2400 5th Avenue S, Suite 200 | Birmingham, Alabama 35233
Tel 205.879.4462 | GMCNETWORK.COM

TRANSMITTAL COVER SHEET

DATE: October 10, 2024

TO: ALL PLAN HOLDERS OF RECORD

FROM: JACQUI HART, AIA, IIDA, LEED AP, PROJECT MANAGER

PROJECT: TUSCALOOSA DEPARTMENT OF HUMAN RESOURCES
GMC PROJECT NO. ABHM220021

RE: ADDENDUM NO. 2 AND
ACKNOWLEDGEMENT OF RECEIPT OF ADDENDUM NO. 2

ACKNOWLEDGEMENT OF RECEIPT:

PLEASE PRINT RECIPIENT'S NAME, FIRM, AND DATE RECEIVED.

THEN E-MAIL BACK TO alyssa.martin@gmcnetwork.com FOR OUR RECORDS AND TO ACKNOWLEDGE YOUR RECEIPT OF THIS ADDENDUM.

_____
NAME *(PLEASE PRINT)*

_____
FIRM *(PLEASE PRINT)*

_____
DATE RECEIVED *(PLEASE PRINT)*

If there are any problems with this transmittal, please contact sender, at the number listed above.

ADDENDUM NUMBER 02

October 10, 2024

PROJECT: **TUSCALOOSA DEPARTMENT OF HUMAN RESOURCES**
GM&C PROJECT NO. ABHM220021

AD2-1 GENERAL:

A. The following revisions and/or additions to the Drawings and Project Manual are hereby made a part of same, and shall be incorporated in the Work of the Contract the same as if originally included in the Bid and Construction Documents.

B. Bidders shall acknowledge receipt of this Addendum in writing, as provided on the Proposal Form.

C. When a revision and/or addition is called for to the Drawings or Project Manual, they shall be fully coordinated with and carried through all applicable Drawings and portions of the Project Manual, including in part, all related Civil, Landscaping, Architectural, Structural, Plumbing, Mechanical, Electrical, and other Documents.

AD2-2 PROJECT MANUAL AND SPECIFICATIONS:

A. 23 0725 – Modular Indoor Air-Handling Units
B. 26 0500 – Basic Electrical Materials and Methods
C. 26 0519 – Power Conductions and Cables 51V-600V
D. 26 0526 – Grounding
E. 26 0533 – Raceways
F. 26 0534 – Outlet Boxes, Junction Boxes, Wireways
G. 26 0536 – Cable Trays
H. 26 0553 – Electrical Identification
I. 26 0943 – Lighting Control System
J. 26 2416 - Power Panelboards – Circuit Breaker Type
K. 26 2417 – Lighting Panelboards
L. 26 2726 – Wiring Devices
M. 26 2816 – Safety Switches and Fuses
N. 26 4100 – Lightning Protection System
O. 26 4300 – Surge Protective Devices
P. 26 5000 – Lighting Materials and Methods
Q. 27 0500 – Auxiliary System Cables, 0-50V
R. 27 1000 – Structured Cabling System
S. 27 4100 – Television Distribution System
T. 28 0723 – Security Management System
U. 28 2000 – CCTV Surveillance System – IP
V. 28 3100 – Fire Alarm System
W. 28 7800 – Emergency Responder Radio Coverage System

AD2-3 DRAWINGS:

A. Revised sheet M0.01
B. Revised sheet M1.01

C. Revised sheet M1.02
D. Revised sheet E1.02

AD2-4 MISCELLANEOUS:

A.

AD2-5 ATTACHMENTS:

A. Section 23 0725
B. New Divisions 26-28 Specification Sections
C. Revised Sheet M0.01
D. Revised Sheet M1.01
E. Revised Sheet M1.02
F. Revised Sheet E1.02

END OF ADDENDUM NUMBER 02

PREPARED BY

2400 5th Avenue S, Suite 200 | Birmingham, Alabama 35233
Tel 205.879.4462 | GMCNETWORK.COM
Goodwyn Mills Cawood, LLC.

SECTION 23 0725

MODULAR INDOOR AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes constant-volume, modular air-handling units with coils for indoor installations.

1.2 SUBMITTAL5S

A. Product Data: For each type of modular indoor air-handling unit indicated. Include the following:
   1. Unit dimensions, weights, structural weights, and required clearances.
   2. Fans:
      a. Certified fan-performance curves with system operating conditions indicated.
      b. Certified fan-sound power ratings.
      c. Certified fan-performance ratings with system operating conditions indicated.
      d. Motor ratings, electrical characteristics, and motor and fan accessories.
      e. Specialties and accessories.
      f. Material gages and finishes.
   3. Dampers, including housings and linkages.
   4. Filters with performance characteristics.

B. Shop Drawings:
   1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
   2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
   3. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control reports from manufacturer.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain modular indoor air-handling units through one source from a single manufacturer.

B. Options: Drawings indicate size, profiles, and dimensional requirements of modular indoor air-handling units and are based on the specific system indicated. Refer to Division 01, Section “Product Requirements.”

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

E. ARI Certification: Modular indoor air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.

F. Comply with NFPA 70.

1.4 COORDINATION

A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Trane Company (The); Worldwide Applied Systems Group.
2. Carrier Corp.; a member of the United Technologies Corp.
3. Daikin.
4. YORK International Corporation.

2.2 MANUFACTURED UNITS

A. Modular indoor air-handling units shall be factory assembled and consist of fans, motor and drive assembly, coils, damper, plenums, filters, condensate pans, mixing dampers, control devices, and accessories.

2.3 GENERAL

A. Unit layout and configuration shall be as defined in project plans and schedule.

B. Manufacturer to provide a full perimeter integral base frame for either ceiling suspension of units or to support and raise all sections of the unit for proper trapping. Base frame will either be bolted construction or welded construction. Refer to schedule for base height and construction type. Contractor will be responsible for providing a housekeeping pad when unit base frame is not of sufficient height to properly trap unit. Unit base frames not constructed of galvanized steel shall be chemically cleaned and coated with both a rust-inhibiting primer and finished coat of rust-inhibiting enamel. Unit base height to be included in total height required for proper trap height.

C. Units shall be specifically engineered for final assembly at the job site. Units requiring any field disassembly to access the mechanical room are not acceptable. The equipment's cooling, heating, humidifying, ventilating, exhausting capacity, and performance shall meet or exceed that shown on the schedule. Tags and decals to aid in service or to indicate caution areas shall be provided. Electrical wiring diagrams shall be attached to the control panel access doors. Operation and Maintenance manuals shall be furnished with each unit.

2.4 UNIT CASINGS

A. Unit manufacturer shall ship unit in segments as specified by the contractor for ease of installation in tight spaces. The entire air handler shall be constructed of galvanized steel. Casing finished to meet ASTM B117 125-hour salt-spray test. The removal of access panels or access doors shall not affect the structural integrity of the unit. All removable panels shall be gasketed. All doors shall have gasketing around full perimeter to prevent air leakage. Contractor shall be responsible to provide connection flanges and all other framework that is needed to properly support the unit.

B. Casing performance - Casing air leakage shall not exceed leak class 6 (CL = 6) per ASHRAE 111 at specified casing pressure, where maximum casing leakage (cfm/100 ft2 of casing surface area) = CL X P0.65.

C. Air leakage shall be determined at 1.00 times maximum casing static pressure up to 8 inches w.g. Specified air leakage shall be accomplished without the use of caulk. Total estimated air leakage shall be reported for each unit in CFM, as a percentage of supply air, and as an ASHRAE 111 Leakage Class.

D. Under 55F supply air temperature and design conditions on the exterior of the unit of 81F dry bulb and 73F wet bulb, condensation shall not form on the casing exterior. The AHU manufacturer shall provide tested casing thermal performance for the scheduled supply air temperature plotted on a psychrometric chart. The design condition on the exterior of the unit shall also be plotted on the chart.

If tested casing thermal data is not available, AHU manufacturer shall provide, in writing to the Engineer and Owner, a guarantee against condensation forming on the unit exterior at the stated design conditions above. The guarantee shall note that the AHU manufacturer will cover all expenses associated with modifying units in the field should external condensate form on them. In lieu of AHU manufacturer providing a written guarantee, the installing contractor must provide additional external insulation on AHU to prevent condensation.

E. Unit casing (wall/floor/roof panels and doors) shall be able to withstand up to 1.5 times design static pressure, or 8-inch w.g., whichever is less, and shall not exceed 0.0042 per inch of panel span (L/240).

F. Floor panels shall be double-wall construction and designed to support a 300-lb load during maintenance activities and shall deflect no more than 0.0042 per inch of panel span.

G. Unit casing panels shall be 2-inch double-wall construction, with solid galvanized exterior and solid galvanized interior, to facilitate cleaning of unit interior.

H. Unit casing panels (roof, walls, floor) and doors shall be provided with a minimum thermal resistance (R-value) of 13 Hr*Ft2*ºF/BTU.

I. Unit casing panels (roof, walls, floor) and external structural frame members shall be completely insulated filling the entire panel cavity in all directions so that no voids exist. Panel insulation shall comply with NFPA 90A.

J. Casing panel inner liners must not extend to the exterior of the unit or contact the exterior frame. A mid-span, no-through-metal, internal thermal break shall be provided for all unit casing panels.

K. Access panels and/or access doors shall be provided in all sections to allow easy access to drain pan, coil(s), motor, drive components and bearings for cleaning, inspection, and maintenance.

L. Access panels and doors shall be fully removable without the use of specialized tools to allow complete access of interior surfaces.

2.5 CABINET CONSTRUCTION

A. Site Assembled units: Units shall be provided by a manufacturer in the business of producing factory and site assembled custom air handling equipment and shall be specifically engineered for final assembly at the jobsite. Site assembly shall be accomplished using the same procedures and techniques as would be used by the manufacturer in the factory and shall yield the same performance characteristics. Site assembly techniques that negate thermal break or other performance characteristics shall not be accepted.

1. The installing contractor shall provide technicians for training at the AHU manufacturer's facility prior to equipment shipment and/or site assembly shall be supervised by a direct employee of the AHU manufacturer or by a manufacturer-certified technician. All unit warranty coverage shall be the same as for a factory assembled unit.

2. Complete units shall be shipped, broken down into individual panel and component form and all pieces shall be engineered for site assembly with no disassembly required. Dimensions and weights of critical sized components shall be provided at time of project submission, for review by the engineer and contractor.

3. All AHU components, assembly instructions, gasket and assembly hardware shall be provided by the AHU manufacturer. Assembly instructions shall include easy-to-follow photo details. These details shall include:

a. Detailed unit specific assembly instructions with typical photo's of assembly for both unit and component installation.

b. List of tools required for field installation.

4. ***Panel gasket supplied with the unit shall be a high quality weather resistant closed-cell EPDM sponge rubber. Units relying on field applied caulk for sealing are not acceptable. Units shall be securely assembled using machine bolts. Units relying on sheet metal binding screws for field assembly are not acceptable.***
5. ***Units shall be accompanied by detailed bills of material for each pallet and crate, pallet check lists, panel maps, parts, construction information and document check lists. All major components shall be identified to match the bills of material and packing lists.***

2.6 ACCESS DOORS

A. Access doors shall be 2-inch double-wall construction. Interior and exterior shall be of the same construction as the interior and exterior wall panels.

B. All doors shall be provided with a thermal break construction of door panel and door frame.

C. Gasketing shall be provided around the full perimeter of the doors to prevent air leakage.

D. Door hardware shall be surface-mounted to prevent through-cabinet penetrations that could likely weaken the casing leakage and thermal performance.

E. Handle hardware shall be designed to prevent unintended closure.

F. Access doors shall be hinged and removable without the use of specialized tools.

G. Hinges shall be interchangeable with the door handle hardware to allow for alternating door swing in the field to minimize access interference due to unforeseen job site obstructions.

H. Door handle hardware shall be adjustable and visually indicate locking position of door latch external to the section.

I. All doors shall be a 60-inch high when sufficient unit height is available, or the maximum height allowed by the unit height.

J. A single door handle shall be provided for each door linking multiple latching points necessary to maintain the specified air leakage integrity of the unit.

K. An optional shatterproof window shall be provided in access doors where indicated on the plans. Window shall either be single pane, or thermal dual pane, as defined on schedule. Window shall be capable of withstanding unit operating pressures and shall be safe for viewing UV-C lamps

2.7 PRIMARY DRAIN PANS

A. All cooling coil sections shall be provided with an insulated, double-wall, galvanized drain pan.

B. The drain pan shall be designed in accordance with ASHRAE 62.1 being of sufficient size to collect all condensation produced from the coil and sloped in two planes, pitched toward drain connections, promoting positive drainage to eliminate stagnant water conditions when unit is installed level and trapped per manufacturer's requirements.

C. The outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.

D. All drain pan threaded connections shall be visible external to the unit. Threaded connections under the unit floor shall not be accepted.

E. Drain connections shall be of the same material as the primary drain pan and shall extend a minimum 2-1/2-inch beyond the base to ensure adequate room for field piping of condensate traps.

F. The installing contractor is responsible to ensure the unit is installed level, trapped in accordance with the manufacturer's requirements, and visually inspected to ensure proper drainage of condensate.

G. Coil support members inside the drain pan shall be of the same material as the drain pan and coil casing.

H. If drain pans are required for heating coils, access sections, or mixing sections they will be indicated in the plans

2.8 FANS

A. Fan sections shall have a minimum of one hinged and latched access door located on the drive side of the unit to allow inspection and maintenance of the fan, motor, and drive components.

B. Provide fans of type and class as specified on the schedule. All fans shall be statically and dynamically tested by the manufacturer for vibration and alignment as an assembly at the operating RPM to meet design specifications. Fans that are selected with inverter balancing shall first be dynamically balanced at design RPM. The fans then will be checked in the factory from 25% to 100% of design RPM to insure they are operating within vibration tolerance specifications, and that there are no resonant frequency issues throughout this operating range. Inverter balancing that requires lockout frequencies inputted into a variable frequency drive to in order to bypass resonant frequencies shall not be acceptable. If supplied in this manner by the unit manufacturer, the contractor will be responsible for rebalancing in the field after unit installation. Fans selected with inverter balancing shall have a maintenance free grounding assembly installed on the fan motor to discharge both static and induced shaft currents to ground.

C. Direct drive plenum fans with integral frame motors, shall be mounted on isolation bases. Fan shall be dynamically balanced throughout the operating range to a BV-3 (0.20 in/s) per AMCA 204 test standard. Fan and motor shall be internally isolated with spring isolators. A flexible connection shall be installed between fan and unit casing to ensure complete isolation. Flexible connection shall comply with NFPA 90A and UL 181 requirements. If fans and motors are not internally isolated, then the entire unit shall be externally isolated from the building, including supply and return duct work, piping, and electrical connections. External isolation shall be furnished by the installing contractor in order to avoid transmission of noise and vibration through the ductwork and building structure.

D. Fan airflow measurement systems shall be provided as indicated on the schedule and drawings to measure fan airflow directly or to measure differential pressure that can be used to calculate airflow. The accuracy of the devices shall be no worse than +/- 5 percent when operating within stable fan operating conditions. Devices shall not affect the submitted fan performance and acoustical levels. Devices that obstruct the fan inlet or outlet shall not be acceptable. Devices shall be connected to transducers with selectable 4-20 mA or 2-10 VDC output. Signal shall be proportional to air velocity.

E. Each horizontal direct drive fan in a multiple-fan array shall be provided with integral back flow prevention: a backdraft damper that prohibits recirculation of air in the event a fan or multiple fans become disabled. Dampers are tested and rated based on AMCA Standard 500. Dampers to be heavy duty type capable of a maximum back pressure that exceeds the design total static pressure with minimal leakage. The dampers should have a minimal total effect on airflow performance both pressure drop when open and system effect on the fan. The damper blades and frame shall be extruded aluminum with blade edge seals locked into the blade edge. Adhesive type seals are unacceptable. AHU manufacturer responsible for providing proper spacing upstream of dampers to ensure full, uniform airflow through upstream components. For units where the damper(s) are supplied at the jobsite, the installing contractor shall contract a certified TAB contractor to verify uniform airflow thru upstream components

F. Motors and Drives

1. Motors shall meet or exceed all NEMA Standards Publication MG 1 - 2006 requirements and comply with NEMA Premium efficiency levels when applicable. Motors shall comply with applicable requirements of NEC and shall be UL Listed.

2. Fan Motors shall be heavy duty, open drip-proof operable at scheduled voltage. If applicable, motor efficiency shall meet or exceed NEMA Premium efficiencies.
3. Direct driven fans utilizing integral frame motors shall use 2-pole (3600 rpm), 4-pole (1800 rpm) or 6-pole (1200 rpm) motors, NEMA Design B, with Class B insulation capable to operate continuously at 104 deg F (40 deg C) without tripping overloads.
4. Motors shall have a +/- 10 percent voltage utilization range to protect against voltage variation

2.9 COILS

A. Coils section header end panel shall be removable to allow for removal and replacement of coils without impacting the structural integrity of the unit.

B. Install coils such that headers and return bends are enclosed by unit casing to ensure that if condensate forms on the header or return bends, it is captured by the drain pan under the coil.

C. Coils shall be manufactured with plate fins to minimize water carryover and maximize airside thermal efficiency. Fin tube holes shall have drawn and belled collars to maintain consistent fin spacing to ensure performance and air pressure drop across the coil as scheduled. Tubes shall be mechanically expanded and bonded to fin collars for maximum thermal conductivity. Use of soldering or tinning during the fin-to-tube bonding process is not acceptable due to the inherent thermal stress and possible loss of bonding at that joint.

D. Construct coil casings of galvanized steel. End supports and tube sheets shall have belled tube holes to minimize wear of the tube wall during thermal expansion and contraction of the tube.

E. All coils shall be completely cleaned prior to installation into the air handling unit. Complete fin bundle in direction of airflow shall be degreased and steam cleaned to remove any lubricants used in the manufacturing of the fins, or dirt that may have accumulated, in order to minimize the chance for water carryover.

F. When two or more cooling coils are stacked in the unit, an intermediate drain pan shall be installed between each coil. The intermediate drain pan shall be designed being of sufficient size to collect all condensation produced from the coil and sloped to promote positive drainage to eliminate stagnant water conditions. The intermediate drain pan shall be constructed of the same material as the sections primary drain pan.

G. The intermediate drain pan shall begin at the leading face of the water-producing device and be of sufficient length extending downstream to prevent condensate from passing through the air stream of the lower coil.

H. Intermediate drain pan shall include downspouts to direct condensate to the primary drain pan. The intermediate drain pan outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.

I. Hydronic Coils
1. Supply and return header connections shall be clearly labeled on unit exterior such that direction of coil water-flow is counter to direction of unit air-flow.
2. Coils shall be proof-tested to 300 psig and leak-tested to 200 psig air pressure under water.
3. Headers shall be constructed of round copper pipe or cast iron.
4. Tubes shall be 5/8-inch .020 copper, with aluminum fins

J. Electric Coil
1. Electric heat shall be factory installed in the air handler and shipped complete to the job site. For blow-thru applications, a diffuser plate shall be installed between the supply fan and electric heater. The complete air handler shall be UL/CUL or ETL listed as shipped from the manufacturer. If the air handler is not UL/CUL or ETL listed with an electric heater, the

contractor is responsible for expenses associated with field inspection and licensing to UL/CUL or ETL.

2. Units with field-mounted electric heat shall be applied in accordance with all applicable NEC, UL/CUL or ETL, and local code requirements. Contractor shall be responsible for installing per electric heat manufacturer's guidelines including, but not limited to, required upstream and downstream distance from coils, filters, motors, or other electrical devices. Contractor assumes responsibility and expenses associated with inspection and site approval to meet local building codes.
3. Construction
   a. The heater shall be an open-coil configuration with Type A wire (80% nickel and 20% chromium) derated to a maximum watt density of 45 watts per square inch. Safeties shall include three-pole, disconnecting-type contactors,airflow proving switch to ensure airflow through the heater, an automatic reset high temperature limit and a manual reset high temperature limit to ensure safe operating temperatures of the heater. The contactors for energizing the electric heater shall be magnetic contactors. Electric heaters above 48 amps shall be fused into circuits not to exceed 48 amps as required by UL and NEC. Kilowatt output shall be selected to the nearest 0.1 kW of scheduled kilowatt.
   b. Resistance wire shall be mechanically staked and heliarc welded to corrosion resistant terminals to ensure maximum reliability and minimum electrical resistance. Heating elements shall be supported by corrosion resistant heavy gauge wire rack construction. The design should feature free airflow around ceramics and the lowest possible pressure drop through elements and rack. The heater shall use high quality anti-thermal shock, moisture resistant steatite ceramics and 105 degree C rated appliance wire.
   c. Voltage shall be as shown on the schedule.
   d. Electric heat stages of control shall be as defined in unit plans. Amperage shall not exceed 48 amps per stage.
   e. The electric heater shall be wired to accommodate SSR-Vernier control. The SSR control can receive a 0-10VDC or 4-20mA signal from a standalone thermostat or building automation system providing full modulating control of the first increment of heat, which is rated at 200% of all other chosen heat increments. There are a minimum of 3 and a maximum of 6 increments of heat stages. These stage increments are turned on and off by a step controller. As each stage is required to fulfill the demand for heat, the SSR increment is used as fully modulating between stages.
   f. Detailed wiring diagrams shall be provided inside each electric heater control panel for installation wiring connections and service requirements

2.10 FILTERS

A. Provide factory-fabricated filter section of the same construction and finish as unit casings. Filter section shall have side access filter guides and access door(s) extending the full height of the casing to facilitate filter removal. Construct doors in accordance with Section 2.04. Provide fixed filter blockoffs as required to prevent air bypass around filters. Blockoffs shall not need to be removed during filter replacement. Filters to be of size, and quantity needed to maximize filter face area of each particular unit size.

B. Filter type, MERV rating, and arrangement shall be provided as defined in project plans and schedule

2.11 DAMPERS

A. All dampers, with the exception of external bypass and multizones (if scheduled), shall be internally mounted. Dampers shall be premium ultra low leak and located as indicated on the schedule and plans. Blade arrangement (parallel or opposed) shall be provided as indicated on the schedule and drawings. Dampers shall be Ruskin CD60 double-skin airfoil design or equivalent for minimal air leakage and

pressure drop. Leakage rate shall not exceed 3 CFM/square foot at one inch water gauge complying with ASHRAE 90.1 maximum damper leakage and shall be AMCA licensed for Class 1A. All leakage testing and pressure ratings shall be based on AMCA Standard 500-D. Manufacturer shall submit brand and model of damper(s) being furnished, if not Ruskin CD60.

2.12 ACCESS STATIONS

A. Access sections shall be provided where indicated in the schedule and plans to allow additional access for inspection, cleaning, and maintenance of unit components. The unit shall be installed for proper access. Procedure for proper access, inspection and cleaning of the unit shall be provided in the AHU manufacturer's maintenance manual.

2.13 VFD PER FAN

A. Multiple VFDs on a common panel, shall be provided for each fan array to provide redundancy in case of loss of function of one of the VFDs or motors. Individual VFD shall be sized based on motor FLA to reduce overall panel input current. In the event of a VFD failure, the remaining VFDs must be capable of compensating and maintaining normal fan array operation.

B. VFD panel shall have a common disconnect that is accessible from the outside of the unit. Disconnect shall open input power to all VFDs simultaneously. Disconnect shall be lockable in the off position. Disconnect shall utilize circuit breaker to provide overcurrent and short circuit protection.

C. VFD panel shall be provided with a common point connection for speed input signal, start/stop signal, fault status, and field interlock connection.

D. VFD panel shall be provided with a single point of field connection for field input power. Each VFD shall be supplied with independent input fusing, as required. Panel shall be provided with short circuit current of 5kA RMS symmetrical.

E. VFD panel shall be provided with a single point of field connection for field input power. Each VFD shall be supplied with independent input fusing, as required. Panel shall be provided with short circuit current of 65kA RMS symmetrical.

F. Externally mounted VFDs shall be provided with independent keypad

2.14 FACTORY WIRING

A. VFDs shall be wired per NEC, UL, and NFPA 90A requirements. Units with factory-mounted controls shall also include power wiring from the VFD or starter/disconnect control transformer to the control system transformers. Units with VFDs and factory-mounted controls shall have a binary start-stop signal and an analog speed signal wired from the direct digital controller to the VFD.

B. All power wiring for voltages greater than 24V and traveling through multiple unit sections shall be contained in an enclosed, metal, power-wiring raceway or EMT. Sections less than 6-inch in length may be contained in FMC.

C. After mounting and wiring of VFDs, on the AHUs, trained factory personnel shall ensure proper operation of each VFD, through a thorough factory test. Testing shall include a Hypot test of unit wiring to ensure that no weaknesses exist in wiring or motor. Each VFD shall be energized and the fan run to ensure the VFD will operate throughout the usable range of the drive and that the fan rotation is correct. Each VFD with bypass shall also be tested in the bypass position to ensure the bypass is operational.

D. On units provided with factory mounted and wired supply fan starter, MICP or VFD and DDC controls, the manufacturer shall provide a single point of power. Line-to-24v transformers shall be provided with sufficient vA to power the unit mounted controller and factory installed control points

2.15 FACTORY-ENGINEERED AUTOMATIC TEMPERATURE CONTROLS

A. Unit shall be provided with a factory wired, installed and tested unit controller, capable of standalone unit control, or tied into a building automation system through Bacnet communication. All control points in unit shall be tested at the unit manufacturers facility prior to shipment.

2.16 UNIT DDC CONTROLLER

A. One programmable DDC controller shall be provided by the AHU manufacturer for each AHU as indicated on the schedule and drawings. Control of multiple units from a single controller is not acceptable. Each programmable DDC controller shall use the LonTalk protocol and shall be LonMark certified to ensure open communication with other open BASs. Complete communications and diagnostics including all AI, BI, AO, BO, set points and alarms shall only require a twisted pair of wires between the unit controller and the BAS. Each unit controller shall be factory wired to the unit end devices. For indoor units, each controller shall have a user display touch screen for user interface. The display on indoor units shall be unit mounted in the factory. For outdoor units, one portable user display touch screen for user interface shall be provided for all controllers. Displays shall give user access to AHU status, set points and alarms.

B. The programmable DDC controller and the control components shall be selected, mounted, wired and tested by the AHU manufacturer to ensure delivery of specified performance and to minimize jobsite startup time. Testing shall be performed to ensure wiring continuity between the controller and all devices, and to ensure proper operation of the end devices. DDC controllers shall be located on unit as indicated on the drawings

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Concrete Bases: Install floor mounting units on 8-inch high concrete bases. See Division 23 Section “Basic HVAC Materials and Methods” for concrete base materials and fabrication requirements.

B. Install modular indoor air-handling units with the following vibration-control devices. Vibration-control devices are specified in Division 23 Section "Mechanical Vibration and Seismic Controls."
   1. Units with Internally Isolated Fans: Secure units to anchor bolts installed in concrete bases.
   2. Floor-Mounted Units: Support on concrete bases using neoprene pads. Secure units to anchor bolts installed in concrete bases.
   3. Floor-Mounted Units: Support on concrete bases using housed-spring isolators. Secure units to anchor bolts installed in concrete bases.

C. Arrange installation of units to provide access space around modular indoor air-handling units for service and maintenance.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to air-handling unit to allow service and maintenance.

C. Connect piping to modular indoor air-handling units mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using NPS 1-1/4, Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

E. Chilled-Water Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.

F. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connections.

G. Electrical: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls.

H. Ground equipment according to Division 26 Section “Grounding and Bonding.”

I. Tighten electrical connectors and terminals according to manufacturers’ published torque-tightening values. If manufactures’ torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installations, including piping and electrical connections.
   1. Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks. Repair leaks and retest until no leaks exist.
   2. Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and restest until no leaks exist.
   3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Prepare test and inspection reports in writing.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Final Checks before Start-Up:
   1. Verify that shipping, blocking, and bracing are removed.
   2. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
   3. Perform cleaning and adjusting specified in this Section.
   4. Disconnect fan drive from motor, verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
   5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
   6. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
   7. Comb coil fins for parallel orientation.

