SECTION 16722

FIRE ALARM (ADDRESSABLE/MULTIPLEX NETWORK)

PART 1 – GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other specifications sections and drawings for related work required to be included as work under Division Sixteen.
   2. General provisions and requirements for electrical work.

1.02 SUBMITTALS

A. Submittal Documentation
   1. Submit AHJ (Authority Having Jurisdiction) and U.L. Listing numbers for each item of fire alarm system equipment and components.
   2. Submit block wiring diagrams and "point-to-point" wiring diagrams with raceway sizes showing major system components, alarm and signaling stations, battery load calculations, circuit voltage drop calculations with interconnecting circuit conductors and conduits, electrical power requirements. Riser type diagram shall be provided if the building has more than one floor level with information shown on riser diagram on each respective floor, and when required by AHJ.
   3. Submit redrawn building floor plan for each building area, same scale as the contract drawing. Drawings shall be on reproducible sepias or vellum tracing paper. Plans shall show walls, doors, room names and numbers, windows, fire and smoke barriers, and all fire alarm system equipment locations. Show interconnecting conduit, conduit sizes, wire size, type and wire quantity between all components.
   4. Submit manufacturer's standard catalog data for each fire alarm components. The submittal shall be arranged in the order of the Specification and shall list the specification paragraph number, the name, the proposed model and manufacturer for each item as well as a reference indicating the specific piece of data which can be easily located in the brochure. The manufacturer's data sheets shall be marked to indicate the specific item being proposed in cases where the sheet covers several types or sizes of item. The data sheet shall completely describe the proposed item including listing numbers. Where modification to the equipment is necessary to meet the operational requirements of the contract documents, the brochure shall include complete mechanical and electrical shop drawings detailing the modification. The brochure shall include a listing of the outlet rough-in needed for every device and equipment item. The applicable symbol, which illustrates that rough-in item on the drawing plans, shall be shown in the submittal opposite the description of the rough-in to facilitate locating the data by field personnel. Submit elevation and dimensional information.
   5. Submit battery sizing and load calculations.
   6. Submit voltage drop calculations on worst case signal, communication and control circuits.
   7. Calculated ambient evacuation alarm sound intensity levels the fire alarm system in each individual room of the building. Estimates of fire evacuation alarm ambient sound intensity levels for each room based on the respective room occupancy description/name.

B. Deferred Approval Submittal

1. The fire alarm system shall be subject to deferred approval by AHJ. The CONTRACTOR shall prepare six (6) copies all documentation necessary for the submittal to be approved by the AHJ including, but not limited to following: Proposed revised drawings and documents, engineering calculations, U.L. listing numbers, Submittal information described in the Contract Documents. After review of the submittals by the OWNER'S REPRESENTATIVE, the CONTRACTOR shall deliver the submittals to the AHJ and obtain AHJ approvals prior to installation of the system. The CONTRACTOR shall provide Fire Alarm system deferred approval documents. The CONTRACTOR prepared documents shall be signed and stamped by a Professional Electrical Engineer (P.E.) registered in the project State. Return three (3) copies with AHJ approvals to the OWNER'S REPRESENTATIVE.
2. Redraw building floor plan for each site and building area, same scale as the contract drawings. Plans shall show walls, doors, windows, room numbers, room names, smoke/fire barriers and all fire alarm system equipment locations. Show interconnecting conduit, conduit sizes, wire size and quantity between all components. All plans shall be drawn on the same architectural vellum or mylar title block as the Contract Drawings.
3. A cover sheet(s) indicating the following:
   a. The AHJ application and file number.
   b. Name of facility.
   c. Address of facility.
   d. A table of contents.
   e. An abbreviated description of the project indicating the occupancy, construction types, and type of fire alarm system proposed.
   f. Space for the ARCHITECT of record's license stamp and "wet" signature.
   g. The ENGINEER of record's P.E. license "stamp" and "wet" signature.
   h. CONTRACTOR'S or installer's name, address, telephone number and license number.
   i. List of the applicable building codes, code dates and standards, which apply to this contract.
   j. Symbol legend for fire alarm system using same legend as contract drawings with all mounting heights and outlet devices indicated.
4. Each sheet shall be boldly marked "Deferred Approval Plan Submittal".
5. List of type, gauge and quantity of wire being used.
6. Description of the sequence of operation/events when the fire alarm system is activated.
7. A single line diagram showing the following:
   a. All devices using the same symbols as the base contract drawings.
   b. Wire type gauge and quantity of wires being used.
   c. Indications of zones.
8. Battery calculations showing the following:
   a. Stand-by condition shall include 100 percent of devices for the period of time described in the Contract Documents.
   b. Total amperes of the control panel plus an itemized list of amperes per device which will draw power from the control panel including:
      1)Zone modules.
      2)Signal modules.
      3)Detectors.
      4)Others.
   c. Alarm condition shall include 100 percent of devices for the period of time described in the Contract Documents. Total ampere of the control panel plus an itemized list of ampere per device which will draw power from the control panel during battery use including:
      1)Zone modules.
      2)Signal modules.

3)Detectors.
4)Signals.
5)Annunciator panel.
6)control units.

d. Total ampere hours required and the ampere hours battery being supplied.

e. Voltage drop calculations including:
1)Point-to-point ohms law calculations.
2)Indication of zones being used.
3)Percent of voltage drop of the system.

9. Where 2 or more fire alarm panels are interconnected, provide details and data relating to the interface.
10. After review of the Deferred Approval submittals by the OWNER'S Representative the CONTRACTOR shall deliver three bound sets of catalog data, the original reproducibles, and a set of contract electrical prints to the Review Agency-AHJ and obtain their stamp of approval prior to commencing contract related work on the fire alarm system.
11. After all Deferred Approval process documents have been approved by the AHJ, the Contractor shall submit to the OWNER'S Representative six (6) sets of blueline prints of the approved drawings and the original reproducibles for the permanent record.
12. The Contractor shall submit to the AHJ the fire alarm submittal complete documentation for the system proposed by the CONTRACTOR within 60 calendar days after award of the contract.
13. All materials, work, AHJ fees, construction costs and time schedules for the deferred approval shall be included in the contract.

1.03 APPLICABLE STANDARDS (ADDITIONAL REQUIREMENTS)

A. General
1. The equipment shall be listed, labeled, and approved for the application shown in contract documents, as fire alarm equipment complying with the most recent versions of the install requirements of the following Applicable Standards. The following standards shall become requirements of and are included in the contract documents:
2. Factory Mutual Approval Guide (FMAG)
3. United States Department of Justice Rules for Building Accessibility by the Handicap (ADA).
4. The equipment Manufacturer guidelines.
5. State Building Codes, local building codes and Authorities Having Jurisdiction (AHJ).
6. National Electrical Contractors' Association: NECA-305, Recommended Practice for Installing Fire Alarm Systems.

B. National Fire Projection Agency (NFPA)
1. NFPA 72, National Fire Alarm Code.
2. NFPA 90A, installation of air conditioning and ventilating systems.
3. NFPA 70, National Electrical Code (N.E.C.), and N.E.C. Article 760.
4. NFPA 101, Life Safety Code.

C. Underwriters Laboratory (UL)
1. UL 864, Control Units for Fire Protective Signaling Systems.
2. UL 268, Smoke Detectors for Fire Protective Signaling Systems.
3. UL 268A, Smoke Detectors for Duct Applications.
4. UL 521, Heat Detectors for Fire Protective Signaling Systems.
5. UL 228, Door Closers-Holders for Fire Protective Signaling Systems.
6. UL 464, Audible Signaling Applications.
7. UL 1638, Visual Signaling Appliances.

8. UL 38, Manually Actuated Signaling Boxes.

9. UL 346, Waterflow Indicated for Fire Protective Signaling Systems.
10. UL 1481, Power supplies for Fire Protective Signaling Systems.
11. Note: Provide the complete, installed and tested fire alarm system with a Underwriters Laboratory Field Certification from a independent third party alarm service company, designated and authorized by U.L. for fire alarm certification.

D. The California Building Code (CBC) and California Fire Code (CFC)
1. 2007 Building Standards Administrative Code, Part 1, Title 24 C.C.R.
2. 2007 California Building Code (CBC), Part 2, Title 24 C.C.R.
3. 2007 California Electrical Code (CEC), Part 3, Title 24 C.C.R.
4. 2007 California Mechanical Code (CMC), Part 4, Title 24 C.C.R.
5. 2007 California Plumbing Code (CPC), Part 5, Title 24 C.C.R.
6. 2007 California Fire Code (CFC), Part 9, Title 24, C.C.R.
7. 2007 California Referenced Standards Code, Part 12, Title 24, C.C.R.
8. 2007 Title 19, C.C.R., Public Safety, State Fire Marshal Regulations.

E. Installation and Testing Completion
1. Written certification by the fire alarm equipment manufacturer shall be submitted to the OWNER'S Representative, stating that the proposed system and its component parts are listed and approved by UL, the AHJ.
2. Upon completion of installation, written certification by the CONTRACTOR and fire alarm equipment manufacturer shall be submitted to the OWNER'S Representative Certifying the installation has been tested, is operational and conforms to the requirements of the Contract Documents, applicable Building Codes and AHJ.

1.04 EQUIPMENT QUALIFICATIONS

A. General
1. The equipment shall be as manufactured Notifier; Edwards Systems Technology; Pyrotronics; Fire Control Instruments (FCI).
2. Fire alarm system items described by manufacturer's part number, shall comply with the performance specifications published by the manufacturer's most recent catalog data sheets at the time of bid date and shall become the requirements of the Contract Documents.
3. The supplier of the equipment shall be the manufacturer factory authorized distributor and service facility for the brand of equipment provided.
4. A fire alarm system technician authorized by the manufacturer of the fire alarm system shall supervise the CONTRACTORS installation, testing, certification and instruction of OWNERS' Personnel in the operation of the fire alarm system. The technician shall be experienced with the specific system and licensed in the respective State for fire alarm systems.
5. Fire alarms must be approved by the local Fire Marshal and have been in operation in an industrial or commercial buildings for at least two (2) years with no recurring maintenance problems. Alarms must be simple enough that local alarm maintenance companies can provide routine service and parts available within a 150-mile radius of Santa Ana.
   a. Fire alarm system shall be monitored by the Installation Contractor for a period of one (1) year after Date of Acceptance.
   b. System shall be capable of reporting to a remote monitoring station, of the County's choice, after one (1) year period is up without any modification to the equipment.
   c. An alarm silencing button shall be located on the alarm panel.
   d. System shall have a battery back-up capable of maintaining a forty-eight (48)-hour power supply while under load.

e. Contractor to provide and install 8 1/2" x 11" floor plan, identifying all zones, alarm panel, keypads, and all devices. This is to be mounted next to the fire alarm keypad at the staff entrance in a protective frame as approved by the Fire Inspector.

B. Fire Alarm System Contractor Design and Build

1. The fire alarm system devices shown on the drawings do not include all of the devices/components/raceways/ connections, etc. of a completely designed and engineered fire alarm system. The fire alarm system has not been submitted for review and approval by the AHJ as a complete system. The devices (if any) shown on the drawings are to show additional devices that may exceed the minimum requirements of the AHJ and to define locations of selected specific significant components. However, the drawings do not represent all of the components and work required for a complete and operable fire alarm system.
2. The CONTRACTOR shall provide design engineering services and shall provide all material and labor for a complete and operable fire alarm system. The Contractor shall submit the fully designed and engineered fire alarm system to the AHJ for review and approval as a Deferred Approval fire alarm system. All of the costs for design engineering, AHJ review approval, material and labor for a complete and operable fire alarm system shall be included in the CONTRACTOR'S contract.

C. Permits and Notifications (Additional Requirements)

1. The requirements of building permits and requirements of the AHJ to proceed shall become a part of the Contract Documents. The fire alarm building permits and AHJ approval to proceed shall be obtained by the CONTRACTOR.
2. Prior to commencement of work and after completion of work, the CONTRACTOR shall provide written notification to the AHJ.

PART 2 - PRODUCTS

2.01 GENERAL SYSTEM OPERATION

A. General

1. The fire alarm system shall be a complete digital, micro processor based with automatic electrical and logic supervision, network/multiplex addressable communication, fire detection, device control and alarm evacuation, software programmable fire alarm system.
2. The microprocessors shall execute all supervisory and control programming to detect, report the failure or disconnection of any system module or peripheral device and initiate programmed control sequences. An isolated supervision "watchdog" circuit shall monitor the microprocessors, related fire alarm circuits and devices and, upon failure, shall activate the system trouble circuits.
3. The automatic fire detection and alarm system shall consist of main control panel, device/equipment control panels, evacuation alarms, communications, communications circuits, remote annunciator, automatic detection devices, manual stations, control systems, installed and connected in accordance with the Contract Documents and shall function as specified herein.
4. The system shall be programmable in the field. All programmed information shall be stored in non-volatile memory.
5. The system shall operate both addressable and non-addressable devices including but not limited ionization, thermal and photoelectric detecting devices, manual stations, fire sprinkler water-flow switches, and external device control modules.

6. The control panel shall provide power, annunciation, supervision, communications and control for the fire alarm system. The system shall function such that alarm indications override trouble and control conditions. The alarm operation of any fire alarm initiating event shall not prevent the subsequence alarm operation of any other initiating event.
7. External circuit supervision shall not require additional wires other than the pair used for detection or alarm (two wires shall be used from the control panel to each loop of initiating devices and two wires for the audible evacuation alarm devices and two wires for the visual evacuation alarm devices). The wires shall provide both supervision and alarm signals. There shall be no loss of supervision for Class "B" wired devices. Class "A" supervision shall be by adding an additional pair of wires for each circuit type.
8. Equipment shall be weatherproof gasketed where installed in locations exterior of the building, or where indicated on the drawings. Weatherproof equipment shall also be tamper resistant.
9. The fire alarm system elapsed time to complete any response action after initiation of an alarm or supervisory action shall not exceed ten (10) seconds, including but not limited to the following examples:
   a. Activation of a alarm condition by a manual or automatic initiating device, resulting in activation of the respective evacuation alarm devices and display of the alarm status at the fire alarm control panel alarm and status display at remote annunciators.
   b. Activation of a supervisory status, or trouble condition, resulting in display of the respective supervisory or trouble condition status at the fire alarm control panel and status display at remote annunciators.
   c. Activation of a alarm condition by a manual or automatic initiating device, resulting in a respective control function (i.e. damper closing air handler shutdown, etc.) response and display of the respective control status at the fire alarm control panel and status display at the remote annunciators.
10. The fire alarm network/multiplex communications circuits shall be configured and installed so that failure or loss of any individual network/multiplex circuit will not affect more than 15-percent (as measured by facility square feet with fire alarm system protection) of the entire building wide [campus wide] fire alarm system.
11. Transient Voltage Surge Suppression – (TVSS)
12. Provide TVSS protection devices to protect each fire alarm circuits from transient voltage surges and lightning strikes. TVSS type and response characteristics as recommended by the manufacturer for the respective circuit.
13. Provide TVSS on each fire alarm circuit as follows:
   a. Each 60HZ A.C. or D.C. power line connection to the fire alarm system.
   b. Each fire alarm circuit that is connected to devices attached to building exterior (outdoor) locations or extending to locations beyond the building exterior wall line.

B. Alarm Conditions

1. Actuation of any manual or automatic alarm initiating device, connected to the fire alarm system shall cause the following automatic functions. The automatic functions and actions shall be selectable by fire alarm system software program control functions and shall comply with the AHJ requirements:
2. Audio and visual alarm evacuation signaling units shall activate continuously. Provide evacuation alarm "coded" signaling and zoning to comply with AHJ.
3. The respective zone alarm annunciator and annunciator displays on the fire alarm control panel, remote annunciator panels, and remote annunciation/monitoring equipment shall be activated.
4. Activate the central alarm system, and offsite central station equipment interface.

5. Activate building security/intrusion detection control system automatic door unlocking mechanisms for security doors located in the exit egress paths.
6. Emergency egress lighting control, automatically "turn-on" to full intensity all emergency egress lighting systems with lighting "dimmer" or "on-off" switching controls.
7. Actuation of HVAC air duct smoke detectors or HVAC area smoke detectors shall energize the operating mechanisms and cause the following actions:
   a. Shut down only the respective HVAC fans and motors supplying the smoke zone of alarm origin.
   b. Shut down any software programmable combination of HVAC fans and motors monitored and controlled by the fire alarm system.
   c. Shut down all HVAC fans and motors monitored and controlled by the fire alarm system.
   d. Close only the respective HVAC electric/pneumatic actuated air duct fire/smoke dampers and air transfer grill dampers, supplying the smoke zone of alarm origination, associated with the respective HVAC fans and motors shut down by the smoke detectors.
   e. Close all HVAC electric/pneumatic actuated air duct fire/smoke dampers and air transfer grill dampers in the building monitored and controlled by the fire alarm system.
8. Actuation of automatic smoke detector self-contained fire/smoke doors/hatches or actuation of area smoke detectors located on either side of smoke/fire doors/hatches or actuation of the fire evacuation alarms shall energize the release mechanism and cause the following actions:
   a. Close all fire/smoke doors and hatches.
9. Actuation of any fire sprinkler flow switch shall energize the operating mechanism and cause the following actions:
   a. Close all fire/smoke doors and hatches.
   b. Shut down all or software program selected respective HVAC fans and motors monitored and controlled by the fire alarm system.
10. Building 3 bedrooms:
    Actuation of smoke detectors within Building 3 bedrooms shall result in the following actions:
    a. Initiate a audio visual fire evacuation alarm. The alarm shall be local only to all of the evacuation alarms located within the respective residential unit containing the smoke zones of alarm origin. Initiate a supervisory trouble display at the fire alarm control panel and remote annunciators.
    b. After the expiration of a time delay where the trouble alarm condition has not been reset, sound a building general fire evacuation alarm . The time delay duration and availability shall be selected by fire alarm system software program control functions. Set the time delay to comply with AHJ requirements.
11. Provide and perform any additional functions as specified herein, shown on the drawings/contract documents or required by the Fire Marshal, and AHJ.

C. Trouble Condition
   1. Actuation of any status or supervisory trouble condition connected to the fire alarm system shall be monitored and cause the following automatic functions:
      a. Activate the respective alarm zone trouble remote annunciator panels and annunciator display on the fire alarm control panel, remote annunciator panels and remote annunciation/monitoring equipment.
      b. Sound and audible trouble signal on the fire alarm control panel, remote annunciator panels and remote annunciation/monitoring equipment.
      c. Activate the offsite central station trouble monitoring circuit.

2. Monitor and detect trouble/failure in any fire alarm systems electrical and electronic circuits, displays, operating software, communications devices, operator controls and equipment control devices.
3. Monitor and detect trouble that may prevent proper operation of any fire alarm initiating device/circuit, evacuation alarm device/circuit, communications device/circuit, control device/circuit etc., including breaks and/or shorts in circuits and display a trouble condition.
4. Actuation of any fire sprinkler shut-off valve tamper switch shall activate a separate zone and display trouble condition for each valve. The trouble zone shall be completely independent of the fire sprinkler flow switch zone, and completely independent of any other fire alarm zone.
5. Each 120 volt AC electric power source connected to any fire alarm system component shall be monitored with indication by a "power on" display annunciator. Upon normal source power outage, the system shall activate a power trouble condition display, and indicate a trouble condition.
6. Monitor the standby batteries and, upon a low battery condition or battery charging failure, activate the low battery display and indicate a trouble condition.
7. System ground detection shall be provided for the entire system. Upon ground detection, activate the ground detection display and indicate a trouble condition.
8. Smoke detector "pre-clean" pre-trouble condition and secondary "dirty-detector" trouble condition, activate the respective detection display and indicate a trouble condition.
9. Trouble conditions for emergency generators, activate the respective detection display and indicate a trouble condition.

D. Status Monitoring
1. In addition to the status monitoring and status display requirements described for the fire alarm system, provided the following additional status monitoring and status display functions.
2. The HVAC equipment motor starter of each fire sprinkler pump connected to the fire alarm system shall be monitored by the fire alarm system to indicate at the fire alarm control panel if the respective motor status as "running" or "stopped" condition.
3. The limit switches of each HVAC fire/smoke air damper, air transfer grill, and smoke hatch connected to the fire alarm system shall be monitored by the fire alarm system to indicate at the fire alarm control panel if the respective HVAC device status is in the "open" or "closed" position.
4. The HVAC equipment motor starter of each fan, air handler or exhaust unit monitored by fire alarm system air duct smoke detector or fire alarm system area smoke detector to indicate if the respective motor status is "running" or "stopped" condition.
5. The status condition of each emergency engine generator normal-run-stop-fail-trouble.

E. Provide a floor plan and fire alarm "riser diagram" of the facility framed under acrylic and mounted adjacent to each fire alarm annunciator panel and fire alarm control panel. The floor plan shall be to scale and shall have room numbers clearly displayed on all rooms corresponding to the annunciator for the purpose of easily identifying the fire zones.

2.02 FIRE ALARM CONTROL PANEL (FACP)

A. General
1. The fire alarm control panel shall be software programmable, microprocessor controlled, solid state, electronic integrated system. The panel shall be the product of one manufacturer. The control panel shall provide power, status display, annunciation, supervision, communications and control for the entire fire detection and alarm system. Initiating alarms and evacuation alarm shall override trouble, status and control conditions. The detection system shall remain 100 percent

operational, responding to alarm condition while in the routine maintenance or test modes.

2. Addressable detection, status monitor and control devices shall be individually identified by the system, for any quantity of addressable detection devices, for any quantity of status monitor points, and for any quantity of addressable control units; shall be operable at any time up to the total number connected to the system.
3. The microprocessor shall access the system program, which is stored in non-volatile programmable memory, for all control-by-event (CBE) functions. The system program shall not be lost upon failure of both primary and secondary power. Volatile memory shall not be acceptable.
4. A modular plug-in "motherboard" bus shall provide communications to the various plug-in modules required for system operation and expansion. The motherboard bus shall provide 20 percent spare unused plug-in locations, but in no case less than (4) four spare bus plug-in locations.
5. A means shall be provided for acknowledging each abnormal condition. Each activation of the appropriate acknowledge interface shall sequentially acknowledge every point in the system. After all the points have been acknowledged, the display function shall return to normal status and the panel audible signal shall be silenced. The total number of alarms, control, supervisory, control and trouble conditions shall be displayed along with a method to review each list chronologically. The end of the list shall be so indicated.
6. The activation by type, loop, and address of the specific device, sub-loop or alarm/monitor/control point. An audible alert, shall sound at the control panel and an display alarm shall flash. Control panels employing alpha numeric displays shall display the required data, along with a prompt to review the list chronologically. The end of the list shall be indicated.
7. If the microprocessor fails, the system shall initiate an executive default signaling program during alarm and trouble conditions. This program shall enable the control panel to sound the audible and activate the visual evacuation alarm signals and summon the Fire Department. In addition, a status display shall indicate the communication loop wherein the alarm originated. Inability of the system to sound signals or summon the fire department during microprocessor failure shall not be acceptable.
8. Protected access to the system controls shall be provided to allow the user/operator access to the following system functions:
   a. Status of all addressable points.
   b. Status of all events logged.
   c. Set/change the real-time clock and date.
   d. Perform an operational manual test of the system from the control panel, including actuation of any initiating device and trouble circuit without alarming the remote central station. The panel shall automatically return to normal mode in the event the panel remains unattended in the service mode.
   e. Memory storage to retrieve from event log previous alarms events, control points operation events and trouble event conditions. Storage capacity shall be sufficient to retain any combination of not less than 1000 previous events. The oldest stored event shall automatically delete when new events are logged to prevent memory saturation.
9. Individual input (monitor) and output (control) device addressability shall all be performed on the same pair of wires. Wiring shall be Class "A" or "B". When Class "B" wiring is used, no special wiring sequence shall be required on addressable device circuits. An unlimited number of wiring branches shall be permitted with no loss of supervision.

10. A minimum of 300 addressable monitor, trouble and control points shall be provided, but in no case, less than described in the Contract Documents. Capabilities shall be provided to allow system equipment future expansion of additional addressable monitor, trouble and control points, but in no case less than an addition of 25 percent increase.
11. The FACP shall provide positive protection against the fire alarm system inadvertently being left in a non-operating status. The alarm system shall automatically restore and resound alarms and trouble signals, if subsequent alarm initiating or trouble signals are received under any of the following conditions:
    a. After the alarm or trouble, silence switch have been activated.
    b. Prior to resetting system after previous alarm or trouble conditions.

B. Alarm Initiating Zone Modules
1. Shall supervise and accept remote alarm actuating device input signals. A visual display shall indicate separate zone alarm and trouble indicators for each zone.
2. Zones shall be compatible, and designed to operate with the connected initiating devices either addressable or non-addressable type.
3. A spare double throw set of software programmable auxiliary alarm relay contacts shall be provided for control of remote devices for each zone. Contacts shall be rated 120 volt-60 AC 3 Ampere.
4. The quantity of alarm initiating zones shall be provided as shown on the drawings, but in no case shall the zoning be less than the following:
    a. Addressable manually activated alarm initiating stations by individual station location. (i.e., pullstation #100 Room 100 1st floor; pullstation #300, corridor #300, 3rd floor north; etc.)
    b. Non-addressable manually activated alarm initiating stations by floor and building area.
    c. Addressable and non-addressable automatic alarm initiating devices (ceiling or wall mounted heat, flame and smoke detectors) by individual device location. Except rooms with multiple automatic smoke alarm initiating devices shall be zoned by room location (i.e., smoke detectors Corridor #121 1st floor south; flame detectors shop 404 4th floor; etc.)
    d. Elevator, elevator lobby and elevator equipment room, automatic alarm initiating devices by floor level and individual elevator lobby and elevator location.
    e. Air duct smoke detectors by individual location.
    f. Smoke or heat activated fire doors/hatches by individual location.
    g. Fire sprinkler water flow switch by individual location.
    h. Fire sprinkler water shut off valve tamper switch by individual location. Activation of the tamper switch shall sound a independent trouble signal only. Activation of the tamper switch shall not cause a general fire alarm evacuation to be activated.
    i. Smoke detectors for activation and control of HVAC fire/smoke air dampers by individual building room/space location.

C. Evacuation Alarm Signal Control
1. Shall supervise and activate remote evacuation alarm devices.
2. Evacuation alarm shall be compatible and designed to properly operate with the connected audio and visual evacuation alarm devices, with no signal degradation. The alarm shall have spare capacity to allow the future addition of an additional 30 percent evacuation alarm devices, on any circuit.
3. The evacuation alarm shall provide software programmable:
    a. Group evacuation signal control of all evacuation zones.
    b. Evacuation by individual evacuation zone.
    c. Evacuation by any combination of evacuation zones.
4. The alarm modules shall be field resettable to provide either continuous or coded audio evacuation alarm signals. The coded alarm signal shall provide an intermittent "on-off" pulsed sound activation of audible evacuation alarm devices.

5. A evacuation alarm circuit trouble indicating display shall be provided for each evacuation zone. An evacuation alarm in progress indicating display shall be provided for each evacuation zone.

D. Automatic Ground Detection
1. Shall detect either positive or negative voltages when earth connections of 50,000 OHMS or less occur, and activate the ground trouble signal.
2. A ground fault display shall provide indication of either a positive or negative ground fault and shall operate the general trouble devices as specified herein but shall not cause an alarm to be sounded.
3. Each communication loop shall be monitored for short circuits and shall have a distinctive error message for visual indication of circuits and operating trouble devices as specified herein but shall not cause an evacuation alarm to be sounded.

E. Equipment Housing Cabinet
1. A metal tamper resistant cabinet shall contain the fire alarm control panel components. Panel shall be surface or flush mounting as indicated on the drawings. Provide multiple cabinet sections where a single cabinet capacity is inadequate.
2. Provide a full height tamper resistant hinged locking cabinet door. The door shall have transparent, high impact tamper resistant windows to allow visual observation of all indicators/displays and switches without opening the panel door.
3. "In-out" circuit conductors shall terminate on numbered screw-type terminals inside the cabinet.
4. All groups of circuits or common equipment shall be clearly marked and shall be expandable by inserting (plug-in) "bus" type interchangeable units.
5. Entire cabinet interior, exterior and door, rust inhibitor prime coating with manufacturer's standard finish color paint over the prime coating.

6. Provide each conduit/raceway entrances into fire alarm control panels with a water-tight conduit seal. The conduit seals shall be accessible and re-enterable. The seals shall prevent water entrance flowing from inside the conduit/raceway into the respective equipment.

F. Power Supply
1. The power supplies for the fire alarm system shall be adequately sized to properly operate the fire alarm system equipment, including remotely connected, spare and future indicated equipment with all alarm devices in alarm condition. Provide (30)-thirty percent spare power supply capacity for future expansion. Provide transfer modules and multiple power supplies as required for proper operation. Power supplies shall be in integral part of the equipment housings.
2. Input voltage 120/240 volt or 120/208 volt 60 HZ. A.C.
3. Lightning protection, surge transient voltage and RF noise filtering protection on each 60HZ A.C. input and output phases of the power supply shall be provided.
4. Supervised voltage types (i.e., 120V-60HZ A.C., 24 volt A.C., 24 Volt D.C., etc.)required by special connected equipment shall be supplied, including but not limited to:
   a. Alarm initiating devices.
   b. Door or hatch hold-open or closing devices.
   c. Automatic fire/smoke doors and dampers.
   d. Evacuation alarm devices.
   e. Control and annunciator panels.
   f. HVAC system and fire sprinkler pump controls.
   g. Fire and smoke dampers and air transfer grills.
   h. Building security system door locking/unlocking systems.
   i. Lighting Controls.

5. A solid-state power transfer circuit shall provide (UPS) uninterruptible power supply between internal standby power and line power automatically and instantaneously if normal power fails or falls 10 percent below normal ("brown out" and overvoltage conditions).

