out of visual sight, with vertical drops to wall-mounted devices. Submit routing proposal to University's Representative for approval prior to installation.
 28. Do not encase raceway in concrete unless specifically called for.
 29. No wire run or circuit shall be longer than 80 percent of the maximum allowable length and power consumption for the wire size and application. No output circuit shall exceed 80 percent of the maximum load capacity specified by the manufacturer.
 30. Terminate all wiring for each floor in a terminal cabinet as indicated on the contract drawings prior to running the wires to the fire alarm panel. Provide at least one terminal cabinet for each floor. Prior to cutting wires to length, obtain approval by the UCSC Fire Alarm Shop on conductor termination plan of action.
 31. All solid wire terminations shall be made bare to screw terminals specifically designed for bare wire connection. Make cable shield terminations with T&B Sta-Kon, Scotchloc, or equal self-insulated spade lugs where connected to screw type terminals.
 32. Wiring in all cabinets and terminal boxes shall be neatly arranged and bundled with tie wraps or equivalent; subject to UCSC Fire Alarm Shop approval.
 33. Paint all junction box covers for the fire alarm system red. Paint J Box covers in finished areas to match the wall or ceiling and put a 1/2 inch minimum red dot on the cover.
 34. All conduit and raceways shall be color-coded by a 3/4 inch red band at 10 foot intervals. All inductive loads (door holders, interface relays) without integral reverse Electromagnetic Field (EMF) suppression must have suppression on those circuits.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with pressure-type terminal blocks.

- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- F. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum 1-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors.
- G. Wiring to Remote Alarm Transmitting Device: 1 inch conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals according to Section [26 XX XX] nameplate and Labeling, and Section [26 XX XX] Basic Electrical Materials and Methods.
- B. Install instructions frame in a location visible from the FACP.
- C. Paint power supply disconnect switch red and label FIRE ALARM.

3.4 GROUNDING

- A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

3.5 FIELD QUALITY CONTROL

- A. The fire alarm testing requirements consist of a 4-part series. Pre-testing by Contractor, pre-testing by University to be coordinated with the University's Representative by UCSC Electrical Inspector then pre-testing by UCSC O&M Alarm Shop and final acceptance testing by the UCSC DCFM.
- B. General: Comply with the following requirements:
 1. Engage a factory authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing. The manufacturer's recommended testing devices shall be used.
 2. Comply with the requirements of Section XX XX XX Starting and Adjusting.
 3. Comply with the requirements of Section XX XX XX Commissioning.
 4. Perform the following field tests and inspections and prepare test reports:
 - a. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.
 - b. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters. All tests shall be conducted under the direct supervision of a NICET technician certified under the Fire Alarm Systems program at Level III.
 - c. Include the existing system in tests and inspections.
 - d. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.
 - e. Testing: Follow procedure and record results complying with requirements in NFPA 72. In addition, perform procedures described in this article.
 - 1) Detectors that are outside their marked sensitivity range shall be replaced.
 - f. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.
- C. Perform a preliminary test, which will be conducted by Contractor and witnessed by the University's Representative.
 1. This test shall be completed after the system is complete and clear of troubles.