8. Verify that proper thermal-overload protection is installed for electric coils.
9. Install new, clean filters.
10. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

C. Starting procedures for modular indoor air-handling units include the following:
1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing" for air-handling system testing, adjusting, and balancing.

3.7 CLEANING

A. After completing system installation and testing, adjusting, and balancing modular indoor air-handling unit according to manufacturer’s written instructions, clean internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain modular indoor air-handling units. Refer to Division 01 Section “Closeout Procedures.”

END OF SECTION 23 0725

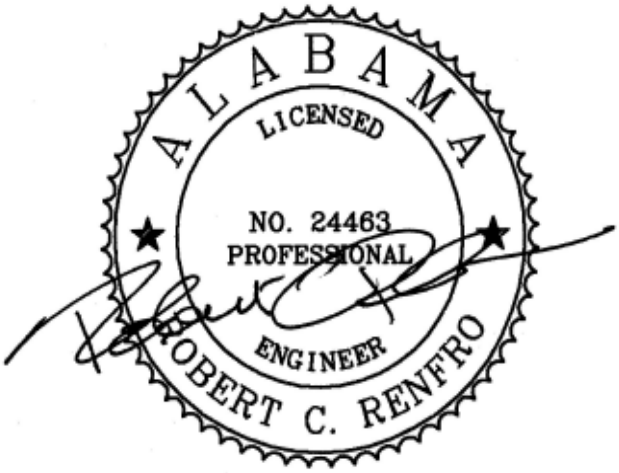
SECTION 26 00 00

COVER - RCR

DIVISION 26/27/28

ELECTRICAL SPECIFICATIONS

PREPARED BY



09/06/2024

SECTION 26 05 00

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 DESCRIPTION

A. General Conditions:
1. The accompanying General Conditions (front-end specifications) shall apply to and form a part of this section.

B. General Requirements:
1. Carefully examine General Conditions, other specification sections, and other drawings (in addition to Electrical) in order to be fully acquainted with their effect on electrical work.
2. Do all work in compliance with all applicable codes, laws, and ordinances, the National Electrical Safety Code, the National Electrical Code (hereinafter referred to as "Code"), applicable energy codes, and the regulations of the local utility companies. Obtain and pay for any and all required permits, inspections, certificates of inspections and approval, and the like.
3. Cooperate with other trades and contractors at job. Perform work in such manner and at such times as not to delay work of other trades. Complete all work as soon as the structure and installations of equipment will permit. Patch, in a satisfactory manner and by the proper craft, any work damaged by electrical workmen.
4. Electrical contracting firm shall be licensed as an electrical contractor in the state where work will be performed

1.2 GENERAL SCOPE OF ELECTRICAL WORK (REFER TO DRAWINGS FOR OTHER SPECIFIC SCOPE ITEMS)

A. Furnish all labor and materials to complete electrical work as shown on drawings and/or herein specified.

B. Remove all existing electrical equipment and wiring made obsolete by this project and remove or relocate all electrical services located on or crossing through the project property, either above or below grade, which would obstruct the construction of the project or conflict in any manner with the completed project or any code pertaining thereto. Dispose of salvageable materials as directed by the Architect. Contractor shall schedule meeting to review scope of electrical demolition and to confirm scope and phasing of proposed demolition with the owner in the presence of the prime consultant prior to start of any electrical demolition.

C. Furnish and install complete power, telephone and other electrical services as shown on drawings and/or specified herein.

D. Pay all electrical utility company service charges (if any) in connection therewith, including permanent meter deposit. Meter deposits will be refunded to Contractor at time of Owner's acceptance.

E. Furnish and install complete power distribution system as shown on drawings and/or specified herein.

F. Furnish and install disconnect switches for motors as shown on drawings and/or specified herein.

G. Furnish and install complete electrical grounding systems as shown on drawings and/or specified herein.

H. Install and connect electrical equipment mentioned in Division 26/27/28 Specifications or noted in drawings, whether furnished by electrical contractor or by others.
1. Where shown or specified, equipment furnished by others shall be installed and connected under this Contract.
2. Where shown or specified, Contractor shall receive, unpack, check and assume custody of equipment furnished by Others. Contractor shall assume responsibility for care and safekeeping of this equipment, when delivered into his custody. He shall protect it from moisture, dust and damage during construction and until Owner acceptance of project.

I. Furnish and install complete electrical lighting systems as shown on drawings and/or specified herein.

J. Furnish and install all electrical items shown on drawings and/or herein specified, unless shown or specified otherwise.

K. Furnish and install complete controls & auxiliary systems as shown on drawings and/or specified herein.

L. Furnish and install complete telephone/data raceway (including all outlet boxes, face plates, conduit raceways, telephone backboards, terminal cabinets, etc.), wiring and devices system as shown on drawings and/or specified herein.

M. Furnish and install a complete Fire Alarm System as shown on drawings and/or specified herein.

N. Furnish and install a complete Surge Protection System as shown on drawings and/or specified herein.

O. Furnish and install a complete Building Lightning Protection System as shown on drawings and/or specified herein.

P. Procure and pay for permits and certificates as required by local and state ordinances and fire underwriter's certificate of inspection.

Q. Balance loads as equally as practicable on services, distribution feeders, circuits and buses. Provide typewritten directory for each panel.

R. Unless specifically indicated or required otherwise, terminate all circuitry/cabling provided within this contract at associated equipment/devices/etc. in accordance with all applicable codes, standards and supplier requirements, whether associated equipment/device/etc. is furnished within this contract or by others.

S. Complete field testing, adjustment & startup of all systems listed above as shown on drawings and/or specified herein.

PART 2 - PRODUCTS

2.1 APPROVED MATERIALS AND DEVICES

A. Where not otherwise specified, provide only new, standard, first-grade materials/systems throughout, conforming to standards established by Underwriter's Laboratories, Inc., and so marked or labeled, together with manufacturer's brand or trademark. All equipment/systems subject to approval of Architect before installation. All like items and associated equipment/systems shall be of one manufacturer.

B. To ensure proper coordination, it is intended that all electrical equipment and materials specified in Division 26/27/28 of these specifications and shown on the electrical drawings be furnished and installed by the electrical sub-contractor. It will not be permissible for any of these items to be furnished directly by the general contractor without the electrical contractor's coordination.

C. To ensure commonality of spare parts, it is required that the electrical contractor provide the same brand for all circuit breakers, starters, power equipment, etc. provided under the following divisions of these specifications:
1. SECTION 26 24 16: POWER PANELBOARDS - CIRCUIT BREAKER TYPE
2. SECTION 26 24 17: LIGHTING PANELBOARDS
3. SECTION 26 28 16: SAFETY SWITCHES AND FUSES

2.2 SUBMITTALS

A. All submittals to the design team shall be accompanied by a letter summarizing all proposed deviations from specified products or pre-approved substitutions. The absence of such a letter shall be understood to indicate that the contractor intends to meet all contract requirements, regardless of cut-sheets/data-sheets provided within the submittal.

B. Submit to Architect ten (10) days prior to bid date three (3) copies of any items and/or manufacturers which are proposed as substitutes for those specified.

C. Submit to Architect promptly after award of Contract and prior to purchasing, the number of copies required by the contract. All drawings of a specific item or system shall be made in one submittal, and within thirty (30) days after award of Contract. Shop drawings of all power equipment shall contain exact details of device placement, phasing and numbering, in form of elevations, for each major piece of equipment. Shop drawings shall be submitted on the following:
1. SECTION 26 05 36: CABLE TRAYS
2. SECTION 26 09 43: LIGHTING CONTROL SYSTEM
3. SECTION 26 24 16: POWER PANELBOARDS - CIRCUIT BREAKER TYPE
4. SECTION 26 24 17: LIGHTING PANELBOARDS
5. SECTION 26 28 16: SAFETY SWITCHES AND FUSES
6. SECTION 26 41 00: LIGHTNING PROTECTION SYSTEM
7. SECTION 26 43 00: SURGE PROTECTIVE DEVICES
8. SECTION 26 50 00: LIGHTING MATERIALS AND METHODS
9. SECTION 27 10 00: STRUCTURED CABLING SYSTEM
10. SECTION 28 20 00: CCTV SURVEILLANCE SYSTEM - IP
11. SECTION 28 31 00: FIRE ALARM SYSTEM

12. SECTION 28 78 00: EMERGENCY RESPONDER RADIO COVERAGE SYSTEM
13. ALL POWER DISTRIBUTION EQUIPMENT (i.e. SWITCHBOARDS, PANELBOARDS, DRY TYPE TRANSFORMER, ETC.)
14. ALL ELECTRICAL AND TELECOMMUNICATION EQUIPMENT LAYOUTS - Submittals shall include ¼" = 1'-0" CAD drawings (hand drawn sketches will not be accepted) of each electrical room, IT room, electrical equipment stand, generator area, or any other similar area with electrical equipment. Drawings shall indicate all panelboards, transformers, switchboards, generators, equipment racks, control panels, HVAC equipment, etc. that are located in each electrical/IT area. Layouts shall show that each piece of electrical equipment has the clearances, working space and dedicated equipment space required by applicable codes. No conduits to equipment within these areas shall be installed until submittals have been provided and returned without exception by the design team.

D. The contractor shall fully review, comment upon and correct all shop drawings as required to assure compliance with contract documents prior to submittal to Architect. The failure of the contractor to properly review and correct shop drawings prior to submittal will result in rejection of shop drawings by the engineer. Review by the Architect will be for general conformance with contract documents. The contractor shall be fully responsible for correctness of all submitted dimensions, details, quantities and locations.

E. None of the above items shall be installed until shop drawings or catalog data have been reviewed by Architect without rejection or required resubmittal. Any listed item not submitted, even if specified, shall be considered not acceptable and shall be removed if directed.

F. Any required resubmittal will be reviewed by the Architect for conformance with previously issued comments only. The contractor shall be responsible for verifying that all items not specifically requiring resubmittal have not been altered from the previously reviewed submittal.

G. Material proposed for substitution shall be of the same quality, perform the same functions, conform to such physical dimensions and appearance as are required by the Architect. All material proposed for substitution is subject to the approval of the Architect and his authority for approval is final. No material proposed for substitution will be considered unless all submittal data complies with the drawings and specifications of Section 16 as to time of submission, number of copies of submittal, and detail requirements.

H. Samples of material shall be furnished where required by drawings or Division 26/27/28 Specification, or as requested by the Architect on items proposed as substitutes.

I. Submit to Architect a certificate of final inspection from local inspection department.

PART 3 - EXECUTION

3.1 SITE VISIT

A. The Contractor shall visit the site to determine existing dimensions and conditions affecting electrical work. Failure to do so in no way relieves Contractor of his responsibility under Contract.

3.2 CLEARANCE WITH UTILITIES

A. It shall be the responsibility of this Contractor, prior to bid, to reaffirm with the utility companies involved, that the locations, arrangement (and with power company voltage, phase, and metering required) and connections to utility service are in accordance with their regulations and requirements. If their requirements are at variance with these drawings and specifications, the Contract price shall include any additional cost necessary to meet those requirements without extra cost to Owner after a contract is entered into.

B. On many projects the utility company may levy charges due to locations, size or type service involved. The Contractor shall be responsible for these charges (including permanent meter deposit), unless such charges are not available prior to bid and Contractor so documents as described below. The meter deposit will be refunded to the contractor at time of Owner's acceptance.

C. Should above cost not be available, prior to bid, Contractor must submit a letter signed by a responsible utility company person so stating with his bid and in turn must be submitted by Prime Contractor with his bid to Owner. The cost will then be deleted from the Contract and become responsibility of the Owner.

D. Arrange with utility companies for such services as shown or herein specified and installation of meter where shown. Furnish with shop drawings a signed document from utility companies describing the location and type of services to be furnished and any requirements they may have. This document shall be signed for each utility company by a person responsible for granting such service.

3.3 WORKMANSHIP

A. All work shall be in accordance with the latest editions of NFPA 70 (National Electrical Code), NFPA 101 (Life Safety Code), National Electric Safety Code, International Building Code, applicable NECA standards and the rules and regulations of State and Local Authorities Having Jurisdiction.

B. All work shall be executed in a workmanlike manner and shall present a neat and mechanical appearance upon completion.

C. All equipment, devices, etc. shall be installed in accordance with manufacturer's recommendations.

D. All items shall be installed straight and plumb in a workmanlike manner and care shall be exercised so that like items are mounted the same position, heights and general location.

E. Keep site clean of accumulation of cartons, trash and debris.

3.4 SAFETY

A. The contractor is solely responsible for all job safety. Architect assumes no responsibility for job safety. Maximum consideration shall be given to job safety and only such methods as will reasonably insure the safety of all persons shall be employed. The codes and regulations of OSHA shall be given strict compliance as well as such other codes, laws, and regulations as may be applicable.

3.5 CONTRACT DOCUMENTS

A. Contract documents indicate diagrammatically, extent, general character and approximate location of work. Where work is indicated but minor details omitted, furnish and install it complete so as to perform its intended functions. For details and mechanical equipment, follow drawings provided by other disciplines (Architectural, Mechanical, Structural, Civil, etc.) and fit electrical work thereto.

B. Contract documents consist only of the hardcopy documents issued by the Prime Architect. Electronic documents issued directly by the electrical engineer to the contractor and/or its sub-contractors/vendors are issued for convenience only (electronic documents are not formal contract documents).

C. If the contractor and/or one of its suppliers require a one-time transfer of electronic files of the current electrical construction documents to prepare shop drawings (or for another similar purpose), it shall:
1. Sign a waiver prepared by the electrical engineer prior to the transmittal of these files.
2. Agree to pay the electrical engineer a fee of $50.00 per drawing, up to a maximum of $400 per transfer, payable upon receipt of the files.
3. To the fullest extent permitted by law, indemnify, hold harmless, and defend JRA from all claims, damages, losses and expenses, including attorneys' fees arising out of or resulting from the use of the CAD files.

D. Take finish dimensions at job in preference to scaled dimensions.

E. Except as above noted, make no changes in or deviations from work as shown or specified except on written order of Architect.

3.6 UNDERGROUND UTILITY/EQUIPMENT COORDINATION

A. Prior to commencement of work, verify exact locations of all existing or proposed underground utilities and/or underground equipment and verify that proposed electrical installation does not conflict with these items. Notify Architect immediately if any conflict is found.

3.7 EQUIPMENT STORAGE

A. Store all electrical equipment in dry, covered locations as directed by equipment manufacturers. Contractor shall be responsible for replacing or repairing improperly-stored equipment as directed by Architect.

3.8 EXCAVATION, CUTTING AND PATCHING

A. Perform all cutting and excavating as necessary for installation of electrical systems, unless specifically covered under another section. After Architect's observation, complete all excavation, filling and backfilling as directed under specifications for preparation of site and earthwork. Foundations for equipment shall be as specified under concrete section. Concrete pads shall be minimum of 6" thick; unless greater thickness required by equipment manufacturer. Obtain specific approval of Architect before cutting into any structural members.

B. For all such work employ competent workmen, and finish up in neat and workmanlike manner, equal to quality and appearance to adjacent work.

3.9 PENETRATIONS

A. All penetrations in water tight barriers shall be made so that barrier rating is not compromised. Furnish roof flashing for all equipment installed under Division 26/27/28 that penetrates through the roof. Appropriate flashing is specified under roofing and sheet metal section. Supply these flashings for installation under roofing and sheet metal section.

B. All fire/smoke barrier penetrations shall be made in accordance with a U.L. listed assembly to maintain the fire/smoke rating of the associated membrane.

C. Where penetrations are required through structural elements, verify penetration locations and sizes with structural engineer. In no case shall the structural integrity be compromised without written approval from structural engineer.

3.10 INSTALLATION OF EQUIPMENT - GENERAL

A. Care shall be exercised in exact routing and location of all items so as not to obstruct access to equipment, personnel walkways, or expose it to potential mechanical damage.

B. Items shall be securely anchored and/or fastened. Provide proper support for all equipment, devices, conduits, boxes, panels, etc. as required by code and for a workmanlike installation. Provide guy wiring for wood poles where required to prevent leaning. All construction shall meet the seismic design requirements of the building code. Items (especially transformers, light fixtures, equipment racks, freestanding gear, etc.) installed in seismic zones C, D, E or F shall be supported and braced per applicable codes and standards.

C. All wall, pole or frame-mounted electrical equipment shall be mounted to metal unistrut (or similar) frames of same material as electrical equipment. For example, pole-mounted painted or galvanized steel disconnect switches shall be mounted to galvanized steel unistrut frames.

D. All electrical equipment, furnished by Contractor or by others shall be covered and protected during construction.

E. All control cabinets, panels, motor control centers and other electrical cabinets and enclosures shall have all trash removed and be vacuumed clean. All foreign paint, etc., shall be removed from exterior and all scratches in finish touched up with same color and material as original. Any rusted areas shall be sanded, primed and repainted.

F. All relays, starters, push-button and other control devices shall be cleaned and if necessary, lubricated with CRC 2-26 to assure free operation.

3.11 MOTORS, STARTERS AND CONTROLS

A. Unless otherwise specified or shown, all motors will be furnished and installed under other sections of this specification.

B. Electrical Contractor shall install all starters and all electrical power wiring and connections to motors and starters.

C. Unless otherwise specified or shown, all control items for motors shall be furnished, installed and wired in conduit under other divisions of this specification.

3.12 CIRCUITS AND BRANCH CIRCUITS

A. Outlets shall be connected to branch circuits as indicated on drawings by circuit numbers. No more outlets than are indicated shall be connected to a circuit.

B. Branch circuit homeruns shall be installed as shown on drawings. Multiple homerun conduits shall not be combined by contractor into larger, single homerun conduits unless specific permission is granted by the Engineer.

3.13 LUG/TERMINAL RATINGS

A. All lug/terminal ratings, sizes, locations, types, etc. shall be coordinated with the associated conductor sizes, types, routings, etc. by the contractor.

B. All lugs/terminals/etc. shall be rated for 75 degree C terminations (minimum, unless specified otherwise).

3.14 EQUIPMENT FAULT CURRENT RATINGS

A. All equipment and breakers shall meet the minimum RMS symmetrical interrupting capacity ratings shown on plans for the associated distribution equipment. All interrupting ratings shall be full ratings. Where new devices or breakers are added to existing distribution equipment, the new devices/breakers shall have interrupting ratings matching or exceeding that of the existing distribution equipment.

3.15 OUTLET LOCATION

A. Symbols shown on drawings and mounting heights indicated on drawings and in specifications are approximate only. The exact locations and mounting height must be determined on the job and it shall be the Contractor's responsibility to coordinate with other trades to insure correct installation.

3.16 IDENTIFICATION

A. Each panel shall have each circuit identified. Panels without branch circuit nameplates shall have typewritten directories.

B. Each individually mounted switch, circuit breaker, starter and/or any other control or protective device shall identify equipment fed and fuse size, if any, by engraved plastic nameplate, white with black letters, screw attached.

C. See Specification Section 26 05 53 for additional requirements.

3.17 GROUNDING

A. All equipment shall be grounded and bonded in accordance with all state/local regulations, The National Electrical Code and as specified herein.

3.18 TELEPHONE WORK

A. Provide telephone raceways, outlets and backboards, as shown. Provide additional work as described in Specification Section 27 10 00 and/or shown on drawings. Bond all raceways together at backboards and provide No. 6 ground wire extending from raceway bonds to cold water pipe, in 1/2 inch raceway. Carefully ream ends of all raceways.

3.19 PAINTING

A. Refer to Painting/Finishing specifications for requirements regarding field painting of exposed conduit. Any scratches, dents or rust spots in conduit electrical enclosures, panels, motor control or any other electrical items shall have the dents removed, and they, along with any rust spots or scratches, sanded and touched up with the same exact color paint as original finish.

3.20 ACCEPTANCE TESTING

A. Upon completion of work, the entire electrical system installed within this project shall be tested and shall be shown to be in perfect working condition, in accordance with the intent of the specifications and drawings. It shall be the responsibility of the Electrical Contractor to have all systems ready for operation and to have an electrician available to operate same in accordance with and under the supervision of the observation representative(s) of the Architect. The Electrician shall be available to assist in removal of panel fronts, etc., to permit inspection as required.

B. The electrical sub-contractor shall include in bid price start-up assistance and training from a certified representative of the manufacturer for the following systems:
1. SECTION 26 09 43: LIGHTING CONTROL SYSTEM
2. SECTION 27 10 00: STRUCTURED CABLING SYSTEM
3. SECTION 28 20 00: CCTV SURVEILLANCE SYSTEM - IP
4. SECTION 28 31 00: FIRE ALARM SYSTEM
5. SECTION 28 78 00: EMERGENCY RESPONDER RADIO COVERAGE SYSTEM

3.21 OPERATION AND MAINTENANCE DATA

A. One set of marked “AS BUILT” drawings, three (3) sets of all equipment catalog and maintenance data and three (3) sets of all final shop drawings, on all equipment requiring same shall be turned over to owner. These items shall be bound in hard back book. Contractor shall explain and demonstrate all systems to Owner’s representative.

3.22 GUARANTY-WARRANTY

A. Furnish a written Guarantee-Warranty, countersigned and guaranteed by General Contractor, stating:
1. That all work executed under this section will be free from defects of workmanship and materials for a period of one (1) year from date of final acceptance of this work.
2. Above parties further agree that they will, at their own expense, repair and replace all such defective work, and all other work damaged thereby, which becomes defective during the term of the Guaranty-Warranty.

END OF SECTION 26 05 00

SECTION 26 05 19

POWER CONDUCTORS AND CABLES 51V-600V

PART 1 - GENERAL

1.1 DESCRIPTION

A. Power Wires and Cables

B. Low Voltage Wires and Cables

PART 2 - PRODUCTS

2.1 POWER WIRES AND CABLES - 600 VOLT

A. General: Conductors shall have current carrying capacities as per N.E.C. and with 600 volt insulation, #12 minimum except for controls and fixture wire. Conductors shall be copper.

B. General Application (see below for exceptions):
1. At or Below Grade (including within slab-on-grade):
   a. #8 or larger conductors:
      1) XHHW or RHH/RHW/USE stranded (in conduit).
   b. #10 or smaller conductors for circuits terminating at motors:
      1) THHN/THWN or XHHW stranded (in conduit).
   c. #10 or smaller conductors (excluding circuits terminating at motors):
      1) THHN/THWN or XHHW solid (in conduit).
2. Above Grade:
   a. #8 or larger conductors:
      1) THHN/THWN, XHHW or RHH/RHW/USE stranded (in conduit).
   b. #10 or smaller conductors for circuits terminating at motors:
      1) Where Exposed within Electrical Rooms OR Concealed in Wall/Ceiling Cavities (not concrete encased, etc.):
         a) THHN/THWN, XHHW or RHH/RHW/USE stranded (in conduit) or
         b) Metal-Clad (MC) cabling with THHN/THWN stranded conductors (conduit not required).
      2) Other Locations (where exposed outside electrical rooms or concrete encased): THHN/THWN, XHHW or RHH/RHW/USE stranded (in conduit).
   c. #10 or smaller conductors (excluding circuits terminating at motors):
      1) Where Exposed within Electrical Rooms OR Concealed in Wall/Ceiling Cavities (not concrete encased, etc.):
         a) THHN/THWN, XHHW or RHH/RHW/USE solid (in conduit) or
         b) Metal-Clad (MC) cabling with THHN/THWN solid conductors (conduit not required).
      2) Other Locations (where exposed outside electrical rooms or concrete encased): THHN/THWN, XHHW or RHH/RHW/USE solid (in conduit).
3. Metal-Clad (MC) cabling shall be rated for redundant grounding where installed in patient care areas per N.E.C. Article 517.
4. Power Wire and cable shall be as manufactured by Southwire, Rome, Encore Wire, American Insulated Wire, Okonite, Phelps-Dodge, Amercable, Aetna or approved equal.

C. Emergency Feeder Wiring
1. Where specifically required by NEC articles 700, 701, or other similar sections, feeder-circuit wiring for emergency systems and legally-required standby systems shall be a listed electrical circuit protective system consisting of 2-hour fire-rated, mineral insulated, copper-sheathed wiring cable (Pyrotenax System 1850 or equal).

D. Class 1 Control Cabling (120VAC Control Circuits, Etc.)
1. Unless specified otherwise, Class 1 control cabling shall:
   a. Be rated for exposed cable tray installation.
   b. Be plenum rated.
   c. Be UL-rated for the proposed application.
   d. Be multi-conductor with overall outer sheath as required by the application. The insulation of each conductor within the overall multi-conductor cable shall be uniquely color-coded. Ground conductors (when provided) within the multi-conductor cable shall have green insulation. Conductors with green insulation shall not be used for conductors other than ground.
   e. Utilize copper conductors.
   f. Have wire gauge as required to limit voltage drop to acceptable limits determined by the system supplier and to meet all applicable code requirements.
   g. Where installed underground, within slab-on-grade or in exterior locations, be rated for wet locations.
   h. Where required for specific systems, meet the specific requirements (conductor quantity, wire gauge, insulation type, shielding, etc.) of the system supplier.
   i. Be rated for 600V.
   j. Be industrial grade.
   k. Have stranded conductors.
   l. Have sunlight/oil-resistant PVC/Nylon insulation and jacket with ripcord.
2. Control cabling shall be as manufactured by Belden, AlphaWire or General Cable.

E. Fixture Wiring
1. Conductor Types:
   a. Type TFFN or XFF.
2. Minimum Sizes:
   a. For fixtures up to 300 watts: #16.
   b. For fixtures over 300 watts up to 1500 watts: #14.
   c. For fixtures over 1500 watts: as required.
   d. Conductors to concrete pour fixtures: #12.
3. Fixture wire shall extend only from fixture to first junction, and not over 6 feet, except for concrete pour units.

2.2 WIRE CONNECTIONS:

A. All connector types:
1. Shall be properly rated for the proposed application by UL and per the manufacturer.

B. At Motor Connections (within motor terminal boxes):
1. On Unshielded Wire:
   a. Single conductor per phase: shall be made with insulated set screw connectors or 3M 5300 Series 1kV Motor Lead Connections kits with mechanical lugs as required.

b. Multiple conductors per phase: shall be made with insulated mechanical lugs, rated for the associated motor cable types, by Polaris or Ilsco.

2. On Shielded Power Wire:
   a. The braided shields and internal grounding conductors of shielded power (not instrumentation) cables shall be grounded at BOTH ends (at VFD/starter and at motor) with a termination kit provided by the cable supplier. This termination kit shall include a connection ring that makes contact around the full circumference of the braided shield, and connects all internal grounds to a common external ground point.

C. Other Dry locations:
1. On Wire larger than #10: shall be made with solderless, non-insulated compression-type connectors meeting requirements of Federal Specification WS-610e for Type II, Class 2 and shall be covered with Scotch #33 electrical tape so that insulation is equal to 150% of conductor insulation.
2. On Wire #10 and smaller: shall be made with one of the following:
   a. Ideal Wing Nuts or equal by 3M .
   b. Ideal Push-In Wire Connectors (for #12 and smaller only).

D. Other Wet/Damp locations:
1. On Wire larger than #10: shall be made with underground/direct-burial, waterproof rated EPDM or TPE-insulated connectors by Ilsco, Burndy or T&B.
2. On Wire #10 and smaller: shall be made with one of the following:
   a. Ideal Weatherproof or Underground Wire Connectors pre-filled with 100% silicone sealant as required by the application.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. All wires and cables shall be installed in conduit unless specifically noted otherwise.

B. Metal-clad (MC) cabling (not required to be installed within conduit) may be used for above-grade, concealed branch circuits where allowed by code. MC cable installation shall:
1. NOT be installed exposed except in electrical rooms.
2. be provided with dedicated neutrals for all multi-wire circuits. Conductors shall be color coded as described below.
3. be run orthogonal with the building structure.
4. be supported per N.E.C. requirements. At a minimum MC cabling shall be supported on six foot intervals and within 12” of all outlet/junction boxes.
5. be supported independently from the building structure and shall not come into contact with other building systems (ductwork, piping, conduits, etc.).
6. be rated for redundant grounding where installed in patient care areas per N.E.C. Article 517.