6. Individual circuit fuses shall be provided for smoke detector power, main power supply signal circuits, battery standby power, and auxiliary output.
7. Battery Back-Up Operation
   a. Internal batteries and battery power supplies shall provide (60)-sixty hours continuous automatic normal operation of the entire fire alarm control panel and fire alarm systems connected to the fire alarm control panel after the failure of the incoming utility power. Sufficient battery capacity shall remain at the end of 60 hour period to provide (15)-fifteen minutes of "alarm mode" continuous operation of all connected evacuation alarm devices both visual and audible types.
   b. Provide thirty (30)-thirty percent spare battery capacity for fire alarm system future expansion and to compensate for deterioration and aging during the batteries useful life cycle.
   c. Batteries shall be sealed lead-acid or [nickel cadmium type]. Batteries shall be earthquake restrained. Batteries shall include catalytic conversion of outgassing hydrogen gasses.
   d. The battery charger, shall be automatic, dual rate with capacity to recharge completely discharged batteries in not less than (18)-eighteen hours. Charger shall be temperature compensated.
   e. The battery backup system shall not be required to provide line voltage capacity to maintain the normal operation of the following equipment during a failure of the incoming utility power. However, the automatic smoke detectors and alarm initiating devices associated with this equipment shall maintain operation during power failures:
      1) Automatic fire/smoke air dampers, "hold open" and "hold close" "magnetic release devices.
      2) Automatic fire/smoke doors and hatches, "hold open" and close magnetic/solenoid release devices.
      3) Motor control circuits of HVAC equipment connected to the fire alarm system motor starter/controller control voltage.
      4) Security system door unlocking system operating power magnetic/solenoid release devices.
      5) Lighting control systems.

G. Provide lightning and transient voltage surge protection for the fire alarm control panel, shall be incorporated in the power supply circuit, common control circuits, signal circuits, communication circuits line circuits.

H. Central Station
   1. Circuitry shall be provided in the control panel to permit transmission of supervisory, trouble and alarm signals over leased or privately owned telephone cables to a remote receiving panel. There shall be a supervised disconnect switch to allow testing of the fire alarm system without transmitting an alarm signal to the central station.
   2. Off premise signaling, central station compatible, including but not limited to the following:
      a. Reverse polarity (3-conditions) – three independent reversing polarity, one each for alarm initiate; supervisory; and trouble. Form-C double throw contacts, for each condition.
      b. Reverse polarity (alarm activate) – alarm active normal state; trouble voltage removal; alarm initiate polarity reversal.

c. City-Tie connection – local energy, master fire alarm box – normally open or normally closed initiating contacts.

I. The system indicating and operational control devices shall be mounted on the control panel face behind the panel door and shall provide the following minimum functions:
   1. Individual visual indicating annunciator displays to monitor the following alarm system conditions:
      a. Input power.
      b. System common alarm.
      c. System common trouble.
      d. Alarm or trouble signal silenced.
      e. Ground fault.
      f. Battery condition.
      g. Each individual alarm, control or initiating zone-activation.
      h. Each individual alarm, control or evacuation zone-trouble.
      i. Report, by specific device number, any device removed from an addressable initiating circuit, all other devices shall continue to function.
   2. Operator manual control to allow the following system controls:
      a. Alarm silence.
      b. Trouble silence.
      c. Test all indicating pilot lights and readouts.
      d. System reset, including remote devices connected to the alarm panel.
      e. Alarm test to initiate an alarm condition from the control panel.
      f. Central alarm disconnect for system testing without activating central alarm system.
      g. Changing the status of configured circuits (arming or disarming and changing status of relays). If any change in status degrades system operation as configured, a trouble condition shall be reported and remain until system operation again meets configured status.
      h. Perform multiple operations at the same time. These operations shall include but not be limited to timed functions and multiple configured sequences.
   3. Individual indicating meters for the following information.
      a. Battery ammeter.
      b. Battery voltmeter.

J. The status displays, annunciators shall list upon request:
   1. Alarms with time, date and location.
   2. Troubles with time, date and location.
   3. Status of output functions, "on" or "off".
   4. Sensitivity of addressable smoke detectors.
   5. Detection device number, type and location.
   6. Status of remote relays, "on" or "off".
   7. Acknowledgment time and date.
   8. Signal silence time and date.
   9. Reset time and date.

   The system shall also provide the following:
   1. Counting the number of addressable detectors within a "zone".
   2. Which devices are in alarm.
   3. Counting "zones" which are in alarm.
   4. Counting the number of addressable detectors, which are in alarm.
   5. Alarm on the system.
   6. Differentiating among types of addressable detectors such as smoke detectors, manual stations, water-flow switches, thermal detectors, flame detectors etc.
   7. Assigning priorities to types of detectors, zones or groups of detectors.
   8. Cross-zoning.

K. CONTROL FUNCTIONS

1. Control functions shall be assigned on the basis of multi relational system initiation patterns of detection devices including full logic element equations using as "anding" zones, counting zones, counting devices, "anding" groups, conditional "if", "then", "else", "not", "or" programming and "anding" types of detection devices.
2. Control functions shall be assigned on the basis of, cycle, delay, count, time of day, day of week, day of month and with a holiday schedule of up to thirty (30) holidays per year. Each addressable detection device shall report its condition to the system control unit not less than every four (4) seconds in a manner such that failure of the connections to the internal electronics of the device will result in a trouble signal which identifies the specific device involved.
3. The system shall be field programmable for the response of control points to monitored devices.
4. The operating software program shall provide programmable control for the Event-Initiated-Programs (E.I.P.) which shall allow automatic operation of system control points in the event of a alarm condition. To program these E.I.P.'s, the system shall use a specifically designed user friendly programming language, which shall not require a knowledge of computer programming to learn and understand.
5. The operating software shall support the following additional capabilities:
   a. Three levels of designated and unique Priority Alarms for each point.
   b. Designated "Sense Mode" for status interpretation for each point.
   c. Designated Print/No Print/Vectoring Mode for each point.
6. The input statement defines the conditions required to activate the associated output statement. The input statement shall consist of single or multiple monitor point status, subroutine status, time comparison and the utilization of AND, OR, NOT, COUNT, and DELAY logic functions.
7. The output statement shall define the action to be taken by the control panel. The output statement shall consist of activation/deactivation of single or multiple control functions, subroutines, and remote Annunciator status display. Output statements shall also include the "Alert" messages.
8. The software shall provide an "alert" message, unique to each point in the system, which will provide specific instructions for the operator on duty. These messages shall be up to 5 lines with up to 70 characters in each line. Each system monitor point shall have 5 specific alert messages when in alarm. Control points shall also be assigned alert messages.
9. The hardware and software shall have the capacity to accept up to 64 independent programs. Each program shall have "Edit" or "No Edit" capability. Each program shall be written in an equation format comparable to ladder-logic equations. The Equations shall consist of an input and an output statement.
10. Provide initial programming services for coding, loading and debugging the initial OWNER specified and AHJ programs.
11. Programming command definition:
    a. Timing command shall provide time delay and time control functions based on internal clock/calendar by time of day; day of week; day of month; month in year.
    b. Count command shall provide a specific number of events to occur before a control action is initiated.
    c. Pulse command shall provide on or off control for a specific period of time.
    d. Cycle command shall provide on-off control for preset periods of time.
    e. Print command shall provide printing of specified information after an event occurs.

2.04 FIRE ALARM SYSTEM INFORMATION DISPLAYS AND FIRE ALARM SYSTEM OPERATOR CONTROL INTERFACES

A. General
   1. The methods for displaying alarms, data, trouble, status and the methods for software programming control setups and operator control override etc. shall comply with the following for Fire Alarm Control Panels and Remote Annunciator Panels.
   2. The method for manual initiating fire alarm system control actions/events, manual responses to initiating alarm/trouble alarms and control of communications shall comply with the following for Fire Alarm Control Panels and Remote Annunciator Panels.
   3. The interfaces shall be integrated into the respective equipment cabinets. Mounting heights for the display and control components shall not exceed 72-inches or be less than 30-inches above finished floor.
   4. All components shall be supervised circuits by the Fire Alarm Control Panel.

B. Fire Alarm System Information Display
   1. Alphanumeric display unit using monochrome liquid crystal visual information display system (LCD). Backlighting to insure legible display during any ambient lighting condition ranging from total darkness to full sunlight. Minimum of 160 alphanumeric simultaneous display characters.
   2. The LCD shall display the text and numerical formatted information of each individual alarm initiating zone, each trouble zone; each fire alarm system status/information indication; each communication zone; each fire evacuation alarm zone; each operator control function.
   3. The LCD shall provide simultaneous display of not less than two (2) independent fire alarm events and control events occurring at the same time. The information shall "scroll" on the annunciator to display all fire alarm system events.

C. Fire Alarm System Operator Control Interface
   1. Dedicated switches, keypads and pushbuttons shall provide operator control selection of fire alarm functions for the fire alarm system.
   2. Permanently and/or software assigned control functions shall provide engraved permanent nameplates describing the respective control function. Software programmable/assigned control functions shall be indicated by "backlighting" of the respective switch, keypad and pushbutton with a descriptive indication of the respective function action.

2.04 MANUALLY ACTIVATED ALARM INITIATING DEVICES

A. General
   1. An electronic, digital network/multiplex, addressable module shall be incorporated into each device. The device shall communicate the alarm condition; the status condition and the trouble condition of each device with unique address codes. The device shall bi-directionally communicate with; be supervised by; and monitored by the fire alarm control panel. Address assignments shall be set electronically and reside at the device location in non-volatile memory. Memory shall be maintained during electric power outage.
   2. Devices shall be suitable for use on a class "A" 4-wire supervised alarm initiating circuit.
   3. Screw type terminals with numbered identification shall be provided for each "in-out" connections of the alarm circuit wiring.
   4. The face of the station shall have lettering indicating "fire" and operational instructions. Stations shall be tamper resistant. Semi-flush mounting in a outlet box unless indicated otherwise on the drawings.

5. Auxiliary spare switch contact shall be provided for control of remote devices rated 120 volts - 60HZ, AC – 1-ampere minimum.
6. Stations shall provide visual indication the station has been activated. A key (and/or special tool) shall be required to gain access into the station to reset the station after being activated.
7. Stations shall be "break-glass" or "non-break- glass" type as required by local Fire Marshal or indicated on the drawings.
8. RF noise, lightning protection and transient voltage filtering shall be provided internally in the device.
9. The devices shall operate in ambient air environment as follows:
   a. Temperature Centigrade 0 degrees to 49 degrees
   b. Humidity 0 to 95 percent non-condensing
   c. Elevation sea level to 15,000 ft.

B. Manual Pull Stations
1. Pull stations shall be non-coded single action [or double action], requiring a manual "pulling" action to initiate the fire alarm.
2. Pull stations installed outdoors shall be weather resistant construction, "double action" type to activate the pullstation.

2.05 AUTOMATIC ALARM INITIATING DEVICES

A. General
1. An electronic digital, network/multiplex, addressable module shall be incorporated into each initiating device. The device shall communicate the alarm condition; the status condition; the trouble condition of each device, with unique address codes. The device shall bi-directionally communicate with; be supervised by; and monitored by the fire alarm control panel.
   Address assignments shall be set electronically and reside at the device location in non-volatile memory. Memory shall be maintained during electric power outage.
2. Devices shall be suitable for use on a Class "A", 4 - wire supervised alarm initiating circuit.
3. Screw type terminals with numbered identification shall be provided for each "in-out" connections of the alarm circuit wiring.
4. Surface mount devices on a flush mounted outlet box, unless indicates otherwise on the drawings.
5. Auxiliary double throw spare relay contact shall be provided for activation of remote rated devices 120V-60Hz, AC - 1 Ampere minimum.
6. Initiating devices shall be reset and tested from the fire alarm control panel and shall not require local individual resetting or testing.
7. LED mounted on device, with continuous LED illumination and flashing LED illumination shall be used to differentiate between alarm/trouble conditions and normal operations
8. RF noise, lightning protection, and transient voltage filtering shall be provided internally in the device.
9. Detector Base
   a. Low profile fixed base, with "twist-lock" mounting for detection device "plug-in" connection and with fire alarm system wiring terminals. Tamper resistant lock/screw shall prevent unauthorized removal of the detector device from the base without the correct "tool/key".
   b. The plug-in base shall provide the network/multiplex unique identification address monitored by the fire alarm control panel, to prevent accidental mislocation of the device address in the event the detector device is removed and relocated as part of the fire alarm system repair/preventative maintenance.c. In addition to the detection device, the base shall provide for the addition of independent individually addressable fire alarm system modules integral to the base. The

modules shall be controllable by software programs from the fire alarm control panel. Operation of the modules shall be independent of the quantity of detectors and quantity of modules on the circuit or the quantity of devices in an alarm state. The modules shall provide the following function types:

1) Electromechanical relay for selective "on-off" contact switching of external electrical circuits, local to the respective initiating devices.
2) Audible fire evacuation alarm horn/buzzer device with not less than 85DB sound intensity measured at 10ft. horizontally from the unit.

10. The devices shall operate in ambient air environment as follows: Automatic "drift" compensation of sensitivity shall maintain sensitivity settings by automatically compensating for effects caused by outside environment and dirt contamination sources:
    a. Temperature Centigrade 0 degrees to 49 degrees
    b. Humidity 0 to 95 percent non-condensing
    c. Elevation sea level to 15,000 ft.

B. Smoke Detector

1. Detectors shall comply with U.L. standards 268, 167 and 168 (latest revisions) and shall use solid state electronic circuits throughout.
2. The smoke detector shall operate on a total of two circuit wires. Alarm signaling, communication and detector power shall use the same conductors.
3. Detector sensitivity shall be adjustable at the sensor and from the fire alarm control panel. A automatic circuit shall compensate for detector aging and dirt accumulation, the dirt/aging compensation shall be adjustable by software programming functions from the fire alarm control panel.
4. A fine mesh insect screen shall be provided on all detector openings.
5. The detector shall lock-in on alarm with local reset and fire alarm control panel remote reset. An electromechanical test feature shall provide functional testing of the unit without smoke.
6. Detection sensing methods:
    a. Photo electric type smoke detectors shall employ a light emitting diode (LED) as the detector light source, activated by the presence of combustion smoke products. Failure of the LED shall activate the alarm/trouble light on the detector.
    b. Ionization type smoke detector shall employ the triple chamber [dual chamber] ionization principle, activated by the presence of combustion products. The ionization chamber shall be RF shielded.
    c. The detector shall also incorporate a fixed temperature heat detector rated at 135 degrees F. The heat detector shall operate the alarm circuit and alarm/trouble light.
7. Plug-in "twist-lock" detector connection to a fixed mounting/connection detector base.
8. Area protection smoke detector, photo electric or ionization type, and with internal fixed temperature heat detector. Self contained inside a protective housing/cover. Suitable for open area coverage and for installation on a wall (vertical) locations, or on a ceiling (horizontal) installation locations.
9. Smoke detectors installed in HVAC air plenums, above ceiling or in floor spaces, shall be listed and approved for the actual installation location.

C. HVAC Air Duct Smoke Detector

1. Photo electric or ionization type for installation on a heating, ventilation, air conditioning (HVAC) air supply and air return air ducts. Two air tubes shall extend into the air duct. The sampling tube shall extend across the entire width of the air duct. The second tube shall provide for air to escape back into the duct from the detector.
2. Omit the fixed temperature heat detector requirements for air duct smoke detectors.
3. The "active" detector head portion of the air duct smoke detector shall mount with plug-in "twist-lock" detector connection to a fixed mounting/connection detector base.

4. Air duct detectors shall be selected and specifically approved and listed by the AHJ and the detector manufacturer for the actual install location:
   a. Access for service and repair
   b. Air duct, size
   c. Air duct, shape
   d. Air flow rates (speed) at installation location
   e. Distances and positions relative to other HVAC components (including, but not limited to, air inlets, air grills, fans, air filters, cooling/heating coils, air flow elbows, air flow/equipment noise silencers, dampers, etc.

D. Fire Detector - Heat
1. Heat detectors shall be dual action electro-thermostatic combination rate of temperature rise and fixed temperature operation. The detector shall automatically compensate for the thermal inertia of the detector.
2. The rate of rise element shall be self restoring, after activation.
3. The fixed temperature unit shall be set at 135 degrees F (190 degrees F for high temperature areas, i.e. areas over 110 degrees F ambient.)
4. Provide a wire guard cover for the detector.
5. Plug-in "twist-lock" detector connection to a fixed mounting/connection detector base.
6. Detectors shall be suitable for wall (vertical) location or ceiling (horizontal) installation location.

E. Fire Sprinkler Water Flow Detector.
1. Vane-type water flow detectors shall be provided on the sprinkler system piping. Detectors shall be designed for mounting on either vertical or horizontal piping, but shall not be installed in a pipe fitting and shall not be installed within 12 inches of any fitting or valve that changes or controls the direction of water flow.
2. The detectors shall have a sensitivity setting to signal any flow of water that equals or exceeds the discharge from one or more sprinkler head(s).
3. Detector switch mechanisms shall incorporate an instantly recycling pneumatic retard element with an adjustable range of 0 to 70 seconds. Switches shall have a minimum rated capacity of 7 ampere 125 volt A.C. - .25 ampere 24 volt D.C., a D.P.D.T. switch shall be actuated by a polyethylene vane extending into the waterway of the piping. The device cover shall incorporate a tamper detection switch, to detect removal of the cover. Removal of cover shall activate the switch and activate a trouble alarm. The trouble alarm shall be a separate zone from the respective water flow alarm.
4. Detectors shall be of weatherproof, water resistant, dust tight, tamper resistant construction and shall provide a 0.75- inch conduit entrance. Detector shall be finished in red baked enamel finish.
5. The water flow detector shall be suitable for "dry-pipe or wet-pipe" fire sprinkler systems shown in the Contract Documents. Where the fire sprinkler system is a "dry stand pipe" system and for fire sprinkler systems employing automatic "on and off" fire sprinklers, the water flow sensor shall also include "high and low" air pressure sensors. Each sensor shall provide not less than two activation set points, to indicate water flow is occurring in the fire sprinkler system.

F. Fire Sprinkler Valve Tamper Switch
1. Tamper switch shall monitor the position of the fire sprinkler shut-off valves. Operation of the valve shall activate the switch and activate a trouble alarm. The valve supervisory trouble alarm shall be a separate zone from the respective water flow alarm and water flow trouble alarm.

2.06 EVACUATION ALARM DEVICES

A. General

1. Evacuation alarm devices shall activate automatically from the control panel. Devices shall operate on a class "A", 4-wire supervised alarm evacuation circuit. Series wired alarm devices shall not be used.
2. Screw type terminals with numbered identification shall be provided for "in-out" connections of the alarm circuit wiring.
3. Devices shall be installed in a metal box, 3.9-inch deep maximum, flush mounting unless indicated otherwise on the drawings. Provide extension ring to increase the box depth, on the mounting box, if additional depth is required to accommodate the evacuation alarm device. Size as required for the audible alarm indicating device and wiring connections. Provide a trim ring and metal grill cover assembly. Cover assembly shall be minimum of 0.062 inch thick flat stainless steel or aluminum. Finish color of cover "red" unless selected otherwise by OWNER'S Representative. The word "FIRE" shall appear on the grill, minimum 0.5-inch high letters. The grill shall be screw attached to the box. The grill shall be square/rectangular shape for wall mounted evacuation devices and round for ceiling mounted evacuation alarm devices.
4. A visual alarm indicating device shall be an integral part of the audible alarm box cover assembly, for wall mounted and ceiling mounted devices. Each audible evacuation alarm device shall incorporate an integral visual alarm indicator unless indicated otherwise on the drawings.
5. Alarm initiating devices, audible evacuation alarm device and visual evacuation alarm devices shall each be connected to separate circuits and conductors. Do not connect these devices to the same circuit conductors. The separate audible evacuation circuits shall provide coded or non-coded audible signaling independent of the visual evacuation alarms.
6. The audio sound fire alarm evacuation system shall provide a sound intensity of not less than 20Dba above average ambient sound intensities, and 5 Dba above maximum ambient sound intensity occurring for 60 seconds. Ambient sound intensities shall be measured after the OWNER has occupied the building spaces. In no case shall the sound intensity of the evacuation devices be less than 90 Dba or greater than 120 Dba when measured 10ft. horizontally from the device.

B. Audible Evacuation Alarms

1. Vibrating horns:
   a. Vibrating type horns shall be provided where audible devices are shown on the drawings for the following areas: Building egress pathways, exterior of buildings, stairs, corridors, lobbies, reception areas, shops, exercise areas, areas exceeding 300 square feet, and all other areas not specifically listed or identified.
   b. Horn shall be heavy duty electro-magnetic vibrating type. Horns shall have field adjustable sound output level control.
   c. Horn shall provide a minimum sound level of 95 DB at 10 feet centerline distance, when installed in the field operating conditions shown on the drawings.
2. Mini-horns:
   a. Shall be used in rooms smaller than 300 square feet. Mini-horns shall not be used as a substitute where vibrating horns are required.
   b. Mini-horn shall be electric-piezo electronic.
   c. Mini-horn shall provide a minimum sound level of 87 DB/90 Dba at ten feet centerline distance, when installed in the field operating conditions shown on the drawings.
   d. "Residential" areas of the building shall be furnished with mini-horns.

C. Visual Evacuation Alarm Indicator

1. Lamp/Strobe internally illuminated projecting lens assembly, with flasher system. Unit shall flash on and off to provide visual indicating of fire alarm.
2. The word "FIRE" shall appear on the lens or lens plate. The lens shall project beyond the face of the cover assembly.
3. All visual evacuation alarm devices with a common evacuation alarm zone shall "flash" in full synchronized unison or in random pattern, software programmable from the fire alarm control panel. The synchronized visual evacuation alarm devices shall not "drift" out of synchronization at any time during operation.
4. The flash rate shall be software programmable from the fire alarm control panel for 1-3 flashes per second, with approximately 0.001 second flash duration.
5. Flash rate independent of audible device coded signal output.
6. Light source, Xenon high intensity flash strobe tube white/clear color.
7. 75 candela (cd) minimum, 180 candela maximum flash intensity, at 10 ft. distance along the direct line perpendicular axis viewing angle. The "Effective Intensity" of each flash shall not be less than 30 Candela from any viewing angle, but under any condition not less than required by AHJ. The flash intensity shall be "field" adjustable over the specified range.
8. Photosensitive induced epilepsy:
   Wherever three or more multiple visual evacuation alarm devices are visible from any single location, the devices shall be adjusted to reduce the risk of inducing photosensitive epilepsy seizure responses in susceptible people, using one or more of the following methods:
   a. Synchronizing the flash rate.
   b. Adjust the flash intensity.
   c. Adjust the physical location of the visual device.
   d. Devices installed closer than 55 feet distance "sight-line" together shall be synchronize flash rate.

D. Door Magnetic Hold-Open and Release-Close

1. Combination electromagnet and separate "pivot" type magnet armature latch. The mechanism shall "hold-open" and "release-close" the door from the open position to the closed position when electric power is interrupted to the "hold open" electromagnet. Door opening operation shall be unobstructed by the hold-open mechanism.
2. The "pivot" shall provide not less than 120 degree adjustment range hinged flat plate to align to the door leaf position when the door is open. Integral "pivot" mounting plate with threaded stainless steel through-bolt attachment to the door leaf. The pivot "armature" shall make "full face" contact with the magnet when the door is open and provide shock absorbing nylon "pivot" bearing. The length of the pivot assembly shall be selected to allow the respective door to be held in a 90-degree or greater open position.
3. The electromagnet shall create magnetic force when energized to retain the armature with a hold-open force of not less than 25-pounds, (111N) and suitable for continuous energized operation. Operating voltage shall match the respective electrical circuit connection. The electromagnet shall mount on and attach to surface or flush outlet box, "single-gang", wall mounted or floor mounted.

2.07 REMOTE EQUIPMENT MONITORING AND CONTROL (REMC)

A. General

1. Provide an electronic digital/network multiplex addressable REMC at each device or equipment indicated to be controlled or monitored by the fire alarm system.

2. Multiple, addressable monitoring and control points shall be provided in each REMC, quantity of points as required for each point controlled or monitored by the fire alarm system.
3. The REMC shall communicate the fire alarm initiation, evacuation alarm, monitor status, control actions and supervisory trouble conditions of each connected device with a unique address code.
4. Shall communicate with; be supervised by and monitored by the fire alarm control panel.
5. "Set-up" software programming instructions and controls, operator override functions and status annunciation display for REMC units shall originate from the fire alarm control panel.
6. Electronic digital, multiplex addressable module shall be incorporated into the REMC. The module shall communicate the status and trouble condition of each device with a unique address code. The module shall communicate with and be monitored controlled by the fire alarm control panel.
7. Circuits connecting from the REMC for devices external from the REMC shall be monitored and supervised by the fire alarm system. Supervisory trouble alarms shall be displayed by the fire alarm control panel.

B. Distributed Processing
1. In the event of a failure that results in the loss of operation of the fire alarm control panel or loss of fire alarm system network/multiplex communications, each REMC with distributed processing shall revert to local self contained operation, independent of the portions of the fire alarm system that are inoperative. The REMC shall continue to operate locally under the fire alarm system software program control for the alarm initiating zones, evacuation alarm zones and control zones connected to the respective REMC. The software program control shall be stored in non-volatile memory within the REMC.
2. Distributed processing shall be provided for each REMC with one (1) or more of the following functions connected to the REMC:
   a. More than five (5) fire alarm system controls and/or status monitoring points.
   b. Fire evacuation alarm zones.
   c. Fire alarm initiating zones.
3. Provide the REMC with CPU-microprocessor, memory, power supply and digital multiplex electronic systems similar to the fire alarm control panel. The REMC shall receive, regenerate and transmit fire alarm system communications data. The REMC shall process and function under the control of the fire alarm system software programs.

C. Monitor and Control Interface
1. Control interface:
   a. Each "REMC control function shall provide a minimum of (2) two independent addressable points, but not less than the quantity required to individually control each equipment item. Class-A or class-B supervised "dry" relay contact single pole double throw maintained contact inductive load rated 10 ampere, 120 volt, 60 HZ A.C. or D.C.
2. Monitor interface:
   a. Each REMC monitor function shall provide a minimum of (2) two independent addressable points, but not less than the quantity required to individually monitor each connected item. Each monitor point shall be not less than one of the following supervised methods of monitoring a remote device, equipment action or status, compatible with the external device connection to be monitored.
   b. "Dry" contact operation normal open, normally closed, maintained or momentary contact operation.
   c. Variable current 0 to 20ma.
   d. Variable voltage.

3. Each REMC with more than (5)-five monitor and/or control points shall be provided with (1)-one additional spare control point plus (1)-one additional spare monitor point, individual independent addressable, for future use.

D. Cabinet Housing
1. The REMC cabinet shall be self contained, tamper resistant construction and hinged locking door. NEMA 1 indoor areas, NEMA 3R for outdoor areas.
2. Provide tamper switch detection zone on the cabinet door, monitored by the fire alarm control panel.
3. Provide barriered, numbered terminal strips. Provide "fire alarm system" sign on door face.
4. Plug-in bus:
   a. REMC with distributed processing shall be expandable by inserting (plug-in) "bus" type interchangeable circuit board cards. Provide internal "plug-in" data bus for circuit cards.
   b. REMC with more than (5) five internal alarm/ monitoring/control points in any combination of ports shall be expandable by inserting (plug-in) "bus" type interchangeable circuit monitor/control printed circuit board cards. Provide internal "plug-in" data bus for circuit cards.
   c. REMC with "plug-in" data bus shall include a minimum of two (2) spare "plug-in" port locations for future circuit cards. Circuit cards shall be interchangeable with fire alarm control panel circuit board cards of the same function.
5. Finish and color shall match the fire alarm control panel.
6. Power supply:
   a. REMC units with five (5) or fewer ports shall obtain their operating supply power directly from the fire alarm control panel communications circuit.
   b. REMC units that do not receive their operating power from the fire alarm control panel, provide internal power supply, with 60 hour internal battery UPS backup and battery charging system. The REMC power supply and battery backup shall comply with the same criteria as described for the fire alarm control panel power supply system.

2.09 REMOTE FIRE ALARM ANNUNCIATOR - RFAP

A. General
1. The remote fire alarm annunciator panel shall be powered and operated from the fire alarm control panel. "In-out" circuit conductors shall terminate on numbered screw-type terminals.
2. A metal tamper resistant, weatherproof cabinet shall contain the annunciator components. Finish and color to match the fire alarm control panel. The panel shall be surface or flush mounting as indicated on the drawings. Provide a full height tamper resistant, hinged locking cabinet door. Door shall have transparent high impact windows to allow visual observation of all indicators and switches.
3. An electronic digital, multiplex, addressable module shall be incorporated into the annunciator. The module shall communicate the status and trouble condition of each device with a unique address code. The module shall communicate with and be supervised and monitored by the fire alarm control panel.
4. Provide internal power supply and battery backup, same requirements to match the fire alarm control panel power supply requirements.

B. Remote Fire Alarm Annunciator (RFAP)
1. Each alarm initiating zone (including spares) shall be individually annunciated in the annunciator panel.
   a. The remote fire alarm annunciator shall employ the same type method of annunciation as the respective fire alarm control panel.

2. A common fire trouble alarm shall be annunciated in the annunciator panel from each fire alarm control panel. The trouble annunciator shall match the alarm zone annunciator. Identification shall be marked "Fire Alarm System Trouble", 18 point letter size.
3. A separate trouble/supervisory alarm shall be annunciated in the annunciator, panel from the fire alarm control panel for each fire sprinkler water valve tamper switch. The trouble annunciator shall match the alarm zone annunciator. Identification shall be marked "sprinkler tamper switch trouble-(location". "Location" shall be the shut off valve location being monitored.
4. Annunciator, lamp/LED, display screen circuits shall be automatically supervised. Provide test switch in the annunciator panel.
5. A audible alarm/trouble buzzer with silence switch and automatic resound for subsequent alarm/trouble signals shall be provided. The annunciator panel shall be automatically reset when the fire alarm control panel is reset.
6. Provide a sign on each remote fire alarm annunciator. The sign shall describe the location of the fire alarm control panel(s) connected to the respective annunciator (i.e. Fire Alarm Control Panel (FACP) located in Art Bldg. 2nd floor, Room #226, etc.). Minimum size sign letters not less than 0.375-inch high, engraved plastic nameplate.