2. Should the results not be satisfactory to the University's Representative, then corrections shall be made by Contractor and a re-test will be required at Contractor's expense. Installer and a factory trained technician for the FACP shall be present for all testing.
 3. The preliminary test shall be in accordance with a written Acceptance Test Procedure (ATP) to demonstrate and certify proper system operation. See Testing and Commissioning Procedures paragraph of this Section.
 4. All detectors shall be removed from their base and checked for trouble.
 5. Remove one device per signaling circuit from its box and lift a wire to test for supervision and ground. Failure due to improper system wiring will require a comprehensive test of the circuit.
 6. All control switches shall be operated to indicate proper supervision of the switch.
 7. All valve and sprinkler supervision switches shall be operated to verify proper response.
 8. All valve and sprinkler supervision switches shall have one wire removed to verify proper supervision.
 9. Each alarm output, detection, or supervision zone may be tested for proper response to ground conditions.
 10. All local remote annunciators shall be tested for proper operation. AC power shall be interrupted for [4] [24] hours and followed by a [5] [15] minute alarm test.
 11. Remove all critical fuses to check for proper supervision (if applicable).
 12. Test the firefighter's telephone system for supervision of the wiring and for quality of voice transmission.
 13. Test all detectors for alarm operation.
 14. Test all signaling devices for proper operation. Devices that fail and are replaced will require a retest.
 15. Test all alarm sounding devices for proper operation.
 16. Audibility tests will be conducted by the Contractor to determine compliance with the dB requirements. [For replacement systems in occupied buildings, the audibility test shall be conducted after normal working hours.] Ambient readings conducted during working hour.
 17. All [elevator,] [fan], [door holder], [damper] and other control functions and circuits shall be tested for proper operation. Test for proper operation of the Public Address portion of the FACP.
 18. Test fan and damper control, including manual override and priorities. Coordinate with other Work.
 19. Test magnetic door closers, holders, locking mechanisms. Verify appropriate priority with security and access control systems.
 20. [Test elevator recall, Phase I and II as required.]
 21. Test transfer to emergency power, where provided.
 22. Test alarm verification function. Confirm no delay occurs if two detectors are activated.
 23. Demonstrate history log functions.
 24. Confirm signal reports to UC Santa Cruz Dispatch Center.
- D. After satisfactory completion of the preliminary testing, the University's Representative will arrange for the UCSC DCFM to witness a final Contractor-executed acceptance test of the system.
1. Final acceptance will be granted by the UCSC DCFM.
 2. Approval from the UCSC DCFM shall be evidenced in writing and a copy forwarded to the University's Representative.
 3. The requirements for final testing shall be the same as listed under preliminary test above.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.
- B. Follow-Up Tests and Inspections: After date of Substantial Completion, test the fire alarm system complying with testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed.

3.7 DEMONSTRATION AND TRAINING

- A. General: Engage a factory-authorized service representative to train University's maintenance personnel to operate, and maintain the fire alarm system, appliances, and devices.
- B. Comply with the requirements of Section XX XX XX Demonstration and Training.
- C. Contractor shall, after 2 weeks (minimum) written notification to the University's Representative, conduct a training session during which all maintenance and operational aspects of the system will be described and demonstrated to personnel selected by the University. This will include O & M Alarm personnel, and training for 3 firefighter shifts. The sessions shall be conducted by a manufacturer's representative thoroughly familiar with the characteristics of the installed system and building layout. Each individual session will be a minimum of 4 hours of instruction: 2 hrs. Classroom and 2 hrs. hands-on training at project site prior to occupancy.

END OF SECTION 28 31 00

Fire Alarm Plan Review Submittal Requirements

Introduction

This document is intended to provide a model plan review checklist to serve the needs of groups both inside and outside of UC Santa Cruz in preparing a complete initial submittal package for review and approval of fire alarm projects.

Much of the information contained in this document has been taken from the Fire Alarm System Plan Review Guide produced by the Office of the State Fire Marshal.

Basis for Requirements

The currently adopted California Fire Code (CFC), Chapter 9 - Fire Alarm and Detection Systems requires complete construction documents for fire alarm systems shall be submitted for review and approval prior to system installation.

CFC Chapter 9 also states plans and specifications for fire alarm systems shall include, but not be limited to, a floor plan indicating use of all rooms; location of all alarm-initiating and notification devices; alarm control and trouble-signaling equipment; annunciation; power connection; battery calculations; conductor type and sizes; voltage drop calculations and manufacturer model numbers and listing information for all equipment, devices and materials; details of ceiling height and construction; interface of fire safety control functions, and state fire marshal listing numbers of all equipment, devices and materials requiring listing.

Complete vs. Correct

While correctness will speed along the review/approval process in requiring fewer resubmission cycles, lack of completeness will prevent a review. The submittal package must be complete for a complete review/approval process to take place.

Installation Codes and Standards (including edition)

The codes and standards applicable to fire alarm installation and design requirements typically include references to specific sections of Title 24, 2007 Edition; Part 2, California Building Code; Part 3, California Electric Code; Part 4, California Mechanical Code and Part 9, California Fire Code. References are also made to NFPA 72 (the National Fire Alarm Code), 2002 Edition as well as to the current UC Santa Cruz Campus Design Guide. Applicable code references must be identified on the plan cover sheet.