C. All joints and splices on wire shall be made with solderless connectors, and covered so that insulation is equal to conductor insulation.

D. No splices shall be pulled into conduit.

E. No conductor shall be pulled until conduit is cleaned of all foreign matter.

F. Wire and cable shall be neatly formed, bundled and tied in all panelboards, wireways, disconnect switches, pullboxes, junction boxes, cabinets and other similar electrical enclosures.

G. All wires and cables installed in underground or other wet locations shall be rated by the manufacturer for wet locations.

H. Network cabling shall be continuous from endpoint to endpoint and shall not be spliced unless specifically noted otherwise.

I. All conductors/cabling (including spare conductors) shall be properly terminated unless specifically directed otherwise. See above for general termination hardware requirements.

3.2 POWER WIRE AND CABLE INSTALLATION:

A. No power conductor shall be smaller than #12 except where so designated on the drawings or hereinafter specified.

B. Multi-wire lighting branches shall be used as indicated.

C. Where more than three current-carrying conductors are installed in a single raceway or cable, conductors shall be derated as indicated in NEC Table 310.15(B)(3)(a).

D. Raceways/cables shall generally not be installed exposed to sunlight on roofs unless specifically required. Where raceways or cables are installed exposed to sunlight on roofs, conductors shall be derated with ampacities adjusted per NEC Table 310.15(B)(3)(c).

E. In installing parallel power conductors, it is mandatory that all conductors making up the feeder be exactly the same length, the same size, the same type of conductor with the same insulation. Each group of conductors making up a phase or neutral must be bonded at both ends in an approved manner.

F. In installing overhead main power services, a minimum of 5’-0” of cable per run shall be extended beyond the weatherhead(s) for connection to service drop. Confirm exact requirements with local utility company.

3.3 WIRE CONNECTIONS

A. See Part 2 above for material types.

B. Aluminum Wire Connections:
1. Where aluminum wiring is allowed, connections shall utilize compression fittings, no exceptions (Anderson Versa Crimp or equal).

C. Any stranded wire connection to wiring devices shall be made with crimp type terminals.

D. All electrical connections and terminals shall be tightened according to manufacturer’s published torque-tightening values with calibrated torque wrenches as required to clearly indicate final torque value to the contractor. Where manufacturer’s torque values are not provided, those specified in UL 486A & 486B shall be used.

E. All connections and connector types shall be installed in strict compliance with all requirements

of the connector manufacturer.

F. Under no condition shall the specified conductors be connected to terminals rated less than 75°C. Where conductors sized #1 or smaller are shown to be terminated at equipment and the terminals of that equipment are rated for less than 75°C, contractor shall install junction box near equipment to capture the specified conductors, splice with compression connections (rated for a least 75°C) and extend conductors with ampacity rating as required by NEC (based on terminal temperature rating) to equipment terminals. The length of the conductors to be terminated shall be as directed by the AHJ but not less than 48 inches.

3.4 LOW VOLTAGE (LESS THAN 50V) CONTROL AND NETWORK CABLE INSTALLATION:

A. All wires and cables shall be installed in conduit unless specifically noted otherwise. Low voltage control and/or network cabling located within concealed, accessible ceiling spaces (such as above lay-in ceilings) may be run without conduit if the following requirements are met:
   1. Cabling shall be plenum-rated, multi-conductor.
   2. Cabling shall be supported by cable tray or with J-hook supports on intervals not to exceed 5'-0" on center. Cabling shall be supported solely from the cable tray or j-hooks supported from the building structure, without using piping, ductwork, conduit or other items as supports.
   3. Cabling shall be properly bundled with plenum-rated Velcro straps on intervals not to exceed 30" on center.
   4. Properly-sized conduit(s) shall be provided wherever cabling enters an inaccessible or exposed area (such as above gyp board ceilings or through walls). End bushings shall be provided on both ends of all raceway terminations. All fire/smoke barrier penetrations shall be made in accordance with a U.L. listed assembly.

3.5 CIRCUITS AND BRANCH CIRCUITS

A. Outlets shall be connected to branch circuits as indicated on drawings by circuit number adjacent to outlet symbols, and no more outlets than are indicated shall be connected to a circuit.

3.6 LABELING AND COLOR CODING OF WIRE AND CABLE

A. Refer to Specification Section 26 05 53 for all labeling requirements.

B. A color coding system as listed below shall be followed throughout the network of branch power circuits as follows:

PHASE	120/208/240/ COLOR	120/240 HIGH LEG DELTA COLOR	277/480 VOLT COLOR
A	BLACK	BLACK	BROWN
B	RED	ORANGE (FOR HI-LEG)	ORANGE
C	BLUE	BLUE	YELLOW
NEUTRAL	WHITE	WHITE	GRAY
GROUND	GREEN	GREEN	GREEN

C. Where dedicated neutrals are installed for multi-wire branch circuits, the neutral conductors shall be color coded as follows:

PHASE	120/208/240/ COLOR	120/240 HIGH LEG DELTA COLOR	277/480 VOLT COLOR
NEUTRAL A	WHITE W/ BLACK TRACER	WHITE W/ BLACK TRACER	GRAY W/ BROWN TRACER
NEUTRAL B	WHITE W/ RED TRACER	WHITE W/ ORANGE TRACER (FOR HI-LEG NEUTRAL)	GRAY W/ ORANGE TRACER
NEUTRAL C	WHITE W/ BLUE TRACER	WHITE W/ BLUE TRACER	GRAY W/ YELLOW TRACER

D. Control Conductors: Shall be color coded by use of colored "tracers". No control circuit shall contain two identical conductors. For example, a set of five (5) control conductors for a pushbutton station represents one (1) control circuit which would require five (5) uniquely-colored control conductors.

3.7 TESTING

A. The insulation resistance of all feeder conductors (feeding electrical distribution equipment such as switchboards, panelboards, transfer switches, transformers, etc.) shall be tested at the load side of the feeder breaker with a 1000-volt DC Megger Tester prior to energization or final termination. Any feeder conductor with an insulation resistance less than the recommended minimums in the latest version of NETA Acceptance Testing Specification ("ATS") standard shall be replaced by the contractor at the contractor's expense. All final test results shall be clearly documented (with date, time, feeder, results, test equipment, etc.), and the final test results shall be submitted to the design team for review.

END OF SECTION 26 05 19

SECTION 26 05 26

GROUNDING

PART 1 - GENERAL

1.1 GENERAL

A. THE WORK UNDER THIS SECTION INCLUDES BUT IS NOT LIMITED TO GROUNDING OF THE FOLLOWING:
1. Service Equipment.
2. Transformers.
3. Non-current carrying conductive surfaces of equipment.
4. Metal Buildings.
5. Structures.
6. Other Equipment.

1.2 GENERAL REQUIREMENTS

A. All equipment, building steel, and main service shall be effectively and permanently grounded with a conductor cross section as required by the National Electrical Code and of capacity sufficient to insure continued effectiveness of the ground connections for fault current. Ground conductors shall be as short and straight as possible, protected from mechanical injury and, if practicable, without splice or joint.

B. All grounding connections shall be installed in accordance with the National Electrical Code and all local codes and requirements. Such codes shall be considered minimum requirements and the installation of the grounding system shall insure freedom from dangerous shock voltage exposure and provide a low impedance ground fault path to permit proper operation of overcurrent and ground fault protective devices.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. All grounding conductors shall be insulated with green colored, 600 volt insulation unless noted otherwise.

B. Motors having power supplied by single conductor wire in conduit shall be grounded through the conduit system. Flexible conduit shall be “jumpered” by an appropriate bonding conductor.

2.2 GROUNDING ELECTRODES

A. Grounding electrodes shall be copper-clad steel rods 3/4 inch in diameter and ten feet long. Where longer electrodes are necessary to reduce the ground resistance, Contractor shall provide sectional rods, connectors, drive heads, etc.

2.3 CONNECTIONS

A. All conductor-to-conductor, conductor-to-ground rod, conductor-to-structure, conductor-to-fence connections of #6 and larger sized conductors and underground ground connections shall

be permanent exothermic welded connections (Cadweld or equal) unless otherwise noted on applicable drawings.

B. Connections to equipment shall be by bolted compression type lugs (except for motors). When the conductor is #6 and larger, the lug shall be joined to the conductor by an exothermic weld (Cadweld or equal).

C. Motors to be grounded by the grounding conductors run with the power conductors shall have a split-post grounding stud installed in the connection box.

D. Each cast pull box or junction box shall have a ground lug, connected to largest ground conductor to enter box.

E. Ground connections at conduit terminations shall be made by approved grounding bushings (see Raceways Specification Section for additional requirements).

2.4 MANUFACTURERS

A. Conduit clamps and connectors shall be manufactured by Raco, OZ., or Ercon.

B. Lugs shall be as manufactured by Square “D”, Burndy, or T and B.

C. Exothermic weld connections shall be as manufactured by Cadweld, or approved equal.

D. Ground rods shall be as manufactured by Joslyn or McGraw Edison.

E. Split post grounding shall be as manufactured by Burndy or T and B.

PART 3 - EXECUTION

3.1 MAIN SERVICE GROUND

A. The main service grounding electrode system shall consist of the following items bonded together by the grounding electrode conductor:
1. The main underground cold water pipe (metal).
2. The metal frame of the building.
3. Driven ground rods. Ground rods shall be embedded at the lowest point in the building and below the permanent moisture level. Ground rods shall be spaced a minimum of ten (10) feet apart and connected in parallel until resistance to ground does not exceed five (5) ohms.

B. The grounding electrode system shall be connected to the grounded conductor (neutral) on the supply side of the service disconnecting means by a grounding electrode conductor not smaller than that shown in Table 250.66 of the N.E.C. The main service equipment grounding conductor shall be connected to the grounding conductor on the supply side of the service disconnecting means in accordance with Table 250.122 of the N.E.C. for the ampere rating of the service entrance equipment. Where in a service entrance switchboard, the equipment grounding conductor shall not be less than 25% of the main bus rating. These connections shall be made inside the service entrance equipment enclosure.

3.2 TRANSFORMER GROUNDS

A. Dry type insulation transformers with a grounded conductor in the secondary shall be grounded in accordance with N.E.C. Section 250-30.

3.3 EXPOSED NON-CURRENT-CARRYING METAL PARTS

A. General: Ground connections to equipment or devices shall be made as close to the current carrying parts as possible, that is, to the main frame rather than supporting structures, bases or shields. Grounding connections shall be made only to dry surfaces that are clean and dry. Steel surfaces shall be ground or filed to remove all scales, rust, grease, and dirt. Copper and galvanized steel shall be cleaned to remove oxide before making welds or connections. Code size ground conductors shall be run in all power conduits and properly terminated at each end.

B. Ground conductors shall be routed as straight as possible. Where possible, ground conductors shall be routed such as to avoid bends exceeding 90 degrees or with a radius of less than 8".

C. Motors: Exposed non-current-carrying metal parts, shall be grounded by a grounding conductor either run with power conductors, and/or separate grounding conductors. Drawings will show method(s) to be used. The ground conductors with all motor conductors shall be connected to the ground buss in the motor connection box. Jumper connections shall be installed between frames and rigid conduit for equipment having flexible conduit connections (sealtight). All AC motor grounds shall provide a low impedance path to ground.

D. Raceways & boxes: All raceways, conduits, armored or shielded cable and all exposed non-current carrying metal parts shall be grounded. Such items shall be bonded together and permanently grounded to the equipment ground buss. Metallic conduits shall be connected by grounding or clamps to ground buss. Flexible "jumpers" shall be provided around all raceway expansion joints. Bonding straps for steel conduit shall be copper. Jumper connections shall be provided to effectively ground all sections or rigid conduit connected into plastic pipe. No metallic conduit shall be left ungrounded. In conduit systems interrupted by junction or switch boxes where locknuts and bushings are used to secure the conduit in the box, the sections of conduit and box must be bonded together. If conduit, couplings or fittings have a protective coating or non-conductive material, such as enamel, such coating must be thoroughly removed from threads of both couplings and conduit and the surface of conduit or fitting where the ground clamp is secured.

E. Enclosures: Metal conduits entering free standing motor control centers, switchboards or other free standing equipment shall be grounded by bare conductors and approved clamp. Any conduits entering low voltage (480 volts or below) equipment through sheet metal enclosure and effectively grounded to enclosure by double locknut or hub need not be otherwise bonded.

F. Equipment: In addition to equipment grounding provisions mandated by code requirements, additional equipment grounding provisions (including local ground rods, connections, etc.) shall be provided by the contractor as directed by equipment suppliers.

G. Both ends of ground busses in motor control centers, switchboards, etc., shall be separately connected to the main ground buss to form two separate paths to ground.

H. Fences and Grills: Fences and metal grills around equipment carrying voltage above 500 volts between phases shall be bonded together and to ground. Fences and grill work shall be grounded at every post, column, or support, and on each side of every gate.

3.4 ACCEPTANCE DOCUMENTATION AND TESTING

A. Contractor shall take and store photographs of all underground grounding system connections prior to burial of connections, for review by Engineer.

B. Upon completion of work, the entire ground system shall be shown to be in perfect working condition, in accordance with the intent of the Specifications.

C. Contractor shall measure the resistance between the main ground bonding jumper to true earth ground using the Fall of Potential method as described by ANSI/IEEE Standard 81 ("Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of an Earth System"). If the measured value is greater than five ohms, additional grounding electrodes shall be installed as described in Part 3.1 above. The final ground resistance value shall be submitted in writing, and documented via picture of the meter reading from the Fall of Potential test, to the Architect prior to the final observation, and shall be included in final O&M documentation.

END OF SECTION 26 05 26

SECTION 26 05 33

RACEWAYS

PART 1 - GENERAL

1.1 DESCRIPTION

A. THE WORK UNDER THIS SECTION INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING:
1. Conduits
2. Conduit Fittings
3. Couplings & Connectors
4. Bushings
5. Raceway Hardware, Conduit Clamps & Supports
6. Watertight Entrance Seal Devices

PART 2 - PRODUCTS

2.1 CONDUITS

A. Rigid Galvanized Steel and I.M.C.:
1. Shall be galvanized outside and inside by hot dipping.
2. Shall be as manufactured by Republic, Wheatland, Triangle, Pittsburg Standard, Youngstown, Allied or equal.

B. E.M.T.:
1. Shall be Electro-Galvanized.
2. Shall be as manufactured by Republic, Wheatland, Triangle, Pittsburg Standard, Youngstown, Allied or equal.

C. Rigid Aluminum:
1. Shall be manufactured of 6063 Alloy, T-1 temper.
2. Shall be as manufactured by Republic, Wheatland, Triangle, Pittsburg Standard, Youngstown, Allied or equal.

D. Schedule 40 and 80 PVC:
1. Shall be composed of polyvinyl chloride and shall be U.L. rated type 40 or 80 for use with 90 degree rated conductors. Conduit shall conform to NEMA Standards and applicable sections of N.E.C.
2. The conduit manufacturer shall have had a minimum of 5 years experience in the manufacture of the products. Non-metallic raceways shall be as manufactured by Carlon, Triangle, Can-Tex, Allied or equal.

E. HDPE Innerduct
1. Shall be composed high density polyethylene and shall be orange in color, unless noted otherwise.
2. Shall be corrugated unless noted otherwise.
3. Shall be manufactured by Carlon, Ipex or equal.

F. Flexible Metallic Conduit:
1. Shall be continuous spiral wound and interlocked galvanized material, code approved for grounding.

G. Liquidtight Flexible Metallic Conduit:
1. Shall be galvanized steel-core sealtite, code approved for grounding.
2. Shall have an outer liquidtight, nonmetallic, sunlight-resistant jacket over an inner flexible metal core.
3. Shall be as manufactured by Electric-Flex, Anaconda or equal.

2.2 FITTINGS, COUPLINGS & CONNECTORS

A. Rigid Galvanized Steel and I.M.C. couplings and connectors shall be standard threaded type, galvanized outside and inside by hot dipping. Threadless and clamp type are not acceptable. Couplings/connectors shall be as manufactured by Raco, Efcor, or Appleton or equal.

B. All rain tight connectors shall be threaded Myers or approved equal, rated for outdoor application.

C. E.M.T. couplings and connectors shall be set screw, or steel compression type. All couplings and connectors shall be 720B, 730, 750B, or 760 series of Efcor or equal series of Raco. Pressure indented type connectors or cast metal will not be approved for any location. E.M.T. couplings and connectors shall be as manufactured by O-Z/Gedney, T&B, Efcor, Raco, Midwest or equal. E.M.T. fittings, couplings and connectors located within concrete (where allowed) shall be compression type and shall be adequately sealed with tape to ensure a concrete-tight seal.

D. Rigid Aluminum couplings and connectors shall be standard threaded type, of the same alloy as the associated conduit. Threadless and clamp type are not acceptable. Fittings shall be as manufactured by Thomas & Betts, Crouse-Hinds, Appleton, Pyle-National or equal.

E. All PVC couplings, adapters, end bells, reducers, etc., shall be of same material as conduit.

F. Liquidtight Flexible Metallic Conduit connectors shall be liquidtight with insulating throat or end bushing, designed for application with Liquidtight Flexible Metallic Conduit. Fittings shall be as manufactured by Efcor, Raco, Midwest or equal.

G. All LB unilets sizes 1 ¼" or larger shall have rollers.

H. Miscellaneous conduit fittings shall be as manufactured by Appleton, Crouse-Hinds, Pyle-National, Russell & Stoll or equal.

2.3 BUSHINGS

A. All non-grounding rigid bushings 1-1/4" and larger shall be the insulating type (O-Z/Gedney type "BB" or equal by T&B, Midwest Electric or Penn Union).

B. All non-grounding rigid bushings 1" and smaller shall be threaded malleable iron with integral noncombustible insulator rated for 150°C. Non-grounding rigid conduit bushings shall be O-Z/Gedney type "B" or equal by T&B, Midwest Electric or Penn Union.

C. All grounding rigid bushings shall be threaded malleable iron with integral noncombustible insulator rated for 150°C. All grounding rigid conduit bushings shall be O-Z/Gedney type "BLG" or equal by T&B, Midwest Electric or Penn Union.

2.4 HARDWARE, CONDUIT CLAMPS AND SUPPORTS

A. All hardware such as expansion shields, machine screws, toggle bolts, "U" or "J" bolts, machine bolts, conduit clamps and supports shall be of corrosion resistant materials (stainless steel, aluminum, galvanized or plated steel, or other approved materials).

B. Hardware in contact with aluminum handrails, plates or structural members and all hardware in exterior, wet or corrosive areas shall be type 316 stainless steel or aluminum (with bitumastic paint coating to isolate aluminum from contact with concrete where necessary) unless specifically noted otherwise.

C. Supports in exterior, wet or corrosive locations shall be type 316 stainless steel or aluminum (with bitumastic paint coating to isolate aluminum from contact with concrete where necessary) unless specifically noted otherwise.

D. Supports in extremely corrosive environments (such as chlorine or fluoride storage rooms) shall be PVC-Coated steel unless specifically noted otherwise.

E. Hardware and conduit clamps shall be as manufactured by Efcor, Steel City, G.A., Tinnerman or equal.

2.5 WATERTIGHT ENTRANCE SEAL DEVICES

A. For new construction, seal devices shall consist of oversized sleeve and malleable iron body with sealing rings, pressure rings, sealing grommets and pressure clamps as required (O-Z/Gedney type FSK/WSK or equal).

B. For cored-hole applications, seal devices shall consist of assembled dual pressure disks with neoprene sealing rings and membrane clamps as required (O-Z/Gedney type CSM or equal).

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Minimum Diameter: 1/2-inch.

B. Raceway Type: Raceway types shall be as specified below, unless indicated otherwise on drawings:
   1. Exterior, Exposed: Rigid Galvanized Steel or I.M.C. unless otherwise noted.
   2. Other Exterior (Concrete-Encased or Direct Earth Buried): Schedule 40 PVC. PVC conduit shall convert to metallic conduit prior to exiting concrete-encasement or direct earth burial. See "transition" items below for additional requirements. Conduits shall be left exposed until after Architect's observation.
   3. Interior, Exposed:
      a. Hazardous Locations: Rigid Galvanized Steel .
      b. Wet Locations (including, but not limited to, Pump Rooms, Wet Wells, Underground Vaults, and other similar locations): Rigid Galvanized Steel or I.M.C. .

c. Dry Locations Where Subject to Mechanical Damage (including, but not limited to, below 10'-0" A.F.F. in shop, storage, warehouse and other similar areas): Rigid Galvanized Steel or I.M.C..
d. Extremely Corrosive Locations (Chlorine Storage Rooms, Fluoride Storage Rooms and other similar areas): Schedule 80 PVC.
e. Other Dry Locations: E.M.T.

4. Interior, Concealed:
   a. Embedded inside Poured Concrete Walls, Ceilings or Floors, with a minimum of 2" of concrete between finished surface and outer wall of conduit on all sides, where no anchor bolts, screws or other similar items will be installed: Schedule 40 PVC. PVC conduit shall convert to metallic conduit (exact type as specified elsewhere within this section) prior to exiting poured concrete-encasement of wall, ceiling, floor or ductbank. See "transition" items below for additional requirements.
   b. Other Raceways Embedded inside Poured Concrete Walls, Ceilings or Floors (not meeting requirements above): Rigid Galvanized Steel or I.M.C. (coated with two (2) spiral-wrapped layers of 3M Scotchrap 50 PVC tape or two coats of asphaltum paint where below grade or within concrete).
   c. Other Raceways: E.M.T.
5. Terminations at motors, transformers and other equipment which has moving or vibrating parts:
   a. Exterior or Wet Locations (including, but not limited to, Pump Rooms, Wet Wells, Underground Vaults, and other similar locations): Liquidtight Flexible Metallic Conduit (shall generally not exceed 24 inches in length) with watertight fittings.
   b. Dry, Interior Locations: Flexible Metallic Conduit (shall generally not exceed 24 inches in length).
6. Terminations at fixtures mounted in grid-type ceilings:
   a. Flexible Metallic Conduit or MC cabling (shall generally not exceed 72 inches in length and shall run from junction box to fixture, not from fixture to fixture).
7. Transition from underground or concrete-encased to exposed:
   a. Convert PVC to Rigid Galvanized Steel (coated with two (2) spiral-wrapped layers of 3M Scotchrap 50 PVC tape or two coats of asphaltum paint where below grade or within concrete) utilizing Rigid Galvanized Steel 90 degree bends (and vertical conduits as required by application) prior to exiting concrete/grade (except at outdoor pull boxes and under freestanding electrical equipment, where terminations shall be by PVC end bells installed flush with top of slab). Exposed portions of these coated conduits shall extend a minimum of 6" above floor level, and shall be installed at uniform heights.

3.2 RACEWAY INSTALLATION

A. General:
1. Follow methods which are appropriate and approved for the location and conditions involved. Where not otherwise shown, specified, or approved in a particular case, run all wiring concealed.
2. Where conduit crosses a structural expansion joint an approved conduit expansion fitting shall be installed.
3. A non-conductive polypropylene pull string, properly tied/secured at either end, shall be installed in all empty conduits.
4. Metal conduit field-cuts shall be cut square with a hacksaw and the ends reamed after threading.
5. PVC conduit field-cuts shall be made with hacksaw, and ends shall be deburred.

6. All PVC joints shall be made as follows:
   a. Clean the outside of the conduit to depth of the socket, and the inside of socket with an approved cleaner.
   b. Apply solvent cement as recommended by the conduit manufacturer to the interior of the socket and exterior of conduit, making sure to coat all surfaces to be joined.
   c. Insert conduit into the socket and rotate 1/4 to 1/2 turn and allow to dry.
7. All metallic conduit installed below grade or within concrete shall be coated with two (2) spiral-wrapped layers of 3M Scotchrap 50 PVC tape or two coats of asphaltum paint prior to installation.
8. Install ground wire sized per N.E.C. Table 250.122 in all conduits.
9. Use of running threads is absolutely prohibited. Conduit shall be jointed with approved threaded conduit couplings. Threadless and clamp type not acceptable.
10. Conduits shall be sized in accordance with latest National Electrical Code except when size shown on drawings. 1/2-inch conduit shall not contain conductors larger than No. 12 or more than four (4) No. 12 conductors.
11. Exposed, field-cut threads on all metal conduits shall be painted with zinc primer (for Galvanized Rigid or I.M.C.) .

B. Routing/Locating:
1. Exposed conduit runs shall be run level and plumb and shall, on interior of buildings, be run parallel and/or at right angles to building walls and/or partitions.
2. Conduit with an external diameter larger than 1/3 the thickness of a concrete slab shall not be placed in the slab. Conduits in slab shall not be spaced closer than 3 diameters on center.
3. Conduit run in ceiling spaces shall be run as high as possible, all at same level, and shall be supported from building structure. Do not support conduit from any other installation.
4. Conduit run within exterior CMU, concrete or other similar walls shall be run within the CMU cells / concrete structure / etc. Conduits shall not be run on the outside surface of CMU cells / concrete structure / etc. underneath exterior veneers / etc., which could cause a thermal break in the wall insulation or a future water intrusion problem.
5. Install conduit runs to avoid proximity to steam or hot water pipes. In no place shall a conduit be run within 6” of such pipes except where crossing is unavoidable, then conduit shall be kept at least 3” from the covering of the pipe crossed.
6. Before installing raceways for motors, HVAC equipment and other fixed equipment, check location of all equipment connections/terminal boxes with equipment supplier and locate and arrange raceways appropriately.
7. A minimum of 12” of clearance (or more as required by associated utility companies) shall be provided between the finished lines of exterior, underground conduit runs and exterior, underground utilities (gas, water, sewer, etc.).
8. Where any portion of raceway is installed in a wet environment (such as below grade) and located at a higher elevation than the raceway termination point in a dry environment, install watertight compound inside raceway at termination around cabling to prevent transfer of water through conduit system. Watertight compound shall be rated for the potential water head pressure, based on the assumption that ground water level would be at grade level.

C. Bends:
1. Do not make bends (in any raceway, including flexible conduits) that exceed allowable conductor bending radius of cable to be installed or that significantly restrict conductor flexibility.

2. All bends within concrete-encased ductbanks installed in exterior locations shall be long radius bends (24" minimum bending radius – varies with conduit diameter).
3. Where numerous exposed bends or grouped together, all bends shall be parallel, with same center and shall be similar in appearance
4. All PVC elbows, bends, etc., shall be either factory bends or made with an approved heat bender.

D. Support:
1. Anchor conduit securely in place by means of approved conduit clamps, hangers, supports and fastenings. Arrangement and methods of fastening all conduits shall be subject to Engineer's direction and approval. All conduits shall be rigidly supported (wire supports may not be used in any location). Use only approved clamps on exposed conduit.
2. Conduit in riser shafts shall be supported at each floor level by approved clamp hangers.
3. Right angle beam clamps and U bolts shall be specially formed and sized to snugly fit the outside diameters of conduits.
4. Where installed in seismic zones, suspended raceways shall be braced in two (2) directions as required to prevent swaying and excessive movement.
5. Raceways installed on top of flat roofing shall be supported a minimum of 3 ½" above roof with rubber block supports (Cooper B-Line Dura-Blok or equal). Installation shall be in strict accordance with support manufacturer's instructions and recommendations.

E. Terminations:
1. All conduit connections to sheet metal cabinets or enclosures located in exterior or wet locations shall terminate by use of rain tight (Meyers) hubs.
2. Where rigid or I.M.C. conduits enter sheet metal boxes, they shall be secured by approved lock nuts and bushings.
3. Where metal conduits enter outdoor pull boxes, manholes, under freestanding electrical equipment or other locations where direct metal-to-metal contact does not exist between enclosure and conduit, grounding bushings shall be installed. Each grounding bushing shall be connected to the enclosure ground and all other grounding bushings with properly sized grounding conductors.
4. Where E.M.T. enters sheet metal boxes they shall be secured in place with approved insulating fittings.
5. Where PVC enters outdoor pull boxes, manholes or under freestanding electrical equipment, PVC end bells shall be installed.
6. Contractor shall be responsible for coordinating required conduit sizes with equipment hubs/conduit entry provisions (such as at motor tap boxes) prior to installation of conduit systems. Contractor shall field adjust final conduit sizes at terminations where so required (only as allowed by code) from those indicated on plans to coordinate with equipment hubs/conduit entry provisions.
7. Where conduit terminates in free air such that associated cabling/circuitry becomes exposed (such as at cable trays, etc.), conduit shall generally terminate in a horizontal orientation (to prevent dust/debris/etc. from entering conduit system). Where vertical conduit termination is necessary, the termination shall be provided with cord-grip conduit terminations to seal the conduit system.
8. Conduit ends shall be carefully plugged during construction.
9. Permanent, removable caps or plugs shall be installed on each end of all empty raceways with fittings listed to prevent water and other foreign matter from entering the conduit system.