PART 3 - EXECUTION

3.01 FIRE ALARM SYSTEM CONFIGURATION

A. Fire Alarm System Survivability
1. The fire alarm system equipment, wiring/cables, alarm initiation, alarm evacuation and zoning shall be configured, supplied and installed so a single point failure and/or fire damage condition does not contribute to the disruption of the operation of the entire fire alarm system. The undamaged portions of the fire alarm system will continue to operate during a fire.
2. Separate and isolated routing paths through the building shall be provided for fire alarm circuits to avoid total loss of fire alarm system communications resulting from failure and/or fire damage, for both lateral/horizontal distribution communication paths on each floor and vertical riser communication paths in multi-story building.
3. Quantities and arrangements of components contained in fire alarm equipment shall assure no single individual component failure will cause a failure of the equipment to provide the continued operation of the fire alarm system.

3.02 IDENTIFICATION (ADDITIONAL REQUIREMENTS)

A. General
1. The inside cover of alarm initiating devices and communicating devices shall be marked with the zone initiating number communications identification address corresponding to the zone number in the respective control panel. Marking shall be with a felt-tip pen or permanent label.
2. The door(s) into the room or closet containing the Fire Alarm Control Panel shall be provided with a sign stating "FIRE ALARM CONTROL PANEL INSIDE". Minimum 1-inch high "block" letters, white letters on a red background. Fasten sign to exterior side of door with a minimum of 4-screws.
3. Provide an instruction placard sign installed at each FACP and RFAP for each fire alarm system connected to a Central Station monitoring Company system as follows:

"THE FIRE DEPARTMENT WILL RESPOND TO A FIRE ALARM SIGNAL."

Unless the following telephone number is called to cancel the alarm:

Fire Alarm Service Company By:	(*insert name*)
Telephone Number:	(*insert name*)
Supervising Central Station Company:	(*insert name*)
Telephone Number:	(*insert name*)

4. Provide an instruction placard sign with the following information:

"THIS EQUIPMENT IS CONNECTED TO THE BUILDING FIRE ALARM SYSTEM."

Automatic on-off operation and alarm monitoring is connected for operation with the fire alarm system."

a. Each security intrusion alarm control panel.
b. Each fire sprinkler pump controller.
c. Each standby engine generator.
d. Automatic Lighting Controller Panel
e. HVAC equipment monitored/controlled by the fire alarm system.

3.03 TESTING (Additional Requirements)

A. General

1. The entire fire alarm system shall be tested after the installation and software programming is complete.
2. Individually activate each manual initiating station and verify correct alarm operation and control panel response, and remote equipment operation.
3. Individually test each automatic initiating device and verify correct alarm operation, control panel response and remote equipment operation.
4. Provide pressure differential testing for each air duct smoke detector.
5. The fire alarm system installation and operation shall be verified by the Manufacturer's Representative and a written Manufacturer's verification certificate delivered to the OWNER'S Representative.
6. Individually operate each control function.
7. Test the battery back-up systems by disconnecting the incoming normal power and allowing the alarm system to operate 60 hours on battery power. Sound the alarm system for the specified reserve operation minutes at the end of 60 hours on battery power.

B. Documents and Performance

1. Perform all electrical and mechanical tests required by the equipment manufacturer's certification form. Measure and adjust each automatic detection detector to the maximum stable sensitivity setting. Detector tests shall be performed with the detector at its operational location and under normal operational environmental conditions in the area. Bench settings are not acceptable. An operational check-out test and report shall be performed. Submit six copies of test report results. The tests and report shall include, but not be limited to:
   a. A complete list of equipment installed and wired.
   b. Indication that all equipment is properly installed and functions and conforms with these specifications.
   c. Test of each individual zones as applicable.
   d. Serial numbers, locations by zone and model number for each installed detector.
   e. Voltage (sensitivity) settings for each ionization and photoelectric detector as measured in place with the HVAC system operating.
   f. Response time on thermostats and flame detectors (if used).

g. Technician's name, certificate number and date.
h. The completed manual and automatic monitoring and control system shall be tested to insure that it is operating properly. This test will consist of exposing the installed units to a standard fire test.

C. Acceptance Demonstration
1. Acceptance of the system shall also require a demonstration of the stability of the system. This shall be adequately demonstrated if the system operates continuously for a ninety (90) day test period without any unwarranted alarms. In the event an unwarranted alarm(s) occur, the CONTRACTOR shall repair, readjust or replace the defective equipment and detector(s) with new equipment and begin another ninety (90) day test period. The CONTRACTOR shall recheck the equipment and detectors using the fire test after each readjustment or replacement of equipment and/or detectors.
2. Testing verification cycle shall be continuously repeated until the system successfully completes the testing. The test period shall not start until the OWNER has obtained beneficial use of the building areas under tests.

3.04 WIRING (ADDITIONAL REQUIREMENTS)

A. General
1. Review the total system point-to-point wiring and cable layout. Provide the correct quantities and types of wires, cables, outlets and conduits/raceways to ensure the correct operation of the fire alarm system.
2. Final connections, testing, adjusting and calibration shall be made under the direct supervision of a factory-trained technician of the system supplier.
3. All wiring and cables shall be in conduits/raceways. All conduits/raceways shall be installed and concealed in walls, above ceilings and in floors.
4. All wiring and cables in cabinets shall be neatly formed and laced.
5. Wiring shall be made up onto bolt and nut terminal blocks. Tag all spares. All wire conductors shall terminate on terminal strips with "spade" "eyebolt" type lugs, of adequate size for respective incoming and outgoing conductors. The terminal strips shall be labeled as to their use and wiring diagram shall be placed on/inside the equipment showing connections of all related equipment to these strips.
6. Wiring requirements for shielding certain conductors from other conductors or routing of fire alarm circuits in separate isolated raceways, shall be as recommended by the manufacturer's documentation and AHJ.
7. The fire alarm circuits, location, quantities of raceways, circuit conductors and devices shown on the drawings is schematic. Provide all conduit, raceways, wiring, cables, devices and conductors per manufacturer's recommendations and as required by AHJ. Include all material and labor costs in the contract price for compliance with providing a complete and operable fire alarm system.
8. Wire and cable shall be type and size to insure installed circuit voltage drop and signal loss does not exceed manufacturer's recommendations, but in no case shall the voltage drop and/or signal loss exceed the values permitted by the AHJ, including allowances for spare capacity/devices.
9. Provide end of the line (EOL) circuit termination device on each wiring circuit, for the trouble supervisory monitoring of each circuit by the fire alarm system.
10. All fire alarm raceways/conduit shall be installed concealed in public areas. All conductors and cables shall be installed in raceways/conduits.
11. Conductors and Cable Types
    a. Conductors, wiring and cables used for fire alarm system circuits shall be AHJ and U.L. labeled and listed for fire alarm system applications. Isolated rated for 600 volts A.C. 60 Hz.

b. Raceways/conduits for installation of fire alarm circuits shall be metal for all locations installed above earth/grade. Metal conduits shall be EMT, RGS or IMC type. FMC and LTFMC conduits shall not be permitted for fire alarm system circuits.

B. Digital Multiplex Network Circuits

1. The conductors for digital, multiplex network and communication circuits shall be twisted insulated pairs, each twisted pair 100% metallic shielded, (4) four twisted pair multi-conductor jacketed cable, with a separate 100% metallic shield enclosing all conductors under the jacket, #16 AWG copper conductors minimum with a separate internal ground/drain conductor.
2. "Tees" and taps at any junction box location in the communication lines, shall be permitted by the system for connecting additional devices without affecting proper system operation.
3. Fiber optic cables, terminations and fiber optic to electrical couplers shall be U.L., AHJ listed for fire alarm system use, and as recommended by fire alarm manufacturer. Provide optical to electrical couplers at all fiber optic equipment connections. Provide additional electrical power supply circuit conductors in each conduit/raceway containing fiber optic cables to supply operating voltage and current to the respective fire alarm equipment.

C. Conductors for Non Digital Circuit

1. The minimum insulated conductor size for fire alarm non-digital evacuation alarm circuits, initiating circuits and control circuits shall be not less than #14 AWG (600 volt THHN/THWN) copper.
2. Conductors for evacuation alarm device circuits shall be insulated (600 volt THHN/THWN) stranded or solid copper conductors, quantity as recommended by fire alarm manufacturer.
3. Not more than a total of ten (10) visual evacuation alarm devices shall be installed on any respective single circuit "run" extending from the fire alarm control panel [or extending from an REMC], including "T" and "branch-tap" connections. Conductors smaller than #12AWG shall not be used for visual evacuation alarm device circuits. Conductors for visual alarm devices shall be independent of audio alarm circuit conductors:

Total Circuit Conductor Length	Minimum Wire Size
a. Up to 300 ft.	#12AWG
b. 301 thru 600 ft.	#10AWG
c. 601 thru 900 ft.	#8AWG
d. Between buildings and over 900 ft.	#6AWG

4. Not more than a total of ten (10) audio (non-voice) evacuation alarm devices shall be installed on any respective single circuit "run" extending from the fire alarm control panel [or extending from an REMC], including "T" and "branch-tap" connections. Conductors smaller than #12 AWG shall not be used for audio evacuation alarm device circuits:

Total Circuit Conductor Length	Minimum Wire Size
a. Up to 300 ft.	#12 AWG
b. 301 thru 600 ft.	#10 AWG
c. 601 thru 900 ft.	#8 AWG
d. Between Buildings and Over 900 ft.	#6 AWG

3.05 FACP, RFAP and REMC UNIT INSTALLATION

A. General
   1. The installation of the units shall be in weather-protected locations, accessible for maintenance and visual inspection. Flush wall mounted for locations visible to the public. Surface or flush wall mounted in electrical equipment spaces, mechanical equipment spaces and in accessible storage spaces. Not less than 48-inch clear working space in front of each unit.
   2. Provide fire alarm system circuit connections and line side electrical power connections. Provide unit digital multiplex and communications systems connections, to the fire alarm system. Provide conduit and wire connection of the status, monitoring and control ports to the respective external devices.
   3. Where multiple REMC units will be required in close physical proximity with other REMC units, the functions performed by the multiple REMC units may be combined into a single REMC with expanded capacity to perform all the described functions of the individual REMC units.
   4. Provide software programming of each unit from the fire alarm control panel, for each FACP, REMC and RFAP to perform its designated monitoring, alarm, control and status operations.

3.06 SPECIAL INSTALLATION REQUIREMENTS

A. General
   1. Whether or not shown on the fire alarm drawings, the following systems shall be provided as part of the contract. Provide fire alarm devices and connection of the systems to the fire alarm control panel including all material, labor and cost in the contract.
   2. Refer to Mechanical, Plumbing and Architectural drawings and contract documents for the location and quantity of these systems.

B. Fire sprinkler water flow detection and shut-off valve tamper switches:
   1. Provide a Remote Equipment Monitoring and Control module (REMC) located at each fire sprinkler water flow detector and fire sprinkler water valve tamper switch.
   2. Provide fire sprinkler water flow switches [and supervisory freeze monitoring] installed on each main fire sprinkler riser pipe, coordinate with the fire sprinkler contractor.
   3. Provide fire sprinkler water valve tamper switches installed on each main fire sprinkler shut-off valve, coordinate with the fire sprinkler contractor.
   4. Provide 0.75-inch conduit with 6#14 from the REMC to each fire sprinkler water flow switch and each respective fire sprinkler water valve tamper switch.
   5. Provide connection of REMC to the fire alarm multiplex control system with 0.75-inch conduit and digital multiplex conductors.
   6. Special Note: Where the fire sprinkler water flow switch detector has been furnished as part of Division-15000 work, provide a REMC and connect between the flow switch detector device and the fire alarm system, with the REMC. Omit the corresponding water flow detection, device shown as part of fire sprinkler water flow switch Division-16000 equipment requirement.

C. HVAC Air Duct Smoke Detector locations:
   1. Provide air duct smoke detectors in each supply air duct and return air duct with an air flow of 2000 CFM or greater. Fire alarm smoke detectors shall not be installed until after the final construction cleanup of all trades is completes and final job site. Coordinate with HVAC CONTRACTORS. Sampling tube shall extend across entire duct width.
   2. The air duct smoke detectors shall be provided on both the return and discharge sides of the air ducts of each unit.

3. Air duct smoke detectors shall be physically accessible for testing and maintenance after installation. Smoke detectors that are installed before final cleanup is complete by all trades shall be cleaned or replaced with new smoke detectors to match original smoke detector.
4. Install the air duct smoke detectors to provide the separation distance, recommended by the manufacturer, from obstructions in the air ducts causing non-uniform air flow patterns, including but not limited to the following:
   a. Elbows/bends in the air duct.
   b. Fan/blower air source.
   c. Air discharge or air intake louvers.
   d. Cooling/heating coils and humidifiers.
5. Provide additional air-flow control "vanes" inside air ducts and air duct length extensions, where air flow turbulence causes operation problems with the respective air duct smoke detectors. Coordinate installation with HVAC CONTRACTOR.
6. Prior to installation of smoke detectors in "air ducts", perform air flow velocity and air flow turbulence test measurements. The tests shall be conducted at each proposed smoke detector installation location in the respective air duct, with normal operational air flow velocities present in the air ducts. Provide individual differential air flow and air pressure test of each air duct smoke detector after installation is complete, to confirm correct operation.
7. The smoke detector type and installation location in the respective air duct shall comply with the manufacturer's recommendations to insure proper smoke detector operation. Adjust the smoke detector locations and provide smoke detectors with air velocity and air turbulence sensitivities compatible with respective air duct.
8. Air duct detectors malfunctioning or failing to function as a result of incorrect application or improper installation shall be removed. Provide proper air duct smoke detector locations and provide smoke detectors with air flow velocity and air turbulence sensitivities compatible with respective air duct.
9. Special Note: Where the airduct smoke detector has been furnished as part of Division-15000 work, provide a REMC and connect between the air duct smoke detector device and the fire alarm system, with the REMC. Omit the corresponding air duct smoke detector device shown as part of Division-16000 equipment requirement.

D. HVAC Equipment Motor Controller Connections
1. Provide a Remote Equipment Monitoring and Control (REMC) module for each HVAC equipment unit controlled and/or monitored by the fire alarm system. Install the REMC at the respective motor control (magnetic motor starter or variable speed drive controller as applicable) unit. Where multiple motor controllers are present in close proximity to each other and require fire alarm system control/monitoring provide additional addressable control and monitoring points in the same REMC for each additional motor controller.
2. Provide connection for status monitoring (run-off) from the REMC to the motor controller auxiliary relay contacts.
3. Provide connection for automatic air flow "shut-down" interlock, upon:
   a. Detection of smoke by the respective HVAC air duct smoke detector and/or area protection smoke detectors, provide connection from the REMC to the motor controller.
   b. Upon detection of a closed HVAC air duct smoke damper or HVAC air duct fire damper, provide connection from REMC to the motor controller.
4. Provide software programming of the REMC from the fire alarm control panel to shut down the respective motor controller and all additional airflow control motors, upon fire alarm detection condition in the building, as required by the Fire Marshal.
5. Provide 0.75-inch conduit with 6#14 from the REMC to respective motor control unit; for monitoring/control circuits, typical for each motor controller.

6. Provide connection of the REMC to the fire alarm multiplex control system with 0.75-inch minimum conduit and digital multiplex conductors.
7. Electrical power to operate the power supply in the REMC shall be obtained from the respective motor controller "non-switched" control power source. Provide 0.5-inch conduit with 3#12 (AWG) from the REMC to the respective motor controller. Provide 120 volt 60HZ AC (secondary side) control power transformer (CPT) to transform the motor controller line side electric source to REMC conditioned operating power.

E. Automatic Fire/Smoke Doors/Hatches/Closures and Hold Opens
1. Provide a Remote Equipment Monitoring and Control module (REMC) located at each automatic fire/smoke door and hatch containing internal or external automatic closures and/or hold open devices for fire and/or smoke.
2. Provide connection from the REMC to the respective door or hatch fire/smoke detection system and automatic "close" circuits. The REMC shall monitor and report the door/hatch automatic detection of smoke/fire. The REMC shall provide activation of the door/hatch automatic closure mechanism upon respective fire alarm detection condition in the building, with software programming from the fire alarm control panel.
3. Provide 0.75-inch conduit 6#14 (AWG) from the REMC to the respective door/hatch system controls and hold open devices.
4. Provide connection of the REMC to the fire alarm multiplex control system with 0.75-inch minimum conduit and digital multiplex conductors.
5. Provide 0.75-inch conduit with 2#10 homerun to the fire alarm control panel from each door/hatch location, for 24 volt D.C. or 120 volt 60 Hz A.C. control power for the door hold open/closing system.
6. Provide connection to the fire alarm control panel, of each fire/smoke rated door/hatch and damper with self-contained fire/smoke detection, hold open or closure devices.
7. Provide automatic smoke detectors installed within three (3) feet of each side of a fire/smoke rated door/hatch and damper. Provide magnetic release hold open devices for each door/hatch. Provide connection to the fire alarm control panel.
8. Provide door magnetic hold-open and release-close device for each fire door shown on the contract drawings.
9. Special Note: Where the fire/smoke door hold open/auto close and smoke detector mechanisms have been specified and furnished as part of the self contained door assembly, provide a REMC and connect between the fire/smoke door self contained assembly and the fire alarm system, with the REMC. Omit the door corresponding smoke detector devices and magnetic door hold open device shown as part of Division-16000 equipment requirements.

F. HVAC Fire/Smoke Air Duct Air Dampers
1. Provide a remote equipment monitoring and control module (REMC) located at each building space/room protected by fire/smoke air dampers.
2. Provide connection from the REMC to each fire/smoke air damper for the respective building space/room. The REMC shall provide activation of the respective dampers open/close mechanism. The REMC shall monitor the open-close position limit switch of each damper.
3. Provide 0.75-inch conduit with 6#14 from the REMC to each respective fire/smoke air damper.
4. Provide connection of the REMC to the fire alarm multiplex control system with 0.75-inch minimum conduit and digital multiplex conductors.
5. Each room with HV/AC air supply and/or air return air ducts passing through one or more fire/smoke air dampers shall be provided with automatic smoke detector protection. The smoke detectors shall open and/or close the respective room Fire/Smoke dampers when smoke is detected by the room automatic smoke detector and activate the fire alarm control panel.

6. Provide automatic air duct smoke detectors or automatic area protection automatic smoke detectors, for fire/smoke air dampers, based on the requirements of Condition #1 or Condition #2 as follows:
   a. Condition #1 - Where all the following criteria are true for the respective room, provide air duct smoke detectors in each HV/AC air duct connecting to the room:
      1) All the fire/smoke dampers for the room are located in HV/AC air ducts for the respective room.
      2) All the air ducts exceed a cross sectional area of 64 square inches.
      3) The minimum and maximum air flow velocity (feet per minute) during HV/AC operation, in all the air ducts complies with the requirements of the air duct smoke detector manufacturer's recommendations.
      4) The separation distance between the fire/smoke damper in each air duct and any air discharge louver, any elbow/bend in the air duct and any fan/blower, air flow restriction, etc. is greater than the minimum installation distance requirements of the air duct smoke detector manufacturer's recommendations.
   b. Condition #2 - Where any of the criteria in Condition #1 are not true, provide full coverage area protection automatic smoke detectors in the respective room.
7. Provide power and control connections to the fire/smoke dampers, and respective fire/smoke damper smoke detectors. Connect all components to the REMC.
8. Connection of fire/smoke air dampers shall comply with the damper manufacturer's recommendations, to insure proper damper and fire alarm system operation.
9. HVAC air duct differential pressure sensor:
   a. Provide a Remote Equipment Monitoring and Control (REMC) unit located at each of the devices and equipment locations described in the paragraphs below.
   b. The REMC shall monitor the individual status of each of the HVAC air duct differential pressure sensors associated with each respective HVAC air duct fire damper and smoke damper. The fire alarm system shall automatically shut down (turn-off) after adjustable time-delay, the motor controller of the respective HVAC fan equipment, when the respective damper is in the closed position, as indicated by the differential pressure switch.
   c. The REMC shall also monitor the individual status of each HVAC air duct fire damper and smoke damper to detect when the damper is in the closed position. The fire alarm system shall automatically close, after adjustable time delay, the dampers when the respective HVAC fan unit is not operating (running), as indicated by the differential pressure switch and the HVAC fan unit motor controller.
   d. Provide separate individual 0.75-inch conduits with 4#14 (AWG)from the REMC to each HVAC air duct pressure differential sensor, air damper and fan motor controller associated with each fire damper and/or smoke damper. Provide connection of the REMC's to the fire alarm system with 0.75-inch minimum conduit and digital multiplex communications conductors.

G. Security System Egress Path Door Unlocking
   1. Provide a remote equipment monitoring and control module (REMC) located at each building security system control unit/panel.
   2. Provide connection from the REMC to the security system control panel, upon fire alarm system evacuation alarm condition, to unlock all autolocking egress exit path doors controlled by the security system.
   3. Provide software programming of the REMC from the fire alarm control panel to unlock the respective doors.
   4. Provide 0.5-inch conduit with 3#14 (AWG) from the REMC to respective security panel.
   5. Provide connection of the REMC to the fire alarm multiplex control system with 0.75-inch conduit and digital multiplex communications conductors.

6. Coordinate with the security system supplier and provide the connection interfaces required for the REMC to communicate the fire alarm system function commands with the security system equipment.

H. Emergency Lighting Fire Alarm Automatic Operation Interface
1. Provide a remote equipment monitoring and control module (REMC) located at each emergency egress lighting building dimming system control and emergency lighting control location.
2. Provide connection from the REMC to the respective emergency lighting switch/dimmer system control panel, upon fire alarm system evacuation alarm condition, to automatically turn on to full intensity all emergency egress lighting connected to the respective switch/dimmer system.
3. Provide software programming of the REMC from the fire alarm control panel to turn the emergency lighting to full-on intensity, during a fire evacuation alarm event.
4. Provide 0.5-inch conduit with 3#14 (AWG) from the REMC to respective lighting control system.
5. Provide connection of the REMC to the fire alarm multiplex control system with 0.75-inch conduit and digital multiplex communications conductors.

I. Area Protection Automatic Smoke Detectors and Heat Detectors
1. Area protection smoke detectors and heat detectors shall be ceiling mounted unless noted otherwise on the drawings. Smoke detectors that are installed before final job site cleanup is complete by all trades shall be cleaned or replaced with new smoke detectors to match original smoke detectors.
2. Provide detector quantities to insure a minimum of one automatic detector for each 600 [900] square feet of area, (and fraction thereof) for each building space where smoke detectors are required by the AHJ. In no case shall detector spacing exceed manufacturer's or AHJ maximum recommendations/limits.
3. Provide detector quantities to insure the centerline to centerline spacing of installed detectors does not exceed 20 [30] feet in the protected area.
4. Locate area protection detectors a minimum of 48 inches horizontal distance from any air transfer grill/vent, air intake grill/vent and air discharge grill/vent.
5. Provide connection of automatic initiating devices to the fire alarm multiplex control system with 0.75-inch conduit and digital multiplex communications conductors.

J. Engine Generator Monitoring and Control
1. Provide a remote equipment monitoring and control module (REMC) located at each engine generator location.
2. Provide connection from the REMC to the engine generator control panel, fire alarm system monitoring and control of each engine generator "run-stop-fail" status and "run-off" control conditions.
3. Provide software programming of the REMC from the fire alarm control panel to monitor and control the respective engine generator.
4. Provide 0.75-inch conduit with 8#14 (AWG) from the REMC to respective engine generator control panel.
5. Provide connection of the REMC to the fire alarm multiplex control system with 0.75-inch conduit and digital multiplex communications conductors.

K. Manual Override Monitoring
1. Engine controls, motor controllers and motor starters with interface connections/controls to the fire alarm system shall provide auxiliary relay/contacts to automatically show "manual-override" monitor/supervisions. A trouble condition shall be automatically detected and reported to the fire alarm control panel if a "manual-override" conditions occurs in the respective engine controls, motor controller and/or motor starter. Each condition shall be a separate trouble alarm zone. Typical override

examples requiring Fire alarm "trouble" supervision, including but not limited to the following locations:

a. "HOA" motor controllers and engine controllers set to "hand/run", or "off" positions instead of being in the "automatic" position.
b. Unit normal operating speed, override controls (such as variable speed motor drive controllers).
c. HVAC variable air volume setpoint, overrides.
d. Line side electrical power supply disconnects in "off/tripped" condition instead of "on" condition.
e. Overload automatic "trip/shutdown" conditions.

2. Equipment types requiring manual override monitoring by fire alarm trouble zones, including but not limited to the following:
   a. Fire sprinkler pump controller.
   b. HVAC air supply and air exhaust equipment motor controllers.
   c. Standby emergency engine generators.
   d. Elevator controllers.
   e. HVAC fire/smoke and air regulation damper operators and damper motor controllers.
3. Provide each respective fire alarm system REMC with sufficient additional monitoring input ports for each of the trouble condition zones. Connect the REMC trouble monitoring ports with conduit and wire 0.5-inch 4#14 AWG for each respective monitor point location. (Note: At locations where a REMC is not available to provide connections for the Manual Override Monitoring, extend the connections directly to the fire alarm control panel from each monitoring point and increase conduit and wire to 0.75-inch with 4#12 AWG for each monitor point location).
4. Provide connection of the REMC to the fire alarm multiplex control system with 0.75-inch conduit and digital multiplex communication conductors.

L. Concealed fire alarm device remote auxiliary status annunciator/test station.
1. Provide remote location status annunciator with device testing control switch, for each fire alarm system alarm initiating device that is concealed from direct visual observation or is not readily accessible; including but not limited to the following fire alarm initiating device and/or HVAC control device:
   a. HVAC air duct smoke detectors located above ceilings or other non-accessible locations.
   b. HVAC air duct smoke/fire dampers that are electrically operated, located above ceilings or other non-accessible areas.
2. Each remote auxiliary status annunciator test station shall provide "LED" visual annunciators to indicate device "alarm/trouble" (or damper "open/close" as applicable), operational "power" status and key-operated "test" – "normal" selector switch. Turning the selector switch to "test" shall initiate "alarm" testing operation, returning selector switch to "normal" shall reset normal operating mode.
3. Provide aluminum or stainless steel coverplate for each station. Engrave cover plate with the described functions plus the remote device identification, zone number and approximate remote device location description.
4. Station outlet box, flush wall mount outlet box with "plaster-extension ring" [or surface wall mount in existing walls] device outlet box. Install □ 42-inches above finish floor in a readily observable area acceptable to the AHJ and locate within 25 ft. of respective fire alarm system device location.
5. Provide 0.75-inch conduit with 6#14 (AWG) from the remote station to respective fire alarm system device. Provide auxiliary relays at each fire alarm system device for operation of the respective internal status annunciator test switch at each remote station.

3.07 OUTLET BOXES (ADDITIONAL REQUIREMENTS)

A. Device outlet boxes shall be flush mounted unless indicated otherwise on the drawings. Provide extension rings to finish flush with finish surface. Where the drawings indicate surface mounted devices, outlet boxes shall be cast metal with threaded hubs. Where the conduit entrances are not exposed for surface mounted devices, provide flush outlet box behind the device box and omit the conduit hubs on the device box.

B. Size device boxes and outlet boxes per manufacturers recommendation and as required by building code for wire fill and construction.

C. Outlet boxes shall be listed and approved for fire alarm system use by AHJ and U.L.

3.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace any fire alarm component devices or any hardware that is part of the system or devices that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 4 years from date of substantial completion.

END OF SECTION

SECTION 16728
ELECTRONIC INTRUSION SYSTEMS - EIS

PART 1 – GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other specifications sections and drawings for related work required to be included as work under Division Sixteen.
   2. General provisions and requirements for electrical work.

B. Electronic Intrusion Systems
   1. Provide complete infrastructure pathways and wiring, power supplies, equipment, outlet boxes, sensors and devices, software, testing, setup, instructions to OWNER and commissioning:
      a. Electronic personnel/staff intrusion identification monitoring.
      b. Electronic access control, monitoring and identification

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Drawings Submittals
   1. Drawings shall be submitted on reproducible bond paper and AutoCAD® Version 2.2 (or later revision) data files on CD-ROM/DVD disk, WINDOWS®-XP/VISTA/Windows-7.
   2. Submit redrawn building floor plan for each building area, same scale as the contract drawing.
   3. Plans shall show walls, doors, windows, furniture, infrastructure, outlets and network systems equipment locations. Show point-to-point interconnecting cables, pathways, conduit, conduit sizes, circuit types, along with circuit identification names, numbers and quantities between all components. Show equipment, devices, sensors.
   4. Provide scaled elevation drawings of each equipment cabinet/rack, terminal blocks, terminal backboard and terminal room/closet showing location and arrangement of each equipment component, outlet and cable training provisions, with estimated weight of each complete assembly.
   5. Submit block wiring diagrams showing major system components, outlets, equipment cabinet/racks, terminal blocks, signal loss with interconnecting circuit conductors, splices, portable patch cords and connectors. Riser type diagram shall be provided if the building has more than one floor level, with information shown on riser diagram corresponding for each respective floor.

B. Submit manufacturer's standard catalog data for each component. The submittal shall be arranged in the order of the Specification and shall list the specification paragraph number, the name, the proposed model and manufacturer for each item as well as a reference indicating the specific piece of data which can be easily located in the brochure. The manufacturer's data sheets shall be marked to indicate the specific item being proposed in cases where the sheet covers several types or sizes of items. The data sheet shall completely describe the proposed item. Where modification to the equipment is necessary to meet the operational requirements of the contract documents, the brochure shall include complete mechanical and electrical shop drawings, detailing the modification. The brochure shall include a listing of the outlet rough-in requirements for every device and equipment

item. The applicable symbol which illustrates that rough-in item on the job plans shall be drawn on the proposal, opposite the description of the rough-in to facilitate locating the data by field personnel. Submit elevation and dimensional information.