Checklist

Each item on the checklist must be provided for a complete submittal. The submittal requirements for modifications to existing systems are the same as for new systems. The required submittal information for existing systems must come from as-built drawings or from field investigation.

All Fire Alarm Shop Drawings submitted to the UC Santa Cruz Fire Prevention Unit for approval must include the checklist with each item checked off to confirm that the submittal was checked for completeness.

UC Santa Cruz Fire Prevention Services

UCSC FIRE ALARM PLAN SUBMITTAL INTAKE CHECKLIST

UC Project Number: _____ Date: _____

Project Name: _____ Project Manager: _____

All fire alarm submittals must be complete, as incomplete submittals will delay the review process. The following checklist must be used to verify that your submittal is complete:

- Title block includes the contractor’s name, address, telephone number and stamp of the contractor’s C-16 license number.
- Title block includes project site address and University CAAN number.
- Title page includes an accurate legend of symbols for all fire alarm devices being installed. The legend must include the quantity and model number for each device.
- Title page includes the following statements:
 - The fire alarm system shall conform to Article 760 of the California Electrical Code. Installation of the fire alarm system shall not be started until detailed drawings and specifications, including current California State Fire Marshal listing sheets for each component of the fire alarm system, have been approved by the California State Fire Marshal and the University Fire Prevention Services.
 - A stamped set of approved fire alarm shop drawings shall be on the job site and used for installation. Any deviation from approved shop drawings, including substitution of devices, shall be approved by the State Fire Marshal and the University Fire Department prior to installation.
 - Any discrepancies between the drawings and the code or recognized standards shall be brought to the attention of the University Fire Prevention Services.
 - Upon completion of the installation of the fire alarm system, the contractor shall coordinate with other trades to test interconnection of the fire alarm system with other building systems and equipment. Once all functions indicated in the fire alarm system sequence of operations have been verified through testing by the installing contractor, an acceptance test must be performed in the presence of the University Fire Department. The acceptance test must successfully demonstrate all functions required in the contract.
- The drawings are stamped and signed by the design professional of record.
- Floor plans show the entire project area, all fire alarm devices (new and existing) and conduit and wire runs.
- Room number and use is indicated for all rooms or spaces.
- Device address is shown for all addressable devices.
- Conductor type, size and quantity are indicated for each conduit run.
- All fire rated walls within the project area are shown and identified.
- Point to point wiring details that indicate the interconnections between the items of equipment including interfaces to equipment supplied by others.
- Single line riser diagram with the circuit style indicated for all circuits.
- Complete interior wiring diagrams for the fire alarm control panel and interior modules, cards and power supplies.

- Technical data showing exact types and quantity of all fire alarm devices. Specific components on catalog cut sheets must be highlighted or otherwise identified. All equipment drawing alarm or supervisory current shall have documentation of the current draw highlighted in the submittal information.
- California State Fire Marshal listing sheet with current expiration date for each component.
- Battery calculation sheets for all fire alarm control panels and auxiliary power supplies. Battery calculation shall include all electrical requirements of the entire fire alarm system, including power consumption of the individual devices, both in alarm and supervisory modes.
- Voltage-drop calculations for all notification appliance circuits. Maximum voltage drop shall not exceed 10% of the system supply voltage.
- Annunciator text message and device address for each addressable device.
- Elevation drawing showing all fire alarm equipment enclosures and raceways on the wall where they will be installed. Panels must not be higher than 6 feet and system status displays should be at eye level (+60" AFF). No equipment or raceways may be located under a cabinet containing batteries.
- Wire list showing the wire type, gauge and conductor count for all wires and cables.
- Elevation details for manual pull stations and visual alarm signaling devices.
- Details and listing numbers of through penetration fire stop systems.
- Sequence of operations matrix showing how system will react to the activation of each type of device.
- Duct air velocity is indicated where each duct smoke detector employing the use of sampling tubes is installed.
- Air handling systems supplying more than 2,000 cubic feet per minute are shown on the drawings.