F. Penetrations:
1. All fire/smoke barrier penetrations shall be made in accordance with a U.L. listed assembly. Refer to drawings and other specifications for additional requirements.
2. All penetrations shall be at right angles unless shown otherwise.
3. Structural members (including footings and beams) shall not be notched or penetrated for the installation of electrical raceways unless noted otherwise without specific approval of the structural engineer.
4. Dry-packed non-shrink grout or watertight seal devices shall be used to seal openings around conduits at all penetrations through concrete walls, ceilings or aboveground floors.
5. All raceways entering structures, or where water is otherwise capable of entering equipment/devices through the raceway system, shall be sealed (at the first box or outlet) with foam duct sealant to prevent the entrance of gases or liquids from one area to another or into equipment/devices.
    a. Where the elevation of the raceway penetration (into the structure) is no more than 15' below the other (higher) end of the same raceway, Polywater FST sealant (rated to hold back up to 22' of continuous water head pressure), or pre-approved equal, shall be used.
    b. Where the elevation of the raceway penetration (into the structure) is between 15' and 75' below the other (higher) end of the same raceway, Polywater PHRD Custom Mechanical Seals (rated to hold back up to 36psi or 83' of continuous water head pressure), or pre-approved equal, shall be used.
    c. Where the elevation of the raceway penetration (into the structure) is more than 75' below the other (higher) end of the same raceway, the contractor shall propose a custom solution designed to hold back or to drain the possible water within the associated raceway. Submittals shall be provided to the engineer for review/approval, including a summary of the anticipated elevations/PSIs, details of the proposed installation, cut-sheets of devices/materials, etc.
6. Additionally, where necessary to ensure that water does not enter equipment/devices through the raceway system (where raceways extend to equipment/devices from wet areas), junction boxes with drain assemblies in bottom shall be located at low point of raceway system near equipment/devices (to drain water out of raceway system before it enters equipment/devices). Contractors shall provide drains in raceway systems where so necessary to prevent water entry into equipment/devices.
7. All raceways passing through concrete roofs or membrane-waterproofed walls or floors shall be provided with watertight seals as follows:
    a. Where ducts are concrete encased on one side: Install watertight entrance seal device on the accessible side of roof/wall/floor as directed by equipment manufacturer.
    b. Where ducts are accessible on both sides: Install watertight entrance seal device on each side of roof/wall/floor as directed by equipment manufacturer.
8. All raceways passing through walls of rooms containing/storing noxious chemicals (chlorine, ammonia, etc.) or through hazardous locations shall be sealed with conduit seals (Crouse-Hinds type EYS or equal).
9. All raceways terminating into electrical enclosures/devices/panels/etc. located in hazardous locations shall be sealed with conduit seals (Crouse-Hinds type EYS, EZS or equal) within 18" of the termination.

G. Exterior Electrical Ductbanks:
1. Where exterior electrical concrete-encased ductbanks are indicated on drawings, conduit runs between buildings or structures shall be grouped in concrete-encased ductbanks as follows:

a. A minimum of 3" of concrete shall encase each side of all ductbanks.
b. A minimum of 1 ½" of separation shall be provided between each conduit within ductbanks. PVC spacers shall be installed at the necessary intervals prior to placement of concrete to maintain the required spacing and to prevent bending or displacement of the conduits.
c. Top of concrete shall be a minimum of 30" below grade. A continuous magnetic marking tape shall be buried directly above each ductbank, 12" below grade.
d. Exact routing of ductbanks shall be field verified and shall be modified as necessary to avoid obstruction or conflicts.
e. Underground electrical raceways shall be installed to meet the minimum cover requirements listed in NEC Table 300.5. Refer to drawings for more stringent requirements.

END OF SECTION 26 05 33

SECTION 26 05 34

OUTLET BOXES, JUNCTION BOXES, WIREWAYS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Outlet and Junction Boxes

B. Pull Boxes

C. Wireways

PART 2 - PRODUCTS

2.1 OUTLET BOXES & JUNCTION BOXES (THROUGH 4-11/16")

A. Sheet Metal: Shall be standard type with knockouts made of hot dipped galvanized steel as manufactured by Steel City, Raco, Appleton, Bowers or equal.

B. Cast: Shall be type FS, FD, JB, GS, or SEH as required for application as manufactured by O-Z/Gedney, Appleton, or equal.

C. Nonmetallic: Shall be type Polycarbonate/ABS construction as required for application with non-metallic quick-release latches as manufactured by Hoffman, O-Z/Gedney, Appleton, or equal.

2.2 JUNCTION AND PULL BOXES (LARGER THAN 4-11/16")

A. Oil-Tight JIC: Shall be Hoffman Type CH box or approved equal.

B. Galvanized Cast Iron or Cast Aluminum: Shall be O-Z/Gedney or approved equal.

C. Stainless Steel: Shall be as manufactured by O-Z/Gedney, Hoffman or approved equal. Boxes shall have continuous hinges, seamless foam-in-place gaskets and screw-down clamps.

D. Nonmetallic: Shall be type Polycarbonate/ABS construction as required for application with non-metallic quick-release latches as manufactured by Hoffman, O-Z/Gedney, Appleton, or equal. Boxes shall have hinged covers and screw-down clamps.

E. Wireways: Shall be standard manufacturer's item as manufactured by Hoffman, Square "D", Burns, B & C or equal. Wireways shall have hinged covers and screw-down clamps.

F. Pre-cast Polymer Concrete Below-Grade Hand Holes & Pull Boxes:
1. Enclosures, boxes and cover are required to be UL Listed and conform to all test provisions of ANSI/SCTE 77 "Specifications For Underground Enclosure Integrity" for Tier 15 applications (15,000lb design load and 22,500lb test load) unless noted otherwise.
2. All covers shall have a minimum coefficient of friction of 0.05 in accordance with ASTM C1028 and the corresponding Tier level shall be embossed on the top surface.

3. Cover shall be bolt-down include factory-labeling to read “Electric”, “Communications” or other as directed.
4. Hardware shall be stainless steel.
5. Shall be Quazite PG/LG Style or approved equal.

G. Galvanized Cast Iron Below-Grade Pull Boxes:
1. Enclosures, boxes and cover are required to conform to AASHTO H-20 requirements for deliberate vehicular traffic applications unless noted otherwise.
2. Cover shall be checkered, bolt-down include factory-labeling to read “Electric”, “Communications” or other as directed.
3. Hardware shall be stainless steel.
4. Shall be furnished with grounding kit.
5. Shall be O-Z/Gedney Type YR or approved equal.
   a.

PART 3 - EXECUTION

3.1 APPLICATION

A. General
1. All boxes and wireways shall be of sufficient size to provide free space for all enclosed conductors per NEC requirements. Fill calculations shall be performed by contractor per NEC requirements.

B. Outlet Boxes & Junction Boxes (through 4-11/16”)
1. Sheet metal boxes shall be used on concealed work in ceiling or walls and exposed work in dry, interior locations
   a. Exception: Where exposed and installed within finished/public spaces such as offices, corridors, lobbies, etc., cast boxes shall be used for wiring device outlets. Cast boxes are not required in back-of-house areas such as electrical rooms, mechanical rooms, etc. .
2. Cast boxes shall be used wherever Rigid or I.M.C. conduits are installed.
3. All boxes installed in extremely corrosive areas (such as chlorine and fluoride storage rooms) where non-metallic raceways are used shall be non-metallic.
4. Except when located in exposed concrete block, switch and receptacle boxes shall be 4" square for single gang installation. Appropriate gang boxes shall be used for mounting ganged switches.
5. When installed in exposed concrete block, switch and receptacle boxes shall be square type designed for exposed block installation.
6. Ceiling outlet boxes shall be 4" octagon 1-1/2" deep or larger required due to number of wires.
7. Boxes installed in hazardous locations shall be explosion-proof rated for the associated application, constructed of copper-free cast aluminum.

C. Junction & Pull Boxes (larger than 4-11/16”)
1. For all below grade exterior use and elsewhere as shown:
   a. In areas subject to future vehicular traffic: shall be galvanized cast iron (rated AASHTO H-20 Loading unless noted otherwise).

b. In areas not subject to vehicular traffic: shall be galvanized cast iron or pre-cast polymer concrete (rated for Tier 15 Loading unless noted otherwise).

2. All boxes installed exposed in exterior or wet areas shall be powder-coated galvanized steel (NEMA 3R).
3. All boxes installed exposed in corrosive areas shall be stainless steel (NEMA 4X).
4. All boxes installed in extremely corrosive areas (such as chlorine and fluoride storage rooms) where non-metallic raceways are used shall be non-metallic.
5. Boxes installed in hazardous locations shall be explosion-proof rated for the associated application, constructed of copper-free cast aluminum.
6. All others shall be oil tight JIC box not less than 16 gauge.

3.2 INSTALLATION

A. General

1. All boxes and wireways shall be securely anchored.
2. All boxes shall be properly sealed and protected during construction and shall be cleaned of all foreign matter before conductors are installed.
3. All boxes and wireways shall be readily accessible. Contractor shall be responsible for furnishing and installing access panels per architect's specifications. Locations shall be as directed by the architect as required to make boxes, wireways, electrical connections, etc. accessible where above gypsum board ceilings or in other similar locations.
4. All metallic boxes and wireways shall be properly grounded.
5. Refer to Specification Section 26 05 53 for identification requirements.

B. Outlet Boxes & Junction Boxes (through 4-11/16")

1. Boxes shall be provided with approved 3/8" fixture studs were required.
2. Recessed boxes for wiring devices, surface fixtures, or connections, shall be set so that the edge of cover comes flush with finished surface.
3. There shall be no more knockouts opened in any sheet metal box than actually used.
4. Any unused opening in cast boxes shall be plugged.
5. Back to back boxes to be staggered at least 3 inches.
6. Under no circumstances shall through-the-wall boxes be used.

C. Junction & Pull Boxes (larger than 4-11/16")

1. Pull boxes shall be installed as indicated on plans and/or as required due to number of bends, distance or pulling conditions.
2. Boxes to be imbedded in concrete shall be properly leveled and anchored in place before the concrete is poured.
3. All pull boxes and/or junction boxes installed exterior below grade, shall have their tops a minimum of 1-1/2 inches above surrounding grade and sloped so that water will not stand on lid. A positive drain shall be installed, to prevent water accumulation inside.
4. Above grade pull boxes shall be installed on concrete anchor bases as shown on Plans.

D. Wireways and/or wall-mounted equipment

1. Mount each wireway to channels of the same metal type as the wireway.
2. Conductors serving a wireway shall be extended without reduction in size, for the entire length of the wireway. Tap-offs to switches and other items served by the wireway shall be made with ILSCO type GTA with GTC cap.

END OF SECTION 26 05 34

SECTION 26 05 36

CABLE TRAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, tests and services to install complete cable tray systems as shown on the drawings.

B. Cable tray systems are defined to include, but are not limited to straight sections of cable trays, bends, tees, elbows, drop-outs, supports and accessories.

1.2 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code

B. ASTM A123 - Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip

C. ASTM A653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality

D. ASTM A1011 - Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High Strength Low Alloy with Improved Formability *(Formerly ASTM A570 &A607)*

E. ASTM A1008 – Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability *(Formerly ASTM A611)*

F. ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel

G. NEMA VE 1-2002 - Metallic Cable Tray Systems

H. NEMA VE 2-2006 - Cable Tray Installation Guidelines

I. TIA 569-A – Commercial Building Standard for Telecommunications Pathways & Spaces

1.3 DRAWINGS

A. The drawings, which constitute a part of these specifications, indicate the general route of the cable tray systems. Data presented on these drawings are as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification, of all dimensions, routing, etc., is directed.

B. Specifications and drawings are for assistance and guidance, but exact routing, locations, distances and levels will be governed by actual field conditions. Contractor is directed to make field surveys as part of his work prior to submitting system layout drawings.

1.4 SUBMITTALS

A. Submittal Drawings: Submit drawings of cable tray and accessories including clamps, brackets, hanger rods, splice plate connectors, expansion joint assemblies, and fittings, showing accurately scaled components.

B. Product Data: Submit manufacturer's data on cable tray including, but not limited to, types, materials, finishes, rung spacings, inside load depths and fitting radii. For side rails and rungs, submit cross sectional properties including Section Modulus (Sx) and Moment of Inertia (Ix).

1.5 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of cable trays and fittings of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Provide cable trays and accessories through one source from a single manufacturer.

C. NEMA Compliance: Comply with NEMA Standards Publication Number VE1, "Cable Tray Systems".

D. NEC Compliance: Comply with NEC, as applicable to construction and installation of cable tray and cable channel systems (Article 318, NEC).

E. UL Compliance: Provide products that are UL-classified and labeled in their final installed form.

F. NFPA Compliance: Comply with NFPA 70B, "Recommended Practice for Electrical Equipment Maintenance" pertaining to installation of cable tray systems.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver cable tray systems and components carefully to avoid breakage, denting and scoring finishes. Do not install damaged equipment.

B. Store cable trays and accessories in original cartons and in clean dry space; protect from weather and construction traffic. Wet materials should be unpacked and dried before storage.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Wire Mesh Basket type cable tray systems:
1. Subject to compliance with these specifications, wire mesh basket type cable tray systems shall be as manufactured by Eaton B-Line, Inc.; Mono-Systems, Inc, Chalfant or Legrand Cablofil.

2.2 CABLE TRAY SECTIONS AND COMPONENTS

A. Typical Cable Tray Application (applicable unless noted otherwise on plans):

1. Containing only low voltage cabling AND concealed above accessible ceilings, below raised access floors or within telecommunications rooms: Wire mesh basket type with:
   a. Useable Loading Depth: 4".
   b. Minimum Load Rating: NEMA 12C.
   c. Material: Black powder coat painted steel.
   d. Width(s): as shown on plans.
2. All other applications: Ladder-type with:
   a. Rung Spacing:9" o.c.
   b. Useable Loading Depth: 4".
   c. Minimum Load Rating: NEMA 12C.
   d. Material: Aluminum.
   e. Width(s): as shown on plans.

B. General: Except as otherwise indicated, provide metal cable trays, of types, classes and sizes indicated; with clamp assemblies, connector/splice plates, splice bars, bolts, nuts and washers for connecting units as required. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards.

C. Cable tray construction:
   1. Wire Mesh Basket type cable tray systems:
      a. All straight section longitudinal wires shall be constructed with a continuous top wire safety edge. Safety edge must be kinked and T-welded on all tray sizes.
      b. Wire mesh basket type cable tray shall be made of high strength steel wires and formed into a standard 2 inch by 4 inch wire mesh pattern with intersecting wires welded together. Minimum wire diameter shall be 5mm (4.5mm for stainless steel). All mesh sections must have at least one bottom longitudinal wire along entire length of straight section.
      c. All fittings shall be factory-built or shall be formed from straight sections in accordance with manufacturer's instructions to maintain the UL Classification of the system.

D. Materials and Finish: Specific material and finish types for each tray type (as specified elsewhere) shall comply with the following general requirements:
   1. Aluminum: All sections and fitting side rails and rungs shall be extruded from Aluminum Association Alloy 6063. All fabricated parts shall be made from Aluminum Association Alloy 5052.
   2. Pre-galvanized Steel: All sections, fitting side rails, rungs, and covers shall be made from steel meeting the minimum mechanical properties and mill galvanized in accordance with ASTM A653 SS, Grade 33, coating designation G90.
   3. Hot-dip Galvanized Steel: All sections and fitting side rails and rungs shall be made from steel meeting the minimum mechanical properties of ASTM A1011 SS, Grade 33 for 14 gauge and heavier, ASTM A1008, Grade 33, Type 2 for 16 gauge and lighter and ASTMA510, Grade 1008 for wire mesh basket type, and shall be hot-dip galvanized after fabrication in accordance with ASTM A123. All covers and splice plates must also be hot-dip galvanized after fabrication; mill galvanized covers are not acceptable for hot-dipped galvanized cable tray. All hot-dip galvanized after fabrication steel cable trays must be returned to point of manufacture after coating for inspection and removal of all icicles and excess zinc. Failure to do so can cause damage to cables and/or injury to installers.
   4. Stainless Steel: All sections, accessories and fitting side rails and rungs shall be made of AISI Type 316 stainless steel. Transverse members (rungs) or corrugated bottoms shall be

welded to the side rails with Type 316 stainless steel welding wire. Wire mesh basket type shall meet minimum mechanical properties of ASTM A580.

5. Black Powder Coated steel: All sections/components shall be powder coated black with an average paint thickness of 1.2mils (30microns) to 3.0mils (75microns).

E. Accessories and Supports:

1. General:
   a. Cable Tray Supports: Shall be placed so that the support spans do not exceed maximum spans allowed to achieve the specified cable tray load ratings.
   b. Center hung supports shall be manufactured of 12 gauge, 1-5/8 inch by 1-5/8 inch B-Line B22 steel strut with a pipe welded at the middle of the support to provide eccentric loading stability. Support shall withstand 700 pounds in a 60 percent vs. 40 percent eccentric loading condition with a safety factor of 3.
   c. Accessories - special accessories shall be furnished as required to protect, support, and install a cable tray system. Accessories shall consist of but are not limited to; section splice plates, expansion plates, blind-end plates, specially designed ladder dropouts, barriers, conduit-to-tray adapters, etc.
2. Wire Mesh Basket type cable tray systems:
   a. Barrier Strips: Shall be provided where specified on plans or where cables/conductors of varying voltage classes are installed within the same tray (per NEC requirements), shall be manufactured by the tray system supplier and shall be fastened into the tray as directed by the tray system supplier.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Installers of wire mesh basket type cable tray systems shall be certified by the supplier of the cable tray system.
2. Install cable trays as indicated: Installation shall be in accordance with:
   a. Equipment manufacturer's instructions.
   b. Recognized industry practices.
   c. NEC (Article 392 and others).
   d. Applicable portions of NFPA 70B.
   e. NEMA-VE2.
3. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the owner or owner’s representative.
4. Coordinate cable tray installation with other work as necessary to properly interface installation of cable tray with other work.

B. Cabling:

1. All cabling/conductors routed in cable tray shall be rated for cable tray application.
2. Cabling/conductors of varying voltage classes installed within common trays shall be separated by barrier strips per NEC requirements.
3. Cable/conductor securing:
   a. Cables/conductors shall be secured to the transverse elements of the associated trays at the following minimum intervals:

1) Seismic, high-shock or vibration prone areas (such as mechanical rooms, process areas, etc.):
   a) All cables/conductors: 24".
2) Non-horizontal cable tray sections:
   a) All cables/conductors: 36".
3) Horizontal cable tray sections:
   a) All power cables/conductors: 36"
   b) Control, instrumentation and network cables in cable trays in exposed areas: 36"
   c) Control, instrumentation and network cables in cable trays in concealed interior areas (such as above lay-in ceilings): No cable ties required.

b. All cable ties used to secure cables to trays in interior areas shall be plenum-rated plastic. Cable ties used in interior exposed areas (subject to light) in interior areas shall be sunlight/UV-resistant. Cable ties used in exterior environments shall be of non-magnetic stainless steel construction.

4. Cable/conductor arrangement:
   a. Provide separation between power cables/conductors within cable trays for proper heat dissipation (and conductor ampacity ratings) per NEC requirements.

C. Bonding:
1. Ground and bond metal cable tray in accordance with NEC Articles 392, 250.96 and 250.102.
   a. Provide continuity between all metal cable tray components.
   b. Make connections to tray using mechanical, compression or exothermic connectors.
2. Cable trays shall be properly bonded with grounding harnesses or other necessary equipment as required to all metal conduits terminating into the cable trays and between cable tray sections.

D. Location/Routing:
1. Location of cable tray shown on plans is for general routing only. Field coordinate exact cable tray locations/routing with all piping, equipment, ductwork, structure, lighting, etc. & other trades prior to ordering cable tray. Provide vertical & horizontal bends as required, maintaining proper clearance around cable trays.
2. Coordinate cable tray with all other work as necessary to properly integrate installation of cable tray work with other work. Any potential conflicts between locations of cable trays and locations of other items shall promptly be brought to the attention of the engineer prior to installation.
3. Provide a minimum of 6" clearance on top of cable trays and 3" clearance on bottom and sides of cable trays to permit access for installing and maintaining cables unless specifically approved or directed otherwise by engineer.

E. Support:
1. Cable tray fitting supports shall be located such that they meet the strength requirements of straight sections. Install fitting supports per NEMA VE-2 guidelines, or in accordance with manufacturer's instructions.
2. Trapeze hangers and center-hung supports shall be supported by 1/2 inch (minimum) diameter all-thread rods unless noted otherwise. Trapeze hangers supporting wire mesh basket type cable trays 12" wide or less may be supported by 3/8 inch (minimum) diameter all-thread rods.

F. Penetrations:
1. Where cable trays pathways pass through walls, floors, ceilings or other similar partitions that are fire-rated, smoke-rated, designed to prevent water entry, designed to limit sound transmission, or designed to limit air passage (for environmental or conditioning purposes), cable trays themselves shall not penetrate the partition but shall be terminated on either side of the partition. The partition shall be penetrated with conduit sleeves sealed with suitable fire caulk or other approved material, per specific instructions of the caulk supplier to maintain partition/etc. ratings (such as fire or smoke ratings), after installation of all cabling. Bonding jumpers shall be provided through sleeves to ensure electrical continuity of cable tray system. Interior cross-sectional area of the conduit sleeves shall match or exceed the interior cross-sectional area of the associated cable tray(s).
2. Contractor shall verify arrangement, sizes and locations of all penetrations through load-bearing walls, floors or other structural items with structural engineer. Contractor shall submit sketch of proposed sleeve locations to structural engineer for review prior to rough-in.

G. Marking:
1. Cable trays containing conductors rated over 600 volts shall have a permanent, legible warning notices installed per NEC 392 requirements.

3.2 TESTING

A. Test cable trays to ensure electrical continuity of bonding and grounding connections. See NFPA 70B, Chapter 18, for testing and test methods.

B. Manufacturer shall provide test reports witnessed by an independent testing laboratory of the "worst case" loading conditions outlined in this specification and performed in accordance with the latest revision of NEMA VE-1; including test reports verifying rung load capacity in accordance with NEMA VE-1 Section 5.4.

END OF SECTION 26 05 36

SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Wire and cable identification.

B. Pullbox & Junction Box Identification

C. Electrical distribution & utilization equipment identification.

D. Emergency and Standby Power receptacle identification.

PART 2 - PRODUCTS

2.1 WIRE AND CABLE IDENTIFICATION

A. Intermediate Locations:
1. Wires and cable labels shall be white, thermal transfer, halogen-free, flame-retardant marker plates (sized to accommodate three lines of text) permanently affixed to the associated cable with UV-resistant plastic wire ties. Labels shall be Panduit #M200X/300X series or equal.

B. Circuit/Cable Termination Locations:
1. Wires and cable labels shall be non-ferrous identifying tags or pressure sensitive labels unless noted otherwise.

2.2 ELECTRICAL DISTRIBUTION & UTILIZATION EQUIPMENT IDENTIFICATION

A. Labels on electrical distribution & utilization equipment shall be black-on-white engraved Bakelite nameplates permanently affixed to the equipment with rivets or silicone adhesive unless noted otherwise.

B. Labels on electrical distribution equipment fed from emergency or legally-required standby sources (such as emergency generators) shall be white-on-red engraved Bakelite nameplates permanently affixed to the equipment with rivets or silicone adhesive.

2.3 EMERGENCY AND STANDBY POWER RECEPTACLE IDENTIFICATION

A. Receptacles fed from emergency or standby power sources (such as emergency generators) shall be provided with factory-marked engraved coverplates as follows:
1. Emergency System source: Red engraved lettering to read “EMERGENCY”.
2. Legally-Required or Optional Standby Generator source:
   a. If only part of facility is fed with generator backup: Black engraved lettering to read “FED FROM GENERATOR”.
   b. If entire facility is fed with generator backup: No “….GENERATOR…” label required.

PART 3 - EXECUTION

3.1 GENERAL

A. Any proposed deviation in identification methods and materials from those described herein shall be submitted to Architect for review and comment prior to installation.

B. Contractor shall provide all labeling or identification required by applicable local, state and national codes. These specifications do not intend to itemize all code-required labeling or identification requirements.

C. All labels/identification shall be positioned such as to be readable from the normal perspective without adjusting wiring/cables/labels. For example, labels/identification of wires/cables within cable trays shall be positioned to point towards the viewer (typically downward for overhead cable trays, or upward for cable trays within trenches).

D. All labels/identification (except for handwritten labels on concealed pullbox/junction box covers as noted below) shall be typewritten/printed/engraved in a neat, workmanlike, permanent, legible, consistent and meaningful manner. Labels shall not be handwritten unless specific approval is granted by engineer.

3.2 WIRE AND CABLE IDENTIFICATION

A. General:
1. Where cabling is exposed (such as within cable trays), provide two wire ties per cable (one on either end of marker plate to provide a flush installation). Where cabling is concealed (such as within pullboxes/wireways), one wire tie per cable will be acceptable.

B. Intermediate Locations:
1. Thermal transfer labels shall be securely fastened to all wiring and cabling in the following locations:
    a. Wireways
    b. Pullboxes/Junction boxes larger than 4-11/16”
    c. Pullboxes/Junction boxes through 4-11/16” where wires and cables are not easily identifiable via the color coding and box labeling
    d. Vaults & Manholes
    e. Approximately every 50 feet within cable trays (especially at locations where cables exit or diverge). Labels within cable trays shall be grouped (rather than being pre-labeled on cables and pulled into cable trays).
    f. Other similar intermediate locations.
2. Labels shall be stamped or printed with the following data so that the feeder or cable can be readily identified and traced:
    a. From where the circuit originates (including panel designation and circuit number):
        1) Ex: “FROM: PP-A CIR. 3 (IN MAIN ELEC ROOM)”
    b. To where the circuit extends (using the common name of the equipment):
        1) Ex: “TO: RTU-6 (ON ROOF)”
    c. The purpose of the circuit:
        1) Ex: “POWER”
    d. The set number (If parallel power feeds are used).
        1) Ex: “SET NO. 3 OF 4”

C. Circuit/Cable Termination Locations:
1. Where multiple termination points exist within a circuit origination point (panelboard, switchboard, MCC, starter, etc.) or other similar circuit endpoint (control panel, etc.), labels shall be securely fastened to all ungrounded and neutral conductors to clearly identify the terminal and/or circuit number associated with each conductor. For example, within lighting panels, each phase and neutral conductor shall be labeled near the terminals at a clearly visible location with the associated circuit number(s), so that if all conductors were unterminated, the labels would clearly indicate which conductor was associated with each circuit.

D. Refer to Specification Section 26 05 19 for all color-coding requirements of wires and cables.

3.3 PULLBOX & JUNCTION BOX IDENTIFICATION

A. Concealed pullboxes/junction boxes:
1. Front surface of all pullbox/junction box covers in concealed areas (such as above lay-in ceilings) or within mechanical/electrical rooms (and other similar areas where appearance of boxes is not an issue) shall be neatly marked with the ID of circuits/cables contained with permanent black marker on cover of box (Ex: “RP-1A Cir. 1, 2 & 3”). Additionally, front surface of box shall be painted red where box contains fire alarm system cabling.