C. Engineering and Drawings

Contractor shall provide the system devices submittals, device location drawings, as-built drawings, Operational and Maintenance Manuals, security system engineering and system hardware programming.

1. Device Submittals:
   a. Manufacturer product specification documentation.
2. Device Location Drawings:
   a. Printed and electronic drawings of device locations shall be provided by Contractor to the County.
3. As-built Drawings:
   a. Printed and electronic drawings showing device locations after project completion on a floor plan shall be provided by Contractor to the County.
4. Operational and Maintenance Manuals:
   a. End user reference guides for the installed system.
5. Security System Engineering:
   a. System design to ensure a fully functional security system shall be provided by Contractor.
6. System Hardware Programming:
   a. Configuration of the system hardware including the County naming convention and basic access level setup shall be provided by Contractor.

D. Provide proposed nameplate and outlet identification/color coding system. Indicate proposed identification naming sequence and methods, itemized for review.

E. Submit manufacturer certified test reports showing test documentation for the proposed material that the material meets or exceeds the performance standards defined in the contract documents. The testing and results shall reflect worst case performance based on a minimum of ten samples. Tests shall be certified by a Nationally recognized independent test lab (i.e., ETL, UL, etc.). The manufacturer shall certify in writing the material has been manufactured and tested to comply with the requirements defined in the contract documents.

1.03 QUALITY ASSURANCE (ADDITIONAL REQUIREMENTS)

A. General
   1. Work and material shall comply with latest revisions of the Standards and Approvals.

B. Standards and Approvals
   1. ASTM International:
      a. ASTM A574: Specification for Alloy Steel Socket-Head Cap Screws.
      b. ASTM A 574M: Specification for Alloy Steel Socket-Head Cap Screws [metric].
      c. ASTM F 835: Specification for Alloy Steel Socket Button and Flat Countersunk Head Cap Screws.
      d. ASTM F 835M: Specification for Alloy Steel Socket Button and Flat Countersunk Head Cap Screws [Metric].
      e. ASTM F 837M: Specification for Stainless Steel Socket Head Cap screws.
      f. ASTM F 837: Specification for Stainless Steel Head Cap Screws [Metric].
      g. ASTM F 879: Specification for Stainless Steel Socket Button and Flat Countersunk Head Cap Screws.
      h. ASTM F 879M: Specification for Stainless Steel Socket Button and Flat Countersunk Head Cap Screws [Metric].

i. : Specification for Cadmium or Zinc Chromate Organic Corrosion Protective Coating for Fasteners.

j. ASTM F 1137: Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.

2. Code of Federal Regulations:
   a. 29 CFR – Labor, chapter XVII – Occupational Safety and Health Administration, Department of Labor, Part 1910 – "Occupational Safety and Health Standards", Subpart A – "General," Section 1910.7 – "Definition and Requirements for a Nationally Recognized Testing Laboratory." 2001.
   b. 47 CFR – Telecommunications, Chapter I – Federal Communications Commission, Part 15 – "Radio Frequency Devices." 2001.
3. Electronic Industries Alliance:
   a. EIA 170: Electrical Performance Standards – Monochrome Television Studio Facilities.
   b. EIA 310: Racks, Panels, and Associated Equipment (ANSI).
4. National Electrical Manufacturers Association
   a. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).
5. NFPA International:
   a. NFPA 70: National Electrical Code.
   b. NFPA 72: National Fire Alarm Code.
   c. NFPA 731: Installation of Electronic Premises Security Systems
6. Underwriters Laboratories Inc.:
   a. UL 294: Access Control System Units.
   b. UL 639: Intrusion Detection Units.
   c. UL 1610: Central-Station Burglar-Alarm Units.
   d. UL 1638: Visual Signaling Appliances – Private Mode Emergency and General Utility Signaling.
7. CEC – California Electrical Code
8. The equipment shall be UL listed, labeled, and approved for the application shown in the contract documents.

1.04 EQUIPMENT QUALIFICATIONS

A. The supplier of the equipment shall be the factory authorized distributor and service facility for the brands of equipment and material provided.

B. Installation Certification
   1. Work and material for intrusion systems shall be performed by certified installers. The installer shall be certified by the respective product manufacturers.
   2. The manufacturers of the indicated work and material, shall provide a installer education/training and certification program for the supplied products.
   3. The installers performing the Contract work for the indicated products, shall have attended and successfully completed each of the respective manufacturer's installation training education programs for the specified products.
   4. Submit six (6) copies of the manufacturer's certifications for each installer performing the work. The submittal shall be approved by the OWNER'S REPRESENTATIVE prior to initiating any related contract work.

1.05 MATERIALS AND METHODS

A. Material and labor not complying with the contract documents shall be removed by the CONTRACTOR from the project site. Material and labor complying the contract documents shall be provided.

B. All the cost to remove deficient work and material, provide work and material complying with the contract documents and the direct, indirect, incidental damages and contract

delays resulting from complying with these requirements shall be the sole responsibility of the CONTRACTOR and shall be included in the bid price.

PART 2 - PRODUCTS

2.01 Operation

A. General

1. The Electronic Intrusion Monitoring System and Electronic Access Control System shall automatically provide selected electronic intrusion monitoring and selected electronic access control at the monitored locations described in the contract documents. All components and circuits shall also be continuously electronically supervised to detect and indicate system trouble and system faults. Integrated as a complete and operational system:
2. Electronic Intrusion Monitoring Personnel and Staff
   a. Electronic intrusion monitoring system functions shall automatically individually identify, display and alarm position status; when each of the monitored access locations is completely or partially "open". Shall also automatically monitor, display and indicate the status of location when the access location is completely physically "closed" or "open" shall also monitor display and indicate when a monitor point has been detected as a trespass violation.
3. Electronic Access Control:
   a. The electronic access control system functions shall provide remote and local automatic selected active "locking" and "unlocking" of each electrically operated access control electrified mechanisms and hardware.
   b. The access control system and the respective control hardware/mechanisms shall be electrically and mechanically compatible with each other. See "door" and "hardware" contract document requirements.
   c. The access control system functions shall also provide and include electronic intrusion monitoring systems functions.
4. Personnel Access Identification Station Readers (PAISR), shall identify the person entering/ transitioning through a specific intrusion/access control location.
5. Each equipment item, device, sensor, reader, access location, etc., shall be assigned a unique electronic digital-address. The digital-address shall function as the method to assign point alpha-numeric identification, system software status, alarm, supervisory trouble, control and reporting, for both the equipment and software monitoring and action-response programmed operations performed by the system.
6. Provide central station monitoring and supervision of the electronic intrusion systems:
   a. Locally on the site/campus locations.
   b. Remote off-site locations.
7. Provide outlet boxes, conduits, circuits/conductors, terminals connections. All circuits and conductors shall be installed in conduit and enclosed raceways end-to-end. No exposed circuits/conductors shall be permitted.
8. The access control system shall utilize the Orange County's existing access control system (Lenel series ON Guard 2008 Version 6.0.148) and WAN network. The Lenel database is centrally managed by the County at 1143 East Fruit Street, Santa Ana. The County uses 26-bit wiegand format ID cards.
   a. Shall provide all access control related hardware including, but not limited to, access panels, reader modules, input/output panels, alarm panels, wireless door receivers and openers, proximity readers, diodes for door supervision, request to exit door contacts, various types of electrified door locking hardware, power supplies, wiring and incidental materials.'
   b. Shall provide a project manager to manage the entire access control project including, but not limited to, access control hardware, hardware/software programming, wiring, electrified door hardware, electrical, testing and documentation.

c. Shall provide software engineering resources to support custom database design. Engineering resources shall be experienced with OnGuard Forms Designer, Data Exchange and Microsoft SQL 2005 database administration.

d. Shall be certified on the latest OnGuard software release and provide documentation for the following certification levels:

1) (2) Lenel MASTER certified technicians

2) (2) Lenel SILVER certified (or better) technicians

2.02 INTRUSION, MONITORING AND CONTROL EQUIPMENT CABINETS - IMCEC

A. General

1. The intrusion monitoring control equipment cabinets shall contain the input/output modules, analog and digital communication ports, operational electronics, software, conductor terminals and power supplies. the modules shall provide operation of the intrusion monitoring equipment, [and access control] devices and circuits connecting to the respective equipment cabinets.

2. IMCEC cabinets consist of the following main types:

a. Type 1, master-site/campus IMCEC cabinet, one or more locations on the Campus site. The entire Electronic Intrusion System shall interconnect to all of the onsite building Master-IMCEC cabinets.

b. Type 2, Building Master-IMCEC cabinet, one cabinet in each building, where the entire building Electronic Intrusion System interconnects to all of the respective building Sub-IMCEC cabinets.

c. Type 3, Building Sub-IMCEC cabinets, multiple IMCEC cabinet locations in the same building. Intrusion devices, sensors and equipment in the building connect to their respective Sub-IMCEC cabinets. The Sub-IMCEC cabinets shall all connect to the respective Building Master-IMCEC cabinet.

3. NEMA 1 wall mount indoor location enclosed metal cabinets, with hinged locking front access doors. Internal tamper switches to monitor and indicate attempted tamper/fault conditions. Manufacturer's standard finish color paint.

B. Communications and Control Modules

1. Provide multiple interface modules in the intrusion monitoring, control equipment cabinets. The modules shall provide integrated supervision, communications and control with the system sensors, devices and equipment connections to the control equipment cabinets, including but not limited to:

a. Personnel stations/readers

b. Detection devices and sensors

c. Access control devices and locks

2. Communications modules shall be multiport connection compatible. Bi-directional input/output communications ports for each connecting remote equipment item. Digital or analog communications ports and protocols, as applicable. Provide communications signal conditioning, infrastructure media conversion and protocol translation, to ensure integrated system end-to-end universal compatibility and function.

3. Communications modules shall provide communications power supplies, ports and protocols compatibility for monitoring, status and control functions for remote equipment connections, devices, sensors, readers, etc.:

a. Supervisory fault/no-fault monitoring of the circuit, conductors connections to each output/input port.

b. Monitor remote sensor/device contact open-close status condition and supervisory tamper monitoring.

c. Supply operational power supply, lock/unlock control and supervisory tamper monitoring for electrically operated electrified "lock" mechanism hardware.

d. Supply operational power supply, alarm/safety status condition and supervisory tamper monitoring, typical for occupancy sensors and devices.

e. Supply operational power supply, alarm/safe status condition and supervisory monitoring. Provide digital communications protocol compatible Ethernet-LAN or serial RS-485 including device for password coded keypads and personnel pass readers.

4. The modules shall be integrated into a communication digital electronic, plug-in multi-pin, common backplane, inside the equipment cabinets.
5. The modules shall plug in to the Master Interface Controller in each respective cabinet.
6. Provide 10% spare communications ports for each protocol, but in no case provide not less than two spare ports for future use, on each module.

C. Master Interface Controller

1. Provide a master interface controller in each intrusion monitoring control equipment cabinet. The master interface controller shall provide integrated communications with the individual plug-in. Communications and Control Interface Modules in the respective equipment cabinet and with the building and remote location campus/site wide Electronic Intrusion System.
2. Communications protocol between the internal master interface controller and the multiple internal interface modules in the same cabinet shall be one or more of the following digital infrastructures:
   a. Serial RS-485, bi-directional
   b. Ethernet-LAN, TCP/IP full duplex
3. Communications protocol between the master interface controller and the remote location building and campus/site wide Electronic Intrusion System shall be digital:
   a. Ethernet-LAN, TCP/IP full duplex, with fiber optic transceiver, dedicated infrastructure for the Electronic Intrusion Monitoring System

D. Each Electronic Intrusion Monitoring System equipment cabinet shall provide two methods of operation:

1. Method #1: Self-contained standalone, independent distributed intelligence, central processing unit CPU and memory, program/software operation. Automatic, self-contained standalone operation shall occur, in the event of a partial or total Electronic Intrusion System communication-LAN network failure or master control equipment failure.
2. Method #2: Electronic Intrusion System integrated communication-LAN network operation, with all of the other system equipment cabinets and with the EIS system supervisory computers.
3. Additionally, a local system supervisory computers shall not be required to be operational for the Electronic Intrusion System to function correctly. The County existing central station Lenel-ON Guard 2008 system and supervisory computers shall function as terminals or windows into the local EIS system and for set-up and operational programming of the local EIS system.

E. Electronic Access Control and Monitoring

1. Provide all electronic access control related hardware:
   a. Substitution to any hardware must be pre-approved by the County of Orange access control supervisor, Ray O'Grady (714) 667-4915.
2. Lenel series LNL-2220, Intelligent Dual Reader Controller.
3. Lenel series LNL-CTX-6, enclosure with lock and tamper switch (18" x 24" x 4.5").
4. Power:
   a. Altronix series AL600ULM, UL listed 12 or 24 VDC selectable boxed power supply; 6 amp, 5 individual outputs; fire alarm interface; built-in battery charger.
   b. Elk series ELK 1270, rechargeable sealed lead acid battery; 12 VDC 8 amp hour.
5. Proximity Readers:

a. HID series RP40 (6125BKN000-PNONE), HID multiCLASS Reader single gang black.

6. Electronic Door Hardware:
   a. Schlage series D80 RHO EU 24 volts DC with Request to Exit (REX), electrified lock with built-in Request to Exit (REX) function.
   b. See hardware and door contract documents, for additional requirements.
7. Command Access series, hinge with monitor switch ETM 4 wire (BB) with 4' lead electrified transfer hinge with monitor switch (door contact).

2.03 PERSONNEL ACCESS IDENTIFICATION STATION READER (PAISR) DEVICES

A. General
1. The PAISR devices shall communicate with the respective IMCEC cabinet, using a digitally encoded data signal, between the PAISR location and the IMCEC location.
2. Shall provide communications link over four (4) pairs of #18 gauge shielded copper conductors, NOT LESS THAN 500 feet pathway communications distance between the PAISR and remote IMCEC locations.
3. Internal tamper switch to monitor and indicate attempted PAISR tamper/fault/missing supervisory conditions.
4. Audible "beep" and visual LED to indicate successful activation of the respective PAISR devices.
5. Impact resistant, waterproof, dust-tight vandal-resistant and tamper-resistant metal housing. JAMB/Frame surface mount narrow housing, for door locations with limited on no install location. Semi-flush mount housing and flush wall mount outlet box for other locations with adequate space.
6. Low voltage CEC/NEC Class-2 power limited using the communication and power link #18 gauge conductors pair.
7. Operating ambients:
   a. Temperature minus 20 to plus 60 degrees centigrade, outdoor locations; 0 to plus 40 degrees centigrade, indoor locations.
   b. Humidity, 0% to 95% non-condensing.
8. Electrical operating power shall originate from the remote wired communications link. Internal power operating batteries shall not be required, unless specifically indicated otherwise, in the contract documents.

2.04 SENSORS DEVICES

A. General
1. Install locations:
   a. Install locations with glass surrounds surface mount device housing on the door vertical jamb/mullion.
   b. Install locations where glass surround is not present, flush mount device and outlet box within 6" of the vertical jamb/mullion.

B. Magnetic Sensor (open-close)
1. The sensor shall operate to indicate when the monitored building element is in an open or in a closed position (i.e., door open/door closed, window open/window closed.
2. Shall be resistant, polarity insensitive to external/internal magnetic defeat tampering. Comply with UL-634, Level-2 high security standards for magnetic contacts and sensors.
3. Resistant to high voltage discharge and transient surge, contact weld failure.
4. Operating gap distance 0.0" to 0.25", set gap at not more than 0.125", for high security standards compliance.
5. Closed loop and open loop alarm/monitor circuit compatible, 0.25 ampere, 28 volt – DC circuit rating, maximum 1-watt power. Internal terminating resistor, for supervisory circuit fault monitoring.

6. Operating ambient temperature minus 40 degrees to plus 60 degrees centigrade for indoor or outdoor locations.
7. Integral mounting plates, with pry-tamper switch and anti-tamper circuit monitoring.
8. High-impact resistant watertight housing for indoor or outdoor install location. Rear connect entrance for concealed circuit conductors. Brown or white housing finish. Color as selected by OWNER's Representative.
   a. An install type shall be suitable for install and use in steel, aluminum, or wood doors jambs/frames. Install magnet in "moving" door/window. Install sensor in stationary jamb/frame.
   b. Flush in Jamb/Frame and top of door/window.
   c. Surface mount on Jamb/Frame and front face of door/window.
9. As manufactured by: Harco; or Magnasphere; or DETEX.

2.06 SOFTWARE

A. General
1. The real-time software shall supervise, monitor and control the entire Electronic Intrusion System. Maintain a detailed historical and current status database for EIS system events, user access/response and equipment.
2. Graphical use interface, based on building architectural plans and site plan.
3. Operator identification and multiple level password protected log-in.
4. Ethernet-LAN protocol TCP/IP communications protocol.
5. Microsoft Windows®-XP, Vista, Windows-7 compatible, PC based operating system with site-wide concurrent user license.
6. Provide integrated executable modules Electronic Intrusion Monitoring System furnished with the initial installation. Provide additional future add-on software modules compatible with future functions and compatible with the initial installation.
7. Latest Lenel series ON Guard software release. Compatible with County of Orange existing software Lenel series ON Guard 2008, Version 6.0.148 and Wide Area Network (WAN).

2.07 MISCELLANEOUS DEVICES

A. General

B. Transfer Hinges for Monitor/Control Circuits and Electric Power Circuits
1. Provide one electrified transfer hinge, center edge position on each door and each respective door jamb/frame. Shall transfer electric power, monitor circuits and control circuits concealed inside and through the hinge. Transfer the circuits into the door interior from the fixed location respective door jamb/frame. Typical for each individual door and for each pair of doors. See door hardware contract documents for door/hardware types and locations.
2. Internal, conceal inside the transfer hinge, a door position monitoring switch.
3. UL – 10B or 10C (as applicable) listed and labeled for electrical circuits, fire rated doors. Shall match the fire rating of the respective door and fire rated jamb/frame. Heavy-duty, tamper-resistant, weatherproof.
4. Hinge appearance, configuration (knuckles), materials, color and finish shall match the other door hinges attached to the same door. Full mortise, unless indicated otherwise in the contract documents. Suitable for metal or wood, solid or hollow doors, jamb/frames as applicable for each location. Refer to door/hardware contract documents.
5. Electrical Circuit Performance
   a. Insulated, flexible stranded/braided copper wire conductors concealed in the hinge, crossing through the hinge.
   b. Shall be conductive for all door/hinge positions:
      1) All conductors rated 30 volt DC/AC.

2) Two (2) conductor pairs; rated 15-ampere 5-second duration inrush, 2-ampere continuous power rating.
3) Three (3) conductor pairs; rated 250 MA continuous control and monitoring.

6. Provide connection circuits concealed inside the door to connect the door transfer hinge power, control and monitoring circuits, to the respective devices in the door:
   a. Electric lock power and control.
   b. Door and lock status monitoring devices.
   c. Request to exit signaling.
   d. Electric strikes in paired doors.
   e. Delayed egress devices.
   f. Electric trim.
   g. Tamper devices.
7. Ball bearing hinges on doors with closers.
8. Non-removable pins, shall secure to the door and jamb/frame with set screw or other method to ensure tamperproof transfer hinge attachments.
9. Provide watertight electric junction box on the fixed position jamb/frame of the transfer hinge as part of the transfer hinge components. Pre-attach the transfer hinge and junction box to the door and frame/jamb in the field or at the fabrication shop. Junction box flush mount. Where the door jamb/frame surround is glass/glazing, position the junction box flush-in-floor or in the ceiling, at the door jamb/frame interface.
10. Ambient operating temperature minus 40 degrees to plus 60 degrees centigrade rated for wet and dry locations.
11. Transfer hinges shall not interfere with the full-open to full-closed continuous positions of the doors.

C. Provide Cable and Conductors in Conduit
   1. Composite wire (Reader, REX, Strikes, Contacts):
      a. Contact wire shall have minimum 2 pair 22 gauge
      b. Lock power wire shall have minimum 2 pair 18 gauge
      c. REX wire shall have minimum 3 pair 22 gauge
      d. Reader wire shall have minimum 4 pair 22 gauge shielded
   2. RS-485 cable shall be 22 gauge, 4 conductor twisted pair, shielded with drain wire.

D. Miscellaneous Mounting Accessories:
   1. Screws, bolts, escutcheons, brackets and similar supplemental items as necessary and recommended by manufacturer for conditions of use for complete function. Provide stainless steel fasteners which are galvanically compatible with contact surfaces and substrate, which will not cause dissimilar metal corrosion.
   2. Bolts and screws shall be "shouldered" for flush appearance for locations exposed to public view.
   3. Shall be UL 10B or 10C (as applicable) listed and labeled for fire rated doors and jambs/frames.

PART 3 – EXECUTION

3.01 GENERAL

A. Install locations:
   1. Install locations with glass surrounds surface mount device housing on the door vertical jamb/mullion/frame.
   2. Install locations where glass surround is not present, flush mount device and outlet box within 6" of the vertical jamb/mullion/frame.

B. Attempts to adjust or disturb the equipment circuits, devices, software and sensors connected to the control equipment shall cause a tamper supervisory alarm.

C. Components, equipment and installation shall be suitable for 24 hour a day, continuous use.

D. Components
   1. Access panels and reader modules:
      a. Provide access Lonel panels (LNL-2220) installed in each building.
      b. Any building exceeding 2 readers provide additional reader modules (LNL-1320 series 2).
      c. Provide enclosures (LNL-CTX-6) for each access control panel and reader module.
   2. Electronic door hardware:
      a. Each reader door shall be fully compatible with door contacts and with request to exit devices.
      b. Reader doors shall retain fire ratings after electrified door hardware is installed.
   3. Power Supplies
      a. Access panels and reader modules shall be configured to use 24 VDC.
      b. Provide in each building, 24 power supplies (AL600ULM) power each access control panels, reader modules, door locks and request to exit devices.
      c. Power supply enclosures shall <u>not</u> share enclosure with access panels and reader modules.
      d. Backup batteries shall provide 8 hours up time for readers, locks and request to exist devices.
      e. Battery and AC supervision shall be connected to the Lenel access panel and/or reader module to indicate loss of AC power and report low battery conditions.
   4. Cabling:
      a. Cabling shall be installed in conduit between all buildings, between all enclosures and all devices.
   5. Miscellaneous:
      a. Provide diodes at each reader door to effect door supervision.
      b. Tamper switches shall be installed and wire in series between access panel or reader module enclosures and power supply enclosures.
      c. Readers, access panels, power supplies and cabling shall be labeled to the County's naming convention standards.
      d. Tests shall be performed of circuitry, controls and switches for failure or malfunctions.

3.02 INTRUSION, MONITORING, CONTROL EQUIPMENT CABINETS, IMCEC

A. General

B. Connection Sequence
   1. Provide each building with one or more IMCEC cabinets as shown on drawings in IDF and MDF rooms.
   2. Main-IMCEC, shall be the single master control and terminus location for the respective building. Sub-IMCEC shall all connect to the main IMCEC in the same building. The building main-IMCEC shall connect to the site/campus Master-IMCEC.
   3. Sub-IMCEC, Multiple Sub-IMCEC shall be provided throughout the building, for horizontal wiring connections of devices. Quantity and locations to ensure device connecting circuit lengths do not exceed the permitted operational maximum lengths. Sub-IMCEC shall connect to the respective building Main-IMCEC for small building (typically one or two-story and less than 15,000 sq. ft.) the Main-IMCEC and Sub-IMCEC may both be at the same location.

3.03 DEVICES AND SENSORS

A. Provide PAISR readers at each door location shown on drawings.

B. Provide electrified transfer hinge device at each door with electrified lock.

C. Provide magnet sensor device at each door with electrified lock and each door with access monitoring.

D. Provide control cabinets in each IDF and MDF room in each building.

3.04 CIRCUITS AND PATHWAYS

A. General
   1. All circuits shall be installed in conduit, end-to-end, to minimize non-authorized access and tampering with circuits.
   2. Provide and execute wiring and pathways in accordance with the contract documents, manufacturer's diagrams and recommendations.

B. Provide communications and control circuits/cables and pathways (see Specification 16750 for additional requirements).
   1. Horizontal circuit connections from devices, readers, sensors, locks, et., to the respective Sub-IMCEC equipment cabinets, in the same building:
      a. Refer to the specific technical description for the circuit conductors and pathways requirements.
   2. Circuit connections between Sub-IMCEC secondary cabinets and the Main-IMCEC equipment cabinets, in the same building:
      a. EIA/TIA-568B, 50/125 multimode fiber optic cable, four (4) fiber strands, jacketed cable.
      b. EIA/TIA-568B, Category-6, 4-pair-UTP copper wire cable, two (2) jacketed cables.
      c. 1.25" conduit for circuits, connection pathway.
   3. Circuit connections between the building Main-IMCEC equipment cabinet, to the site/campus Master-IMCEC equipment cabinet:
      a. EIA/TIA-568B, 50/125 multimode fiber optic cable, eight (8) fiber strands jacketed cable (indoor-outdoor type).
      b. 2.0" conduit for circuits, connection pathway.

3.05 TESTING AND COMMISSIONING (ADDITIONAL REQUIREMENTS)

A. General
   1. Functional Performance Tests
      a. The functional performance tests shall demonstrate the equipment/installation can meet the functional and performance requirements as defined in the contract documents. Functional performance test should proceed with the testing of individual components, devices, sensors and the testing of each complete system in the contract.
      b. The Contractor shall make modifications and corrections as the test proceeds. Retest after modification. Repeat until correct function is demonstrated.
      c. Performance deficiencies revealed during the tests shall be evaluated to determine the cause. After completion of the necessary corrective measures, the Contractor shall repeat the tests.
      d. Provide test equipment, personnel and temporary setups.
   2. Commissioning Inspection
      a. Commissioning shall be the advancement of the system and installation from the stage of static completion to full working conditions and to meet the performance requirements as specified in the contract documents. Shall

include setting into operation the regulation of the installation. Fine-tuning of the commissioned system shall be done by the Contractor to match system performance to the actual needs of the building occupier.

3. Documentation and Deliverables
   a. The Contractor shall submit the proposed testing procedures together with the Testing and Commissioning Progress Chart for review, six (6) copies.
   b. All inspection and testing results shall be recorded by the Contractor in the appropriate approved test record forms, the reference of which is shown against each individual test.
   c. Upon completion of all the required testing and commissioning works, the Contractor's project engineer shall complete and sign a testing and commissioning certificate stating to the effect that the testing and commissioning works have been properly and correctly carried out.
   d. A functional performance test report covering all measured data, data sheets, and a comprehensive summary describing the operation of the system at the time of the functional performance tests shall be prepared and submitted to the OWNER's Representative. Deviations in performance from the Particular Specifications or the design intent should be recorded, with a description and analysis included.
   e. The Contractor shall conduct a final evaluation of the performance of the installed and tested system, the results of which shall be included in the commissioning report.
4. Procedures
   a. The Contractor shall submit the testing and commissioning procedures together with the Testing and commissioning Progress Chart for approval. The submission shall be made at least one month before the commencement of testing six (6) copies for review.
   b. Where tests are required to be witnessed, the Contractor shall give due advance notice not less than five days and provide details of date, time and type of tests to be performed.
   c. Before carrying out any test, the Contractor shall ensure that the installations comply with the statutory requirements, regulations and contract documents.

B. Testing and Inspection
1. Test and Inspection During Construction
   The purpose of these tests is to ensure that all components and systems are in a satisfactory and safe condition before start up. Preliminary adjustment and setting of equipment at this stage shall also be carried out at the same time to pave way for the functional performance tests.
2. The Contractor shall submit the details of the tests and inspection during construction to OWNERS Representative for approval on commencement of the function performance tests, six (6) copies for review.
3. The tests and inspection during construction shall include, but not limited to, the followings:
   a. The checking of the catalogues numbers/series numbers of the equipment/cables in accordance with the approved shop drawings.
   b. Continuity test, insulation resistance/loop resistance tests of wiring conductors after being drawn in conduits in each section of work;
   c. Identification labels of conductors;
   d. Adequacy of the sizes and quantities of conductors in relation to the system design;
   e. Correct connections of all equipment in accordance with supplier's instruction;
   f. Methods of protection against direct contact with live parts (including measurement of distances where appropriate), i.e. protection by insulation of live parts, or protection by barriers or enclosures;
   g. Labeling of power circuits, protective devices, switches and terminals;

h. Selection of equipment and protective measures appropriate to adverse environmental conditions;
i. Presence of danger and warning notices;
j. Presence of diagrams, instructions and other similar information;
k. Method of protection against indirect contact;
l. Prevention of mutual detrimental influence of equipment;
m. Any other appropriate inspection as required by the systems installation.

C. Functional Performance Test

1. Before the functional performance test is carried out, the Contractor shall prepare checklist and Testing & Commissioning procedures to meet the requirements of the system, six (6) copies for review. The procedures shall include all elements of the system.
   a. Master control check that the interconnecting wiring between computers
   b. Peripheral are securely connected and installed according to working drawings;
   c. Check that all peripherals are provided and according to approved equipment submission;
   d. Check the database associated with each input point has been provided in accordance with the designed purposes;
   e. Check detailed floor plan with positions of security devices, door, partitions, and room names has been provided correctly in the computer database and can be summoned from the computer;
   f. Activate each alarm to check alarm buzzer, alarm visual indicators, and reset function are in proper working order, and the alarm shall be terminated automatically not more than 15 minutes after the activation of the alarm.
2. Communication Network Systems
   a. Check that the anti-tamper micro-switches protecting the junction boxes in communication networks function properly;
   b. Check the identification ferrules provided;
   c. All wiring connection securely fixed and enclosed in conduit;
3. Remote Signal Transmission
   a. Test the continuity of the signal line and proper display in the control center monitor when it is disconnected.
4. Card Access Control Systems
   a. Check setting of current time and date;
   b. Check access codes are provided according to the level of holder and proper access levels are provided;
   c. Check proper fields are allocated to each cardholder, including time allowed for in/out and area of access;
   d. Check proper program are allocated to each point of access, including proper parameters such as door release time, door re-locking time;
   e. Check whether graphics are updated, clear and accurate.
5. Card Reader for Card Access Control Systems
   a. Check the proper operation of the card readers by use of the central control station and at the readers locally; (LED and audio tone provided with different color and tone for authorized/ unauthorized entry).
   b. Simulating to case of failure of normal power supply, check the operation of the emergency release button as well; check the working period of the UPS supply in accordance with the requirement;
   c. Activating the fire alarm, check the proper operation of the door lock unlock according to the fail safe/fail secure requirement;
   d. Activating the lighting control system.
6. Security Locks and Switches
   a. Check the proper operation of each of the security lock (of the exit) and the alarm activation under no fire alarm is activated;

b. Check the proper operation of each of the tamper switch and duress push button;
c. Carry out line fault test and remote off test.