B. Exposed pullboxes/junction boxes:
1. Interior surface of all pullbox/junction box covers in exposed areas shall be labeled “Power”, “Telecommunications”, “Fire Alarm” or with other similar general text neatly with permanent black marker to indicate function of box. Circuit/cable labeling within box (see above) shall identify specific cables contained. Additionally, interior surface of cover shall be painted red where box contains fire alarm system cabling.

C. Where pullboxes/junction boxes are named on contract documents (Ex:”PULLBOX #3”), an engraved nameplate shall be installed on the front surface of the box to identify the name.

3.4 ELECTRICAL DISTRIBUTION & UTILIZATION EQUIPMENT IDENTIFICATION

A. General:
1. All new and existing equipment modified by this project shall include arc-flash warning labels in accordance with NEC article 110.16.

B. All Panels, Motor Control Centers, Switchboards, Switchgear, Transformers, Etc.:
1. Engraved nameplates identifying name of equipment, nominal voltage and phase of the equipment and where the equipment is fed from shall be installed on front surface of all panels, motor control centers, switchboards, switchgear, transformers, etc.:
   a. Ex: First Line: “NAME: RP-A”, Second Line: “120/208V-3Ø-4W”, Third Line: “FED FROM: PP-A CIR. 4 (IN MAIN ELEC ROOM)”
2. Refer to Panelboard Specification Sections for additional labeling requirements (circuit directory cards, permanent circuit labels, permanent circuit numbers, etc.) required inside panelboards.

C. Safety/Disconnect Switches and Utilization Equipment (HVAC Equipment, Pumps, Powered Valves, Control Panels, Starters, Etc.)::
1. Engraved nameplates identifying equipment being fed and where the equipment is fed from shall be installed on front surface of all disconnect switches (including both visible blade

type switches and toggle-type switches) and on utilization equipment (where not clearly identified by immediately adjacent local disconnect switch):
   a. Ex: First Line: "RTU-6", Second Line: "FED FROM: PP-A CIR. 5"
2. Where safety/disconnect switches are installed on the load side of variable frequency drives, the safety/disconnect switch shall be furnished with an additional engraved nameplate to read: "WARNING: TURN OFF VFD PRIOR TO OPENING THIS SWITCH".
3. Safety/Disconnect switches feeding equipment that is fed from multiple sources (such as motors with integral overtemperature contacts that are monitored via a control system) and Utilization Equipment fed from multiple sources shall be furnished with an additional BLACK-ON-YELLOW engraved nameplate to read: "WARNING: ASSOCIATED EQUIPMENT FED FROM MULTIPLE SOURCES – DISCONNECT ALL SOURCES PRIOR TO OPENING COVER".

D. Emergency Systems:
1. A sign shall be placed at the service entrance equipment (and at any remote shunt trip operators, or similar, for service equipment) indicating the type and location of on-site emergency power sources (such as generators, central battery systems, etc.) per NEC requirements.
2. All boxes and enclosures (including transfer switches, generators, power panels, junction boxes, pullboxes, etc.) dedicated for emergency circuits shall be permanently marked with white-on-red engraved nameplates so they will be readily identified as a component of an emergency circuit or system.
3. Where an Essential Electrical System (EES) is installed, all enclosures, raceways and equipment that are components of the EES shall be readily identified as such. Raceway shall be identified at intervals not exceeding 25 ft.

E. Services:
1. All Service Equipment:
   a. Engraved nameplates identifying maximum available fault current, including date the fault current calculation was performed, in accordance with NEC article 110.24.
      1) Ex: First Line: "AVAILABLE FAULT CURRENT: 16,154 AMPS", Second Line: "DATE CALCULATED: JULY 8, 2013"
   b. All service entrance equipment shall be clearly labeled as being service entrance rated.
2. Where a building or structure is supplied by more than one service (or any combination of branch circuits, feeders and services), a permanent plaque or directory shall be installed at each service disconnect location denoting all other services, feeders & branch circuits supplying that building or structure and the area served by each, per NEC requirements.

F. Generators:
1. Generators shall be labeled with engraved nameplates identifying name of equipment.

3.5 EMERGENCY AND STANDBY POWER RECEPTACLE IDENTIFICATION

A. Receptacles fed from emergency or standby power sources (such as emergency generators) shall be provided with factory-marked engraved coverplates as described above.

3.6 OTHER IDENTIFICATION

A. Factory-engraved coverplates identifying functions of light switches and other similar devices shall be installed where so required by plans/specifications.

END OF SECTION 26 05 53

SECTION 26 09 43

LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.1 INTRODUCTION

A. The work covered in this section is subject to the requirements in the General Conditions of the Specifications. Contractor shall coordinate the work in this section with the trades covered in other sections of the specification to provide a complete and operable system.

1.2 SYSTEM DESCRIPTION

A. Extent of lighting control system work is indicated by drawings and by the requirements of this section. Contractor shall furnish and install a complete, integrated, stand alone automatic lighting control system including programmable Lighting Control Panels with internal astronomic timeclock(s), Networking between panels, Dataline low voltage control switch inputs for zone control, Photocell input for outdoor lighting control, Occupancy Sensors, and Daylighting Controls from a single supplier. Contractor is responsible for confirming that the panels and sensors interoperate as a single system.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Comply with NEC, NEMA, and FCC Emission requirements for Class A applications.

C. UL Approvals: Relay panels and accessory devices are to be UL listed under UL 916 Energy Management Equipment. Configured to order or custom relay panels shall be UL Listed under UL 508, Industrial Control Panels.

1.4 SUBMITTALS

A. Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.
   1. Shop Drawings: Building floorplans showing all proposed devices and composite wiring and/or schematic diagram of each control circuit as proposed to be installed (standard diagrams will not be accepted).
   2. Product Data: Catalog sheets, specifications and installation instructions.

1.5 APPROVED MANUFACTURERS

A. Watt Stopper/Legrand – Lighting Integrator series

B. Equal by Acuity Lighting

C. Any other system wishing to be considered must submit descriptive information 10 days prior to bid. Prior approval does not guarantee final approval by the electrical engineer. The contractor shall be completely responsible for providing a system meeting this specification in its entirety.

All deviations from this specification must be listed and individually signed off by the consultant.

PART 2 - PRODUCTS

2.1 LIGHTING CONTROL PANELS

A. Provide lighting control panels in the locations and capacities as indicated on the plans and schedules. Each panel shall be of modular construction and consist of the following components:

1. Enclosure/Tub shall be NEMA 1, NEMA 3R, or NEMA 4 as indicated on the plans, sized to accept an interior with 1-8 relays, 1-24 relays and six (6) four pole contactors, or 1-48 relays with six (6) four pole contactors, per enclosure. Multiple enclosures shall be provided where required for the specified quantities of relays/contactors.
2. Cover shall be configured for surface or flush wall mounting of the panel as indicated on the plans. The panel cover shall have a hinged and lockable door with restricted access to line voltage section of the panel.
3. Interior assembly shall be supplied as a factory assembled component specifically designed and listed for field installation. The interior construction shall provide total isolation of high voltage (class 1) wiring from low voltage (class 2) wiring within the assembled panel. The interior assembly shall include intelligence boards, power supply, DIN rails for mounting optional Class 2 control devices, and individually replaceable latching type relays. The panel interiors shall include the following features:
    a. Provision for one or two optional control and automation cards.
    b. Removable, plug-in terminal blocks with screw less connections for all low voltage terminations.
    c. Individual terminal block, override push button, and LED status light for each relay
    d. Switch inputs associated with each relay and group channel shall support two or three wire, momentary or maintained contact switches or 24VDC input from occupancy sensors.
    e. Automatic support for occupancy sensor sequence of operation. Low voltage inputs automatically reconfigure when connected to a Watt Stopper occupancy sensor head. Occupancy sensor shall switch lighting on and off during unoccupied periods but shall not turn lighting off during scheduled occupancy periods.
    f. Isolated contacts within each relay shall provide true relay state to the electronics. True relay state shall be indicated by the on-board LED and shall be available to external control devices and systems.
    g. Automatic sequenced operation of relays reduces impact on the electrical distribution system when large loads are controlled simultaneously.
    h. Group, channel, and pattern control of relays shall be provided through a simple button-press interface within the panel. Any group of relays can be associated with a channel for direct on/off control or pattern (scene) control via a simple programming sequence using the relay and channel override push buttons and LED displays.
    i. Relay group status for each channel shall be provided through bi-color operation of the LED indicators. Solid red indicates that all relays in the group are on, solid green indicates that the group is in a mixed state, and blinking green indicates that the relays have blink warned and are currently timing out.

j. Each relay and channel terminal block shall provide a 24V pilot light signal. It shall be possible to configure the system for support for any Class 2 pilot light voltage with the use of an auxiliary power supply.
k. Single pole latching relays with modular plug-in design. Relays shall provide the following ratings and features:
    1) Electrical:
        a) 30 amp ballast at 277V
        b) 20 amp ballast at 347V
        c) 20 amp tungsten at 120V
        d) 30 amp resistive at 347V
        e) 1.5 HP motor at 120V
        f) Short circuit current capacity equal to (or greater than) that of the associated circuits (see associated panelboard schedules on drawings)
    2) Mechanical:
        a) Individually replaceable, ½" KO mounting with removable Class 2 wire harness
        b) Actuator on relay housing provides manual override and visual status indication, accessible from Class 2 section of panel
        c) Dual line and load terminals each support two #14 – #12 solid or stranded conductors
        d) Tested to 300,000 mechanical on/off cycles
    3) Isolated low voltage contacts provide for true relay status feedback and pilot light indication.
l. Power supply shall be a multi-voltage transformer assembly with rated power to supply all electronics, occupancy sensors, switches, pilot lights, and photocells as necessary to meet the project requirements. Power supply to have internal over-current protection with automatic reset and metal oxide varistor protection.

2.2 LONWORKS® BASED DIGITAL COMMUNICATIONS

A. The lighting control panel shall support digital communications to facilitate the extension of control to include multiple panels and other intelligent field devices. Digital communications shall be LonWorks® based and use the LonTalk® protocol in an open topology architecture.
    1. Dataline communications wire shall be 18 AWG, 4 unshielded copper conductors (two independent twisted pairs) meeting Class 2P NEC code requirements. The dataline shall be topology free and can be run in a serial, "T"or star configuration.
    2. The Dataline wire will be supplied by the equipment manufacturer and will include the manufacturers name, catalog number printed on the wire jacket. The contractor, at their own expense will, replace an improper dataline wire.
    3. Panels shall be digitally addressed and support bi-directional communication between each other and other intelligent field devices specified elsewhere.
    4. Intelligent field devices supported shall include digital dataline switches, network clock/programmer, telephone interface module, BMS interface module, photocell control module, programmable thermostat, and universal switch module.

2.3 BROWSER BASED PROGRAMMING AND CONTROL

A. The lighting control system shall include a web browser based user interface that shall allow programming and override of the system from any PC browser with network connectivity to the lighting controls. The Automation Appliance shall include as a minimum the following

features:

1. The interface shall be a TCP/IP based server device that is connected to the lighting control system global dataline and shall not require that software be installed on the client PC(s) for operation.
2. Provide support for connection of one or more personal computers directly via Ethernet or enterprise connectivity via a local area network, wide area network or internet connection.
3. Provide the option for a plug-in 56K baud modem to enable dial in connection via standard telephone line. All functionality of the browser interface shall be available through the dial-up connection.
4. Log in to the lighting control system through the browser interfaced shall provide multi-level security. Users shall be assigned log in access levels to restrict program modification to authorized users.
5. User programming shall include eight independent schedules for each lighting control panel, as well as, eight global schedules that affect channels in all panels on the network. Schedules shall overlap such that a panel specific schedule for any channel will override a global schedule for that channel.
6. Schedules shall be capable of seven day repeating and calendar date event based formats.
7. User programming shall be scenario based and shall include the following options:
   a. Scheduled ON / OFF
   b. Manual ON / Scheduled OFF
   c. Manual ON / Auto Sweep OFF (for AS-100 Switches)
   d. Astro ON / OFF (or Photo ON / OFF)
   e. Astro and Schedule ON / OFF (or Photo and Schedule ON / OFF)
8. It shall be possible to view the status of and override any relay or channel group via the browser interface screens.
9. Provide support and user interface screens for integration of the photocontrol module, dataline switches, touch-tone telephone module, and universal switch module.
10. Provision for integration with the building automation system shall be via the industry standard BACnet protocol. Any of the eight global schedule channels shall individually be set to follow the BAS schedules rather than the internal Automation Appliance schedules. Relays in all panels shall be exposed to the BAS as binary output objects. It shall be possible for the BAS to read the status of each relay and to override each relay via BACnet.
11. The interface shall monitor all networked components and automatically generate alarms if any component fails to properly respond to control. Alarms shall be annunciated via the browser screens and via email to selected recipients where a proper SMTP server connection has been set up.
12. The user programming in the lighting control panels and dataline switches shall be available for viewing or download to the client PC as a standard PDF file.
13. A backup function shall permit the complete system program to be saved to the hard drive of any client PC connected to the lighting control system through the browser interface. A restore function shall allow a saved program to be reloaded to the interface.

2.4 EIGHT CHANNEL DIGITAL PHOTOCONTROL MODULE

A. Provide a weatherproof Class 2 photocell for measuring exterior light levels. The photocell shall be mounted facing north as indicated on the plans. The photocell shall be connected to a photocontrol module mounted on the DIN rail inside the low voltage section of a lighting control panel and connected to the dataline communications wire.

1. The photocontrol Module shall integrate seamlessly with either the Network Clock, Automation Appliance, or the BMS Interface Module. The control module shall measure the actual exterior light and display this level in foot candles (fc) on the unit LCD display.
2. The controller shall have eight individual set point adjustments that are available to the lighting control network over the dataline communications wire.
3. Features
   a. Real time, 2 line LCD display of actual exterior light level up to 200 fc.
   b. Channel set points and parameters programmed via the Network Clock or BMS Interface Module.
   c. Choice of OPERATE or TEST modes, with simulated light level for testing.
   d. Automatic dead band and 5 minute time delay to avoid cycling.

2.5 DIGITAL DATALINE SWITCHES

A. Intelligent digital switching shall be provided operating on the dual twisted pair communication wire. Switches shall be available in single, dual, quad, or octal (1-button, 2-button, 4-button, or 8-button) designs. The single, dual, and quad devices shall mount in a standard single-gang box, the octal version in a two-gang box.
   1. Each button shall be individually programmable. Programming of buttons shall not require the use of a computer or other programming device. It shall be possible to assign relays or channels to buttons using a simple button press interface. Each button can control any one of the following options:
      a. Any individual relay in any single panel.
      b. Any group of relays in any single panel.
      c. Any group of relays in the system (via network clock, Automation Appliance, or WinControl software package).
   2. For applications that require pattern switching, buttons shall function as a scene control using an ON/OFF/Not Controlled pattern of relays instead of the normal All ON/OFF.
   3. Switches shall be constructed of non-breakable grey Lexan on all exposed parts and shall include a stainless steel wall plate, unless noted otherwise on plans.
   4. Individual buttons shall have a removable clear cover to allow standard 9 mm (3/8 inch) labeling tape to be used to identify the controlled loads.
   5. Each switch shall use a bi-color LED pilot light for the individual buttons to indicate status of the controlled relay or group of relays. LED indications are Red for All ON, Green for Mixed State (some relays in the group ON and others OFF), and No LED for All OFF.
   6. Switch LED pilot lights shall flash green to indicate impending off sweep during the five-minute grace period following blink warning of the lights. Once the button is pressed, the LED will change to Red to acknowledge the occupant's override command to keep lights ON.
   7. Multiple dataline switches programmed to control the same relay or relay group shall indicate the same status automatically.
   8. Each switch shall also include a locator light illuminating the switch for easy location in the dark.
   9. The dual, quad, and octal switches shall all include a single master button that will override all relays controlled by the individual buttons OFF, or Restore them to their original state. Each switch's master button configuration can be altered to perform a Master ON/OFF, OFF Only, or Disabled function if desired.
   10. Switches can be configured to follow a "Cleaning" scenario. This specific scenario shall prevent the cleaners from overriding OFF any relays previously turned ON by an occupant.

11. Each switch is available in a Key lock override version. Once a key is inserted, the individual buttons will function for five minutes.

2.6 AUTOMATIC LIGHTING CONTROLS

A. System shall provide automatic lighting shutoff for all interior lighting circuits controlled by the system (excluding night lights and other similar circuits) per latest ASHRAE 90.1 & IECC standards, unless specifically shown otherwise on plans.

B. System shall provide blink-warnings for interior lighting circuits (excluding circuits with HID light fixtures) controlled by the control panel 5 minutes prior to automatic shutoff.

C. System shall include provisions for holiday scheduling, to allow automatic “ON” programming to be skipped on holidays and other scheduled off days per applicable energy code requirements.

D. Low voltage remote override switches shall be provided as shown on drawings.

E. Exact preset times for lighting control zone controls (where applicable) and lighting control system operation shall be per owner’s direction. Contractor shall submit a proposed lighting control schedule indicating type of “ON” control (occupancy, time-of-day, manual, etc.), type of “OFF” control (occupancy, time-of-day, manual, etc.) and proposed preset times for all zones to owner for review prior to implementation. The following general control schemes shall generally be used where the owner has no preferences unless shown otherwise on plans:
   1. Exterior Security Lighting (at doorways, etc.):
      a. On: Photocell or Astronomic – dusk.
      b. Off: Photocell or Astronomic – dawn.
   2. Other Exterior Lighting:
      a. On: Photocell or Astronomic – dusk.
      b. Off: Preset Time (as directed by the facility operator).
   3. Interior Lighting with Occupancy Sensor Controls:
      a. Corridors, restrooms, lobbies and other similar public spaces
         1) On: Occupancy Sensor.
         2) Off: Occupancy Sensor.
      b. Storage rooms, janitor's closets, telecommunications rooms, and other similar unoccupied spaces:
         1) On: Occupancy Sensor.
         2) Off: Occupancy Sensor.
      c. Offices, classrooms, breakrooms, conference rooms, work areas, kitchens, gymnasiums, and other similar occupied spaces:
         1) On:
            a) Manual Local Switch (if digital controls are provided) or
            b) Occupancy Sensor (if hardwired controls are provided).
         2) Off: Occupancy Sensor (A "grace period" shall be provided, in which the occupancy sensor can turn lights back "on" for a short period of time (approximately 15 seconds) after lights are turned off automatically).
   4. Interior Lighting with Time-of-Day Controls:
      a. Corridors, restrooms, lobbies and other similar public spaces
         1) On: Preset Time (as directed by the facility operator).
         2) Off: Preset Time (as directed by the facility operator).

b. Storage rooms, janitor's closets, telecommunications rooms, and other similar unoccupied spaces:
   1) On: Manual Local Switch
   2) Off: Preset Time (as directed by the facility operator).
c. Offices, classrooms, breakrooms, conference rooms, work areas, kitchens, gymnasiums, and other similar occupied spaces:
   1) On: Manual Local Switch
   2) Off: Preset Time (as directed by the facility operator).

2.7 WIRING

A. See Specification Section 27 05 00 for additional requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Specification Section 27 05 00 for additional cable installation requirements.

B. Master/centralized lighting control switches (particularly switches located in areas where not all associated lighting fixtures are visible from the switch) and individual buttons of other lighting control stations with more than two (2) buttons shall be labeled (on switch coverplate or directly on buttons) with factory-engraved labeling. Exact wording of labeling shall be per owner's direction unless shown otherwise on plans.

3.2 SUPPORT SERVICES

A. Pre-installation Coordination
1. Exact occupancy sensor and daylight sensor types and locations shall be determined by the lighting control system supplier for a fully-functional system with adequate coverage throughout areas controlled by occupancy sensors. Exact locations shall be coordinated with actual HVAC register locations, furniture/casework/etc. locations, sensor coverage patterns, etc. for proper coverage in all areas. In no case may fewer devices or lower-quality devices be used in each area than indicated on contract documents.

B. System Start Up and Commissioning
1. The electrical contractor shall provide the manufacturer, the facility owner and the electrical engineer with ten working days written notice of the system startup and adjustment date.
2. Manufacturer shall provide a factory authorized technician to confirm proper installation and operation of all lighting control system components. The startup requirement is intended to verify:
   a. That all occupancy and daylighting sensors are located, installed, and adjusted as intended by the factory and the contract documents.
   b. The occupancy sensors and daylighting sensors are operating within the manufacturers specifications.
   c. The sensors and relay panels interact as a complete and operational system to meet the design intent.
3. Manufacturer to provide a written statement verifying that the system meets the above requirements.

C. Re-commissioning – After 30 days from occupancy re-calibrate all preset times, sensor time

delays and sensitivities and relocate occupancy sensors if so required to meet the Owner's Project Requirements. Provide a detailed report to the Design Team and Owner of re-commissioning activity.

D. System Training
1. Manufacturer shall provide factory authorized technician to train owner personnel in the operation, programming and maintenance of the lighting control system including all occupancy sensors and daylighting controls.

E. System Programming
1. Manufacturer shall provide system programming including:
   a. Wiring documentation.
   b. Switch operation.
   c. Telephone overrides.
   d. Operating schedules.

3.3 WARRANTY

A. The contractor shall warrant the completed lighting control system to be free from inherent mechanical and electrical defects for a period of one (1) year from the date of the completed and certified test or from the date of first beneficial use.

END OF SECTION 26 09 43

SECTION 26 24 16

POWER PANELBOARDS - CIRCUIT BREAKER TYPE

PART 1 - GENERAL

1.1 GENERAL

A. The work under this section includes but is not limited to the following:
1. Power Panelboards
2. Power Circuit Breakers

PART 2 - PRODUCTS

2.1 PANELBOARDS - GENERAL

A. Panelboards shall be dead front type, having lugs only or circuit breaker in mains as shown in panelboard schedule with circuit breaker branches.

B. Panelboard bus structure and main lugs or main breaker shall have current ratings as shown on plans. Such rating shall be established by heat rise test with Maximum hot spot temperature on any connector or bus bar not to exceed 50 degrees C rise above ambient at full rated load. Heat rise test shall be conducted in accordance with UL Standard UL67. Bus structure shall be tin-plated aluminum or tin-plated copper. All neutral busses shall be full size. All panelboards shall contain ground buss.

C. Entire panelboard assembly, including all bussing, shall have SCCR ratings meeting or exceeding the minimum AIC ratings listed on the plans for the panel. All ratings shall be full ratings. Series ratings will not be allowed unless shown otherwise on drawings.

D. Panelboards shall be listed by Underwriters Laboratories and shall bear the UL label. Panelboards shall be suitable for use as service equipment when required.

E. Top/bottom feed arrangement and lug sizes/quantities shall be coordinated by the contractor.

F. Service entrance panelboards shall be provided with barrier such that no uninsulated, ungrounded service busbar or service terminal is exposed to inadvertent contact by persons or maintenance equipment while servicing load terminations**.**

2.2 CIRCUIT BREAKERS

A. Where the highest continuous current trip setting for which the actual overcurrent device installed in a circuit breaker is rated (or can be adjusted to is 1200A or higher, breakers shall be electronic trip and shall be provided with arc energy-reducing maintenance switching (with local status indicator) to reduce arc flash energy per NEC 240.87 requirements.

B. Circuit breakers shall be quick-make and quick-break, whether actuated automatically or manually. Circuit breakers shall have inverse time tripping characteristics with automatic release which shall trip free of the handle. Circuit breaker handles shall be three distinct positions—“OFF”, “ON”, and “TRIPPED”. When a circuit breaker opens on overload or short

circuit, the operating handle shall automatically assume the "TRIPPED" position.

C. Multipole breakers shall be internal common trip with single operating handle. External handle ties are not acceptable, unless specifically noted otherwise (such as for multi-wire branch circuits described below).

D. Circuit breakers feeding multiwire branch circuits (as defined by NEC) consisting of separate single phase loads sharing a common neutral shall be provided with handle ties to simultaneously disconnect all ungrounded conductors per NEC Article 210.4(B). The necessary locations of these handle ties shall be coordinated by the contractor. Where necessary, the contractor may rearrange circuit breakers (as minimally as possible) as required to meet this requirement.

E. Circuit breakers shall be of the bolt-on type.

F. Circuit breakers shall be "FA" frame and larger.

G. All breakers shall meet the minimum RMS symmetrical interrupting capacity ratings shown on plans for the associated panel. All interrupting ratings shall be full ratings. Series ratings will not be allowed unless shown otherwise on drawings.

H. The front face of all circuit breakers shall be flush with each other. Breaker numbers shall be permanently attached to trim.

I. All branch circuit breakers shall be listed to UL489 or shall be specially-tested to be HACR listed.

2.3 CABINETS, TRIM AND WIREWAY SPACE

A. Clear space from bottom of lugs to bottom of wireway shall be not less than 6 inches for 400 amps and below, 10 inches for 600 amps, 12 inches for 800 amps and above.

B. Panelboard interiors shall be fastened to cabinets by adjustable aligning supports.

C. Panelboard assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel to be as specified in UL Standard 50 for cabinets.

D. Fronts of cabinets shall be made from a single sheet of full finished steel having the door cut out. Doors shall have flush hinges, and lock utilizing all metal construction (with all locks keyed alike). Front shall be attached to cabinets with hinged trim with piano-hinge down full length of one side to allow access to wiring without complete removal of outer trim. Front shall be provided with a metal directory and holder with clear plastic covering welded to the inside of the door. Fronts shall be code gauge full-finished steel with rust inhibiting primer and baked enamel finished in ASA #49 gray. Panelboards installed in exterior or wet locations shall have NEMA 3R enclosures.

E. Each section of multi-section panelboards shall be of matching heights and depths.

F. Panelboard enclosures shall be furnished as shown on panel schedule on plans for surface, flush or motor control center mounting.

2.4 MANUFACTURER

A. Panelboards shall be as manufactured by Square 'D', G.E., Siemens or Cutler Hammer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All panelboard dimensions and clearances shall be carefully checked and coordinated with the proper trades to insure proper mounting space and support prior to roughing in equipment. In no case shall any circuit breaker be located above 6’-7” A.F.F..

B. Wiring in panelboard gutters shall be done in a neat and workmanlike manner. Wiring shall be grouped into neat bundles and secured with approved tie wraps.

3.2 PANEL IDENTIFICATION

A. Refer to Specification Section 26 05 53.

END OF SECTION 26 24 16

SECTION 26 24 17

LIGHTING PANELBOARDS

PART 1 - GENERAL

1.1 GENERAL

A. The work under this section includes but is not limited to the following:
1. Lighting Panelboards
2. Circuit Breakers

PART 2 - PRODUCT

2.1 PANELBOARDS

A. Enclosure:
1. Panelboards shall be dead front type and shall be in accordance with Underwriter's Laboratories, Inc., standard of panelboards and enclosing cabinets and so labeled.
2. Panelboards installed in dry locations shall have enclosures fabricated from sheet steel and shall be finished in ASA #49. Panelboards installed in exterior or wet locations shall have NEMA 3R enclosures.
3. The door shall have a cylinder type lock. Lock shall be held in place by concealed screw to a captive nut, welded to inside of door. All locks shall be keyed alike.
4. A metal framed circuit directory card holder with clear plastic covering shall be factory-mounted on the inside of door.
5. Panels for 20 or more circuits, including spares and spaces, shall be 20 inches wide.
6. Panelboards enclosures shall be as shown on panel schedule on plans for surface, flush or motor control center mounting.
7. Provide hinged trim with piano-hinge down full length of one side to allow access to wiring without complete removal of outer trim.
8. Each section of multi-section panelboards shall be of matching heights and depths.

B. Bussing/Lugs:
1. Ampacity and service voltage of main buss, lugs or main breakers and branch circuit breakers shall be as shown on drawings.
2. All bussing and associated connectors shall be tin-plated aluminum or tin-plated copper.
3. All panelboards shall contain ground buss.
4. Entire panelboard shall be capable of withstanding a short circuit not less than the interrupting capacity of any breaker in the panel. When a power distribution system electrical study (including short circuit stud, etc.) is a part of the project, contractor shall further verify that all proposed equipment is properly rated (per the results of the study) prior to submitting shop drawings. Interrupting ratings shall be full ratings. Series ratings will not be allowed unless shown otherwise on drawings.
5. Buss connectors shall be for distributed phase arrangement.
6. Top/bottom feed arrangement and lug sizes/quantities shall be coordinated by the contractor.
7. Entire panelboard assembly, including all bussing, shall have SCCR ratings meeting or exceeding the minimum AIC ratings listed on the plans for the panel. When a power

distribution system electrical study (including short circuit stud, etc.) is a part of the project, contractor shall further verify that all proposed equipment is properly rated (per the results of the study) prior to submitting shop drawings. All ratings shall be full ratings. Series ratings will not be allowed unless shown otherwise on drawings.

8. Service entrance panelboards shall be provided with barrier such that no uninsulated, ungrounded service busbar or service terminal is exposed to inadvertent contact by persons or maintenance equipment while servicing load terminations

C. Breaker arrangement and numbering:
   1. Panelboards shall be factory assembled with branch breakers arranged exactly as indicated on plans.
   2. Breakers shall be numbered vertically beginning top left. Multi-section panelboards shall be numbered consecutively through all sections.
   3. Breaker numbers shall be permanently attached to trim.
   4. Main breakers shall be vertically-mounted (branch-mounted or back-fed main breakers will not be acceptable unless specifically so shown on plans).

2.2 CIRCUIT BREAKERS

A. Circuit breakers shall be quick break, quick make, thermal magnetic type, for alternating current. Breakers shall trip free for the handle and tripping shall be indicated by the handle assuming a position between OFF and ON.

B. Circuit breakers shall be of the bolt-on type.

C. Multi-pole breakers shall be internal common trip with single operating handle; external handle ties are not acceptable, unless specifically noted otherwise (such as for multi-wire branch circuits described below).

D. Circuit breakers feeding multiwire branch circuits (as defined by NEC) consisting of separate single phase loads sharing a common neutral shall be provided with multi-pole breakers or handle ties to simultaneously disconnect all ungrounded conductors per NEC Article 210.4(B). The necessary locations of these multi-pole breakers or handle ties shall be coordinated by the contractor. Where necessary, the contractor may rearrange circuit breakers (as minimally as possible) as required to meet this requirement.

E. All breakers shall meet the minimum RMS symmetrical interrupting capacity ratings shown on plans for the associated panel. All interrupting ratings shall be full ratings. Series ratings will not be allowed unless shown otherwise on drawings.

F. All branch circuit breakers shall be listed to UL489 or shall be specially-tested to be HACR listed.

2.3 SPECIAL REQUIREMENTS

A. Any special requirements on the drawings, such as for increased interrupting rating, ground fault protection, etc., shall supersede these specifications, but only insofar as that particular requirement is concerned.

B. Lighting panels larger than 400A shall conform to the requirements for power panels.

2.4 MANUFACTURER

A. Panelboards shall be as manufactured by Square 'D', G.E., Siemens or Cutler Hammer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All panelboard dimensions and clearances shall be carefully checked and coordinated with the proper trades to insure proper mounting space and support prior to roughing in equipment. In no case shall any circuit breaker be located above 6’-7” A.F.F..

B. Wiring in panelboard wireways shall be done in a neat and workmanlike manner. Wiring shall be grouped into neat bundles and secured with approved tie wraps.

C. For all flush-mounted panelboards, a minimum of three (3) one-inch empty conduits shall be stubbed out above the nearest accessible ceiling space for future use.

3.2 PANEL IDENTIFICATION

A. Refer to Specification Section 26 05 53.

END OF SECTION 26 24 17

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Wiring Devices

B. Plates

C. Finishes

PART 2 - PRODUCTS

2.1 WIRING DEVICES AND PLATES

A. Switches shall be AC type, extra-heavy duty industrial grade (unless otherwise shown) of ratings shown on drawings. Switches shall be as manufactured by Hubbell, P & S, Sierra, Bryant, GE, Arrow Hart or equal.

B. Receptacles shall have blade configuration and shall be heavy duty industrial grade (unless otherwise shown) of current and voltage rating as shown on drawings. Receptacles shall be as manufactured by Hubbell, P & S, Sierra, Bryant, GE, Arrow Hart or equal.

C. All GFCI-type receptacles shall continuously self-test and shall trip/deny power if the receptacle does not provide proper GFCI protection or if the line/load terminations are miswired and shall provide visual indication of power status, trip conditions, ground fault conditions and end-of-life status.

D. Each wiring device shall have a plate (see “Finishes” section below for specific requirements).

2.2 FINISHES

A. All wiring devices (switches, receptacles, etc.) shall be colored to match the coverplates described below. For instance, all items covered by stainless steel, aluminum or malleable iron plates shall be gray in color.
   1. Exceptions:
      a. Emergency wiring devices shall be red.
      b. Isolated ground wiring devices shall be orange.

B. Coverplates for recessed, wall-mounted electrical items (switches, receptacles, telephone outlets, etc.) shall be stainless steel unless shown otherwise.

C. Coverplates, trim rings, etc. for recessed, floor-mounted electrical items (floor outlets, underfloor duct junctions, etc.) shall match finish of building hardware (302/304 stainless steel, brass, etc.) in area installed.

D. Coverplates for exposed electrical items (switches, receptacles, telephone outlets, etc.) shall be

of same material as exposed boxes (see Outlet Box Specification for required material type) and shall have beveled edges.

E. Coverplates for receptacles in wet locations shall be metallic, in-use type, rated for wet locations per NEC requirements unless noted otherwise.

F. See "Electrical Identification" specification section for coverplate labeling requirements.

PART 3 - EXECUTION

3.1 GENERAL MOUNTING

A. Symbols on drawings and mounting heights are approximate. The exact locations and mounting heights shall be determined on the job, and it shall be the Contractor's responsibility to coordinate with all trades to secure correct installation. For example, Contractor shall coordinate exact mounting heights over counters, in or above backsplashes, in block walls, and at other specific construction features.

B. Verify all door swings with Architectural. Locate boxes for light switches within four inches of door trim on swing side (not hinge side) of door.

C. Devices and associated plates shall not be used as support; outlet boxes shall be rigidly supported from structural members.

D. Mount all straight-blade receptacles vertically with ground pole up, unless specifically noted otherwise.

E. Unless otherwise shown or required by local handicap codes, outlet boxes shall be the following distances above the finished floor unless otherwise noted.
1. Receptacles and telephone outlets in offices and other finished areas: 1'-6" to the center of the box.
2. Receptacles and telephone outlets in equipment rooms and other unfinished areas: 4'-0" to the center of the box.
3. Receptacles over counters: As Noted
4. Switches, general: 4'-0" to the top of the box.
5. Fire Alarm Pull Stations: 4'-0" to the top of the box.
6. Fire Alarm Audio/Visual Devices: As shown on fire alarm shop drawings (Entire lens shall be above 80" and below 96" per NFPA 72).
7. Push-button, etc., general: 4'-0" to the top of the box.
8. Other device types: verify with engineer prior to rough-in.

END OF SECTION 26 27 26

SECTION 26 28 16

SAFETY SWITCHES AND FUSES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Safety Switches

B. Fuses

C. Branch Feeders

D. Feeders

PART 2 - PRODUCTS

2.1 SAFETY SWITCHES

A. Safety switches shall be quick-make, quick-break, NEMA heavy duty type HD, fused or nonfused as shown. Switch blades shall be fully visible in the off position.

B. Safety switches shall be furnished with transparent internal barrier kits to prevent accidental contact with live parts. Barriers shall provide finger-safe protection when the switch door is open and shall allow use of test probes and removal of fuses without removing barrier.

C. Fused switches shall have provisions for class R, rejection type fuses.

2.2 FUSES (600V)

A. Fuses for all branch switches shall be Bussman Mfg. Co., Dual Element, Class “R” Fusetron.

B. Fuses for main switch/switches shall be Bussman Mfg. Co. Hi-Cap.

2.3 MANUFACTURER

A. Safety switches shall be as manufactured by Square 'D', G.E., Siemens or Cutler Hammer.

B. Fuses shall be as manufactured by Bussman Mfg. Co. or equal.

PART 3 - EXECUTION

3.1 SAFETY SWITCHES

A. Safety switches shall be installed as shown on the plans and in accordance with N.E.C.

B. Locations shown for safety switches on plans are diagrammatical only. Exact locations shall be field coordinated by contractor as required to provide code-required clearances.

C. Switch enclosures shall be rated NEMA I indoors in dry locations and NEMA3R outdoors and

in wet areas.

D. Adequate support shall be provided for mounting safety switches. Safety switches shall not be mounted to the associated equipment (unless the safety switch is furnished with the equipment).

3.2 FUSES

A. Fuses shall be sized as shown on drawings, unless a smaller size is required by the associated equipment supplier, in which case the contractor shall provide fuses sized as directed by the associated equipment supplier at no additional cost.

B. Provide not less than one spare set of fuses for each size used. Provide an additional spare set for each five sets of same size fuses used.

END OF SECTION 26 28 16

SECTION 26 41 00

LIGHTNING PROTECTION SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. Furnish and install all materials and labor required to provide a complete and functional Lightning Protection and Common Grounding System as indicated, in strict accordance with this section of the Specifications and the applicable Contract Drawings.

1.2 STANDARDS & QUALITY ASSURANCE

A. The lightning protection system shall comply with all requirements of the latest edition of each of the following codes and standards. The latest edition of these codes and standards form a part of this specification:
1. U.L. Standard 96A.
2. Lightning Protection Institute - Installation Code LPI-175.
3. N.F.P.A. 780.

B. Equipment manufacturer shall be certified by the Lightning Protection Institute, and products approved for UL listing. All materials shall be manufactured by one of the following manufacturers:
1. Bonded Lightning Protection Systems
2. East Coast Lightning Protection
3. Erico/Eritech Lightning Protection
4. Harger Lightning Protection
5. Preferred Lightning Protection
6. Robbins Lightning
7. Thompson Lightning Protection

C. For approval of LPI manufacturer other than specified, complete proposed material data and installation drawings shall be submitted to Engineer for review not less than 10 days prior to bid date.

D. In order to insure integrity of installation, the system shall be installed under the direct jobsite supervision of a Certified Master Installer/Designer, who has qualified under the LPI's Certification Program as a Master Installer/Designer.

1.3 SUBMITTALS

A. Complete shop drawings of the entire lightning protection system showing the type, size, mounting details, and location of all equipment, grounds, cable routings, roof materials (for coordination of lightning protection system materials), etc., shall be submitted to the Architect-Engineer for approval prior to start of work.

B. Submittals shall document the local manufacturer’s representative’s Certified Master Installer/Designer qualifications from LPI.

PART 2 - PRODUCTS

2.1 SYSTEM

A. System materials in general shall be copper, copper alloy or aluminum with high-copper content bronze castings or aluminum castings (all compatible with associated surface materials and installed per UL, NFPA & LPI standards), and shall comply in weight, size and composition for the class of structure to be protected. The system shall consist of all necessary cables, air terminals, mounting bases, fittings, couplings, connectors, fasteners, surge protection devices, etc., as required to give a complete and coordinated system.

B. Copper conductors shall be utilized for all downleads and below-grade conductors.

C. Aluminum components shall be utilized in cases where copper is not compatible with mounting surfaces.

D. All ground rods shall be copper-clad steel.

E. All cable and all air terminals shall bear proper UL labels.

F. Air terminals shall have blunt tips.

G. System design shall be concealed wherever practical, with roof perimeter cables concealed in parapet walls, and mid-roof cables installed under roof slabs. Exposed cable on parapet walls will only be accepted if structural details preclude cable concealment. Cable drops for roof penetrations at downlead locations shall be made with solid-bar thru-roof connectors, with copper rod flashings. Bond rebars top and bottom at each downlead position and risers. Primary and secondary bonding of roof metals and equipment shall also be under roof slabs. Ground level, intermediate and roof level potential equalization shall be provided per current building Code classifications.

H. All system fittings except cable holders, regardless of Structure classification, shall be heavy-duty type made from bronze or aluminum castings and secured with bolted-pressure clamps. Pressure plates made from stamped or pressed metal parts, or fittings utilizing crimp-type pressure devices will not be allowed. All bolts, screws, and related type hardware shall be stainless steel.

I. Contractor shall coordinate with the roofing contractor to insure compatibility of any adhesive with the roofing system in use.

J. Cable fasteners shall be substantial in construction, electrolytically compatible with the conductor and mounting surface, and shall be spaced according to LPI, UL, and NFPA code requirements.

K. Where applicable, an approved bimetal transition fitting shall be used at the roof level to change from aluminum roof conductor to copper downlead cable.

L. Surge protection devices shall be provided on the power, telecommunications and other conductive electrical services at the points of entrance into the building(s) as required by UL96A in order to obtain the UL Master Label Certificate of Inspection. It shall be the

responsibility of the electrical contractor to install or verify that a proper surge protection device has been installed on the each of the building electrical services to meet this requirement. This may require surge protection devices in addition to those specifically shown on plans or called out within other specifications.

PART 3 - EXECUTION

3.1 SUPERVISION AND CERTIFICATION

A. The manufacturer's local representative shall be a Certified Master Installer/Designer under the LPI program, and shall provide direct jobsite technical supervision to Contractor's personnel during installation to insure compliance with all Code requirements. Upon job completion, Contractors shall furnish Owners with written certification on UL Master Label "C",that system is installed in compliance with above Standards.

END OF SECTION 26 41 00

SECTION 26 43 00

SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes field-mounted SPDs for low-voltage (<1000 V) power distribution and control equipment.

B. The specified unit(s) shall provide effective high energy transient voltage surge suppression, surge current diversion and high frequency noise attenuation in all electrical modes for equipment connected downstream from the facility's meter or load side of the main overcurrent device. The unit(s) shall be connected in parallel with the facility's wiring system.

C. The unit(s) shall be designed and manufactured in North America by a qualified manufacturer of suppression filter system equipment. The qualified manufacturer shall have been engaged in the commercial design and manufacturer of such products for minimum of ten (10) years.

D. All products that are submitted according to these specification will be required to meet this specification in it's entirety for both service and distribution TVSS systems. Any product that is submitted and does not comply with all parts of this specification will be subject to rejection.

1.3 DEFINITIONS

A. VPR: Voltage Protection Rating.

B. SPD: Surge Protective Device(s)

C. $I_{(n)}$: Nominal Discharge Current

1.4 SUBMITTALS

A. See specification section 26 05 00.

B. Product Data: For each type of product indicated. Include:
1. Maximum Single Impulse Surge Current Rating.
2. Surge Life (Repetitive Surge) Rating.
3. UL1449 (Latest Edition) Voltage Protection Ratings (VPR).
4. UL1449 (Latest Edition) Nominal Discharge Current (In).
5. Product dimensions and weights.
6. Furnished specialties and accessories.

C. Qualification Data:

D. Safety Agency File Number.

E. ISO 9001-2008 Certification.

F. ISO 1401-2001 Certification.

G. Operation and Maintenance Data: For SPDs to include all submittal data and any applicable operation and maintenance manuals.

H. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.

B. The unit shall be UL 1449 Listed and CUL Approved as a Surge Protective Device and UL 1283 Listed as an Electromagnetic Interference Filter

C. Provide 2nd party certified data demonstrating SPD response to ANSI/IEEE C62.41.2-2002 standard waveforms when tested according to IEEE C62.45.

D. Comply with NFPA 70.

E. All SPDs provided within this project at the service entrance, distribution panels, and sub-panels shall be from the same manufacturer.

1.6 PROJECT CONDITIONS

A. Service Conditions: Rate SPDs for continuous operation under the following conditions unless otherwise indicated:
1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Temperature: 30 to 150 deg F.
3. Humidity: 0 to 95 percent, non-condensing.
4. Altitude: Less than 13,000 feet above sea level.

1.7 COORDINATION

A. Where field-mounted SPD's are specifically shown on plans, coordinate locations of field-mounted SPDs to allow adequate clearances for maintenance.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.
1. Warranty Period: 10 years from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective

covering for storage and identified with labels describing contents.

1. Replaceable Protection Modules: 1 of each size and type installed, where field-replaceable modular SPDs are provided.
2. Fuses: 1 of each size and type installed, where field-replaceable fuses are provided.

PART 2 - PRODUCTS

2.1 SURGE PROTECTIVE DEVICES

A. Manufacturer:

1. Integral Devices: Surge Protective Devices shall be as manufactured by the distribution equipment manufacturer (Square D, etc.), or by Surge Suppression Inc. if all of the performance of this specification are met and all UL listing of the equipment manufacturer are met.
2. External Devices (where specifically specified on plans): Surge Protective Devices shall be as manufactured by the distribution equipment manufacturer (Square D, etc.) or Surge Suppression Inc.

B. Each Surge Protective Device shall:

1. Be internal to the associated distribution equipment (without violating any applicable UL listings) unless specifically shown otherwise on plans.
2. Be UL 1449 (Latest Edition) listed.
3. Have short-circuit current rating complying with UL 1449 (Latest Edition), that matches or exceeds the short-circuit rating of the associated distribution equipment.
4. Be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage.
5. Have fuses, rated at 200-kA interrupting capacity.
6. Have a minimum UL 1449 Nominal Discharge Current (I_n) Rating of 20kA.
7. Be fabricated using bolted compression lugs.
8. Provide suppression for all ten (10) modes of protection.
9. Have LED indicator lights for power and protection status of each phase.
10. Have audible alarm, with silencing switch, to indicate when protection has failed.
11. Have form-C contacts rated at 2 A and 24-V ac minimum, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with facility monitoring and control system if monitoring by that system is required by plans or other specifications.
12. Have six-digit transient-event counter, mounted to front of equipment door, set to totalize transient surges (externally mounted SPD's may have the transient –event counter monted on the visible face of the SPD).
13. Meet all UL 96A requirements (for Lightning Protection Systems) where the device is installed at a service entrance of the facility. At a minimum, these devices shall:
    a. Be marked as Type 1 or Type 2 SPDs with product Identity consisting of "Surge Protective Device" or "SPD", and identifying all ratings so required by UL96A and the 4 digit alpha numeric Control Number.
    b. Have a minimum UL 1449 Nominal Discharge Current (I_n) Rating of 20kA.
    c. Be UL listed and labeled with holographic label.

C. Peak Single-Impulse Surge Current Rating shall be meet the following minimums unless

specifically shown otherwise on plans:

Application	**Per Phase**	**Per Mode**
Service Entrance Devices	240 kA	120 kA
Downstream Devices	160 kA	80 kA

D. The ANSI/UL 1449 voltage protection rating (VPR) in grounded wye circuits, the SPDs shall not exceed the following:

Modes	**208Y/120V**	**480Y/277V**	**600Y/347V**
L-N,L-G, N-G	800	1200	1500
L-L	1200	2000	2500

E. The ANSI /UL 1449 VPR for 240/120 V, 3-wire or 4-wire circuits with high leg shall not exceed the following:

Modes	**240/120V**
L-N,L-G, N-G	1200/800

2.2 ENCLOSURES

A. Where external units are specifically specified on plans, units not mounted within electrical distribution equipment (such as switchboards, MCC's, etc.) shall be provided in enclosures with NEMA enclosure ratings that match or exceed the NEMA enclosure ratings of the equipment from which the units are fed. For example, a unit fed from a NEMA 4X stainless steel panelboard shall also be mounted within a NEMA 4X stainless steel enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All SPD's shall be integrally-mounted within the associated distribution equipment unless specifically shown otherwise on plans.

B. Install SPDs at service entrance on load side, with ground lead bonded to service entrance ground.

C. Install SPDs downstream of the service entrance with conductors or buses between suppressor and points of attachment as short and straight as possible. The lead lengths between the TVSS unit and the equipment being protected shall not exceed fourteen (14) inches without approval from the engineer. Do not bond neutral and ground. Leads shall be as straight as possible with no sharp bends.

D. Where externally-mounted SPD's are specifically shown on plans, provide circuit breaker as

directed by the SPD supplier as a dedicated disconnecting means for SPD unless otherwise indicated.

3.2 FIELD QUALITY CONTROL

A. Ensure that interiors are free of foreign materials and dirt.

B. Check and test switches, pushbuttons, meters for proper operation.

C. Check and test indicating lights for proper operation and color.

D. Perform manufacturer's on site field test procedures.

3.3 STARTUP SERVICE

A. Do not perform insulation resistance (MEGGER) tests of the distribution wiring equipment with the SPDs installed. Disconnect all wires, including neutral, before conducting insulation resistance tests, and reconnect immediately after the testing is over.

3.4 SYSTEM WARRANTY

A. The SPD system manufacturer shall warranty the entire SPD system against defective materials and workmanship for a period of ten (10) years from the date of substantial completion. This warranty is in effect as long as the unit is installed in compliance with the manufacturer's installation, operation, and maintenance manual, UL Listing requirements, and any applicable national or local electrical codes.

B. Any SPD device which shows evidence of failure or incorrect operation, including damage as the result of lightning strikes, during the warranty period shall be replaced by the manufacturer at no charge to the owner. Warranty will provide for multiple exchanges of any inoperable devices at any time during the warranty period which starts at the date of substantial completion of the system to which the surge suppressor is installed.

C. The manufacturer is required to have a nationwide network of factory-authorized local service representatives for repair and service of this product. The manufacturer shall have a dedicated 1-800 telephone number for service problems and questions. This number shall be manned by a knowledgeable factory employee to ensure prompt response to any emergency situation that may arise.

END OF SECTION 26 43 00

SECTION 26 50 00

LIGHTING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Lighting Fixtures

B. Drivers

1.2 SUBMITTALS

A. Complete submittals shall be provided identifying all lighting fixture types and options, all lamp types (where applicable) and compliance with all contract requirements. The absence of clear submittal information specifically listing exceptions/deviations from detailed contract requirements will be understood to indicated that the contractor/supplier intends to meet all contract requirements. Refer to specification section 26 05 00 for additional requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. Lighting fixtures shall be furnished as shown on plans and specified herein. It shall specifically be the responsibility of Contractor to verify exact types ceilings, walls, etc. and recessing depth of all recessed fixtures and furnish the specific mounting trims and accessories of the specified and/or accepted fixture specifically for the ceiling, wall etc. in which each fixture is to be installed.

B. Base bid manufacturers are listed on the lighting fixture schedule. Manufacturers listed without accompanying catalog numbers are responsible for meeting the quality standards, efficiency, maximum wattages and photometric distributions set by the specified product.

C. All lighting fixtures shall be so designed and shall have drivers and other similar items so installed as to function without interruptions or failures when operating in the environment in which they are proposed to be installed. Special attention shall be given to environments with potentially high ambient temperatures such as attic spaces, exterior soffits, confined interior soffits, coves, unconditioned spaces, etc. and shall be addressed by providing fixtures with suitable high ambient temperature ratings, remote mounting of drivers/ballasts, providing approved ventilation, etc. as directed by fixture manufacturer and approved by engineer, at contractor’s expense.

D. All fixtures installed such as to create penetrations through fire rated ceiling or wall assemblies shall be labeled as suitable for that purpose or installed with covers, tenting or other means as required to maintain the fire rating of the assembly.

2.2 LED LUMINAIRES

A. For the purpose of these specifications, LED Luminaires shall be defined as the entire LED fixture assembly including LED array, drivers, housing, electronics, etc. that compose the

lighting fixture.

B. Furnish and install LED Luminaire of proper size, type, efficacy, delivered lumen output, color temperature, distribution pattern, operational life, and CRI as shown on drawings.

C. LED Luminaires shall be tested in accordance with LM-79 and LM-80 standards.

D. LED drivers shall comply with NEMA 410 standards for inrush current, etc.

E. Exterior, pole mounted LED Luminaires shall be provided with an easily-serviceable, UL recognized surge protection device that meets a minimum 10kA Category C Low operation (IECC C62.41.2-2002). Device shall be wired in front of light engine(s) and driver(s) and shall fail "open" such as to prevent fixture operation after a surge protection failure.

F. LED Luminaires shall have a guarantee-warranty of at least five years unless specifically noted otherwise on contract documents.

G. LED Luminaire assembly shall comply with ambient temperature requirements specified in General section above.

2.3 STEMS/PENDANTS

A. Hangers shall be approved ball aligner type swivel, 30 degrees from vertical with swivel below canopy.

B. Stems/Pendants shall be rigid or IMC conduit unless specified otherwise on plans. Proposed stem/pendant types shall be submitted for review prior to shipment of light fixtures from factory.

C. Stems/Pendants shall be provided as required to prevent swaying of fixtures due to HVAC system airflow or other similar occurrences.

D. Shall be painted the same color as the fixture trim unless noted otherwise.

2.4 MANUFACTURER

A. Fixtures and stems shall be manufactured as shown in fixture schedule or approved equals.

B. Drivers shall be as manufactured by Philips/Advance, GE, Lutron, Magnatec, Motorola, EldoLED or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF LIGHTING FIXTURES

A. Support:
1. Support of all lighting fixtures shall be responsibility of electrical contractor. All lighting fixture supports shall be installed in accordance with lighting fixture supplier's recommendations.
2. Contractor shall coordinate installation requirements for all wall-mounted fixtures (especially for wall-mounted fixtures on uneven wall surfaces, etc.) as required to assure a

level/flat mounting surface and level/plumb/secure finished installation. Contractor shall provide flat mounting plates or other mounting provisions where necessary. Any proposed mounting plates, etc. shall be submitted to and approved by project architect prior to ordering materials.

3. Fixtures shall be supported independent of ceiling from structural members of building.
4. Lay-in fixtures shall be supported by four (4) taut 12 gauge hanger wires connected from each corner of the fixture to the structure above so that fixture is supported independent of the ceiling.
5. Other recessed light fixtures (including recessed downlights) shall be supported with two (2) taut 12 gauge hanger wires connected from opposing corners of the light fixture to the structure above so that fixture is supported independent of the ceiling.
6. Pendant mounted fixtures shall be directly supported from the structure above using a 9 gauge hanger wire or an approved alternate support without using the ceiling suspension system for direct support.
7. Tandem fixtures may utilize common hanger wires.
8. All lay-in fixtures shall be attached to ceiling grid by means of approved clips and in accordance with the N.E.C.
9. Contractor shall submit typical hanging detail to Engineer before installing any fixtures.

B. Connections:
1. All grid fixtures shall be wired by flex individually to junction and not wired fixture to fixture.
2. All flex shall contain 3 conductors (3rd wire ground). Ground wire shall be securely grounded at each end. Other conductors shall be connected by approved connectors.

C. Row-Mounted fixtures:
1. All stems on row-mounted fluorescent fixtures shall be installed as follows (except fixtures with slide grip hangers):
   a. One stem shall be installed in the first fixture knockout from end of row (on the first and last fixture of the row).
   b. One stem shall be installed between each two fixtures. Stem shall center joint where fixtures join and shall attach by use of “joining plates”.
2. All fixtures in continuous rows other than recessed grid type shall be connected by nipples with locknuts bushings.

D. Coordination:
1. Contractor shall coordinate all dimensions & locations of light fixtures prior to rough-in to insure proper fit and coordination with other trades.
2. Contractor shall verify exact ceiling types being installed and shall adjust fixture trim types accordingly (prior to submitting light fixture shop drawings).

END OF SECTION 26 50 00

SECTION 27 05 00

AUXILIARY SYSTEM CABLES, 0-50V

PART 1 - GENERAL

1.1 DESCRIPTION

A. Cables rated for 0V-50V application

PART 2 - PRODUCTS

2.1 GENERAL

A. Unless specified otherwise, all cables within the scope of this specification section shall:
1. Be rated for exposed cable tray installation.
2. Be plenum rated.
3. Be UL-rated for the proposed application.
4. Be multi-conductor with overall outer sheath as required by the application. The insulation of each conductor within the overall multi-conductor cable shall be uniquely color-coded. Ground conductors (when provided) within the multi-conductor cable shall have green insulation. Conductors with green insulation shall not be used for conductors other than ground.
5. Utilize copper conductors.
6. Have wire gauge as required to limit voltage drop to acceptable limits determined by the system supplier and to meet all applicable code requirements.
7. Where installed underground, within slab-on-grade or in exterior locations, be rated for wet locations.
8. Where required for specific systems, meet the specific requirements (conductor quantity, wire gauge, insulation type, shielding, etc.) of the system supplier.