D. Commissioning and Inspection
1. Other than the functional tests carried out for the systems, the Contractor shall also prepare the following for the commissioning and inspection for the completion of work:
   a. All works, such as the blanking off openings by fire barrier/thermal insulation, painting and sign boards are completed by the building;
   b. All works by other Contractors such as fire signal interfacing connection, lighting controls, air-conditioning/mechanical ventilation for security equipment room and normal electrical supply, etc., are completed;
   c. All weatherproof housing and protective measures to security equipment, warning notices and painting by the Contractor shall be completed.
2. The commissioning procedures and test records are classified as "Restricted" and are to be distributed on a "Need to Know" basis.
3. The Contractor shall provide all the necessary staff, labor, materials and equipment for a thorough test and examination of the installation.
4. The contractor shall supply calibrated equipment to perform the work required in the Contract documents and for the inspection, measuring and testing of the system.
5. Attempts to adjust or disturb the equipment circuits, devices, software and sensors connected to the control equipment shall cause a tamper supervisory alarm.
6. Components, equipment and installation shall be suitable for 24 hour a day, continuous use.

END OF SECTION

SECTION 16750
ELECTRONIC NETWORK SYSTEMS INFRASTRUCTURE
(Computer/Data, Telephone/Voice, TV and Multimedia)

PART 1 - GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other specifications sections and drawings for related work required to be included as work under Division Sixteen.
   2. General provisions and requirements for electrical work.

B. Provide electronic network systems infrastructure for the following systems:
   1. Computer Data Networks.
   2. Telephone and Intercom Voice Communications.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Drawings Submittals
   1. Drawings shall be submitted on reproducible bond paper and AutoCAD® Version 2.2 (or later revision) data files on 3.5" floppy disks or CD-ROM disk, WINDOWS®-98/XP format.
   2. Submit redrawn building floor plan for each building area, same scale as the contract drawing.
   3. Plans shall show walls, doors, windows, furniture, infrastructure, outlets and network systems equipment locations. Show point-to-point interconnecting cables, pathways, conduit, conduit sizes, circuit types, along with circuit identification names, numbers and quantities between all components.
   4. Provide scaled elevation drawings of each equipment rack, terminal blocks, terminal backboard and terminal room/closet showing location and arrangement of each equipment component, outlet and cable training provisions, with estimated weight of each complete assembly.
   5. Submit block wiring diagrams showing major system components, outlets, equipment racks, terminal blocks, signal loss with interconnecting circuit conductors, splices, portable patch cords and connectors. Riser type diagram shall be provided if the building has more than one floor level, with information shown on riser diagram corresponding for each respective floor.

B. Submit manufacturer's standard catalog data for each component. The submittal shall be arranged in the order of the Specification and shall list the specification paragraph number, the name, the proposed model and manufacturer for each item as well as a reference indicating the specific piece of data which can be easily located in the brochure. The manufacturer's data sheets shall be marked to indicate the specific item being proposed in cases where the sheet covers several types or sizes of items. The data sheet shall completely describe the proposed item. Where modification to the equipment is necessary to meet the operational requirements of the contract documents, the brochure shall include complete mechanical and electrical shop drawings, detailing the modification. The brochure shall include a listing of the outlet rough-in requirements for every device and equipment item. The applicable symbol which illustrates that rough-in item on the job plans shall be drawn on the proposal, opposite the description of the rough-in to facilitate locating the data by field personnel. Submit elevation and dimensional information.

C. Performance Calculation:
   1. Provide engineered calculations showing the Passive Cable System Signal Attenuation losses of the proposed installed system. The intent is not to require calculations for every system segment, port and outlet. The intent is to require engineered calculations for proposed typical worst case port to port, head end to farthest distance outlet and patch port to outlet signal attenuations.
   2. Provide calculations for a minimum of 50 complete channel/circuit paths. The calculations shall include attenuation insertion loses for each system component including individually itemized cable-fiber/wire; outlet, termination, connector, electronic component (if any), coupler and patch cord along the entire path from the head end equipment to the end use outlet.
   3. The calculations shall serve as the basis for verifying the system performance with the system testing specified in the Contract Documents.

D. Provide proposed nameplate and outlet identification/color coding system. Indicate proposed identification naming sequence and methods, itemized for review.

E. Submit manufacturer certified test reports showing test documentation for the proposed material that the material meets or exceeds the performance standards defined in the contract documents. The testing and results shall reflect worst case performance based on a minimum of ten samples. Tests shall be certified by a Nationally recognized independent test lab (i.e., ETL, UL, etc.). The manufacturer shall certify in writing the material has been manufactured and tested to comply with the requirements defined in the contract documents.

F. Submit 3-three samples of each of the following, fully assembled with 24" inches of cable type connected:
   1. Copper wire outlet and connector, with each type of specified inserts.
   2. Copper cables and patch cords, each type.
   3. Fiber optic cables and patch cord each type.
   4. Mechanical splice - fiber optic.
   5. Fusion splice - fiber optic.
   6. Fiber optic connector each type.
   7. Fiber optic cable connector each type of termination, with interconnection coupler.

1.03 APPLICABLE STANDARDS

A. The equipment shall be UL listed, labeled, and approved for the application shown in the contract documents.

B. The complete system material, equipment, testing, installation and workmanship shall comply with the mandatory requirements and the guideline/recommendation requirements of the following latest published version, supplements, revision including addendums and TSB. Both the mandatory and advisory criteria shall be included as requirements of the Contract Documents:
   1. TIA 526 – Optical Power and loss measurements – multimode and single mode fiber.
   2. ANSI/TIA/EIA-568B Commercial Building Telecommunications Standards.
   3. ANSI/TIA/EIA-569A – Commercial Building Standards for Telecommunications Pathways.
   4. ANSI/TIA/EIA-570A Residential Telecommunications Standard.
   5. ANSI/TIA/EIA-598B Optical Fiber Cabling Color-coding.
   6. ANSI/TIA/EIA-606A Administrative Standard for Commercial Telecommunications Infrastructure.

7. ANSI/TIA/EJA-607 Commercial Buildings Grounding and Bonding Requirements for Telecommunications.
8. National Electrical Code including Article 800 and Article 770 with ETL verified testing.
9. FCC – FYU/FT6.
10. ISO/IEC 11801
11. National Electrical Code (NEC) and California Electrical Code (CEC) and local code jurisdictions.
12. Manufacturer's recommendations for the respective equipment.

C. The completed computer/data system shall be tested and provide electronic data/network multi-channel communications for the following protocols:
1. IEEE 802.3/ETHERNET, 10 Mbps 10Base-T and 100Mbps 100Base-Tx and 1000 Base-Tx for copper wire; 10Base-Fl, 100Base-FX and 1000Base-Lx-Sx for fiber optics and pending IEEE-5td.802.3ab 1000Base-T for 1000 Mbs operation.
2. FDDI - Distributed data interface on fiber or copper wire, 100Mbps.
3. EIA RS-232.
4. ANSI - TPPMD 55Mbps, 155Mbps and 622 Mbps Asynchronous Transfer Mode - ATM.

D. The complete telephone/voice system shall be Gigabit ETHERNET suitable for the telephone/voice suitable analog and digital communications. The system shall be compatible with the telephone/voice equipment installed as part of the contract.

E Installation of all equipment, devices, splices, terminations, cables, outlets, etc. shall comply with manufacturer's recommendations.

1.04 EQUIPMENT QUALIFICATIONS

A. The supplier of the equipment shall be the factory authorized distributor and service facility for the brands of equipment and material provided.

B. Installation Certification
1. Work and material for cables, cable terminations, outlets and related components for infrastructure systems shall be performed by certified installers. The installer shall be certified by the respective product manufacturers.
2. The manufacturers of the indicated work and material, shall provide a installer education/training and certification program for the supplied products.
3. The installers performing the Contract work for the indicated products, shall have attended and successfully completed each of the respective manufacturer's installation training education programs for the specified products.
4. Submit six (6) copies of the manufacturer's certifications for each installer performing the work. The submittal shall be approved by the OWNER'S REPRESENTATIVE prior to initiating any related contract work.
5. Contract material installed and work performed by installers not complying with these requirements shall be removed. Removal of work and material not in compliance with these requirements shall done at the CONTRACTOR'S expense, without any additional cost to the contract and without any additional contract completion due date extensions. New material and work required to replace the non-compiling removed work and material shall be provided at the CONTRACTOR'S expense, without any additional cost to the contract and without any additional contract completion due date extensions.

C. Extended Material and Performance Warranties
1. In addition to the warranty requirements described elsewhere in the contract documents, provide the following extended material and performance warranties.

The warranty period shall be for not less than fifteen (15) years from the Contract Notice of Completion.

2. Warranty scope includes network cables and terminations, network workstation plug-in outlets, and patch panel plug-in outlets, cable splices and connectors.
3. Repair or replace the defective material with new material at the project premise, to comply with the performance standards outlined in the contract documents during the warranty period.
4. Submit six (6) copies of proposed warranty statements, with shop drawing submittals.

1.05 ABBREVIATIONS

Abbreviation	Terminology
ACR	Attenuation to Cross Talk
AHJ	Authority Having Jurisdiction
Backbone	Interconnections between MDF and IDF locations
dB	Decibel
dBm	Decibel referenced to a milliwatt
Demarc	Demarcation location where operational control change or ownership change occurs
ft.	Feet
GHZ	Gigahertz
Horizontal Connection	Interconnections between individual workstation outlet location to IDF or MDF
IDF	Intermediate distribution frame (horizontal or vertical cross connect) for an individual building area/floor
KM	Kilometer-IKM
kpsi	1000 pounds per square inch
m	Meter=39.37 inches
Mbps	Megabits per second
MDF	Main distribution frame (central/main cross connect)for multi-building site or for a single individual building
Mhz	Megahertz
micron	Micrometer
mm	Millimeter=10^{-3} meter
NEXT	Near end cross talk
nm	Nanometer=10^{-9} meter
PS	Nanometer
pF	Picofarad=10^{-12} farad
RTDE	Equipment rack mount fiber optic termination distribution enclosure, with fiber optic patch panel
RMSE	Equipment rack mount fiber optic enclosure, splice only, (without patch panel)
STP	Shielded twisted pairs copper wire
ScTP	Shield Screened twisted pairs copper wire
um	Micrometer=10^{-6} meter
USE	Universal splice enclosure
UTP	Unshielded twisted pairs copper Wire
WGNA	WideBand Gigabit Networking Alliance
Workstation Or Workstation location	Spaces remote from the MDF/IDF terminal room/closet, where occupant interacts with the electronic systems infrastructure equipment connection device
WMIC	Wall mount fiber optic cable interface cabinet

1.06 MATERIALS AND METHODS

A. Material and labor not complying with the contract documents shall be removed by the CONTRACTOR from the project site. Material and labor complying the contract documents shall be provided.

B. All the cost to remove deficient work and material, provide work and material complying with the contract documents and the direct, indirect, incidental damages and contract delays resulting from complying with these requirements shall be the sole responsibility of the CONTRACTOR and shall be included in the bid price.

C. System Performance Requirements
   1. The work, performance and type of materials provided as part of the contract shall comply with the following ANSI/TIA/EIA-568B and related standards for all Electronics Network Systems Infrastructure work and materials described in the specifications and shown the drawings:
      a. Computer/data network systems: Category-6.
      b. Telephone/intercom voice systems: Category-6.
   2. The Electronic Network Systems Infrastructure system shall be based on "star-topology" for MDF to IDF backbone connections and workstation outlet to MDF/IDF horizontal connections.

PART 2 - PRODUCTS

2.01 FIBER OPTICS CABLES

A. General
   1. Operating temperature range - 20 degrees centigrade through +60 degrees centigrade.
   2. Electronic network systems infrastructure cables that are not installed inside conduit raceways. Electronic network system infrastructure cables that are installed in concealed spaces including plenums, access floors, ceiling spaces, walls, floor, etc., without conduits/raceways. The cable insulation and jacket shall be listed and labeled "limited combustible cable" (LC or LCC) and shall comply with all of the following:
      a. Limited combustible "FHC-25/50" per UL-2424.
      b. NEC/CEC;CMP, additional listing/labeling where the install location is an environmental air plenum, "FHC-25/50-CMP".
      c. NFPA-90A; ceiling cavity plenums and raised floor plenums, limited-combustible.
      d. NFPA-5000; defines combustible material including wire and cable.
      e. NFPA-13; spaces containing "limited combustible loading".
   3. All fibers in a multi-fiber cable shall be fully operational within the performance characteristics specified prior to and after the cable is installed. The use of spare fibers in the cable to compensate for defective fibers is not permitted. Defective cables shall be removed and replaced with fully functional cables at no additional cost to the contract.
   4. Cables shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with specified requirements. ANSI/TIA/EIA-568B including related standards, amendments and TSB. ETL certified and tested to comply with or exceed specified requirements:
      a. ANSI/TIA/EIA0568B including related standards and TSB.
   5. Each fiber shall be individually identified with factory color coding or factory imprinted label. The outer cable jacket shall be imprinted with date, manufacturer's model and catalog number, along with agency listing identification.

6. All fiber optic cable shall be produced by the same manufacturer including portable patch cables, as manufactured by Corning, Belden, Berk-Tek, AMP, Optical Cable, Siemons or equal.
7. The outer cable jacket shall be imprinted with date, manufacturer's model and catalog number and AHJ listing identification.
8. Cables installed in raceways or conduits below grade, through in-grade manholes or pullboxes shall be rated for installation in water/wet locations.
9. Cables containing less than six (6) fiber strands shall be provided with a color coded outer jacket (red or orange).
10. Multimode (50/125)
    a. 50/125 fiber optic cables optical fibers, graded index multimode optical glass fibers, 50.0 micron fiber core and 125 micron fiber cladding, 0.2 numerical aperture. Optical fibers shall be 100 kpsi proof tested, with maximum 0.7 micron flaw size for dual operation at 850nm and 1300nm wave lengths.
    b. Minimum bandwidth:
       @ 850nm-wave length 500Mhz per KM length
       @ 1300nm-wave length 500Mhz per KM length
    c. Maximum attenuation:
       @ 850nm-wave length 3.4db @ 1 KM length
       @ 1300nm-wave length 1.4db @ 1 KM length

B. Indoor/Outdoor Cables
1. The cable shall be fungus resistant, UV resistant, moisture resistant for installation indoors with or without a enclosed raceway and outdoors in underground enclosed raceway/conduit and manholes/pullboxes continuously flooded with water, and in conduits exposed to the sun.
2. Each optical fiber shall be primary coated with 500 micron uniform acrylate tight buffered and with elastomeric uniform 900 micron diameter tight buffered, secondary coating. Aramid yarn strength member elements shall be tensioned and symmetrically and uniformly distributed around the fibers, along the length of the cable.
3. A overall cable jacket uniformly extruded directly around and mechanically interlocked with the optical fibers/strength members. The extruded jacket shall form internal helical cusped ridges that interlock with the optical fibers and strength members. The interlocking jacket shall not allow cable fibers to move axially within the cable jacket.
4. Cables containing more than 24 optical fibers shall be constructed with sub-cable fiber bundles. Each sub-cable bundle shall contain equal quantities of optical fibers, with a separate PVC jacket around each sub-cable. Sub-cable and sub-cable jacket construction shall match the overall cable requirements and jacket requirements.
5. The cable shall be UL listed and comply with NEC [CEC] and NFPA requirements for each installation location shown in the Contract Documents. ETL tested and certified to comply with or exceed specified requirements.
    a. NEC [CEC] - OFNR (Vertical Riser Type Locations) OFNP (see additional requirements for Plenum Type Locations).
    b. NEC [CEC] - OFNG (Where continuously enclosed inside conduits for entire cable length).
    c. Limited combustible FHC 24/50 when not enclosed inside conduits.

2.02 COPPER WIRE CABLES (TWISTED PAIRS)

A. General
1. Conductors shall be copper wire, individually insulated and color coded, with multiple conductors arrange in twisted pairs.

2. An overall non-conductive jacket shall encase the copper wires and any shielding (where shielding is specified)shall also be encased by the jacket.
3. Cables shall be UL listed, complying with NEC National Electrical Code, National Fire Protection Agency and NFPA requirements for each installation location shown. ETL tested and certified to comply with or exceed specified requirements.
   a. ANSI/TIA/EIA-568B; including related standards, amendments and TSB.
4. Electronic network systems infrastructure cables that are not installed inside conduit raceways. Electronic network system infrastructure cables that are installed in concealed spaces including plenums, access floors, ceiling spaces, walls, floor, etc., without conduits/raceways. The cable insulation and jacket shall be listed and labeled "limited combustible cable" (LC or LCC) and shall comply with all of the following:
   a. Limited combustible "FHC-25/50" per UL-2424.
   b. NEC/CEC;CMP, additional listing/labeling where the install location is an environmental air plenum, "FHC-25/50-CMP".
   c. NFPA-90A; ceiling cavity plenums and raised floor plenums, limited-combustible.
   d. NFPA-5000; defines combustible material including wire and cable.
   e. NFPA-13; spaces containing "limited combustible loading".
5. The outer cable jacket shall be imprinted with date, manufacturer's model and catalog number and agency (AHJ) listing identification.
6. Cables installed in air plenums, air handling spaces and cables installed without raceway or conduit shall additionally be UL listed and labeled for installation in air plenums.
7. Cables installed in raceways or conduits below grade, through in-grade manholes and pullboxes shall be rated for installation in water/wet locations.
8. All copper wire electronic network systems cable of the same type shall be produced by the same manufacturer including portable patch cables. As manufactured by AMP, Berk-Tek, Siemons, Belden, or equal.
9. The outer jacket of cables with less than nine (9) pair of conductors shall be color coded. The jacket color shall be different for each system type; multimedia; telephone/voice; computer/data network; and fiber cable jackets.
10. 300 volt RMS insulation material for each data conductor shall be the same material; shall be the same electrical characteristics and shall be the same dielectric constant, for all data conductors contained within the respective common cable jacket, along the entire installed length of the cable. Data cables employing differing insulation materials for individual data conductors contained within a common cable jacket are not acceptable and shall not be provided.
11. The "skew" rate (nominal velocity of propagation delay) between any twisted pair in a combination of 4-twisted pair conductors grouped in the same cable, shall not exceed 30 nano seconds between any wire pair contained in the conductor group, and as required by cable Category rating, over a cable length of 100 meters, for all frequencies up to the cable maximum frequency rating.
12. Copper wire cables with 25 or more twisted pairs of conductors shall be constructed with 25-pair binder groups of conductors. The cable binder groups shall be enclosed in colored binders and assembled to form a single cable. The twisted pair/binder groups shall be enclosed with multi-layer dielectric protective sheaths underneath a cable jacket enclosing the entire cable assembly. A corrugated metal 100% shield shall be provided under the cable jacket enclosing all conductors.

D. Category-6 Computer/Data Cables – UTP, Voice and Data
   1. Category-6 cables shall be tested and shall pass the ANSI/TIA/EIA test recommendations for Category-6.

2. Operation Characteristics:

a.	Wire size	23AWG solid copper (23AWG stranded copper for portable patch cables)
b.	Quantity of twisted pairs	As indicated but in no case less than (4) four pairs
c.	Impedance	100 OHM ± 15%, 1-250Mhz

2.03 COPPER WIRE CABLES (COAXIAL)

A. General

1. An overall non-conductive jacket shall encase the copper wires and shielding.
2. Cables shall be UL listed, complying with NEC National Electrical Code, National Fire Protection Agency and NFPA requirements for each installation location shown. ETL tested and certified to comply with or exceed specified requirements. In addition to the UL listing requirements for Copper wire Cables twisted pair, coaxial cable shall additionally be UL listed and labeled for each install location.
   a. ANSI/TIA/EIA-568B; including related standards, amendments and TSB.
3. Electronic network systems infrastructure cables that are not installed inside conduit raceways. Electronic network system infrastructure cables that are installed in concealed spaces including plenums, access floors, ceiling spaces, walls, floor, etc., without conduits/raceways. The cable insulation and jacket shall be listed and labeled "limited combustible cable" (LC or LCC) and shall comply with all of the following:
   a. Limited combustible "FHC-25/50" per UL-2424.
   b. NEC/CEC;CMP, additional listing/labeling where the install location is an environmental air plenum, "FHC-25/50-CMP".
   c. NFPA-90A; ceiling cavity plenums and raised floor plenums, limited-combustible.
   d. NFPA-5000; defines combustible material including wire and cable.
   e. NFPA-13; spaces containing "limited combustible loading".
4. The outer cable jacket shall be imprinted with date, manufacturer's model and catalog number and agency (AHJ) listing identification.
5. Cables installed in air plenums, air handling spaces and cables installed without raceway or conduit shall additionally be UL listed and labeled for installation in air plenums.
6. Cables installed in raceways or conduits below grade, through in-grade manholes and pullboxes shall be rated for installation in water/wet locations.
7. All copper wire electronic network systems cable of the same type shall be produced by the same manufacturer including portable patch cables. As manufactured by AMP, Berk-Tek, Siemons, 3M, Belden or equal.

B. RG6 Coaxial Cables

1. ANSI/TIA/EIA-568B cables. RG-6, Quad-Shield cables shall be tested and shall pass ANSI/TIA/EIA test recommendations for the cable type. Rated for both analog and digital RF signal circuits.
2. Operational characteristics:

a.	Single center conductor size stranded or solid bare copper.	18AWG
b.	Velocity of propagation not less than	82%.
c.	Impedance 75-OHM ± 3-OHM.	
d.	Maximum signal attenuation per	100 ft.

- Baseband Video 0.26 dB @ 1 MHz
- Upstream Digital Cable 0.76 dB @ 10 MHz
- TV ch. 2 1.46 dB @ 50 MHz

▪ FM Radio	2.05 dB @ 100 MHz
▪ TV Ch. 12	2.83 db @ 200 MHz
▪ CATV Ch. 54	4.05 dB @ 400 MHz
▪ CATV Ch. 109	5.60 dB @ 700 MHz
▪ CATV Ch. 142	6.23 dB @ 900 MHz
▪ DBS	6.59 db @ 1000 MHz
▪ DBS	7.50 dB @ 1200 MHz
▪ DBS	8.04 dB @ 1450 MHz
▪ PCS Cell Phones	8.50 dB @ 1800 MHz
▪ Wireless Cable	9.00 dB @ 2200 MHz
▪ High Frequency	13.7 dB @ 3000 MHZ

e. Capacitance 16.2 pf/ft

f. ASTM-D4566, 5 thru 3000 MHz
Return Loss Headroom (RLH)
not less than 20 dB

g. 100% sweep tested 5 MHz
thru 4500 MHz

3. Four (4), alternating layers of metal foil shielding and brass braiding shielding, 100% metallic shielding below the jacket and symmetrically enclosing the individual layers of dielectric insulation surrounding the center conductors.

2.04 FIBER OPTIC FIBER SPLICES

A. General

1. Fiber optic cable splices shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements, ANSI/TIA/EIA - 568B including related standards, amendments and TSB.

B. Mechanical Splice

1. Mechanically splice each fiber with a splice suitable for use with the type of fiber optic fibers. Re-enterable and reusable splice. Splice shall be recommended as compatible with the optical fibers by the manufacturer. Splice shall not require the use of adhesives. Splice shall provide integral strain relief. As manufactured by AMP "finger splice" series, 3M, Siemons or equal.
2. Performance requirements after installation:
   a. Operating temperature range minus 20 degrees centigrade through plus 60 degrees centigrade.
   b. Loss variation over temperature range, 0.05dB or less at specified wave lengths.
   c. Insertion loss, 0.3dB or less at specified cable wave lengths.
   d. Reflection (return loss), -40dB at specified cable wave lengths.

C. Fusion Splicing

1. Fusion splicing shall be performed with equipment providing the following features:
   a. Cleaving and cleaning optical fiber.
   b. Integral splice optimization verification system with local injection and detection.
   c. Projection screen optics and fiber core alignment system.
   d. Fiber cleaning/stripping.
   e. Cleaning fiber ends and fusing of fiber together with an electric arc.
2. Fusion splice insertion loss as measured at the completion of the splice shall be less than 0.1dB at specified cable wave lengths.

2.05 FIBER OPTIC FIBER CONNECTORS AND INTERCONNECTION COUPLERS

A. General
1. The connectors and interconnection couplers shall be compatible, maintain the same performance Category rating and be compatible with the corresponding fiberoptic cable type attached to the connectors.
2. Fiber optic cable connectors and interconnection couplers shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements. Connectors and couplers shall comply with ANSI/TIA/EIA-568B, related standards, amendments, TSB, and Fiber Optic Connector Intermate Standard (FOCIS) documentation.
3. Connectors and couplers shall be the product of the same manufacturer.
4. Shall be UL listed and comply with UL94V-0.
5. Color code connectors for fiber optic cables to match the respective fiber optic strand/jacket color.

B. Multimode Fiber Optic Fiber Connectors
1. "ST" type bayonet termination connector:
   a. Ceramic aluminum oxide 2.5mm ferrule, multi-cure ultra violet or heat cured epoxy bonded, for multimode or single mode to match cable fiber. Insertion loss of each mated connector shall be less than 0.3dB at specified wave lengths.
   b. Strain relief boot, long boot type unless indicated otherwise, short or angled boot type to match the connector installation application. Provide dust cover cap for each connector.
   c. Locking type, to automatically align fiber cable and prevent accidental pullout.
   d. "ST" connectors shall all be of the same manufacturer to insure compatibility. As manufactured by AMP, Siemons, 3M or equal.

C. FIBER OPTIC FIBER INTERCONNECTION COUPLERS
1. Interconnection couplers shall be "like-to-like" compatible, and shall provide "plug-in" coupling of two fiber optic cable connectors terminated with fiber optic fibers front-to-rear "in-line" together. The coupler shall provide interlocking, automatic optical self alignment of two mating fiber optic connectors.
2. The centerline to centerline spacing of the interconnection couplers shall allow removal and insertion of portable patch cords, fiber cable connectors for both "single" and "duplex" type fiber adapter connectors without interfering with adjacent connectors.
3. Patch panel mounted interconnections couplers shall be factory pre-mounted to a modular nominal 0.09 inch thick metal panel, couplers aligned and anchored on the plate.
   a. The metal panel shall be predrilled for standard EIA mounting in high density 19 inch wide metal patch panel frames.
4. Interconnection couplers in workstation outlets shall be installed in outlet boxes with coverplates.
5. The interconnection couplers shall all be of the same manufacturer as the fiber optic cable termination connectors to insure compatibility.
6. Provide removable dust caps for the front side of each coupler.

2.05 COPPER WIRE OUTLET CONNECTORS

A. General
1. Connectors shall comply with FCC part 68 Subpart F for gold plating.
2. Connectors shall be UL listed and shall comply with UL94V-0.

3. Provide a removable blank dust cover for each plug-in outlet insert. The dust cover shall protect the insert from contamination until a workstation or patch cord is "plugged" into the outlet.
4. Copper wire outlet connectors shall be color coded to distinguish telephone/voice separately from computer/data. The outlet coverplate shall be engraved to identify telephone/voice, computer/data and other infrastructure outlets separately.
5. Copper wire outlet connectors shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements, ANSI/TIA/EIA-568B including related standards, amendments and TSB.

B. Universal Outlet Connector (for twisted pair Copper Wire Premise/Workstation Wiring and copper wire patch panels).
1. General
   a. Connections for twisted pairs copper conductors shall provide a universal outlet connector between the building premise copper wire, and plug-in workstation locations. Patch panel/equipment plug-in connectors. The connector components shall assemble with "snap-in" spring loaded retainers to prevent dislocation during insertion or removal of external plug-in devices.
   b. The contacts shall be gold plated with a 250 insertion/withdrawal cycle rating.
   c. As manufactured by AMP, 3M, Siemons, or approved equal.
   d. Unless specifically noted otherwise the universal outlet connector shall comply with ANSI/TIA/EIA 568B; related standards, amendments and TSB.
   e. Operational characteristics shall match or exceed and shall be compatible with the respective twisted pairs cable.
   f. A metal ground shield with EMI/RFI metal ground clip shall be provided where shielded cable is connected to the universal outlet connector for each universal outlet connector assembly.
   g. Each universal outlet connector shall consist of three major components.
      1) Universal edge connector assembly.
      2) Plug-in adapter inserts.
      3) Connector housing.
   h. Provide snap-in blank removable insert covers for connector installed without plug-in adapter inserts.
2. Universal edge connector:
   a. Insulated assembly shall connect to the premise copper wire. The connectors shall be multiple plug type connector contacts, one contact (total of 8 contacts) for each individual premise wire connection interconnected to the individual wire terminations.
   b. Connector shall provide insertion of individual insulated copper wire, gas tight, 110 style punch down/displacement termination, for 22-26 AWG insulated premise wire.
   c. The edge connector assembly shall provide termination of 8 separate wire conductors, twisted or untwisted pairs, solid or stranded, shielded or unshielded, with color codes and numbered identification of each contact. Integral cable/conductor strain relief to prevent pullout of terminated premise wire conductors.
3. Plug-in adapter inserts:
   a. Plug-in adapter inserts shall be internally factory connected to the universal edge connector assembly to adapt the universal connector to the specific outlet type configuration (i.e. "RJ" style computer/data, telephone/voice, (multimedia) modular jacks, etc.)

b. Inserts shall be certified for shielded or unshielded wire, to match premise wire type connected to the universal edge connector.

c. Inserts shall provide correct pin-to-pin connections, electrical and mechanical matching characteristics for the specific equipment connected to the respective outlet.

d. Inserts for different infrastructures shall be color coded with different colors from each other, for system identifications.

e. Plug-in adapter insert type:

1) Computer/data network systems:

a) ANSI/TIA/EIA 568B, female modular jack 8-position/contact "RJ-45" style.

2) Telephone/intercom voice systems:

a) ANSI/TIA/EIA 568B female modular jack 8-position/contact RJ-45 style.

4. Connector housing:

a. Connector housing shall contain the universal edge connector assembly and the plug-in adapter inserts in a rigid assembly. Connector housing shall provide integral cable strain relief for the permise wiring connection.

b. The connector housing shall mount to a metal panel, metal device cover plate or plastic device cover plate with spring loaded snap-in retainers. Nominal depth of connector housing behind the mounting panel and/or device cover plate shall not exceed 1.625 inches including premise wiring termination depth requirements.

C. Coaxial Cable Connectors

1. General

a. BNC type connectors, for coaxial cable premise/workstation wiring and coaxial cable patch panel equipment.

b. Unless noted otherwise, the BNC connectors shall comply with ANSI/TIA/EIA-568B and related standards, addendums and TSB.

c. Brass body and male contact. Beryllium copper or bronze female contact. Bayonet coupling with threaded or cam-locking mating connection.

d. As manufactured by AMP, Siemons, 3M or equal.

2. Operational characteristics shall match or exceed and shall be compatible with the respective coaxial cable. 75-OHM, operational frequency range 0-4000 MHz.

2.06 FIBER OPTIC FIBER DISTRIBUTION ENCLOSURES

A. General

1. Fiber optic fiber distribution enclosures shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements, ANSI/TIA/EIA - 568B including related standards, amendments and TSB.

B. Equipment Rack Mount Fiber Optic Termination Distribution Enclosure - RTDE

1. The RTDE enclosure shall mount in a EIA standard 19 inch wide enclosed or open frame equipment rack assembly. The RTDE enclosure shall be metal, painted finish, manufacturers standard color. As manufactured by AMP, Siemons, 3M or equal.

2. The RTDE shall provide the following self-contained functions internal to the RTDE assembly.

a. Fiber cable termination.

b. Fiber cable "pig-tail" splicing.

c. Fiber cable patch panel.

d. Fiber cable management, training and strain relief.

e. Individual fiber and patching port identification numbers, color coding of incoming trunk and out-going distribution fiber ports.

f. Plug-in fiber optic interconnection couplers for port to port patching with portable fiber optic patch cords.

3. Fiber splice drawers:

a. Horizontal sliding metal drawers adjustable to approximately 30 degree angle when fully open, and removable for easy access. Each drawer shall contain two fiber optic splice trays with tray holders.

b. Drawers shall stack vertically one above the other in the RTDE and allow sufficient slack in all fiber cables for removal of the drawer and splice trays.

c. Provide one sliding drawer and two splice tray assemblies for each group (24 individual fibers or fewer fibers per group) of fiber optic fibers terminated in the equipment rack, but in no case provide not fewer than two sliding drawers with splice tray assemblies in each RTDE.

4. Fiber cable patch panel

a. Metal panel shall provide a patch port for each fiber consisting of metal panel mounted fiber optic interconnection couplers for each fiber optic fiber indicated to be terminated at the RTDE.

b. The fiber optic fiber interconnection coupler shall be provided to match and be compatible with the fiber cable connectors. Quantity shall match quantity of terminated fibers, unless indicated otherwise on the equipment rack schedules.

c. Nominal panel thickness 0.09 inches.

d. Provide a minimum of 8 unused spaces for additional couplers in the patch panel.

5. Nominal height of the RTDE shall be as follows:

Quantity of Patch Ports	Quantity of Splice Drawers	Nominal Height
24	2	11 inches
48	2	11 inches
72	3	14 inches
144	6	28 inches

2.07 COPPER WIRE PATCH PANELS

A. General

1. Copper wire patch panels shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements, ANSI/TIA/EIA-568B including related standards, amendments and TSB.

B. Equipment Rack Mounted Patch Panel

1. Standard EIA 19" wide metal panel, manufacturers standard color. Prepunched for copper wire outlet connectors. Panel shall mount on a EIA standard 19 inch wide enclosed or open frame equipment rack assembly. Nominal 24 copper wire outlet connectors in a horizontal row, quantity of rows as required for total quantity of connectors. Provide not less than one spare empty rows for future copper wire outlet connectors.

2. The patch panel shall provide the following self contained functions.

a. Copper wire cable termination including conductor termination and strain relief.

b. Plug-in copper wire outlet connectors for port to port patching with copper wire portable patch cords.

3. Patch panel height shall be based on the quantity of copper wire outlet connectors described plus the specified space for future outlets and shall not exceed the following dimension height:

Outlet Quantity	Nominal Patch Panel Height
1-48	3.5 inches
49-96	7 inches
97-125	14 inches

4. Horizontally mounted, cable support metal bracket shall be provided for each 24 outlet/connector groupings. The brackets shall be bolted to the equipment rack located at the back side of the patch panel, the brackets shall support and provide strain relief for each incoming copper wire cable connecting to the patch panel.
5. The copper wire connector installed in the patch panel shall be the same configuration, manufacturer and type as the corresponding copper wire connector provided in the remote workstation outlet locations connecting to the respective patch panel outlet, unless indicated otherwise.

2.08 TELEPHONE/VOICE TERMINAL BLOCKS

A. General
1. Telephone/voice indoor circuits shall comply with the same Category-6 requirements as the copper wire data indoor circuits:
   a. Same horizontal copper wire twisted 4-pairs UTP types and ratings.
   b. Same RJ-45 jacks at workstation outlets and equipment rack patch panels.
   c. Same wire insulation and conductor jacket type, except jacekt color shall be difference for the telephone/voice circuits.
2. Telephone/voice circuits connecting between MDF and IDF equipemnt racks shall be twisted pairs copper wire multiple condutor, UTP, Category-6, 25 pair cable bundles rated for underground installation. Provide the following quantity of multiple bundle cables connecting to the MDF patch panel, but in case less than indicated on the drawings:
   a. Inside each buiding from each IDF to the same building MDF, four (4) 25-pair cable bundles, for 100-pair total.
   b. Site-to-site from each building MDF to the site master/main MDF.
      1) Six (5) 25-pair cable bundles, for 150-pair total for each buiding with a single internal IDF/MDF.
      2) Twelve (12) 25-pair cable bundles, for 300-pair total, each building with two (2) or more internal IDF/MDF.
3. Provide TVSS/lighting protector for each pair of conductors extending site-to-site between buildings IDF to MDF equipment racks. Provide ground connect to room ground bus.

B. Prewired 50 pin-amphenol connectors:
1. Provide factory prewired 50-in amphenol connectors for connection from telephone/voice patch panel to the telephone switch equipment. [and telephone Utility company outside telephone service lines].
2. Provide 50 pair cables complying with ANSI/TIA/EIA-568B and related standards, addendums and TSB, connected to 50 pin amphenol connectors at one end (telephone equipment connection) and connected to the respective telephone/patch panel at the other end.

3. The 50 pin amphenol connectors shall group together and be positioned at the top of the respective equipment rack section near the ceiling.
4. The pin-to-pin conductor assignments shall conform to the telephone switch manufacturer's requirements.
5. The amphenol connector/cable assemblies shall connect to and extend the telephone/voice outlet horizontalpremise wiring from telephone/ voice patch panel to the telephone switch equipment. The amphenol connector/cable assembly shall connect to and extend the telephone utility company outside telephone service lines to the telephone switch equipment.

C Prewired "RJ" style modular jacks

1. Provide factory prewired 8-position/contact plug-in "RJ" style jacks for patch panel portable patch cord cross connects, located on the front side of the equipment racks.
2. The pin-to-pin conductor assignments shall conform to the telephone switch manufacturer's requirements.

2.12 EQUIPMENT RACK

A. General

1. A equipment grounding bus, nominal 19 inches long, UL labeled as a ground terminal bus, shall be provided on each equipment rack. The ground bus shall be bolted to the rack main metal frame member with 1" standoff non-insulating bolts. Provide a minimum of ten drilled and taped bolt holes in the ground bus with ground lug bolts, for connection of equipment grounding conductors to the ground bus, size to accept ground conductors #14-#4 AWG.
2. Vertically mounted, cable management metal rings (aluminum or stainless steel) shall be provided full height, continuously along the front and rear of each vertical rail of the equipment rack. The rings shall be bolted to the equipment rack. The rings shall train and dress portable patch cords connecting between outlet connectors located in the equipment rack or in adjacent equipment racks.
3. Provide horizontal cable management panels with multiple cable training rings on each panel (not less than 5 rings for each panel). Management panels (for up to 24 outlet grouping) nominal 19 inches wide x 1.75 inches high x 3 inches deep and/or (for up to 48 outlet groupings) 3.5 inch high x 3 inches deep, for EIA rack installation. Rings shall provide horizontal routing and support by grouping portable patch cords connecting between patch ports in the same equipment rack or adjacent racks. Patch cords shall be grouped and bundled with "Velcor" tie wraps and shall not overlap patch fields or rack mounted equipment.

   The panels shall be installed on both the front and rear of the equipment racks, mounted both above and below horizontally between groups of patch ports as follows:

   a. One cable management panel (front and rear of rack) for each group of 48 or less copper wire outlets for patch ports.
   b. One cable management panel (front and rear of rack) for each group of 48 fiber optic outlet patch ports.
4. The entire rack assembly including any support arms shall comply with seismic zone 4 earthquake structural standards. The assembly shall provide support for the weight of the equipment installed on the rack, but in no case less than 500 pounds of equipment, plus the weight of the rack and connecting cables. Mini-equipment wall racks shall be rated for not less than 150 pounds of equipment A 2.0 times safety factor shall be included in the equipment rack assembly structural design.
5. Provide Transient Voltage Surge and RF Suppresser (TVSS), a 120 volt - 1 phase, 20 ampere 60 HZ A.C. plug horizontal strip, mounted in each equipment rack. The TVSS shall contain not less than(8) eight "plug-in" on the rear of the

TVSS and not less than two (2) on the front of the TVSS protected outlet plugs. (Refer to other specification sections for additional specific TVSS requirements.)

6. Provide pre-drilled mounting holes the entire length of equipment vertical mounting frames, EIA-310D-19 inch (nominal) wide standard spacing for indicated equipment. Racks shall provide 17.75 inches (nominal) equipment horizontal mounting space between vertical rails.
7. Provide all floor standing equipment racks with wall bracket support arms extending from the stationary portion of the rack to adjacent wall. Provide "dual-rail arm" cable "runway tray", horizontally from each equipment rack, to the wall directly behind the equipment rack
   a. The tray shall extend from and bolt to the top of the equipment rack "fixed" top rail.
   b. The tray side rail arms shall be a minimum of 6-inches deep, with "ladder" type rungs spanning horizontally between the side rail arms. The rail arms shall be parallel with each other. The rail-to-rail arm spacing shall be the same as the equipment rack width.
   c. The rungs shall be spaced not more than 6-inches on center between the side rails, along the length of the side rail arms. The rungs shall have a minimum cable bearing surface of not less than 0.75 inches, lengthwise along the tray.
   d. The runway tray shall support a minimum of 200 pounds per linear foot live conductor/cable loading, with not more than 0.25 inches deflection at mid-span.
   e. Provide a continuous horizontal support "C" channel along the wall behind the equipment racks and bolt the dual-rail arm cable runway tray to the channel at the wall. The channel elevation on the wall above the finish floor, shall support the runway tray horizontally (± 0.2 inches), from the equipment rack to the wall.
   f. Equipment racks shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements, ANSI/TIA/EIA-568B including related standards, amendments and TSB.
   g. The wall mounted horizontal support channel shall be securely through bolt to wall structural member, a minimum of 16 inches on center. The horizontal support channel shall extend a minimum of 6-inches past each side of the runway tray. As manufactured by Unistrut-P1001C series, B-Line or approved equal.
   h. Equipment racks shall be manufacturer's standard rust inhibitor primer. Manufacturer's standard color finish paint over primer, Unless noted otherwise.

B. Fixed Position Floor Standing Open Frame Equipment Racks:
   1. Floor mounted self supporting rack, nominal 78 inches of usable mounting frame height for equipment, as manufactured by Siemons, B-Line; Saunders; Hendry or equal.
   2. Bolted or welded hot dip galvanized steel or gold iridite finish aluminum support frame. Hardware shall be stainless steel.
   3. Open frame rack construction, fixed, non-swing gate, "4-post" (vertical) support type.

E. Mini-Equipment Racks Sectional – Surface Wall Mount (Indoor Locations Only)
   1. The mini-equipment rack shall be fully metal enclosed, tamper resistant, wall surface mounted, multiple section construction. The rack shall consist of 3-sections; a fixed wall mounting pan; a hinged center section and a hinged door. The rack shall provide a minimum of 20" clear internal depth for mounting of

equipment inside the rack. Provide brackets inside the pan for stress relief, training/lacing, support of cables. As manufactured by Black Box #RM-A-R2 series.

2. The mini-equipment racks nominal dimensions shall be as follows:
   a. Overall depth 26 inches.
   b. Overall width 22 inches.
   c. 30 inch overall height, for termination of up to a quantity of 24 copper wire workstation patch panel outlets and up to a quantity of 12 individual fiber strands combined, into the mini-equipment rack.
   d. 40 inch overall height, for termination of up to quantity of 48 copper wire workstation patch panel outlets and up to a quantity of 48 individual fiber strands combined into the mini-equipment rack.
3. Fixed wall, surface mounted pan section, nominal 3 inches pan depth, metal enclosed on all sides and back, open front; shall anchor the rack to the wall; provide support for the hinged center rack section and provide knockouts for side/top/bottom and rear conduit/raceway entrances.
4. Center section, metal enclosed on all sides, open front and rear, nominal 16 inch depth, full height and width hinged attachments to the pan-section, to provide hinged 90 degrees open-close operation of the center section on the pan and allow access to the front and rear of equipment and terminations mounted inside the center section. Two internal vertical, front mounted, pre-drilled equipment mounting frame rails.
5. Front access door section, metal, full height and width hinged 90 degree open-close operation attached to the center section. The door shall allow for 2.45 inches minimum of interior projections extending from the front face of the internally mounted equipment located behind the front access door when the access door is in the closed position. Clear plexiglass view window in the door.
6. Minimum 16 gauge metal, fully welded construction; Manufacturer's standard rust inhibitor "prime" base coating, with "finish" color [black or as selected by Architect]. The equipment racks shall provide support for the weight of the equipment installed in the rack, but in no case less than 150 pounds (instead of 500 pounds) of equipment plus the weight of the rack and connecting cables.
7. Provide two (2), 120 volt 60Hz A.C. motor direct driven air ventilation, "muffin" style, nominal 4 inches square, exhaust air fans. Flush mount fans in the top of each equipment rack. The fans shall be low speed, low noise type with wire guards to prevent accident contact with the fan blades. The fan motor shall be high impedance, self protecting type motors. Provide "SO" cord with plug caps to connect from the fans to the 120 volt plug-strip inside the equipment rack.
8. Provide cooling air intake louvers with removable air filters and air filter holder, mounted in the bottom of the rack. The louver shall be protected with internal screening to prevent the intentional insertion of foreign objects into the housing.
9. The mini-equipment rack shall be easily convertible in the field, to allow for "left" or "right" center section and/or door section hinge operation. Provide a minimum of two key-locks on each hinged section to prevent unauthorized access into the unit. Provide gasketing on all "mating" cabinet interfaces to insure proper cooling air flow through the air filters.

2.13 SPLICE TRAY FIBER OPTIC FIBERS

A. General
   1. Trays shall be suitable for installation in equipment racks and enclosures. The trays shall be the same product as the manufacturer of the enclosures.
   2. Splice trays shall be UL listed, complying with national Electrical Code, ETL tested and certified to comply with or exceed specified requirements, ANSI/TIA/EIA-568B including related standards, amendments and TSB.

B. Splice Trays

1. A metal or non metal splice tray shall provide space for up to 24 splices of individual fiber cable single mode and multimode optical fibers. The trays shall provide individual splice holder inserts for each splice to adapt the tray for mechanical or fusion splices, with or without splice sleeves.
2. The tray shall incorporate integral fiber tie down clamps, fiber routing rings, provide strain relief and two full 360 degree fiber loops around the tray perimeter with sufficient slack fiber for removal of the tray for access and splicing of the fiber cable. The tray shall insure the minimum bending radius of the optical fibers is not violated.
3. Provide a removable clear plastic tray top cover for each tray, to protect and isolate the fibers.

2.14 WORK STATION OUTLETS

A. General

1. Engrave outlet cover plates with the port number corresponding to the port number at the respective terminal block, patch panel, or head-end equipment.
2. The outlet cover plates shall be factory prepunched and formed to accommodate the installed outlet connector with attachment screws.
3. Workstation outlets shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements, ANSI/TIA/EIA-568B including related standards, amendments and TSB.

B. Computer/Data Workstation Copperwire Outlets

1. The outlets shall be the same configuration, manufacturer and type as the corresponding connector provided in the copper wire patch panel outlet, unless noted otherwise.
2. ANSI/TIA/EIA-568B, and related standards, addendums and TSB.
3. The copper wire outlet connectors for twisted pair wire connections in computer workstation outlets shall be universal outlet connector RJ-45 type.

C. Telephone/Voice Handset Twisted Pair Wire Connection Work Station Outlets

1. The copper wire outlet connectors provided in telephone/voice handset outlets, shall be universal outlet connector type, unless noted otherwise, ANSI/TIA/EIA 568B and related standards , addendums and TSB.
   a. RJ-45 type
2. The outlets shall be the product of the same manufacturer as the computer/data workstation outlets.

E. Fiber Optic Workstation Outlets

1. The fiber optic outlet connectors workstation outlets shall be fiber optic fiber interconnection couplers, installed in universal outlet connectors. Provide one (1) coupler for each fiber connecting to the outlet, but in no case less than the following for each outlet and as shown on the Drawing:
   a. Computer workstation data network- two (2) couplers.
   b. Data network server - four (4) couplers.
2. The universal outlet connector housing and coverplates shall be the same as copper wire outlet connectors, except with adapters for fiber optic interconnection couplers, for the fiber optic fibers plug-in connectors.
3. The centerline-to-centerline spacing of the interconnection couplers shall provide for "plug-in" insertion of "single or duplex" fiber connectors.
4. Color code and identify the "in"-receiving and "out"-transmitting position for each interconnection coupler.

F. Outlet Boxes
   1. Wall mounted
      a. Flush or surface and size wall mounted outlet box as indicated on the drawings, but in no case less than 4.69 inches x 4.69 inches x 2.125 inches deep.
      b. 1-gang wide extension ring for outlet box to extend outlet flush with finish surface, or as noted on the drawings.
      c. 1-gang wide cover plate, or as noted on the drawings.
   2. Pedestal Mounted "Poke-Thru".
      a. Shall combine a computer/data and a telephone/voice copper wire universal outlet connector in a duplex outlet in the pedestal/poke-thru outlet.
   3. Inside flush floor boxes and other locations where indicated in the contract documents.

G. Multioutlet Raceway Work Station Outlets
   1. Copper wire outlet:
      a. Where copper wire connection is indicated for the workstation outlet, provide one universal outlet connector for each outlet.
      b. Each universal outlet connector shall be single connector housing type.
      c. Provide a rectangular cutout and metal device plate in the raceway sized to outlet manufacturer's recommendations. The workstation copper wire outlet shall mount a modular faceplate kit with outlet bezel and faceplate sized to match the workstation outlet.
      d. Offset the location of outlets for electronic network systems 6 inches in the raceway from other outlets, do not "stack" outlets one above the other in the raceway.
   2. Fiber optic outlet:

H. Combination Outlets
   1. Infrastructure outlet connectors shown at the same location for either wall box outlet locations and floor box outlets locations.
   2. The outlet connectors shall be installed in a common outlet box with a common cover plate in the respective wall location or floor location.
   3. In infrastructure patch panels install the connectors in the respective patch panels.

2.17 PORTABLE PATCH CORDS

A. General
   1. Provide portable patch cords for all copper wire and fiber optic cabled infrastructure outlets:
      a. For interconnecting electronic network equipment to electronic network workstation outlets.
      b. For interconnecting equipment rack patch panel outlet patch locations with each other.
      c. For interconnecting patch panel outlets equipment rack mounted hubs, switches, routers etc.
   2. Patch cords shall be factory assembled tested and certified with factory terminated plugs at each end. Field terminated portable patch cords shall not be permitted. Terminated plugs shall incorporate integral bending radius limiting molded "boots" and strain relief. Patch cord assemblies shall be rated for "heavy duty", "high-abuse" service.
   3. Patch cords shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements. ANSI/EIA/T1A 568B, related standards, addendums & TSB.

a. NEC/CEC - OFNG/OFN for fiber optic portable patch cords.
b. NEC/CEC - MPP/CMP/CMR/CMG/MPG for copper wire twisted pair portable patch cords.

4. Patch cords which are not installed shall be delivered to the OWNER in cardboard boxes. The patch cords shall be neatly bundled and tied together. Mark each box with quantity and type of cords contained in the box.
5. Patch cords shall comply with the same cable communication performance requirements and testing requirements as the respective infrastructure cables and outlets to which the patch cords are intended to be connected (plug-in).
6. The outer jacket of each portable patch cord shall be imprinted with date, manufacturer's model and catalog number and AHJ listing identification.

B. Computer/Data Copper Wire Portable Patch Cords

1. Computer/data patch general:
   a. "Male" eight (8) position modular "RJ" male style jacks install on each end of the patch cord cable. The jack shall be provided with a rear "fin" to prevent the plug tab from snagging when pulled backwards through adjacent wiring.
   b. Patch cord cable shall be UTP to match permise wiring, 4-pair twisted, stranded copper individually insulated wires, thermoplastic jacket over all the wires and shield.
   c. Connectors shall comply with FCC 68.5 and Part 68 Subpart F.
   d. Connectors UL listed and shall comply with UL-94V-O.
   e. Contacts gold plated with not less than a 750 insertion/with drawl cycle rating.
2. Patch cord quantities and lengths for connecting port-to-port equipment rack patch panels
   a. Patch cord quantity: Provide one complete patch cord assembly for each copper wire computer workstation outlet port in the equipment rack patch panels. One-to-one straight through pin-to-pin wiring. Provide additional spare patch cords, quantity equal to 25% of the total quantity of patch cords provided for copper wire computer workstation outlets in the equipment rack patch panels. Cable jacket color shall be yellow:
   b. Provide the following lengths of copper wire patch cables for copper wire equipment rack patch panel outlets.
      1) 2 ft. long - 10% of total quantity
      2) 4 ft. long - 30% of total quantity
      3) 6 ft. long - 30% of total quantity
      4) 10 ft. long - 20% of total quantity
      5) 16 ft. long - 10% of total quantity
3. Patch cord quantities and lengths - for connection from computer workstations to computer workstation outlets.
   a. Patch cord quantity: Provide one complete patch cord assembly for each copper wire computer workstation outlet located remote from the equipment rack patch panels. Provide additional spare patch cords, quantity equal to 15% of the total quantity of patch cords provided for each copper wire computer workstation outlets. Cable jacket color shall be black.
      1) Ethernet network outlet segments the pin-to-pin patch cord wiring configuration and jacks shall be compatible with the network interface card, and computer workstation outlet.
   b. Provide the following lengths of copper wire patch cables for copper wire computer workstation outlets. The patch cords shall provide internal cross over wiring to conform the pin-to-pin connections required between the computer workstation outlet and the network interface card installed in the respective computer workstation:

1) 8 ft. long - 30% of total quantity
2) 15 ft. long - 70% of total quantity

4. Patch cord quantities and lengths - for connection from equipment rack patch panel ports to network HUB and concentrator equipment ports; between network HUB and network concentrator equipment ports. Cable jacket color shall be white.
   a. Patch cord quantity: Provide one complete patch cord assembly for each copper wire outlet port located in network HUBS and network concentrator equipment. Provide additional spare patch cords, quantity equal to 15% of the total quantity of HUB and concentrator ports.
      1) Ethernet network outlet segments - the pin-to-pin patch cord wiring configuration and jacks shall be compatible with the respective network equipment and patch panel outlets as applicable.
   b. Provide the following lengths of copper wire patch cables for outlet ports located in network HUBS and network concentrators. The patch cords shall provide quantity of conductors, internal crossover wiring to conform the pin-to-pin connectors and jack/connectors to the ports in the HUB's concentrators and equipment rack patch panels.
      1) 4 ft. long - 15% of total quantity
      2) 6 ft. long - 30% of total quantity
      3) 10 ft. long - 35% of total quantity
      4) 16 ft. long - 20% of total quantity

C. Telephone/Voice Copper Wire Portable Patch Cords
1. Patch cords shall be UTP 4-pair twisted, 24 AWG stranded copper individually insulated wires with a thermoplastic jacket over all the wires. Cable shall be ANSI/TIA/EIA 568B.
2. Patch cord quantity and length - telephone/voice terminal block:
   a. Provide one complete patch cord assembly for each copper wire telephone/voice outlet connecting to the telephone/voice terminal block. Provide additional spare patch cords, quantity equal to 25% of the total quantity of patch cords provided for telephone/voice patch cords.
   b. Provide the following lengths of copper wire patch cables for telephone/voice connecting block portable patch cords.
      1) 3 ft. long - 25% of total
      2) 5 ft. long - 50% of total
      3) 15 ft long - 25% of total

D. Fiber Optic Portable Patch Cords
1. General
   a. Provide fiber optic fiber connectors installed on each fiber end of the patch cord cable. The fiber optic portable patch cord shall be 50% "single" with one fiber strand and 50% "duplex" with two fiber strands type, for each patch cable. The connector shall be mechanically and optical compatible with the respective connecting patch panel couplers and network work equipment couplers.
   b. The entire patch cord assembly total insertion loss shall be less than 1.0 dB at the specified operating wave lengths.
   c. Operating temperature range - 30 degrees centigrade through +60 degrees centigrade. Cables shall be flame retarding.
   d. Each fiber shall be individually identified with factory color coding or factory imprinted label. The outer cable jacket shall be imprinted with date, manufacturer's model and catalog number, along with agency listing identification. The cable jacket color shall be manufacturer's standard color, except black or yellow jacket color shall be unacceptable.

e. All fiber optic patch cord cable shall be produced by the same manufacturer.

f. Optical fiber shall be coated, 900 micron diameter uniform coating, with uniform tight buffering over the coating, uniform dielectric strength member surrounding the buffering coating and an overall jacket around each optical fiber assembly.

g. A dielectric strength member shall surround the fiber assemblies.

h. An outer dielectric jacket shall envelope the entire cable.

i. The cable shall be UL listed and comply with NEC and NFPA requirements for each installation location shown in the Contract Documents.

j. Patch cord quantity and length

a) Patch cord quantity: Provide one complete patch cord assembly for each fiber optic patch panel outlet in the equipment rack.

b) Provide one complete patch cord assembly for each computer workstation fiber optic outlet remote from the patch panel.

c) Provide additional spare patch cords, quantity equal to 25 percent of the total quantity of patch cords provided.

k. Provide the following quantities and lengths of fiber optic patch cords.

1) 3 ft. long - 20% of total

2) 6 ft. long - 35% of total

3) 10 ft. long - 30% of total

4) 20 ft. long - 15% of total

2. Multimode patch cords

a. Patch cord cable shall be fiber optic cable with equal or better characteristics as the premise fiber optic cables.

PART 3 - EXECUTION

3.01 NETWORK CABLE TESTING

A. General

1. In addition to the testing recommended in ANSI/TIA/ EIA-568B and related standards, amendments and TSB, test each individual optical fiber, each copper wire conductor, and each connector in all terminated and unterminated cables, portable patch cord, outlet and patch panel provided in the contract shall be tested after installation splicing and termination is completed.

2.

	Cable Circuit	Type of TEST
a.	Each patch panel to patch panel segment	Attenuation Test and Signature Trace Test
b.	Each patch panel to workstation outlet	Attenuation Test Ring-out Test
c.	Transmission link performance	ANSI/EIA/TIA-T5B67
d.	Electronic network equipment port to port and port to work station outlet	Transmitter Receiver Level Test
e.	"NEXT" test	Each End of Each Circuit

3. Provide six (6) copies of all test reports, bound in three ring binders to Owner's Representative.

4. The CONTRACTOR shall repair or replace equipment, cables, outlets, connectors, splices, terminations, etc. identified during testing as not complying with

the contract documents, without additional cost to the contract. Retest all replaced or repaired components at CONTRACTOR'S expenses.

B. Attenuation Testing
   1. Attenuation shall be measured at each of the following wave lengths.
      a. Fiber optic cables:
         1) Up through all rated wave length frequencies
      b. Copper wire cables:
         1) Up through all rated frequencies.
   2. End to end attenuation termination points measure the power loss between end points, from both directions.
   3. End to end attenuation testing shall be performed with a temporary test jumper cable at each end of the installed fiber cable. Test jumper cables shall be the same size as the installed cable. The measured attenuation of the test jumpers, test connectors, and test interconnection sleeve between the two test jumper shall be less than 1dB as calibrated at the time of the test at indicated wave lengths and frequencies.

C. Signature Trace Testing
   1. Test equipment:
      a. Optical Time Domain Reflectometer (OTDR) for fiber optic cable.
      b. Time Domain Reflectometer for copper wire cable (TDR).
      c. Test instruments shall be high resolution characteristics (less than 15 feet point to point resolution) and hard copy print out of the signature trace.
   2. The test instrument trace shall show the "as-built" relative power in dB verses cable distance along the entire cable length as follows:
      a. Determine the point to point continuity of each optical fiber and copper wire conductor.
      b. Measure the normalized cable loss at the specified wavelength or frequency in dB/ft for each fiber and copper wire conductor.
      c. Detect fault points and discontinuity in the cable for each fiber and copper wire conductor.
      d. Measure the length of the cable.
      e. Measure the location and losses of individual splices and connectors in each fiber and copper wire conductor.