2.2 CLASS 1 CONTROL CABLING (120VAC CONTROL CIRCUITS, ETC.)

A. In addition to above requirements, and unless specified otherwise, Class 1 control cabling shall:
1. Be rated for 600V.
2. Be industrial grade.
3. Have stranded conductors.
4. Have sunlight/oil-resistant PVC/Nylon insulation and jacket with ripcord.
5. Be manufactured by Belden, AlphaWire or General Cable.

2.3 CLASS 2 & 3 CONTROL CABLING (FED FROM CLASS 2 OR 3 POWER SUPPLIES)

A. In addition to above requirements, and unless specified otherwise, Class 2 & 3 control cabling shall:
1. Be rated for 300V.
2. Be shielded if so recommended by the system supplier/integrator.
3. Have twisted conductors.
4. Have plenum-rated insulation/jacket with ripcord.
5. Be manufactured by AlphaWire, Belden, General Cable, Superior Essex or West Penn.

2.4 NETWORK CABLING

A. Furnish and install all Ethernet, Fiber Optic and Backbone Copper Telephone cabling in accordance with all BICSI requirements and in accordance with other applicable specification sections.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Routing:
1. All wires and cables shall be installed in conduit unless specifically noted otherwise. Where conduit is not otherwise required by contract documents, 0-50V Cabling located within concealed, accessible ceiling spaces (such as above lay-in ceilings) may be run without conduit if the following requirements are met:
   a. Cabling is plenum-rated, multi-conductor.
   b. Cabling is supported by cable tray or with J-hook supports on intervals not to exceed 5'-0" on center. Cabling shall be supported solely from the cable tray or j-hooks supported from the building structure, without using piping, ductwork, conduit or other items as supports.
   c. Cabling is neatly formed, bundled and tied with plenum-rated Velcro straps on intervals not to exceed 30" on center.
   d. Properly-sized conduit(s) are provided wherever cabling enters an inaccessible or exposed area (such as above gyp board ceilings, within walls or through walls).
   e. Cabling is not a part of a Fire Alarm System, Smoke Control System, Emergency Generator Control System or other life-safety related system.
2. End bushings shall be provided on both ends of all raceway terminations.
3. No splices shall be pulled into conduit.
4. No cabling shall be pulled until conduit is cleaned of all foreign matter.

B. Penetrations:
1. All fire/smoke barrier penetrations shall be made in accordance with a U.L. listed assembly.
2. For cabling not installed in conduit:
   a. Fire/smoke barrier penetrations shall be sealed utilizing an enclosed fire-rated pathway device (STI EZ Path or equal) containing a built-in fire sealing system sufficient to maintain the hourly fire rating of the barrier being penetrated. The self-contained sealing system shall automatically adjust to the installed cable loading and shall permit cables to be installed, removed or retrofitted without the need to remove or reinstall firestop materials. The pathway shall be UL Classified and tested to the requirements of applicable ASTM/UL1479 standards.
3. For cabling installed within conduit from endpoint to endpoint:
   a. Fire/smoke barrier penetrations shall sealed utilizing fire caulk or other equivalent firestop systems around perimeters of conduits per UL requirements.
4. For cabling installed within cable trays:
   a. Fire/smoke barrier penetrations shall be sealed with one of the following methods:
      1) Continuous cable tray through the penetration, with a combination of large firestop pillows and small firestop pillows contained, supported and secured (to prevent unauthorized removal) on both sides by aluminum wire mesh and firestop putty. Firestop pillows shall be STI Series SSB or equal and Firestop putty shall be STI Spec Seal or equal.

2) Cable tray broken at the penetration, with fire/smoke barrier penetrations sealed utilizing an enclosed fire-rated pathway device (STI EZ Path or equal) containing a built-in fire sealing system sufficient to maintain the hourly fire rating of the barrier being penetrated. The self-contained sealing system shall automatically adjust to the installed cable loading and shall permit cables to be installed, removed or retrofitted without the need to remove or reinstall firestop materials. The pathway shall be UL Classified and tested to the requirements of applicable ASTM/UL1479 standards.

C. Excess Cabling:
1. Excess cabling shall be neatly coiled within all junction boxes, pullboxes, wireways, etc. and at all terminations as required to allow future re-termination of cabling.

D. Terminations:
1. All conductors/cabling (including spare conductors) shall be properly terminated unless specifically directed otherwise. See below for general termination hardware requirements.
2. Cabling shall be neatly formed, bundled and tied at all terminations.

3.2 SPLICES/CONNECTIONS/TERMINATIONS:

A. Network Cabling:
1. Network and fiber optic cabling shall be continuous from endpoint to endpoint and shall not be spliced unless specifically noted otherwise.

B. Control Cabling:
1. Connections shall be made with T & B Sta-Kon wire joints EPT66M, complete with insulating caps. To be installed with WT161 Tool or C nest of WT11M Tool, Ideal Super - Nuts (not wire nuts), Ideal Wing Nuts, or Buchanan Elec. Products B Cap or Series 2000 Pressure connectors complete with nylon snap on insulators to be installed with C24 pressure tool.

C. Shielded cabling:
1. Unless directed otherwise by the system supplier, 0-50V cable shielding shall be grounded at the PLC/control panel end only (not at the field device end) with a termination kit as directed by the PLC/control panel supplier.
2. Shielded cabling shall be continuous from endpoint to endpoint and shall not be spliced without prior written approval from the Engineer.

3.3 LABELING

A. Refer to Specification Section 26 05 53 for all labeling requirements.

END OF SECTION 27 05 00

SECTION 27 10 00

STRUCTURED CABLING SYSTEM

PART 1 - GENERAL

1.1 SCOPE:

A. This document describes the products and execution requirements relating to furnishing and installing Telecommunications Cabling. Backbone and Horizontal cabling comprised of copper and fiber cabling, and support systems are covered under this document.

B. All cables and related terminations, support and grounding hardware shall be furnished, installed, wired, tested, labeled, and documented by the structured cabling contractor as detailed in this document.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. Quantities of telecommunications outlets, typical installation details, cable routing and outlet types are indicated on the plans. If the bid documents are in conflict, this specification shall take precedence.

D. Refer to Specification Section 26 05 53 (Electrical Identification) for additional identification requirements.

E. Refer to Specification Section 27 05 00 (Auxiliary System Cables, 0-50V) for additional material and installation requirements.

1.2 REGULATORY REFERENCES:

A. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association, the National Electrical Code, local ordinances and present manufacturing standards.

B. All materials shall be UL Listed and shall be marked as such. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.

C. All modular jacks, patch cords, consolidation point, and patch cords shall be ETL Verified (not just tested) to be category 6 component and channel compliant.

D. The cabling system described in this specification is derived from the recommendations made in recognized telecommunications industry standards. The following documents are incorporated by reference:
1. ANSI/TIA/EIA - 568-B.1, Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, April, 2001
2. ANSI/TIA/EIA - 568-B.2, Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components, April, 2001

3. ANSI/TIA/EIA - 568-B.2-1, Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted Pair Cabling Components, Addendum 1 – Transmission Performance Specifications for 4-pair 100 Ω Category 6 Cabling
4. ANSI/TIA/EIA - 568-B.3, Commercial Building Telecommunications Cabling Standard Part 3: Optical Fiber Cabling Components, March, 2000
5. ANSI/TIA/EIA – 569-A, Commercial Building Standard for Telecommunications Pathways and Spaces, February, 1998
6. ANSI/TIA/EIA – 606-A, Administration Standard for Telecommunications Infrastructure of Commercial Buildings, February, 2002
7. ANSI/TIA/EIA – 607-AJ, Commercial Building Grounding and Bonding Requirements for Telecommunications, August 1994
8. ANSI/ TIA/EIA – 758, Customer-Owned Outside Plant Telecommunications Cabling Standard, April 1999
9. BICSI - TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual (TDMM) 10^{TH} edition.
10. National Fire Protection Agency (NFPA – 70), National Electrical Code (NEC) –2002
11. ANSI/TIA/EIA – 45-B, Test Procedures for Fiber Optic Connections.
12. ANSI/TIA/EIA – 526-14, Power Test for Fiber Runs.
13. FCC 47 CFR 68
14. NEMA 250
15. NEC Articles 770 and 800
16. ADA, Americans with Disabilities Act

E. If this document and any of the documents listed above are in conflict, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release.

F. This document does not replace any code, either partially or wholly. The contractor must be aware of local codes that may impact this project. All local State and federal codes are to be followed.

1.3 APPROVED CONTRACTOR:

A. The Structured Cabling Contractor must meet the following requirements:
1. Contractor must have a certified RCDD on staff. The project manager for this project shall have an RCDD certification, and RCDD shall be responsible for reviewing all aspects of the design, submittals and installation of all products.
2. All required submittal information shall be stamped by the RCDD.
3. Contractor must have a minimum of 3 years experience with projects of similar size and scope to this project.
4. The company performing the work must have been in business for a minimum of 3 years.
5. The company must have an office within 75 miles of the job site.

B. The Structured cabling contractor is responsible for workmanship and installation practices in accordance with the requirements of the standards described in these specifications and manufacturer's requirements.

1.4 WORK INCLUDED:

A. The work included under this specification consists of furnishing all labor, equipment, materials, and supplies and performing all operations necessary to complete the installation of this structured cabling system in compliance with the specifications and drawings. The structured cabling contractor will provide and install all of the required material to form a complete system whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:
1. Furnish and install a complete telecommunications wiring infrastructure.
2. Furnish, install, and terminate all UTP and Optical Fiber cable
3. Furnish and install all wall plates, jacks, patch panels, and patch cords at equipment racks and at work outlets (unless shown otherwise on plans).
4. Furnish and install all required cabinets and/or racks as required and as indicated.
5. Furnish any other material required to form a complete system.
6. Perform channel testing (100% of horizontal and/or backbone links/channels) and certification of all components.
7. Furnish test results of all cabling to the owner on disk and paper format, listed by each closet, then by workstation ID.
8. Provide owner test results and documentation. (Testing documentation and As-built drawings)

1.5 SUBMITTALS:

A. Within thirty (30) days of notice to proceed the structured cabling contractor shall submit the following items:
1. Submit copies of the certification of the company and names of staff that will be performing the installation and termination of the installation to provide proof of compliance of this spec.
2. Submit proof from manufacturer of contractor's good standing in manufacturer's certification program.
3. Submit copy of contractor's RCDD certification.
4. Submit listing of five (5) projects of similar size and scope to this project that have been completed within the last five years. Include in this submittal owner's contact information for each project.
5. Submit letter from the manufacturer stating that the manufacturer will provide a twenty-five year (25) warranty in accordance with the requirements paragraph 1.03 (B) of these specifications.
6. Submit appropriate cut sheets and samples for all products, hardware and cabling.
7. Submit 1/8" = 1'-0" drawings of floor plans indicating all work outlets and the labeling designation for each jack.
8. Submit ½" = 1'-0" drawings of each MDF and each IDF showing all racks, patch panels, 110 blocks, etc.

B. Work shall not proceed without the engineer's approval of the submitted items.

C. The structured cabling contractor shall receive approval from the engineer on all substitutions of material. No substituted materials shall be installed except by written approval from the engineer.

1.6 DRAWINGS:

A. It shall be understood that the electrical details and drawings provided with the specification package are diagrammatic. They are included to show the intent of the specifications and to aid the structured cabling contractor in bidding the job. The structured cabling contractor shall make allowance in the bid proposal to cover whatever work is required to comply with the intent of the plans and specifications.

B. The structured cabling contractor shall verify all dimensions at the site and be responsible for their accuracy.

PART 2 - PRODUCTS

2.1 EQUIVALENT PRODUCTS:

A. Due to the nature and type of communications all products, including but not limited to faceplates, jacks, patch panels, racks, 110 blocks, and patch cords, for the purpose of this document, shall be manufactured by Hubbell, Ortronix, Panduit, Amp or Systimax. See below for acceptable cable manufacturers.

2.2 WORK AREA OUTLETS:

A. Work area cables shall each be terminated at their designated work area location in the connector types described in the subsections below. Included are modular telecommunication jacks. These connector assemblies shall snap into a faceplate.

B. The Telecommunications Outlet Assembly shall accommodate:
1. A minimum of two (2) modular jacks
2. Additional accommodations for specific locations as noted in the plans for optical fiber and/or additional copper cables as necessary
3. A blank filler will be installed when extra ports are not used.
4. A dust cap shall be provided on all modular jacks with the circuit number on the identifier strip.
5. Multiple jacks will be placed as documented on the plans.
6. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation. Prior to installation, the structured cabling contractor shall submit the proposed configuration for each outlet assembly for review by the architect.
7. The modular jack shall incorporate printed label strip on the dust cap module for identifying the outlet. Printed labels shall be permanent and compliant with ANSI/TIA/EIA-606-A standard specifications. Labels shall be printed using a printer such as a Brady hand held printer. Hand printed labels shall not be accepted.

C. Faceplates: The faceplates shall:
1. be UL listed and CSA certified.
2. be constructed of stainless steel (except where noted otherwise). All faceplate colors/materials in public areas shall be approved by the architect. In all cases the material and color of the faceplate shall match the adjacent electrical faceplate.
3. (where plastic faceplates are specifically allowed by the architect/engineer) shall match the faceplate color used for other utilities in the building or match the color of the raceway if installed in surface raceway.
4. be compliant with the above requirements along with the following when incorporating optical fiber:

a. be a low profile assembly,
b. incorporate a mechanism for storage of cable and fiber slack needed for termination,
c. position the fiber optic couplings to face downward or at a downward angle to prevent contamination and,
d. incorporate a shroud that protects the optical couplings from impact damage.

5. be available as single-gang or dual-gang.
6. possess recessed designation windows to facilitate labeling and identification.
7. shall include a clear plastic cover to protect labels in the designation window.
8. have mounting screws located under recessed designation windows.
9. comply with ANSI/TIA/EIA–606-A work area labeling standard.
10. allow for the UTP modules to be inverted in place for termination purposes.
11. be manufactured by an ISO 9001 registered company.

D. Voice / Data Jacks

1. Voice/Data jacks shall be 8-position modular jacks and shall be Category 6 performance as defined by the references in this document including ANSI/TIA/EIA-568-B.2-1. All pair combinations must be considered, with the worst-case measurement being the basis for compliance. Modular jack performance shall be third-party verified by a nationally recognized independent testing laboratory including, but not limited to, ETL.
2. The wiring scheme shall be T568A or T568B as directed by the owner.
3. The modular jack shall use dual reactance modular contact array.
4. The modular jack shall have low emission IDC contacts.
5. The modular jack shall use standard termination practice using 110 impact tool
6. The modular jack shall be backwards compatible to Category 3 and 5.
7. The modular jack shall be center tuned to category 6 test specifications.
8. Dust cover shall be used on each termination.

2.3 110 COPPER TERMINATION BLOCK:

A. The voice cross connect shall be a passive connection between the horizontal termination blocks and the backbone termination blocks. The wall mount frames shall be field terminated kits including all blocks, connecting blocks, and designation strips. Management rings shall be mounted between vertical columns of blocks to provide management of cross-connect wire. Backbone and horizontal blocks shall use 4-pair connecting blocks. Blocks shall be oriented so that backbone terminations are located on the left and horizontal frames are located on the right of the termination field when facing the frame assembly.

B. 110 Block Kits shall

1. include both the wiring block and connecting block in a 50, 100 and 300 pair footprint as required
2. be manufactured using fire retardant molded plastic.
3. include 4-pair 110C connecting blocks for field termination.
4. support termination of 22-24 AWG solid conductor
5. wiring blocks shall contain back openings for the feed through of cable
6. meet category 6 component compliance and be verified by a third-party nationally recognized independent testing laboratory
7. have color-coded tips on the wiring block and color coding on the connector blocks for installation identification.
8. shall use standard termination practice requiring a single conductor 110 impact tool

9. Termination hardware shall maintain the paired construction of the cable to facilitate minimum untwisting of the wires.
10. be backwards compatible to category 3 and 5.
11. be labeled in compliance with ANSI/TIA/EIA-606-A labeling specifications using permanent labels and label printer.
12. be manufactured by an ISO 9001 registered company.

2.4 MODULAR PATCH PANELS:

A. The Modular Patch Panels shall
1. be modular design.
2. meet category 6 component compliance and be verified by a third-party nationally recognized independent testing laboratory
3. use low emission IDC contacts
4. use dual reactance technology to enhance the signal-to-noise ratio
5. require standard termination practices using a 110 impact tool
6. use a single piece IDC housing designed to accept larger Category 6 conductors
7. support both T568B and T568A wiring
8. include easy to follow wiring labels
9. include label fields
10. allow for the use of icons
11. include full length metal rear cable management
12. be available in standard or high density
13. be backward compatible to category 3 and 5.
14. be center tuned to category 6 test specifications
15. be sized to accommodate number of data or data and phone cables (where phone cables are terminated on patch panels in lieu of 110 blocks) served by each equipment room plus 30% spare capacity.
16. be separated by horizontal cable management sections.

2.5 RACKS:

A. The equipment rack shall provide vertical cable management and support for the patch cords at the front of the rack and wire management, support, and protection for the horizontal cables inside the legs of the rack.

B. Waterfall cable management shall be provided at the top of the rack for patch cords and for horizontal cables entering the rack channels for protection and to maintain proper bend radius and cable support. Double-sided wire management shall also be mounted above each patch panel and/or piece of equipment on the rack. The rack shall include mounting brackets for cable tray ladder rack to mount to the top of the rack. Velcro cable ties shall be provided inside the rack channels to support the horizontal cable. Rack shall be black in color to match the patch panels and cable management.

C. Free-Standing Racks shall:
1. have the necessary strain relief, bend radius and cable routing for proper installation of high performance cross connect products, meeting all specifications of ANSI/TIA/EIA-568-B.
2. have top cable trough with waterfall and built in patch/horizontal cable distribution separator.

3. have horizontal front and rear cable management above, below and between each 48-port patch panel.
4. have a rack-mounted power strip.
5. have EIA hole pattern on front and rear.
6. be available with a 6.0" channel depth.
7. be available with hook and loop straps for securing bulk cables inside the vertical U-channels.
8. assemble as 19" (483 mm) or 23" (584 mm) with no additional hardware.
9. be available with three styles of vertical patch cord management: interbay with latches, cable management rings, or fingerduct with covers.
10. provide floor and ceiling access for cable management and distribution.
11. provide pre-drilled base for floor attachment of rack.
12. be available in standard color of black.
13. be manufactured by an ISO 9001 registered company.

D. Wall-Mounted Racks shall:
1. provide the necessary strain relief, bend radius and cable routing for proper installation of high performance cross connect products, meeting all specifications of ANSI/TIA/EIA-568-B.
2. have top cable trough with waterfall and built in patch/horizontal cable distribution separator.
3. have horizontal front and rear cable management above, below and between each 48-port patch panel.
4. have a rack-mounted power strip.
5. have EIA hole pattern on front and rear.
6. be available with a 6.0" channel depth.
7. be available with hook and loop straps for securing bulk cables inside the vertical U-channels.
8. assemble as 19" (483 mm) or 23" (584 mm) with no additional hardware.
9. provide usable depth as required for standard network ethernet switch and other equipment
10. be available with three styles of vertical patch cord management: interbay with latches, cable management rings, or fingerduct with covers.
11. provide floor and ceiling access for cable management and distribution.
12. provide pre-drilled base for wall attachment of rack.
13. be available in standard color of black.
14. be manufactured by an ISO 9001 registered company.
15. be constructed to swing-out from wall (for rear access) via heavy-duty hinged corner and configurable for either left or right opening.

2.6 HORIZONTAL DISTRIBUTION CABLE:

A. Horizontal Distribution Cabling shall meet the following requirements:
1. Shall be 100 Ohm Enhanced Category 6 Unshielded Twisted Pair (UTP) Cable.
2. Physical Characteristics:
   a. Unless directed otherwise by owner (contractor shall verify with owner), Cat6 cable coloring shall be based on system type as follows, unless specifically approved otherwise:
      1) Data (or IP Voice): Blue
      2) Analog Voice: Grey
      3) Lighting Control System: White

4) Fire Alarm or other Life-Safety System: Red
5) CCTV Surveillance Cameras: Yellow
6) Other: As directed by owner

b. Shall be plenum-rated.
c. Shall meet applicable requirements of ANSI/ICEA S-80-576.
d. The diameter of the insulated conductor shall be .023 in. maximum.
e. Shall consist of (4) 22-26 AWG twisted pairs.
f. The overall diameter of the cable shall be no larger than 0.240 inches.
g. The ultimate breaking strength measured in accordance with ASTM D 4565 shall be 400 N minimum.
h. Cable shall withstand a bend radius of 1 inch at -20 degrees Celsius without jacket or insulation cracking.
i. Cable shall be third party verified to meet ANSI/TIA/EIA-568-B.2-1.
j. Where installed underground, within slab-on-grade or in exterior locations, be gel-filled and rated for wet locations.

3. Transmission Characteristics:
   a. DC resistance of any conductor shall not exceed 9.38 Ohms per 100m max. at 20° C. Measured in accordance with ASTM D 4566.
   b. The mutual capacitance of any pair at 1 kHz for 100m of cable shall not exceed 4.4 nF nominal.
   c. DC resistance unbalance any two conductors of any pair shall not exceed 5% when measured at or corrected to 20° C in accordance with ASTM D 4566.
   d. Structural return loss swept measurement for 100m or longer shall meet or exceed Category 6 requirements.
4. Shall be manufactured by Amp NetConnect, Berk-Tek, Leviton, General Cable, Mohawk or Superior Essex.

2.7 BACKBONE - FIBER:

A. Backbone Fiber Optic Cabling shall meet the following requirements:
   1. All optical fiber shall be Indoor/Outdoor,Tight-Buffered, All-Dielectric, Plenum rated (unless specified otherwise on plans) with Enhanced Multimode OM4-rated 50/125 Optical Fibers.
   2. Each Multimode Fiber shall:
      a. Be graded-index optical fiber wave-guide with nominal 50/125µm-core/cladding diameter.
      b. Comply with ANSI/EIA/TIA-492AAAC-A
      c. Have attenuation measured in accordance with ANSI/EIA/TIA-455-46, 53 or 61.
      d. Have information transmission capacity measured in accordance with ANSI/EIA/TIA-455-51 or 30.
      e. Have measurements performed at 23 degrees C +/- 5 degrees.
      f. Have Maximum attenuation dB/Km @ 850/1300 nm: 3.5/1.0
      g. Have bandwidth $\geq$ 4700 MHz-km @ 850nm. (EMB)
      h. Have bandwidth $\geq$ 500 MHz-km @ 1300nm.
      i. Be laser optimized and guarantee a 1 Gb/s distance of 1000 meters @ 850nm and 10 Gb/s at 600 meters @ 850nm.
      j. Terminate on fiber patch panel using SC Type fiber connectors.
   3. Each indoor/outdoor fiber optic cable shall:
      a. Be suitable for use in both outdoor and indoor applications without the use of a transition at the building entrance.
      b. Be suitable for use in risers, plenums and horizontal applications.

c. Have a dry water blocking system for cable.
d. Have a fiber strand count of 12 (unless shown otherwise on plans).
e. Have a nominal 2.21 mm sub-unit diameter.
f. Have and be marked with an UL-OFNP Flame Rating (unless engineer specified otherwise on plans).
g. Comply with Bellcore GR-409 and GR20
h. Be independently verified to comply with ICEA S-104-696
i. Have strength members of FGE/Aramid yarn.
j. Be suitable for underground or above ground conduits.
k. (Where applicable) Have Tight Buffered fibers color coded in accordance with EIA / TIA 598 with an overall black jacket.
l. Be suitable for operation between -40° to +70° C
m. Be UV resistant
n. Be of an all dielectric design

4. Shall be manufactured by Berk-Tek, Corning, General Cable or Superior Essex.

2.8 BACKBONE - COPPER:

A. Backbone Copper Cabling shall meet the following requirements:
1. Shall be Cat 3 rated.
2. Shall be RDUP PE-39 rated.
3. Where installed underground or in wet locations, shall include fully-flooded waterblocking compound to provide wet-location rating of cable.
4. Size of the backbone cables shall be determined by multiplying the number of horizontal voice cables to be terminated in each IDF by 200% and rounding up to the nearest 50 pair group. For Example if 94 horizontal voice cables are to be terminated in IDF1, install 94 x 1 pr x 200% = 188 pr rounded up to nearest 50 pr = 200 pr cable to IDF1.
5. Shall be manufactured by Berk-Tek, Corning, General Cable, Mohawk or Superior Essex.

2.9 COPPER CABLE SURGE PROTECTION DEVICES:

A. All copper circuits routed between or outside of buildings shall be provided with a surge protection device at each end. The surge protection device shall be labeled as meeting the requirements of the latest edition of UL 96A (exact requirements shall be coordinated with the lightning protection system supplier, where applicable).

B. The surge protection device shall be connected with a #6 AWG copper bonding conductor between the protector ground lug and the TC ground point.

2.10 PATCH CORDS:

A. The structured cabling contractor shall provide factory terminated and tested UTP and optical fiber patch cords and equipment cords for the complete cabling system. Patch cords shall be provided by the structured cabling contractor to connect patch panels to owner furnished electronics. The UTP patch cables shall meet the requirements of ANSI/TIA/EIA-568-B.2 and ANSI/TIA/EIA-568-B.2-1 for patch cord testing. Provide one set of optical fiber patch cables per fiber run that terminates on fiber patch panel and provide one category 6 patch cord for each category 6 work outlet that terminates on patch panel.

B. Copper (UTP) patch cords shall:
1. Be furnished to connect each patch panel jack to owner supplied electronics.

2. Be furnished for each work outlet jack.
3. Be a Category 6 patch cord manufactured by Panduit, Amp or Systimax.
4. Use 8 position connector with impedance matched contacts and designed using dual reactance.
5. Be constructed of 100 ohm, 4 pair, 24 AWG, stranded conductor, unshielded twisted pair copper per the requirements of the ANSI/TIA/EIA-568-B.2 and ANSI/TIA/EIA-568-B.2–1 standard.
6. Meet TIA category 6 component specifications in ANSI/TIA/EIA-568-B.2-1 100% factory tested to meet category 6 performance and ETL or any other nationally recognized 3rd party verification
7. Be capable of universal T568A or T568B wiring schemes.
8. Have modular connector that shall maintain the paired construction of the cable to facilitate minimum untwisting of the wires.
9. Have a performance marking indelibly labeled on the jacket (by the manufacturer).
10. Have the ability to accept color-coded labels and icons to comply with ANSI/TIA/EIA-606-A labeling specifications.
11. Have "snagless" protection for the locking tab to prevent snagging and to protect locking tab in tight locations and provide bend relief
12. Be available in three standard colors
13. Be available in 3 foot, 5 foot, 7 foot, 10 foot, and 14 foot standard lengths
14. Be backwards compatible to Category 3, 5 and 5e

C. Fiber Optic patch cords shall:
1. Be furnished in the quantity of two (2) per IDF in each IDF and two (2) per IDF in each MDF.
2. Be manufactured by Panduit, Amp or Systimax.
3. Be multimode OM4 type.
4. Have connector type as directed by owner.
5. Have a performance marking indelibly labeled on the jacket (by the manufacturer).
6. Have the ability to accept color-coded labels and icons to comply with ANSI/TIA/EIA-606-A labeling specifications.
7. Be available in three standard colors
8. Be available in 3 foot, 5 foot, 7 foot, 10 foot, and 14 foot standard lengths

2.11 GROUNDING AND BONDING:

A. The facility shall be equipped with a Telecommunications Bonding Backbone (TBB). This backbone shall be used to ground all telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor. The TBB shall be installed independent of the building's electrical and building ground and shall be designed in accordance with the recommendations contained in the ANSI/TIA/EIA-607 Telecommunications Bonding and Grounding Standard.

B. The main entrance facility/equipment room in each building shall be equipped with a telecommunications main grounding bus bar (TMGB). Each telecommunications room shall be provided with a telecommunications ground bus bar (TGB). Each grounding bus shall be 12"W x 4"H x ¼"THK and be mounted to the backboard with porcelain isolators.