D. Ring-Out Test
   1. Test the pin-to-pin continuity of each copper wire conductor. The test shall verify the outlet end to outlet end continuity of each conductor and the correct pin-to-pin orientation and polarity between each interconnected outlet.
   2. Test voltage shall not exceed 100 volts DC or AC.

E. Transmission Link Performance
   1. Provide end-to-end testing certification of the transmission performance of each network channel link including cabling, patch cords, connectors, outlets and hardware.

F. Transmitter Receiver Level Testing
   1. Measure the Transmitter Output Power (TOP) and Receiver Power Level (RPL) at the operative wave length and frequency of the installed equipment electronics.
   2. Transmitter output power - connect the measure power meter to the transmitter output and the output power in dBM, compare the measured output value with transmitter output specification.

3. Receiver power level connect the power meter to the receiving end (outlet) and measure the received power in dBM to verify the receiver power level for the installed system is within the receiver operating specifications.

3.02 FIBER OPTIC CABLE TYPE

A. Cables shown as fiber optic type shall comply with the following installation locations.

B. Provide indoor/outdoor type fiber optic cable for any of the following installation location conditions.
   1. Inter building (between buildings)
   2. In a conduit or raceway located underground below grade.
   3. In an exposed outdoor conduit or raceway not located underground or below grade.

C. Provide FHC-25/50 plenum rated type fiber optic cable for any of the following installation location conditions.
   1. In any air plenum (supply or return) when a conduit or enclosing raceway is not provided for the entire cable length.
   2. Where the cable is installed without a conduit or the cable is not fully enclosed in a raceway along the entire cable length in a building.

E. Optical Fiber Quantity:
   1. The minimum fiber quantities in each fiber optic cable shall be as follows, but in no case less than indicated on the drawings.
   2. Between main IDF (SUB-MDF) in separate buildings and the MDF main terminal rack fiber optic patch bay for the entire site/campus.
      a. Twenty-four (24) optical fibers, multimode.
   3. Between satellite IDF terminal rack fiber optic patch bays and the main terminal rack IDF (sub-MDF) patch bay located in the same building.
      a. Twenty-four (24) optical fibers, multimode.
   4. Between a terminal rack patch bay:
      a. To each network file server outlet location whether or not shown on the drawings, four (4) optical fiber, multimode.
   5. Other locations as indicated on the drawings or described in the contract documents.

3.03 COPPER WIRE CABLE TYPE

A. Cables shown as copper wire type shall comply with the following installation conditions, unless noted otherwise on the drawings.

B. Cable Types and Quantities - Cable types and quantities shall be as follows unless specifically noted otherwise on the drawings. The following minimum type and quantity of copper wire cables from each individual workstation/device outlet, to the respective terminal equipment patch panel/bay, (unless specifically noted otherwise), but in no case less than what is shown on the drawings and in no case less than one (1) four-pair cable to each outlet "Jack" position:
   1. One (1) Category-6, UTP 4-pair cable, for each computer workstation outlet location.
   2. One (1) Category-6 UTP 4-pair cable, for each telephone handset (instrument) workstation outlet location.
   3. Two (2) RG6 (QUAD) coaxial cables for each broadband television/video outlet device location.

C. Provide FHC-25/50 plenum rated copper wire cable for any of the following installation location conditions.

1. In any air plenum (supply or return) when a conduit or enclosed raceway is not provided for the entire cable length.
2. Where the cable is installed without a conduit or the cable is not fully enclosed in a raceway along the entire cable length in the building.

3.04 CABLE INSTALLATION

A. General

1. Cables connecting to equipment racks and terminal blocks shall be installed with not less than six feet of slack cable between the equipment rack/terminal block and terminal backboard. The slack cable shall be coiled and supported on the backboard and/or cable tray.
2. Cables in terminal closets and terminal rooms shall be trained, dressed and racked on the plywood backboards. Provide cable, metal support arms and re-enterable type cable support rings not less than 12 inches on center mounted onto the plywood along the entire length of all cables.
3. Provide separate routing paths on plywood backboards for fiber optic cables, computer data, copper wire cables [and telephone/voice copper wire cables. Provide separate routing paths on plywood backboards for shielded copper wire cables and unshielded copper wire cables.
4. Cables shall be routed parallel to floors and walls. Do not route cables diagonally on backboards.
5. Provide 25 feet of cable slack where unterminated cables are specified at terminal backboards. Provide a minimum of 18 inches of slack cable in each workstation outlet box and outlet locations. Provide 24 inches of slack in each cable at patch panel locations. Coil and "tye" wrap slack cable.
6. Provide cables installed from individual computer/data workstation outlets to respective terminal closet/room patch panel. Cables shall be continuous without cutting or splices.
7. Provide cables installed from individual workstation telephone/voice handset outlets to respective terminal closet/room terminal block/patch panel. Cables shall be continuous without cutting or splices.
8. Provide cables installed from individual multimedia, TV outlets to respective terminal closet/room patch panel. Cables shall be continuous without cutting or splices.
9. Provide cables installed between MDF/IDF terminal rooms/closets continuous without cutting or splices.

B. Cable Pulling Lubrication

1. Cable pulling lubricants shall be specifically approved by the cable manufacturer. The following lubricants shall be used where approved by the cable manufacturer.
   a. Slip X -300, American Colliod Co.
   b. Bishop #45, Bishop Electric.
   c. MacLube CA51, MacProducts.
   d. Minerallac H2B,- Minerallac Electric.
   e. Winter grade #7437-PC, General Machine Products.
   f. Gel-lube 7/5 , Cable associates.
   g. Polywater , A, C, G - American Polywater.
2. Lubricants shall be continuously applied as cable enters raceway.

C. Cable Installation:

1. Do not pull conductors until factory test reports have been submitted and reviewed.

2. Minimum bending radius of fiber optic cables shall not be less than the following. Maximum pulling tension shall not exceed the following. In no case shall the manufacturer's recommendations be violated.

Cable Type	Cable Fiber Quantity	Minimum Bend Radius	Maximum Pulling Tension
Tight Buffered	2-12	5 inches	400 pounds
Tight Buffered	14-24	7 inches	600 pounds
Tight Buffered	26-28	11 inches	1100 pounds
Tight Buffered	48-72	12 inches	1200 pounds

3. The minimum bending radius for copper wire cables shall be 10 times the cable outside diameter. The maximum pulling tension and minimum bending radius shall not violate manufacturer's recommendations.
4. Cables installed in manholes and pullboxes on terminal backboards shall be installed on wall mounted cable support racks.
5. Provide a full 360 degree loop of cable around manhole and pullbox interiors.
6. The attachment of pulling devices directly to the cables shall be with individual split mesh basket grips. Direct connection for pulling cables to cable fibers and copper wires shall not occur. Securely tape cable ends to prevent moisture or pulling compound from penetrating cable.
7. The attachment of the pulling device to the cable basket grips shall be made through a swivel connector.
8. The Contractor shall ensure that the cables are fed straight into the raceway taking care to avoid short bends, sharp edges and cable "cross-overs".
9. All lashings used for temporary bunching of the individual cables shall be removed before the cables enter the raceway.
10. Cables shall be "pulled through" or pulled from a "center of run pull" without splices or terminations and minimize cable rolling tension. Leadout the cables at all manholes, pullboxes and conduits taking care to feed them in again by hand for the next portion of the cable run.
11. For each cable pull where a cable direction change is required, flexible feed-in tubes, pullout devices, multi-segmented sheaves etc. shall be used to insure proper cable pulling tensions and side wall pressures. Cables shall not be pulled directly around a short right angle bend. Any device or surface the cable comes in contact with when under pull-in tension shall have a minimum radius 50% greater than the final specified minimum installed cable bending radius. The maximum possible size radius sheaves and feed-in tubes, usable in the available working space, shall be provided in all situations, to insure the minimum possible cable sidewall pulling pressure. Do not use devices with multi-segment "roller" type sheaves.
12. Cable lengths over 50 feet shall be machine pulled not hand pulled into and through all raceways. Cables shall be pulled in a continuous, smooth operation without jerking or stop-start motion after initiation of pull. Maximum cable pulling speed shall be less than 50 feet per minute. Minimum cable pulling speed shall be greater than 15 feet per minute.
13. Cables shall be pulled straight into or out of the raceway without bends at the raceway entrance or exit. Pull in cable from the end having the sharpest bend (i.e., bend shall be closest to reel). Keep pulling tension to minimum by liberal use of lubricant, hand turning of reel, and slack feeding of cable into duct entrance. Employ not less than one man at reel and one at manhole or pullhole during this operation. Cables shall be pulled directly from cable reels.
14. Cables shall be trained or racked in trenches, vaults, manholes and pull boxes with consideration given for the minimum specified bending radius of the cable and the possibility of cable movements due to load cycling. The cables shall be

racked and supported in such a manner that adequate space is allowed for splicing and the cables shall always be fanned out from the duct or conduit so as not to cross other ducts, conduits or cables. To prevent damage from falling objects or personnel entering the manhole the cables shall not pass directly under the manhole opening.

15. Cable shall be supported in manholes, pull boxes and vaults a minimum of 18 " on center with cable racks. Provide hot dip galvanized, T-slot racks and support arms. Secure cables to racks with porcelain supports for each cable on the racks. Loosely lash cables to racks. Splices shall be directly supported, on racks. Do not install cables more then one feeder on the same rack hook.
16. Cables shall be routed the long way around manhole, pullhole, etc. with not less than a full 360 degree loop around the perimeter walls unless noted otherwise.
17. Existing conductors shall be protected at all times when contract work occurs in the same area, including but not limited to pullboxes, vaults manholes, cable trenches etc. Provide temporary electrical insulating blankets and barriers over existing conductors to reduce the possibility of accidental mechanical damage to existing conductors.
18. Where cable tray is provided, all cables shall be routed and trained on the cable tray. The cables shall enter the cable tray and route along the tray prior to entering any equipment racks or computer works station outlets.
19. A dynamometer to measure pulling tension shall be used on all cable runs in excess 200 feet or with more than 180 degrees in bends. The actual pulling tension value shall be calculated and recorded for each pull.
20. Bends shall not be made in cable splices or terminations.
21. The portions of cables installed without raceways or cable tray supports shall be installed with "J-hook" cable supports.
    a. The "J-hooks" shall provide multitiered "J" shaped hooks, with wide flat cable support base (0.5 inch wire minimum) and smooth rounded corners, specifically designed for copper wire and fiber optic infrastructure cable support. As manufactured by Erico Inc.
    b. The individual "J-hook" attachment to the building structure shall be "beam clamp", "hanger rod", clevis hanger styles.
    c. Install "J-hooks" not more than 48 inches on center along the entire cable length, within 6 inches of each cable change in direction. Locations of "J-Hooks" and tension of cables shall insure between 4-inches and 6 inches of cable sag between adjacent hooks. Secure cables to "J-hooks" with cable tie wraps. "J-hook" supported cables, bundle cables together with tie wraps not less than 12 inches on center along the entire cable length.
    d. Each J-hook shall not support more than 12 individual cables. Provide multiple "tiered" J-hooks for additional cable quantities at each location.
    e. "Bridle rings" shall NOT be used to support cables.
    f. Cables shall not lay directly on ceilings, ceiling hangers, lighting fixtures, air ducts, piping, or equipment.
22. Electronic network cables containing non-dielectric components shall be installed with a minimum separation from other electrical power conductors and equipment as follows:

Equipment Type		Minimum Separation
a.	Lighting fixtures	12 inches
b.	Electric motors, electric solenoids, electric Heaters	40 inches
c.	Transformers	48 inches

d.	Circuits over 100 volts to ground, in metallic raceways	5 inches
e.	Circuits over 100 volts to ground, in non-metallic raceway or without any raceway	12 inches
f.	Circuits over 100 volts to ground, suspended on overhead pole lines	48 inches

D. Movement, Storage, and Handling of Cable:
1. Reels of cable shall not be dropped from any height, from trucks or other transporting equipment.
2. Lift and move cable reels using following methods:
   a. Crane or boom type equipment-insert shaft (heavy rod or pipe) through reel hubs and lift with slings on shaft, with spreader or yoke to reduce or avoid sling pressure against reel head.
   b. Fork lift type of equipment may be used to move smaller, narrower width reels. Fork times should be placed so that lift pressure is on reel heads, not on cable, and shall reach all the way across reels so lift is against both reel heads.
   c. Reels may be moved short distances by rolling. Reels shall be rolled in the direction indicated by arrows painted on reel heads. Surfaces over which the reels are to be rolled shall be solid clear of debris, and also clear of protruding stones, humps, etc. which might damage the cable if the reel straddles them.
3. Storage of reels of cable:
   a. Cable ends shall be sealed prior to shipment to prevent moisture entry into cable. Cable ends shall remain sealed at all times including during installation. Where ends seals are removed, reseal cable ends by stripping cable finishes back 2" down to insulation. Then apply four layers of an insulating tape criss-cross over the cable end and carry back at least 4" onto cable outer finish. Add a containing cover of two layers of vinyl electrical tape completely over the end seal.
   b. Cable reels shall be shipped with factory applied lagging (protective cover) left in place until removal is absolutely necessary. Additional covering such as tarpaulin, plastic sheeting, etc. shall be used if cable is to be stored outdoors.
   c. Store reels of cable on a firm surface, paved, or on planking to prevent settling into soft ground.
   d. Use fencing or other barriers to protect cables and reels against damage by vehicles or other equipment moving about in the storage area.

3.05 CABLE SPLICES

A. General
1. Splice(s) in cables shall occur only in the following locations:
   a. Terminal backboard, closets or rooms.
   b. Equipment racks.
   c. Wall mounted interface cabinet.
   d. Do not splice cables in conduit, cable tray, raceways or plenums.
2. Polarity and color coding shall be maintained consistent through splices, terminations and outlets for the entire electronic network system.

B. Fiber optic cable splices unless specifically indicated otherwise below fiber optic cable splices between fiber optic cables fibers shall be fusion type splices/

C. Copper Wire Splice
1. Copper wire extending from infrastructure workstation outlets to respective equipment rack patch panel outlets shall not be cut or broken and shall be continuous end to end.
2. Copper wire extending from telephone/voice workstation outlets to respective terminal blocks shall not be cut or broken and shall be continuous end to end.
3. Continuity of cable shields (where occurs), polarity and color coding shall be maintained across all splices.
4. Copperwire splices shall be performed to maintain the data transmission rates specified for the entire respective system.

3.06 CABLE TERMINATIONS

A. General
1. Infrastructure workstation outlets connecting to ports in patch panels [and terminal blocks] shall be grouped together in the patch panel [and terminal block] by outlet function, room location and building area location (i.e. Group #I Room #120 1st floor; Group #2 Room 200 east wing, etc.). Each group shall be identified with engraved (etched) nameplates indicating grouping identification and individual port numbers.
2. Polarity and color coding of cable connections at splices, terminations and outlets shall be consistently maintained throughout the entire electronic network system.
3. Terminate all cables onto respective outlets connectors, interconnection couplers and terminals. Terminations shall comply with manufacturer's recommendations, ANSI/TIA/EIA-568B related standards, amendments and TSB.
4. Fiber optic cable fiber strands and copper wire cable conductors terminated at outlet locations shall be connected with a strain relief device attached to the cable jacket to prevent cable tension from being transmitted to the termination connectors.

B. Fiber Optic Terminations
1. Individual fiber optic fibers shall each be terminated with a fiber optic fiber connector. The connector for each fiber shall be "plugged" into separate fiber optic fiber interconnection couplers on the rear of each respective outlet.
2. Each fiber optic termination ferrule shall be inspected, after completion of the termination, visually with a fiber optic inspection microscope and an interferometer, to insure fiber "undercut", "protruding" fiber, over polish and underpolish of fiber termination ends does not exist in the finished termination ferrule.
3. Fiber optic cables terminated between two fiber optic patch panels located in separate equipment racks. The fibers shall be paired together for purposes of identification. Each pair of connectors for fibers shall be "plugged" into separate, physically adjacent fiber optic fiber interconnection couplers at each patch panel. The horizontal/vertical arrangement of paired patch panel fiber couplers shall match at both ends of the fiber cable.
4. Fiber optic cable fiber strands terminated at patch panels shall be installed with a minimum of 540 degrees of each fiber strand looped around the splice tray individual fiber "training" rings.
5. Fiber optic cable connecting from infrastructure workstation outlet to a fiber optic patch panel.
   a. The connectors for fibers shall be "plugged" into separate, physically adjacent fiber optic fiber interconnection couplers.

b. The patch panel coupler shall be color coded to identify the polarity of the transmitting and receiving optical fibers.

6. Fiber optic cable connections at workstation outlets.

a. The connectors for fibers shall be "plugged" into separate physically adjacent fiber optic fiber interconnection couplers in the outlet.

C. Copper Wire Terminations

1. Where occurs, the shield on metal shielded copper wire shall be terminated and connected to the shield grounding connection at each termination point.
2. Twisted wire pairs shall not be untwisted for a length of more than 0.4 inches at any location and the cable jacket shall not be striped back not more than 0.5 inches any location including splices and terminations.
3. Unless specifically directed otherwise by the Owner's Representative, Pin assignment for wiring terminations shall comply with ANSI/TIA/EIA 568B type T568A or T568B as required for compatibility with the electronic network equipment. The termination type shall be consistent throughout the project contract area.
4. Copperwire termination's shall be performed to maintain the transmission rates specified for the respective entire system.

3.07 EQUIPMENT RACKS

A. General

1. Install, assemble, mount and connect devices and equipment in the respective equipment racks, bolted securely to the rack frame with stainless steel hardware. "Star" style lock washers shall be provided to insure an electrically continuous ground path between the equipment/devices and rack frames.
2. Provide blank metal filler panels to close unused equipment "front" mounting space in equipment racks, manufacturer's standard finish color.
3. Provide a copper wire outlet connector in the respective equipment rack for each remote copper wire infrastructure workstation outlet and copper wire cable shown connected to the respective equipment rack, plus the spare copper wire outlet connectors required in the contract documents. The copper wire outlet connectors in the equipment racks shall be provided in equipment rack mounted copper wire patch panels. In no case shall the quantity of equipment rack mounted copper wire outlet connectors be less than the quantity of cables indicated on the drawings, plus required spaces/spares.
4. Provide fiber optic fiber connectors and fiber optic fiber interconnection couplers in the respective equipment rack for each remote fiber optic infrastructure workstation outlet, and fiber optics cable fiber shown connected to the respective equipment rack, plus the spare fiber optic fiber optic fiber connectors required in the contract documents. The fiber optic fiber connectors and fiber optic fiber interconnection couplers in the equipment racks shall be provided in equipment rack mounted fiber optic fiber distribution enclosure, in no case shall the quantity of equipment rack mounted fiber optic fiber connectors and fiber optic fiber interconnection couplers be less than the quantity of cables indicated on the drawings, plus required spaces/spares.
5. Fiber optics cable fibers specifically shown as non-terminated "splicing-thru" in the equipment rack shall route through fiber optic splice only enclosures (RMSE), mounted in the respective equipment rack.
6. The maximum quantity of cable terminations, in each equipment rack mounted patch panels shall not exceed the following:

a. 100% copper wire outlet connectors, 196 maximum per rack. [48 maximum in 30 inch high and 96 maximum in 40 inch high mini-equipment racks].

b. 100% fiber optic fiber terminations, 144 maximum per rack [24 maximum in mini-equipment racks].

c. Combination of copper wire outlet connectors and fiber optic fiber terminations in the same rack; 48 maximum fiber optic fibers plus 144 maximum copper wire outlet connectors per rack. [12 maximum fiber plus 48 maximum copper wire in 30 inch high and 24 maximum fiber plus 48 maximum copper in 40 inch high mini-equipment racks.]

Provide additional equipment racks to ensure the maximum specified quantity of terminations in single rack are not exceeded and the quantity of cable terminations complies with the requirements of the Contract Documents.

7. Terminal racks, equipment locations, patch panels, and cross connects shall be arranged to allow for natural cabling progression, minimize crossing of cables and allow easy access to each system component.

8. Equipment Rack Anchorage:
   a. Equipment racks installed on raised "access floor" systems, shall be anchored with bolts that extend into the "structural" floor located below the "access floor".
   b. Securely anchor the support arms of swing gate racks to the wall structural support system.
   c. Securely anchor fixed support base of the racks to the floor.
   d. Mounting method shall support the total rack weight including installed equipment, but in no case less than 500 pounds with a 2.0 times safety factor.
   e. Attachments and anchorages shall comply with the requirements for earthquake seismic zone 4.

9. Unless specifically noted, otherwise provide the following equipment rack types:
   a. Floor standing equipment racks containing data, telephone, patch panels, multimedia, audio/video, shall be open frame floorstanding fixed position equipment racks.
   b. Wall mounted external to dedicated IDF/MDF terminal rooms/closets (i.e., inside individual classrooms), shall be Mini-Equipment racks.

10. Install ground bus, TVSS, power distribution unit (PDU), cable management rings, equipment, patch panel and patch panel outlets, etc. in equipment racks.

11. Equipment rack terminology:
   a. The location containing the main campus equipment rack location shall be identified as the Main Distribution Frame – (MDF).
   b. The locations remote from the MDF containing satellite equipment racks shall be identified as Intermediate Distribution Frames (IDF).
   c. A individual building located on a multi-building campus site with multiple equipment rack locations in the building, the building main rack location shall be identified as Sub-MDF and the remaining equipment rack locations in the building shall be identified as IDF.

B. Floor Standing Equipment Racks

1. General:
   a. Securely anchor racks to floor.
   b. All incoming cables shall enter through the top or bottom of the racks.
   c. The front of the racks shall maintain a minimum of 42 inches of clear working space.
   d. Multiple floor standing racks shall be installed directly adjacent to each other (i.e., side by side).
   e. Cables entering racks shall enter into the top of the rack from overhead cable tray, or from wall along wall support arms to rack.

2. Floor standing open (non-swing gate) equipment racks.
   a. The rear of the rack shall maintain a minimum of 54 inches clear working space behind the rack frame rails for adequate installation depth of HUBS/switches equipment, for "walk" behind access to equipment and for cable terminations access.
   b. Provide a minimum spacing between (edge-to-edge) racks of not less than 6-inches.

D. Mini-Equipment Racks:
   1. Install surface mount on the wall, on wall mount horizontal "C" channels; top of the rack shall not exceed 6 ft. - 6 inches above finish floor.
   2. Position the rack to allow the door section, and center section to swing open a full 90 degrees ARC without obstructions.
   3. Connect raceways to the non-moveable pan section.
   4. Provide 120 volt - 60HZ AC 20 ampere branch circuit outlet inside the rack for plug-in connection of internal air ventilation fans and infrastructure equipment.

3.08 TELEPHONE/VOICE TERMINAL BLOCKS

A. The telephone/voice terminal blocks shall be assembled in vertical sections, for wall mounting. Install adjacent vertical sections with not less than eight (8) inch blank space between sections, for cable training space.

B. Install terminal blocks on plywood terminal back board with #8 x 1 inch wood screws. Minimum 6 inches on center, along each side of each terminal block.

C. Terminal block wire pair capacity:
   1. The minimum wire termination capacity shall not be less than 600 [900, 1200] pairs of telephone/voice conductors, at any telephone/voice terminal block.
   2. The quantity of wire pair terminations provided at each terminal block shall be based on the following formula. However, under no case shall any terminal block wire pair capacity be less then the specified minimum.

   Total quantity of telephone/voice feeder copper wire pairs connected to the terminal board = QFP

   Total quantity of telephone/voice outlets connected to terminal board - QTO

   (QFP) x (QTO x 4) + (specified spares) = Minimum terminal block pair capacity.

3.09 CIRCUIT TERMINAL ROOMS AND CLOSETS

A. Terminal Backboard
   1. A 3/4 inch thick marine "A-C" grade plywood backboard shall fully cover each wall of terminal closets and terminal rooms. Provide backboard on the wall for equipment racks, incoming cable raceways and terminal blocks. Plywood shall extend from the finish floor to 8 ft. above the finish floor. "A" side of plywood shall be exposed.
   2. Attach plywood to wall structural framing with mechanical fasteners a minimum 6 inches on center vertically on walls at each framing vertical member, and along the length of the wall, but not less than 16 inches on center horizontally along the length of the wall.
   3. Paint plywood terminal backboards after installation and prior to mounting any equipment. One coat of wood paint fire resistant primer and one fire resistant finish coat of paint. Finish color high gloss white [finish color as selected by ARCHITECT, acrylic enamel fire resistant latex paint.

B. Cable Tray

1. Provide a horizontal cable tray above the equipment racks [and terminal blocks] in each circuit terminal room and closet where two or more equipment racks, [and/or terminal blocks] are installed.
2. Cable tray 18 inches wide x 6 inches deep; length-end wall to end wall, of the closet or room.
3. Install the cable tray centered above all equipment racks [and terminal blocks] with ceiling and wall suspension system. Install trays not more than 36 inches above and not less than 12 inches above the top of the equipment racks.
4. Where multiple segments of cable trays occur in terminal closets and rooms, provide interconnecting cable trays between each segment located in the respective room/closet.

C. Conductor Training and Support

1. Provide conductor/cable training and racking support distribution rings installed on backboards. As manufactured by Newton 3042 series, Saunders or equal.
2. Support rings shall be spaced a minimum of 10 inches on center along all cable/conductor routing paths on backboards and within 4 inches of each change in cable/conductor direction.
3. The capacity of support rings shall be equal to the weight and quantity of conductors/cables passing through the respective support ring plus 100% spare capacity for installation future conductors/cables. In no case shall support rings be smaller than 3 inches.
4. Attach support rings to backboards with not less than two (2) 3/8 inch diameter x 1 1/8 inch long threaded wood anchor bolts for each individual bracket.

3.10 GROUND (ADDITIONAL REQUIREMENTS)

A. Electronic Equipment Terminal Rooms and Closets

1. Terminal equipment ground bus (TEGB) - Provide a wall mounted TEGB ground bus at each location where two or more equipment racks [and/or terminal blocks] are provided. The TEGB ground bus shall be copper 1/4 inch x 2 inch (nominal) x 12 inches long (minimum). Install the TEGB on the wall with a minimum of two "stand-off" electrical insulators. Drill and tap the ground bus and provide bolted type ground lugs for connection of each ground conductors size #10 AWG - #1 AWG. Provide (4) spare unused ground lugs on the TEGB. Provide 1 1/4 inch conduit with 1#1 AWG copper insulated ground conductor from the TEGB to the building main ground reference bus. Provide 1 1/4 inch conduit with 1 # 1 ACWG copper insulated ground conductor from the TEGB to the nearest building main structural steel member.
2. The ground conductor required from the TEGB to the building main ground reference bus may be looped between separate TEGB ground bus locations if all of the following conditions are met.
   a. The ground conductor is increased to 1 1/2 inch conduit with 1#2/0 AWG copper insulated and the total end to end length does not exceed 300 feet.
   b. The building exceeds two floors in height.
   c. Not more than (4) TEGB buses are connected to the same "looped" ground conductor.
   d. The TEGB ground conductor is continuous (not cut, spliced or broken) along its entire length.
   e. The TEGB ground conductor is connected to the TEGB ground bus with a UL listed "Exothermic" welding process. A bolted ground lug shall not be used at the intermediate ground connections.

B. Equipment Racks:

1. Provide a separate 12AWG copper stranded green insulated ground conductor from each individual equipment element in the rack to the respective rack ground bus.
2. Provide a separate #8AWG copper insulated ground conductor from each equipment rack ground bus to the TEGB terminal equipment ground bus located in the same space. Where only one equipment rack is installed, provide 1 1/4 inch conduit with 1#1 AWG copper insulated ground conductor from the equipment rack ground bus to the building main ground reference bus and provide 1 1/4 inch conduit with 1 # 1 AWG copper insulated ground conductor from the TEGB or single equipment rack ground bus (as applicable), to the nearest building main structural steel member.
3. Provide 1 1/4 inch conduit with 1#4 AWG copper insulated ground conductor from each wall mounted fiber interface cabinet to the respective TEGB ground buses.
4. Provide a 1#10 AWG copper insulated ground conductor connecting in a loop to all miscellaneous cable trays and metal support equipment located in the terminal closet or room to the TEGB ground bus.

C. Telephone/Voice Terminal Blocks:

1. Provide a separate #8 copper insulated ground conductor from each terminal block section ground bus to the TEGB terminal equipment ground bus.
2. Provide a separate #6 copper insulted ground conductor from the terminal room/closet to the lightning ground system.

3.11 IDENTIFICATION (ADDITIONAL REQUIREMENTS)

A. General

1. Fiber optic and copper wire cables shall be identified in each manhole, pull box, equipment rack, patch panel and computer workstation outlets.
2. Infrastructure documentation, identification labels and color coding shall comply with ANSI/TIA/EIA-606A Administration Standard for Telecommunications Infrastructures, Class-1 thru Class-4. Provide management software MS-Windows-based single user license, with all as-built data entry documentation information complete.

B. Identification tags shall include the following information:

1. Cable name as indicated on drawings (i.e., HV1, F4, MSB3 etc.).
2. Installation month and date (i.e., 3/92, 4/78 etc.).
3. Conductor size conductor type (i.e., loose tube fiber; (#24 AWG ScTP Category 5, 200 pair, telephone/voice etc.).
4. Feeder taps to equipment or building shall also be identified with equipment name or building (i.e. library, SW1, Rack #21, etc.)

C. Tags shall be 1/8" thick 98% lead, approximately 2" square with chamfered corners. Two holes shall be drilled for attachment to primary cable. Lettering shall be 1/8" high, engraved or die stamped. Attach tags to primary cables with two #14 AWG (THWN insulated) solid copper conductors "twist-tied", with insulated CAP wire-nut on the tie-wire ends, to cover sharp edges of tie-wire conductor.

D. Alternate identification tags, at the CONTRACTOR'S option in lieu of lead tags. Provide polypropylene tag holders with interchangeable, yellow polypropylene tag with black alpha/numeric characters sets. Characters shall be approximately .25" high. As manufactured by Almetek industries "EZTAG" - Ledgewood, New Jersey.

E. Equipment and outlet naming identification and color coding shall comply with ANSI/EIA/TIA latest revision.

1. Naming method for equipment, outlets and cables; where a position in the naming string is unused, provide multiple "****" symbols.

   Typical naming string "ADM-02-1141-PP17-1271"

   a. "ADM" - Abbreviated Building Name or Number (i.e., Administration, B127, etc.)
   b. "02" - Floor Level #2 or as applicable.
   c. "1141" - Outlet, Equipment or Terminal Room/Closet name or room number as applicable.
   d. "PP17" - Terminal Rack Patch Panel Identification.
   e. "1271" - Individual Outlet or Port Identification.

2. Connecting hardware color coding shall be as follows:

   "Green" - Main central terminal location for entire site.

   "White" - Distributed terminal locations other than the main terminal.

   "Blue" - Horizontal wiring hardware systems for workstations.

F. Provide warning nameplates on fiber optic patch panels, fiber optic outlets, and any location where fiber optic cables are terminated. Minimum 1/8" high engraved/etched letters. "WARNING - LASER LIGHT SOURCE. DO NOT LOOK DIRECTLY AT OUTLET OR FIBER CABLE ENDS. RISK OF SEVERE EYE DAMAGE OR BLINDNESS".

G. Operation and Maintenance

1. Prior to final acceptance, the Contractor shall provide operation and maintenance instruction manuals to the system Owner. Checklists and procedures for emergency situations, troubleshooting techniques, maintenance operations and procedures shall be included in the manual.

END OF SECTION

SECTION 16754

CCTV SURVEILLANCE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The drawings and general provisions of the contract, including general conditions and Division-1 specification sections, apply to the work of this section.

B. Refer to the following Sections for interfaces:

1.02 DESCRIPTION OF WORK

A. Extent of CCTV surveillance systems work is indicated by drawings and schedules, and by the requirements of this section.

B. Refer to Division-2 sections for excavating, trenching, backfilling and grading work related to the CCTV surveillance systems; not work of this section.

C. Refer to applicable Division-16 sections for identification, raceways, wires and cables, boxes and fittings, supporting devices and grounding required for CCTV surveillance systems; work of this section.

D. The CCTV surveillance systems work shall be performed by a single Contractor.

1.03 SCOPE OF WORK

A. Work included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with designing, furnishing, delivery and installation of the work of this section, complete as shown on the drawings and/or specified herein.

B. Rough in work (equipment back-boxes, conduit, terminal cabinets, junction boxes, and outlet boxes and other items shown on electrical drawings or specified herein) shall be supplied and installed by the Electrical Contractor under another section. Electrical power to electronic equipment shall be provided by the Electrical Contractor.

C. All video and related equipment shall be furnished by a qualified video and/or security subcontractor hereafter referred to in this section as "the Contractor" or "Video System Contractor".

D. The Contractor shall submit a detailed system design that shall perform and operate within all parameters specified. It shall ultimately be the Contractor's responsibility to ensure the submitted design meets all county criteria, features, and requirements.

E. The Contractor shall design, furnish, functionally test, and document the systems of this section. The governing overall requirement is completely functioning systems.

1.04 CONTRACTOR QUALIFICATIONS

Due to the complexity and specialization of the electronic systems involved, the following qualifications are to be strictly enforced:

A. To qualify as an acceptable vendor under this section, the Contractor shall hold a valid C-10 or C-61 Electrical Contractors License, issued by the Contractor's State License Board of California. The Contractor shall have completed at least ten (10) projects of equal scope, giving demonstrable satisfactory performance, and references when requested.

B. The Contractor shall have been in business in the State of California a minimum of two (2) years. The Contractor shall have been in business primarily as a Professional Video and/or Security Systems Contractor as well as represented the main lines of industrial/commercial security, video and/or audio equipment during this time.

C. The Contractor shall operate and maintain a competent service organization and a full inventory of all necessary replacement parts. He shall be capable of performing all warranty work within the response and "turn around" times specified elsewhere herein.

D. The Contractor must have a permanent business address at which a shop or facility suitable for routine component repairs is maintained, and is located within a fifty (50) mile radius of the project site. No home workshop, garage, or place of residence (all or part) shall be accepted as fulfilling this requirement.

E. The Contractor shall have at least one (1) individual and/or project manager assigned to the project that has been extensively trained or degreed in the science and the professional procedures of video/security system installation and design, and where applicable, programming methods and implementation of software based system.

F. Upon request from the County or Owner's Representatives, the Contractor shall submit a statement from the manufacturer who supplies the equipment the Contractor is bidding, that he is an authorized vendor fully empowered to support he manufacturer's warranty program.

G. The Contractor shall be in good financial standing with all his suppliers as to not delay the project.

1.05 QUALITY ASSURANCE

A. This specification includes the equipment of manufacturers who have been approved by the county as representatives of the end users and any specific units listed herein named shall be considered as meeting the requirements of this specification. This equipment was specified in keeping the established standards or quality and function both by the Owner/Tenant and the manufacturer(s) named.

B. It shall be the responsibility of the Contractor to supply complete and operational video surveillance sub-systems. The Contractor is responsible for verifying the completeness of the parts list, the correctness of the type numbers and the overall suitability of the equipment to meet the main purpose of the specification.

C. The Contractor shall review all architectural, electrical, and any related plans prior to submittal of any proposals or bids to ascertain all local and general conditions of the work to be performed. This shall include, but not be limited to the acoustical suitability, design, and treatment incorporated within the architectural design of the facility which would affect or prevent the completed system from operating as specified. Failure to do so shall not release the Video Contractor from responsibility for fully installing the complete and operational systems as specified without cause or additional payment.

D. The Contractor shall furnish and install all equipment, power supplies, transformers, lights, controls, and miscellaneous parts that may not be specifically enumerated herein but required or incidental for the proper integration of the systems so that each system shall perform the functions listed herein, in compliance with all the specified requirements.

E. Contractor shall comply with all applicable local, state and national codes.

F. The Contractor shall comply with all applicable industry standards for systems, equipment, and components installed under this section. These standards include those of the following organizations:

- American National Standards Institute (ANSI)
- Electronics Industry Association (EIA)
- Institute of Electrical and Electronic Engineers (IEEE)
- National Electrical Manufacturers Association (NEMA)
- Underwriters Laboratories

1.06 SUBMITTALS

A. The Contractor shall prepare and submit for approval six (6) sets of bound proposal brochures. The brochures shall include a complete and accurate listing of all major items of equipment to be used in assembling the system, including all items of equipment listed in this specification, as well as Contractor's block diagrams indicating the proposed interconnection of al equipment to be furnished. All modifications of standard equipment necessary to meet specifications shall be explained fully and must be accompanied by schematic diagrams.

B. The Contractor shall submit floor plans for all systems, indicating all equipment and device locations, conduit sizes and wire quantity and type in each conduit run.

C. The Contractor shall submit elevations and details of all custom built assemblies.

D. Operation / Service Manuals: The Contractor shall furnish four (4) complete manuals for each system with the name and location of the project and/or system prominently displayed on the cover. The name, address, and phone number of the Installing Contractor and manufacturers of all components utilized shall be included with the information. The manuals shall be provided within five days after the date the Contractor files a Notice of Completion, and shall be used to facilitate the final acceptance procedure by the Owner.

These manuals shall contain the following minimum information for each system in this section:

1. Operation Manual(s): A complete set of the manufacturer's instructions and procedures for proper operation shall be provided.
2. As-Built (Record) Drawings: A complete set of revised shop drawings, including equipment layout, wire lists ("run" sheets), and a single line drawing shall be included in, or submitted with, each Service Manual.
3. Theory of Operation: Block diagram illustrations with text discussing the major circuit components, their function interrelation to one another, inputs and outputs, and major control parameters.
4. Detailed Diagrams and Parts List: Part numbers, schematic drawings and component parts lists for displays, annunciators, switch assemblies, electronics, and any other major components contained within the complete system.

5. Preventative Maintenance Instructions: Periodic maintenance schedules, spare parts lists, test equipment requirements, calibrations, mechanical or electrical adjustments.
6. Detailed Equipment Inventory: Serial numbers of all manufactured products including location and/or disposition to facilitate the county's fixed asset accounting procedures and warranty assistance.
7. Corrective Maintenance Instructions: Tests procedures for isolation of faulty components, major component replacement instructions (mechanical and electrical removal and replacement), and test equipment requirements.

1.07 OPERATIONAL FEATURES

A A CCTV surveillance system shall be provided within the Housing Units for the observation and movement control of security doors and gates which are not directly visible to the operator. Camera scene shall be identified by location on the screen.

B. CCTV surveillance cameras shall be provided in the housing areas, outdoor, administration, and entry security doors.

1.08 IN SERVICE INSTRUCTION

The Contractor shall provide adequate on-site instruction to end users in the operation of the equipment. A general information class and orientation shall be given to applicable county personnel. This class will be scheduled and coordinated through the Project Manager at least 14 days in advance and will take place on-site. Additional training may be requested for county technical personnel. The Contractor shall provide up to eight hours of scheduled instruction as required by the Owner or the county without exception for additional payment.

PART 2 - PRODUCTS

2.01 CCTV SURVEILLANCE EQUIPMENT

A. Provide CCTV surveillance systems, of types, sizes, capacities and characteristics as indicated, consisting of cameras, lenses, housings, monitors, alarm interface assemblies, switchers, video distribution amplifiers, video patch panels, video equipment racks, cabinets, enclosures, backboxes, mounting hardware, appurtenances, wall plates, power supplies, video cables, crimp-on connect adapters, accessories, hardware, mounting brackets, relays, identification, raceways, wiring, cabling, boxes and fittings, supporting devices, grounding and other components as required for a complete installation. Except as otherwise indicated, provide manufacturer's standard CCTV surveillance systems components; design, construct, program, test and document in accordance with published product information. The system shall be programmed as per county's directive. Provide CCTV surveillance systems for application intended and with the specified systems and components features.

B. As this specification includes systems and/or sub-systems which must integrate with existing video equipment, Contractor shall sleet and provide equipment, sub-systems, and assemblies which are 100% compatible with the existing system. Interoperability includes video signal, video sync, and remote control data compatibility.

C. Supply items of equipment already developed and with adequate operating experience to indicate suitability for the intended use. Select for accessibility of replacement parts, maintenance, and alignment purposes.

D. Select products at time of bid to be of the manufacture's latest model or type offered which meet applicable specifications. Do not select discontinued items replaced by newer models or versions.

E. Use only products which are new and of the best quality of their respective kind. No used materials will be installed.

F. Select and adjust all equipment to operate on 115 to 120 volts 50 Hz AC power, unless otherwise noted in the equipment list or the Drawings.

G. All products shall be rated for 24 hours per day continuos service.

H. All electrical materials shall be in compliance with applicable Division-16 specifications (if 1.01-C applies to this specification).

I. Contractor shall design systems to make liberal use of built-in test equipment for rapid corrective maintenance. Faulty component indictor lights, line supervision circuits, switchable bypass circuits, meters and other built-in test equipment shall be used wherever appropriate to help isolate faulty components.

J. Contractor shall utilize only wire and cable of a type passing the UL FR-1 flame test. Select wire and cable specifically designed, marketed, and listed for the specified applications.

K. Contractor shall select connectors, terminals, lugs, circuit boards, wire installation materials, and other products not otherwise described from products specifically designed and marketed by manufacturers for the specified purpose.

L. Every cable and wire run including spare conductors will be labeled with machine generated wire labels in a logic sequence.

2.02 PRODUCTS

The following minimum equipment complement shall be provided in accordance with the specifications and drawings. This list is for the convenience of the Contractor in preparing his bid; omission from this list of any items required elsewhere in the specifications, shown in the drawings, or necessary to achieve the functional requirements of workmanship standards of the specifications shall not relieve the Contractor of the obligation to supply such items. Where quantities are marked "as required" (A/R) the Contractor is referenced to the applicable drawings or specifications which show the necessary quantities and locations.

QTY	DESCRIPTION	MANUFACTURER/MODEL
A/R	CCD Cameras, color	Panasonic WV-CW474
A/R	Camera Lenses	Panasonic Aspherical fixed or auto iris as required
A/R	19" Video Monitors, color	Panasonic, JVC, Ikegami
A/R	Switchers	Tops
A/R	Camera Mount Brackets	Panasonic
A/R	Equipment Rack(s)	Per Section 16760
A/R	Camera Power Supplies	Panasonic, Altronic

A/R	Coaxial Cable	Belden 9259
A/R	Camera Power Cable	West Penn 25224

2.03 EQUIPMENT SPECIFICATIONS

A. Fixed Surveillance Cameras

1. Cameras shall be compact color units, with solid state image sensors. Camera output signals shall conform to EIA RS-170, composite video signal. The cameras shall accommodate both standard "C" mounted and "CS" mount lenses, either directly or with an adapter furnished by the same manufacturer.
2. The image sensors shall be solid-state Charged-Coupled Devices (CCD). Metal-Oxide Substrate (MOS), interline transfer CCD 1 C X 130-AK.
3. The cameras shall met all specified performance requirements without readjustment over any combination temperature and humidity of 140°F to 122°F and 30% to 90% relative humidity. They shall not be damaged or require readjustment in the range of 11 Hz to 200 Hz when subjected to shock up to 60g or vibration up to 6g. They shall accommodate external synchronization signals in the form of composite sync or horizontal and vertical drive pulses. In the absence of external sync signals, the cameras shall generate sync pulses internally. Camera may also utilize multiplexed sync pulses over the video signal output via a remote data unit, provided such corresponding compatible equipment is included as part of the system.
4. Horizontal resolution shall be at least 430 lines. Vertical resolution shall be at least 350 lines. Video output shall be 1.0 volts p-p into 75 ohms. Signal to noise ratio shall be 47 dB or better.
5. Minimum illumination required for usable color image shall be .30 footandle scene illumination at 75% average reflectivity using an f/1.4 lens, and a clear picture display at two (2) footcandles. Monochromatic cameras shall yield a usable image with 0.002 footcandles scene illumination at 75% average reflectivity using an f/1.4 lens, and a clean picture with 0.0004 footcandles.
6. The units shall operate from an external 120VAC supply providing 24 volts AC to the camera unit. The power supply shall conform to NEC Class 2 remote control requirements,
7. Automatic Gain Control (AGC) shall be 10: 1 minimum. Allowable light range shall be 100,000: 1 minimum.
8. Provide auto iris lens control to maintain video output within 3 dB over a 100,000: 1 minimum scene illumination range indoors 400,000: 1 outdoors. The servo-iris and/or AGC circuits shall be mechanized such that the cameras are always operated at optimum sensitivity and signal to noise ration throughout the entire range of illumination variations.
9. Provide infrared filtering and other accessories as required.

B. Lenses

1. Lenses shall be fixed focal length or manual zoom and shall be compatible with the cameras specified herein.
2. Auto iris shall be motor driven servo-type and shall be compatible with the cameras specified herein. Auto iris Aspherical design lenses shall be supplied for interior color cameras.
3. Focusing range shall be from 3 feet to infinity or better.
4. All lenses shall be standard "C-mount" type, unless the application and lens design requires use of "CS" type mount. In either case, all lenses shall be 100% compatible with the mounts on the cameras supplied.
5. Exterior auto iris lenses shall be high speed aspherical lenses F 1.0 or faster.
6. Interior color camera lenses shall be fixed iris aspherical lenses, F 1.0 or faster.

C. Color Video Monitor

1. Monitors shall be high resolution 19-inch color units mounted LCD monitors.
2. The monitor electronics shall have separate high voltage and low voltage regulation circuits to prevent size and brightness variances within a wide range of AC line voltage.
3. Front panel controls shall include: On/Off, horizontal hold, vertical hold, black level, color, brightness, and monochrome/color mode switch.
4. Rear panel control and connectors to include: sync selector switch, looping sync connectors, composite and y/C video input connectors, and 75 ohm / high impedance termination switch and audio input.
5. Video input level shall be from .5v peak to peak.
6. The video resolution of the displayed image at 50 foot-lamberts luminance shall be a minimum of 330 lines center.
7. Built-in 1.0 watt audio amp and speaker.

D. Cameras Enclosures

1. Type 1 – Environmental Housings: Provide camera environmental housings for all outdoor surveillance TV cameras. Housings shall be weatherproof with sufficient internal space and mounting hardware for the cameras. Housings shall have a sunshield to minimize internal temperature effects of direct sunlight. Housings shall have lower with thermostat control. The thermostat shall turn on the blower when internal temperature exceeds 90 degrees F. Mounts shall be of lightweight aluminum welded construction and shall have a corrosion-resistant finish. Column mounts or wall mount shall be provided with adjustable head mounts. Color shall be off-white or as directed by the Architect.
2. Enclosures shall be constructed of light-weight aluminum with a white vinyl textured baked enamel finish. Enclosures shall have a 1/4" thick Lexan viewing window. A rain shield shall be furnished to keep rain off the window surface. Enclosures shall be provided with all required mounting hardware.
3. Internal blowers shall operate from 120 volt AC power. Cable entry shall be through compression fittings.
4. Type 2 – Standard Housings (Wall Mount): Provide camera standard housings mounted on adjustable downward tilting mounts, where noted on drawings. Enclosures shall have keyed, tamper-proof lock and hinged access cover, with no exposed fasteners. Enclosure construction shall be extruded steel housing. Camera viewing windows shall measure minimum 4.5" x 6.25". Mounts shall be of lightweight aluminum welded construction and shall have a corrosion-resistant finish. Wall mounts shall be provided with adjustable head mounts. Color shall be as directed by the Architect.

E. Programmable Matrix Switchers

1. The programmable switchers shall be microprocessor based control systems consisting of transmitter/CPU's, receiver CPU's, software, keyboard controllers, and associated equipment. The Matrix Switch shall be Tops software based DVR.
2. The main transmitter/CPU and/or keyboard controller shall coordinate all information flow between the remote operator panels, the video switcher ports and the receiver/CPU's. The status of each receiver shall be constantly monitored (polled) and shall be automatically reported to the operator control consoles by identify lights on the front panels.
3. The programmable switchers shall include receiver alarm closure input for remote stations, alarm indicator/reset switches which illuminate during any alarm condition, and a ten position operator-programmable preset for each remote camera station.

4. The system shall have complete facilities to accommodate a minimum of 384 cameras and 64 monitors with future expansion capability of 512 cameras and 96 monitors.
5. The main CPU rack or integrated keypad/CPU shall include the following functions and features:
   a. Alpha-numeric LED or LCD displays for camera, monitor or status.
   b. Keypad for control selection.
   c. Auto/manual iris selector and indicator.
   d. Communications failure indicator.
   e. Alarm reset and indictor.
   f. Four latching auxiliary controls and indicators.
   g. Two momentary auxiliary control and indictors.
   h. Alpha-numeric LED or LCD displays fore preset number.
   i. Preset enter selector and solve indicator.
   j. Video Switch Control – Manual Routing.
   k. Video Switch Control – Sequential.
6. The software shall include alarm with switching and camera-seize capability.
7. The associated equipment shall include DVR interfaces, time/date titler card cage assemblies (if not integral with switcher electronics), time-date titler card assemblies, distribution lien control, alarm interfaces, control signal transmission and power supplies.

F. Programmable Keyboard Controllers
1. The programmable keyboard controller shall be a 19-inch rack panel control unit with preset position option. The unit shall provide keypad selection of any camera to any monitor at a remote location.
2. The programmable keyboard controller shall include the following functions and features:
   a. Camera monitor select numeric keypad.
   b. Momentary lever switches for iris control
   c. Six auxiliary functions (four latching, two monetary).
   d. Momentary pushbutton switches for "auto/manual iris" and "preset enter" electrically latched.
   e. Camera alarm acknowledge.
   f. Communication failure acknowledge.
3. Displays:
   a. Camera number.
   b. Monitor/status.
   c. Communication failure.
   d. Camera alarm.
   e. Auxiliary On/Off status.
   f. Auto iris status.
   g. Preset index number display.
   h. Preset "Enter" status.

G. Video Distribution Amplifiers:
1. The video distribution amplifiers shall provide six video outputs from a single video input. The units shall be designed for EIA standard 19-inch rack mounting.
2. Video inputs and outputs shall have BNC connectors. Input and output signal levels shall be IV p-p nominal. Frequency response shall be 10 Hz to 7 MHz +/- 0.5 dB. Input and output impedances shall be 75 ohms, unbalanced.
3. Phase Linearity shall be better than 2 percent from 100 Hz to 10 MHz. Phase shift shall be less than 3 degrees at 3.58 MHz.

H. RS-170 Black Level / Syn Generator

1. A separate video sync generator shall provide RS-170 sync signals to video distribution amplifiers for the purpose of "gen-locking" all cameras. A "y'd" output of a camera or other video device in the system will not be accepted as a substitute.

PART 3 – EXECUTION

3.01 INSTALLATION AND WORKMANSHIP

A. All installation workmanship shall meet professional as well as county standards. All assemblies and equipment shall be installed physically square and true for proper appearance and operation.

B. All wire runs shall be made "homeruns" with a minimum of mid-run splices possible observed. All splices and terminations shall be made in junction boxes specifically provided for the purpose and located on electrical drawings. No splices in conduits shall be allowed.

C. All wires, twisted pair, or cable shall be individually color coded or tagged at both ends with Thomas and Betts E-Z Markers or equal. All conductors in terminal cabinets and harnesses in equipment rack shall be carefully formed and harnessed utilizing plastic cable ties in a workmanlike manner. The appropriate cable tie "gun" set at proper tension shall be used to cut all excess. Appropriate service loops shall be provided at all terminal locations.

D. Proper grounding and shielding methods are to be observed to avoid ground loops in all audio circuits. "Daisy chains" or other grounding schemes that introduce ground loops shall not be tolerated. In general, the system master ground shall be located at the lowest level input. All shields shall be positively grounded at one point and positively isolated from ground at other points.

E. All surface or other exposed wiring not enclosed in conduit provided in the electrical drawings shall be covered or enclosed in Wiremold or approved equal by the county.

F. All connector plates and customer assemblies shall have engraved and filed designations describing the input function and/or input number in a logical and workmanlike manner.

G. The physical configuration, location, and installation of all system components in the system shall be such as to facilitate setup, maintenance, and repair of any component.

H. Supply and install at least one rack mounted power distribution panel for each equipment rack.

I. Provide metal outlet strips (ground type) mounted vertically in each rack or console selection. A minimum of two unused receptacles shall be provided in each rack or console selection for future expansion.

J. All power wiring interconnect in each group of equipment racks or consoles shall be done with flexible conduit, properly installed and of the proper size.

K. Power cords from individual equipment to power outlet strips shall be neatly shortened to the proper length and dressed into the rack of console.

L. Grounding:

1. Provide equipment grounding connections, sufficiently tight to assure a permanent and effective ground for system components and support structures In general, the system master ground shall be located at the lowest level input. All shields and equipment including chassis and bulkhead connections shall be positively grounded at one point and positively isolated from ground at other points.
2. Provide and install a dedicated, insulated, 4 AWG minimum, stranded copper ground wire without splices or joints from each equipment room single point ground to an approved location on the building ground electrode system. Total path resistance from the equipment room ground to earth ground shall not exceed 1 ohm.

3.02 SPARE CONDUCTORS

Provide spare installed conductors in accordance with Section 16700, Part 2.02, "Spare Conductors".

3.03 PERFORMANCE TESTS

A. A complete functional system test of the video surveillance system shall be conducted according to the procedures specified in Section 16750. In addition to the general requirements of Section 16750, the following acceptance tests and measurements may be required by the county to determine the performance level and function of the system.

B. Video Test Instruments: Contractor shall have available during final checkout and acceptance the following instruments or equivalent approved by the county Telecommunications Engineer.

C. System Characteristics

1. Video amplitude of a composite video signal of standard system video level shall be measured from blanking level to reference white level and shall be 100 IRE units (0.74 volt nominal) at all points.
2. The overall video frequency response shall be measured form any camera output via any normal signal path to the input of a terminal device. It shall be +/-2 dB from 60 Hz to 9 MHz and no more than 4 dB down at 10 MHz.
3. The low frequency distortion shall be measured from any camera output via any normal signal path to the input of a terminal device. It shall be less than 2% at line and field rates.
4. The peak-to-peak signal to RMS noise ratios shall be measured from any camera output via any normal signal path to the input of the terminal device (monitor).
5. The signal to crosstalk ratio shall be measured as the signal to noise while observing for any transient caused by the operations of any device associated with (a) the video system, or (b) any other electrical, lighting, portable radio, ventilation equipment, etc. The signal to transient ratio shall not exceed the signal to noise ratio and under no conditions shall it be greater than 40 dB.

3.04 INSTALLATION OF BASIC IDENTIFICATION

Install electrical identification in accordance with Division-16 Section "Electrical Identification".

3.05 INSTALLATION OF BASIC WIRING MATERIALS

A. Install wiring, raceways, and electrical boxes and fittings in accordance with Division-16 Sections. Review system raceways indicated in drawings and provide any additional raceways required for the work of this section.

B. Stranded wire and flexible cable shall be used for all connectors to equipment not permanently attached to walls, floors or racks.

C. All conductors shall be installed in conduit. Install a nylon pull line in each conduit at the time of installation.

D. All conduits shall be clearly identified at all terminals or cabinets as to its terminating ends.

3.06 QUALITY ASSURANCE INSPECTION

A. All equipment herein specified shall be inspected by the manufacturer's quality assurance inspector and any defects corrected before delivery.

B. The county, at its option, may verify the inspections or re-inspect any item. Inspection shall include examination for quality of workmanship, neatness, part and wiring identification, conformance to building codes, and compliance with system specifications and shop drawings. The county reserves the right to reject materials and workmanship found unacceptable during inspections.

C. The county's project manager or his authorized representative shall have the right at all times to inspect or otherwise evaluate the work performed or being performed and the premises in which the work is being performed.

3.07 QUALITY CONTROL

A. General

1. Upon completion of installation of CCTV Surveillance systems and after electrical circuitry has been energized, perform the necessary adjustments and balancing of all signals and levels to ensure proper systems operation and compliance with requirements. If proper systems operation and compliance with requirements is not achieved, correct malfunctioning units at site by making necessary changes or remove and replace with new units, then proceed with necessary re-adjustments and re-balancing of al signal and levels to ensure proper systems operation and compliance with requirements.
2. Prior to systems performance and operational tests, conduct pre-tests to identify potential failures and to expedite the performance and operational tests. A high rate of failure or the need to perform an excessive amount of field adjustments or tuning during the performance and operational tests will be cause for suspension and rescheduling of the tests.

B. Performance Tests

1. Conduct performance tests in accordance with the following criteria standards and in the presence of the county's representatives. Record test results on a report which shall include a list of all personnel witnessing the tests. If test results are not in compliance with requirements, make necessary changes or adjustments at no additional cost to the county, and arrange for another performance test. This process shall continue until the systems are acceptable to the county.

2. Test Standards: Standard System Video Level shall be 1.0 volt peak-to-peak composite picture and sync. Standard System Video Polarity shall be white positive-going. Standard System Pulse Level shall be 4.0 volts for combined horizontal and vertical blanking pulses, horizontal drive pulse, vertical drive pulse and composite synchronizing pulses. Standard System Impedance shall be 75 ohms +/-2% over the frequency range 0 to 10 MHz.

C. System Characteristics

1. Peak-to-peak amplitude of the composite waveform at all points shall be 1.0 volt and shall be referred to as Standard System Video Level. It shall be measured in IRE units. 140 IRE units represent 1.0 volts.
2. Synchronizing pulse amplitude of a composite video signal of Standard System Video Level shall be measured from blanking level to reference white level and shall be 40 IRE units (0.286 volt nominal) at all points.
3. Video amplitude of a composite video signal of Standard System Video Level shall be measured from blanking level to reference white level and shall be 100 IRE units (0.714 volt nominal) at all points.
4. Picture setup of a composite video signal of Standard System Video Level shall be measured from blanking level to black level and shall be 7.5 IRE units (7.5% of the video amplitude) at al points.
5. Overshoot of any pulse shall be less than 2% of the pulse amplitude at all points.
6. The overall video frequency response shall be measured form any camera output via any normal signal path the input of a terminal device. It shall be +/-2 dB form 60 Hz to 9 MHz and no more than 4 dB down to 10 MHz.
7. The low frequency distortion shall be measured from any camera output via any normal signal path to the input of a terminal device. It shall be less than 2% at line and field rates.
8. The peak-to-peak signal-to-RMS noise ratios shall be measured from any camera output via any normal signal path to the input of a terminal device with all circuits except the test terminated at their inputs and outputs.
9. The signal-to-crosstalk ratio shall be measured as the signal-to-noise while observing for any transient caused by the operations of (a) any piece of equipment associated with that program path, or (b) any other electrical, lighting, ventilation equipment, etc. The signal-to-transient ratio shall not exceed the signal-to-noise ratio and under no conditions shall it be greater than 40 dB.
10. Pulse duration measurements shall be made with the calibrated waveform monitor. Pulse duration shall be measured at 10% amplitude, except for horizontal blanking pulse duration, which is measured at 90° amplitude. Rise and decay times shall be measured between 10% and 90% of the pulse amplitudes. All shall be within EIA standards.

D. Methods of Measurement

1. The system timing and synchronizing waveform shall be according to EIA RS-170, EIA RS-330, or equal standard.
2. The normal test setup consists of the test signal generator output feeding the input of the equipment under test. All circuits shall be operated at 75 ohms + 2$. This shall apply to cable as well as inputs and outputs. Terminations shall be connected as close as physically possible to the input of equipment.
3. All system measurements shall be made by bridging directly across the terminated 75 ohm circuit with an approved waveform monitor.
4. Standard video test signals shall be 10-step stair-step, sine pulse and window, multiburst and grating as generated by an approved TV retest signal generator.

3.08 SPARE PARTS

A. Deliver the following spare parts to the Owner at a location to be designated:
   1. Cameras: Color: (2)
   2. Camera Lenses: (One of each type utilized)/

END OF SECTION