C. All wires used for telecommunications grounding purposes shall be identified with a green insulation. Non-insulated wires shall be identified at each termination point with a wrap of

green tape. All cables and bus bars shall be identified and labeled in accordance with the System Documentation Section of this specification.

2.12 FIRESTOP:

A. A firestop system is comprised of the item or items penetrating the fire rated structure, the opening in the structure and the materials and assembly of the materials used to seal the penetrated structure. Firestop systems comprise an effective block for fire, smoke, heat, vapor and pressurized water stream.

B. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an UL listed firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating item i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly firestopped.

2.13 INNERDUCT:

A. Innerduct, shall be:
1. Non-metallic, corrugated with pre-installed pull tape.
2. Plenum-rated, where installed within buildings.
3. UL listed for the application.
4. Size as required by the application.
5. Orange in color in concealed areas or within telecommunications or electrical rooms. Color shall be custom as selected by owner in exposed areas (such as within cable trays overhead in areas without ceilings outside telecommunications/electrical rooms).

PART 3 - EXECUTION

3.1 PRE-INSTALLATION SITE SURVEY:

A. Prior to start of work, meet at the project site with the owner's representative and representatives of trades performing related work to coordinate efforts. Review areas of potential interference and resolve conflicts before proceeding with the work. Facilitation with the General Contractor will be necessary to plan the crucial schedule completions of the equipment rooms and telecommunication closets.

B. Examine areas and conditions under which the system is to be installed. Do not proceed with work until satisfactory conditions have been achieved.

3.2 WORK AREA OUTLETS:

A. Cables shall be coiled in the in-wall or surface-mount boxes if adequate space is present to house the cable coil without exceeding the manufacturer's bend radius. In hollow wall installations where box-eliminators are used, excess wire can be stored in the wall. No more than 12" of UTP and 36" of fiber slack shall be stored in an in-wall box, modular furniture raceway, or insulated walls. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.

B. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568-B.1 document, manufacturer's recommendations and best industry

practices.

C. Pair untwist at the termination shall not exceed 12 mm (one-half inch).

D. Bend radius of the horizontal cable shall not be less than 4 times the outside diameter of the cable.

E. The cable jacket shall be maintained to within 25mm (one inch) of the termination point.

F. Data jacks, unless otherwise noted in drawings, shall be located in the bottom position(s) of each faceplate. Data jacks in horizontally oriented faceplates shall occupy the right-most position(s).

G. Voice jacks shall occupy the top position(s) on the faceplate. Voice jacks in horizontally oriented faceplates shall occupy the left-most position(s).

3.3 HORIZONTAL DISTRIBUTION CABLE INSTALLATION:

A. All horizontal voice and data cabling shall be terminated on modular patch panels except for horizontal voice cables serving life safety related functions (fire alarm systems, security systems, elevator communications, etc.). All horizontal voice cabling serving life safety related functions shall be terminated on 110 blocks.

B. The voice and data cables shall be installed in separate patch panels.

C. All wiring above ceilings shall be installed in cable tray or open top cable hangers or in provided conduit.

D. Cable above accessible ceilings shall be supported 60” on center from cable support attached to building structure.

E. Do not untwist cable pairs more than 0.5 in. when terminating.

F. The Contractor shall be responsible for replacing all cables that do not pass Category 6 requirements for data and 5e for the voice applications.

G. Maximum horizontal cable length shall be 90 meters.

H. Cable shall have no physical defects such as cuts, tears or bulges in the outer jacket. Cables with defects shall be replaced.

I. Install cable in neat and workmanlike manner. Neatly bundle and tie all cable in closets. Leave sufficient cable for 90° sweeps at all vertical drops.

J. Do not install Category 6 cable with more than 110N (25 lbs) pull force, as specified in ANSI/TIA/EIA and BICSI TDDM practices. Utilize appropriate cable lubricant in sufficient quantity to reduce pulling friction to acceptable levels on long pulls inside conduit, pulls of multiple cables into a single small bore conduit, on conduit runs greater than 100 lineal feet with bends of opposing directions, and in conduit runs that exceed 180 degrees of accumulated bends. Use of tensile rated cords (i.e. fishing line) should be used for difficult or questionable

pulls - to judge to go/no-go condition of the conduit and pulling setup.

K. Cables jackets that are chaffed or burned exposing internal conductor insulation or have any bare copper (“shiners”) shall be replaced.

L. Test, label and document as called for in contract documents.

M. Firestop all openings where cable is installed through a fire barrier.

3.4 HORIZONTAL CROSS CONNECT INSTALLATION:

A. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568-B standard, manufacturer's recommendations and best industry practices.

B. Pair untwist at the termination shall not exceed 13 mm (0.5 inch).

C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.

D. Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

E. The cable jacket shall be maintained as close as possible to the termination point.

F. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.5 OPTICAL FIBER TERMINATION HARDWARE:

A. Fiber slack shall be neatly coiled within the fiber splice tray or enclosure. No slack loops shall be allowed external to the fiber panel.

B. Each cable shall be individually attached to the respective splice enclosure by mechanical means. The cables strength member shall be securely attached the cable strain relief bracket in the enclosure.

C. Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.

D. Each cable shall be clearly labeled at the entrance to the splice enclosure. Cables labeled within the bundle shall not be acceptable.

E. A maximum of 12 strands of fiber shall be spliced in each tray

F. All spare strands shall be installed into spare splice trays.

3.6 BACKBONE CABLE INSTALLATION:

A. Raceways:

1. All backbone cables shall be installed inside innerducts (see specification above) within conduits meeting specification requirements unless specifically noted otherwise.
2. Backbone cables shall be installed separately (in separate innerducts/conduits) from horizontal distribution cables.
3. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.
4. Where backbone cables and distribution cables are specifically specified to be installed in a cable tray or wireway, backbone cables shall be installed first, within innerducts meeting specifications above, bundled separately from the horizontal distribution cables.

B. Support:
1. Within Telecommunications Rooms or at Telecommunications Backboards, all backbone cables shall be securely fastened to the backboards on the walls.
2. Backbone cables spanning more than three floors shall be securely attached at the top of the cable run with a wire mesh grip and on alternating floors or as required by local codes.
3. Vertical runs of cable shall be supported to messenger strand, cable ladder, or other method to provide proper support for the weight of the cable.
4. Large bundles of cables and/or heavy cables shall be attached using metal clamps and/or metal banding to support the cables.

3.7 COPPER TERMINATION HARDWARE:

A. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568-A/B standard, manufacturer's recommendations and best industry practice.

B. Pair untwist at the termination shall not exceed 12 mm (one-half inch).

C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.

D. Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

E. The cable jacket shall be maintained to within 25 mm (one inch) of the termination point.

F. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.8 RACKS:

A. Floor-mount racks shall be used unless specifically shown otherwise.

B. Floor-mount racks shall be securely attached to the concrete floor using a minimum 3/8” hardware or as required by local codes.

C. Racks shall be placed with a minimum of 36 inches clearance from the walls on all sides of the rack. When mounted in a row, maintain a minimum of 36 inches from the wall behind and in front of the row of racks and from the wall at each end of the row.

D. All racks shall be grounded to the telecommunications ground bus bar in accordance with Section 3.11 of this document.

E. Rack mount screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.

F. Wall mounted termination block fields shall be mounted on 4' x 8' x .75" void free plywood. The plywood shall be mounted vertically 12" above the finished floor. The plywood shall be painted with two coats of grey fire retardant paint.

G. Wall mounted termination block fields shall be installed with the lowest edge of the mounting frame 18" from the finished floor.

H. Rack-mounted patch panels (and the associated horizontal cable management sections) furnished within the contract shall occupy no more than 40% of the available space within the associated racks (also furnished within the contract) unless specifically shown or specified otherwise. A minimum of 60% of available rack space shall be reserved for owner-furnished equipment. Where the number of patch panels and horizontal cable management sections would exceed 40% of the available rack space, an additional rack shall be installed.

3.9 EQUIPMENT TRAY FOR TELECOMMUNICATION ROOMS:

A. All equipment trays shall be 18" in width.

B. Furnish and install 18" equipment tray from each floor mount rack/server cabinet to wall. Furnish 18" equipment tray around wall as required to support cables. A minimum of two (2) walls shall be completely covered by equipment tray.

C. Furnish and install cable retaining posts on each side of tray every 4 feet as required to supports cables.

3.10 FIRESTOP SYSTEM:

A. All firestop systems shall be installed in accordance with the manufacturer's recommendations and shall be completely installed and available for inspection by the local inspection authorities prior to cable system acceptance.

3.11 GROUNDING SYSTEM:

A. The TMGB in the MDF shall be connected to the building electrical entrance grounding facility with a #6 AWG ground. Each TBB in each IDF shall be connected to a ground bus in the MDF with #4/0 AWG minimum ground. The intent of this system is to provide a grounding system that is equal in potential to the building electrical ground system. Therefore, ground loop current potential is minimized between telecommunications equipment and the electrical system to which it is attached.

B. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the TR or ER shall be grounded to the respective TGB or TMGB using a minimum #6 AWG stranded copper bonding conductor and compression connectors.

C. The TBB shall adhere to the recommendations of the ANSI/TIA/EIA-607 standard, and shall be installed in accordance with best industry practice.

D. Installation and termination of the main bonding conductor to the building service entrance ground shall be performed by the electrical contractor.

3.12 IDENTIFICATION AND LABELING:

A. The contractor shall develop and submit for approval a labeling system for the cable installation. The Owner will negotiate an appropriate labeling scheme with the successful structured cabling contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. Labeling shall follow the guidelines of ANSI/TIA/EIA-606-A.

B. All label printing will be machine generated by Panduit software (or other) using indelible ink ribbons or cartridges. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Outlet, patch panel and wiring block labels shall be installed on, or in, the space provided on the device.

3.13 TESTING AND ACCEPTANCE:

A. General
1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-B. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.
2. All cables shall be tested in accordance with this document, the ANSI/TIA/EIA standards, the Panduit Certification Program Information Manual and best industry practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.

B. Copper Channel Testing
1. All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category performance. Horizontal cabling shall be tested using a Level III test unit for category 6 performance compliance, respectively.
2. Continuity - Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. Shielded/screened cables shall be tested with a device that verifies shield continuity in addition to the above stated tests. The test shall be recorded as pass/fail as indicated by the test unit in accordance with the manufacturers' recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.

3. Length - Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA/EIA-568-B.1 Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.
4. Category 6 Performance:
   a. Follow the Standards requirements established in:
      1) ANSI/TIA/EIA-568-B .1, B.2 and B.2-1
   b. A Level III test unit is required to verify category 6 performance.The basic tests required are:
      1) Wire Map
      2) Length
      3) Attenuation
      4) NEXT (Near end crosstalk)
      5) Return Loss
      6) ELFEXT Loss
      7) Propagation Delay
      8) Delay skew
      9) PSNEXT (Power sum near-end crosstalk loss)
      10) PSELFEXT (Power sum equal level far-end crosstalk loss)

C. Fiber Testing
1. All fiber testing shall be performed on all fibers in the completed end to end system. There shall be no splices unless clearly defined in an RFP. Testing shall consist of an end to end power meter test performed per EIA/TIA-455-53A. The system loss measurements shall be provided at 850 and/or 1300 nanometers for multimode fibers and 1310 and/or 1550 nanometers for single mode fibers. These tests also include continuity checking of each fiber.
2. Backbone multimode fiber cabling shall be tested at both 850 nm and 1300 nm (or 1310 and 1550 nm for singlemode) in both directions.
3. Test set-up and performance shall be conducted in accordance with ANSI/EIA/TIA-526-14 Standard, Method B.
4. Where links are combined to complete a circuit between devices, the structured cabling contractor shall test each link from end to end to ensure the performance of the system. ONLY LINK TEST IS REQUIRED. The structured cabling contractor can optionally install patch cords to complete the circuit and then test the entire channel. The test method shall be the same used for the test described above. The values for calculating loss shall be those defined in the ANSI/TIA/EIA Standard.
5. Attenuation testing shall be performed with an approved hand held tester from an industry recognized test equipment manufacturer.

3.14 SYSTEM DOCUMENTATION:

A. Upon completion of the installation, the structured cabling contractor shall provide three (3) full documentation sets to the owners for approval. Documentation shall include the items detailed in the sub-sections below.

B. Documentation shall be submitted within ten (10) working days of the completion of each testing phase (e.g. subsystem, cable type, area, floor, etc.). This is inclusive of all test result and

draft as-built drawings. Draft drawings may include annotations done by hand. Machine generated (final) copies of all drawings shall be submitted within 30 working days of the completion of each testing phase. At the request of the Engineer, the structured cabling contractor shall provide copies of the original test results.

C. The Engineer may request that a 10% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the structured cabling contractor, additional testing can be requested to the extent determined necessary by the Engineer, including a 100% re-test. This re-test shall be at no additional cost to the Owner.

3.15 TEST RESULTS:

A. Test documentation shall be provided on disk within three weeks after the completion of the project. The disk shall be clearly marked on the outside front cover with the words "Project Test Documentation", the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.

B. The field test equipment shall meet the requirements of ANSI/TIA/EIA-568-A/B including applicable TSB's and amendments. The appropriate Level III tester shall be used to verify Category 6 cabling systems.

C. Test results generated for each cable by the wire (or fiber) test instrument shall be submitted as part of the documentation package. The structured cabling contractor must furnish this information in electronic form (CD-ROM).

D. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

3.16 AS-BUILT DRAWINGS:

A. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The Owner will provide floor plans in paper and electronic (DWG, AutoCAD rel. 2002) formats on which as-built construction information can be added. These documents will be modified accordingly by the structured cabling contractor to denote as-built information as defined above and returned to the Owner.

B. The Contractors shall annotate the base drawings and return a hard copy (same plot size as originals) and electronic (AutoCAD DWG) form.

3.17 WARRANTY:

A. The manufacturer shall provide a 25 year extended product warranty with a 25 year applications assurance warranty. Manufacturer shall provide the warranty directly to the end user.

B. An Extended Product Warranty shall be provided which warrants functionality of all components used in the system for 25 years from the date of registration. The Extended Product Warranty shall warrant the installed horizontal copper and the backbone optical fiber portions of the cabling system.

C. The Application Assurance Warranty shall cover the failure of the wiring system to support current or future applications that are designed for the link/channel specifications of ANSI/TIA/EIA–568-B.1. These applications include, but are not limited to, 10BASE-T, 100BASE-T, 1000BASE-T, and 155 Mb/s ATM.

D. The contractor shall provide a warranty on the physical installation.

3.18 FINAL ACCEPTANCE & SYSTEM CERTIFICATION:

A. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation, and successful performance of the cabling system for a two week period will constitute acceptance of the system. Upon successful completion of the installation and subsequent inspection, the end user shall be provided with a numbered certificate, from the manufacturer, registering the installation.

END OF SECTION 27 10 00

SECTION 27 41 00

TELEVISION DISTRIBUTION SYSTEM

PART 1 - GENERAL

A. The contractor shall provide and install a complete television distribution system as specified herein and as shown on the plans together with all accessories required to provide a complete operating system.

B. Equipment manufacturer name and model numbers specified are provided to establish quality of equipment and system operational features. Any proposed substitution of equipment from that specified must be approved by the Architect within ten (10) days prior to bid date.

C. The entire system shall be guaranteed for a period of one (1) year from the date of final acceptance of the installation and the Contractor shall repair or replace defective equipment, during this period, at no cost to the owner.

D. The system shall be designed to receive and distribute channels to all TV locations.

PART 2 - PRODUCTS

A. The line splitters shall be 2-way and 4-way as required and shall be Blonder Tongue SCVS series.

B. The directional couplers shall be Blonder Tongue SRT series as required.

C. The television distribution amplifier shall be Blonder Tongue BIDA550-50 and shall receive its input from Cable TV Company and other locations shown on the plans.

D. The receiver outlet shall consist of suitable connector mounted to wall plate. The receiver outlet shall be installed at all locations shown on the drawings.

E. All distribution cable shall be low-loss coaxial type, plenum-rated RG-6U (as manufactured by West Penn or Belden). See Specification Section 27 05 00 for additional requirements.

F. All head-end equipment shall be rack-mounted.

G. Provide filters, amplifiers, and any miscellaneous items required to rebroadcast the signal at the proper level for each channel.

H. All copper circuits routed between or outside of buildings shall be provided with a surge protection device at each end. The surge protection device shall be labeled as meeting the requirements of UL 96A (exact requirements shall be coordinated with the lightning protection system supplier, where applicable).

PART 3 - EXECUTION

A. Wiring shall be in strict accordance with the National Electrical Code and all state and local

regulations. Wiring shall be installed in accordance with manufacturer's wiring diagrams and shall test free from ground, opens and short circuits.

B. All connections shall be made under the direct supervision of a qualified technician.

C. All cables shall be terminated.

D. Wiring for the Television Distribution System is based on one manufacturer's recommendation. This contract requires that the installed wire be in accordance with the accepted manufacturer's recommendations.

E. Refer to Specification Section 27 05 00 for additional installation requirements.

F. Upon completion of job, the entire system shall be tested and a certificate shall be forwarded to the Architect be technician stating that he has personally verified the the following:
1. System is in accordance with specifications.
2. System is in correct operating condition.

END OF SECTION 27 41 00

SECTION 28 0723

SECURITY MANAGEMENT SYSTEM

PART 1 – GENERAL

1.1 CONDITIONS AND REQUIREMENTS

A. The General Conditions, Supplementary Conditions, and Division 01 P General Requirements apply.

1.2 SECTION INCLUDES

A. General description, functional requirements, operational characteristics, and criteria for the Security Management System (SMS).

1.3 RELATED SECTIONS

A. Division 26 - Electrical.

B. Division 8 - Door Hardware.

1.4 DEFINITIONS

A. API: Application Programming Interface.

B. LDAP: Lightweight Directory Access Protocol.

C. NTSC: National Television Standards Committee.

D. PAL: Phase Alternating Line. PAL is the color video standard used in Europe and many other countries.

E. SMS: Security Management System.

1.5 REFERENCE STANDARDS

A. Where more than one (1) reference standard, code, or regulation applies, the more stringent one shall govern.

B. Electronic Industries Alliance (EIA):
1. EIA RS-170 - Standard for Composite Video Signals.

C. Federal Communications Commission (FCC).
1. FCC Part 15 - Unlicensed RF Devices.
2. FCC Part 68 - Requirements for Connecting to the U.S. Phone Network.

D. Institute of Electrical and Electronics Engineers, Inc. (IEEE).

E. International Organization for Standardization (ISO).

F. International Radio Consultive Committee (CCIR).

G. Microsoft® Open Database Connectivity (ODBC) Interface.

H. National Fire Protection Association (NFPA):
1. NFPA 70 - National Electrical Code.

I. National Institute of Standards and Technology (NIST):
1. Federal Information Processing Standards Publication (FIP PUBS 197) - Specification for the Advanced Encryption Standard (AES).

J. National Television Standards Committee (NTSC):
1. Color Camera Broadcast Standard.

K. Underwriters Laboratories Inc. (UL):
1. UL 294 - Standard for Access Control System Units.
2. UL 1076 - Standard for Proprietary Burglar Alarm Units and Systems.

1.6 ACCESS CONTROL SYSTEM SHALL BE ONE OF THE FOLLOWING SYSTEMS

A. Honeywell Corporate ProWatch System vs 3.8.

B. Lenel OnGuard vs 6.4

C. Software House c Cure 9000 Enterprise

1.7 SECURITY MANAGEMENT SYSTEM (SMS) DESCRIPTION

A. The Security Management System (SMS) outlined in this section and detailed in Part 2 of this section is the key central component for managing physical security and the bridge between physical and logical security for a project. The system shall provide a variety of integral functions including: regulation of access and egress; provision of identification credentials; monitor, track and interface alarms.

B. The SMS shall utilize a single seamlessly integrated relational database for all functions utilizing a fully multi-tasking multi-threading Microsoft Windows 7 or 2008 or Vista or XP or 2003 Operating System. The SMS shall be written so that all system modules (access control, alarm monitoring, ID or credential management, visitor management, asset management and digital video management) are developed and built from a unified single 32-bit source code set. Separate source code bases for individual modules of the SMS are not acceptable.

C. Upgrades or expansion of the SMS to a larger size system in scale shall not require installation of a different and/or new SMS application or require the administrator or operator to learn a different and or new interface from the previous version.

D. The SMS shall be written using Unicode format. Unicode enables a single software product to be targeted across multiple platforms and languages without re-engineering and allows for data to be transported through different systems without corruption. Language Accessory Add-ons shall require a special language-specific license bit in order for the Language Pack to be used. E. The SMS software developer shall be a Microsoft Gold Certified Partner.

F. The SMS shall be Microsoft Windows XP Certified.

G. The SMS shall be compatible with Microsoft Windows 7, and shall have passed Microsoft-designed tests for compatibility and reliability on Windows 7.

H. The SMS shall be UL 1076 Listed (pending).

I. The SMS shall have FIPS 140-2 certification (pending).

J. The SMS shall only require a single license key to be present on the database server for the SMS to operate. The license key shall either be a physical device or a software license key. The SMS shall allow the SMS USER the ability to activate, return, or repair the software license key. The software license shall only be used on a physical computer or in a VMware virtual environment. License keys shall not be required at the client workstations. The license key on the database server shall determine the number of client workstations that shall be able to connect to the SMS as well as all SMS functionality. An alarm shall be generated in the SMS's Alarm Monitoring application as the license expiration date approaches.

K. The License Administration login and password shall be encrypted when they are passed to the License Server. The hash shall not be the same data even with the same logon credentials on different systems. This is a requirement for U.S. government DIACAP certification.

L. The SMS shall support concurrent licensing with respect to client licenses. CUSTOMER shall purchase a fixed number of client workstation licenses (or connections) that shall be programmed into the database server license file. The SMS shall be installed on any number of client workstations in the CUSTOMER facility. Then, any of the client workstations that have the SMS software installed shall have the ability to connect to the database server as long as the maximum number of concurrent connections purchased has not been reached. Connections shall be licensed on a per module basis. This shall provide CUSTOMER with great flexibility in system design and layout.

M. The SMS shall provide support for single sign-on capability. Single sign-on shall allow System Administrators/System Operators to authenticate into SMS applications using their Windows domain account.

N. Single sign-on shall support the following scenarios:

1. Allow System Administrators/System Operators to interactively run SMS applications without having to enter a username or password. This shall make administration of the SMS easier since maintenance of separate SMS usernames and passwords is not required.

2. Allow SMS API scripts to authenticate. These scripts shall be run using a Windows account allowing a seamless and secure way to authenticate the account and restricting the script to those actions that the user is permitted to perform.

O. The SMS shall be able to seamlessly interface with and monitor intelligent system controllers, reader interface modules, I/O panels, alarm panels, alarm panel receivers, biometric devices, personal protection devices, intercom systems, fire alarm panels (secondary monitoring only), building management systems and digital video recorders approved for use by the SMS manufacturer.

P. The SMS shall be able to communicate with intelligent system controllers via RS-485, RS-232, TCP/IP or Ethernet, and dialup via modem.

Q. Tasks shall be accessible from any compatible client workstation on the network utilizing one (1) or all of the following:

1. Traditional client-server architecture.
2. N-tier architecture where the SMS supports the expansion of the system architecture and allows for user deployment based upon their system architectural needs. The SMS shall allow for, but not require, the separation of the database, application server, Web server, and client interface. The system shall require that all connections to the database be performed through a trusted link from the client or internet browser interface.
3. Centralized distribution (publishing) of applications using Windows Terminal Server and Citrix® on Windows, UNIX, Linux or Apple Macintosh based systems through any compatible internet browser application and/or by means of a mobile computing platform using a wearable computer, Tablet PC, or PDA device.

R. Utilize an open architecture where all data must reside on a single database and must be accessible in real time to SMS workstation or Web-based client connected to the network. The system shall be configurable to support all of the following databases: Microsoft SQL Server 2008, Microsoft SQL Server 2005, Oracle Server 11g, and Oracle Server 10g. Oracle data may reside on Windows or UNIX platforms.

S. The system architecture shall support Microsoft Windows Clustering, Hot Standby, Fault Tolerant Servers and Fault Tolerant Hot Standby Servers.

T. The SMS shall be able to connect to and interface bi-directionally with external data sources utilizing all of the following methods:

1. ASCII with support for XML formatted text exchange of data activated both manually and automatically.
2. ASCII with support for XML formatted text exchange of data using a direct table interface activated both manually and automatically.
3. Real-time exchange of data via Active Directory or LDAP utilizing an API (Application Programming Interface) written by the SMS manufacturer. The live exchange of data shall expose SMS events and transactions to other data sources in real-time and allow for receipt of data into the SMS where this data may be acted upon and trigger linked events in the SMS in real-time.

U. All exterior cameras will be grouped in such a manner as to allow access by owner and Elmore County Sheriff's Department. All interior cameras will be grouped in such a manner as to allow access by owner only.

1.8 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Reference each product to a location on Drawings.

1. Manufacturer's technical data for all material and equipment at the system and sub system level to be provided as part of the SMS.

2. A system description including analysis and calculations used in sizing equipment required by the SMS. The description shall show how the equipment will operate as a system to meet the performance requirements of the SMS. The following information shall be supplied as a minimum:

a. Server(s) processor(s), disk space and memory size.
b. Description of site equipment and its configuration.
c. Network bandwidth, latency and reliability requirements.
d. Backup or archive system size and configuration.
e. Start up operations.
f. System expansion capability and method of implementation.
g. System power requirements and UPS sizing.
h. Device or component environmental requirements (cooling and or heating parameters).
i. A description of the operating system and application software.

B. Shop Drawings: Submit plans, elevations, sections, details, and attachments to other work.
1. Indicate all system device locations on architectural floor plans. No other system(s) shall be Included on these plans.
2. Include full schematic wiring information on these drawings for all devices. Wiring Information shall include cable type, conductor routings, quantities, and connection details at device.
3. Include a complete SMS one-line, block diagram.
4. Include a statement of the system sequence of operation.

C. Operation and Maintenance Data: For electronic security system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23, include the following:
1. Provide Six (6) sets electronic format manuals including operating instructions, maintenance recommendations and parts list including wiring and connection diagrams modified to reflect as-built conditions.
2. Manuals: Deliver final copies of the manuals within thirty (30) days after completing the installation test. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of the Contractor responsible for the installation and maintenance of the system and the factory representatives for each item of equipment for each system. The manuals shall have a table of contents and labeled sections. The final copies delivered after completion of the installation test shall include all modifications made during installation, checkout, and acceptance testing. The manuals shall consist of the following:

a. Functional Design Manual: Identify the operational requirements for the system and explain the theory of operation, design philosophy, and specific functions. Include a description of hardware and software functions, interfaces, and requirements.
b. Hardware Manual: Describe equipment furnished including:
    1) General description and specifications.
    2) Installation and check out procedures.
    3) Equipment layout and electrical schematics to the component level.
    4) System layout drawings and schematics.

5) Alignment and calibration procedures.
6) Manufacturer's repair parts list indicating sources of supply.

c. Software Manuals: Describe the functions of software and include all other information necessary to enable proper loading, testing, and operation. The manual shall include:
1) Definition of terms and functions.
2) System use and application software.
3) Initialization, startup, and exit.
4) Reports generation.
5) Details on forms customization and field parameters.

3. As-Built Drawings: During system installation, the Contractor shall maintain a separate hard copy set of drawings, elementary diagrams, and wiring diagrams of the SMS to be used for record drawings. This set shall be accurately kept up to date by the Contractor with all changes and additions to the SMS. Copies of the final as-built drawings shall be provided to the end user in DXF format.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. SMS manufacturer shall be an established organization with referenced and documented experience delivering and maintaining SMS of equal or higher sophistication and complexity as compared to the system detailed in this specification.
2. SMS manufacturer shall employ at a minimum the following methods for quality assurance of component and assembly devices.
a. Perform visual inspection of devices to verify assembly according to defined procedures. Perform end of line operational tests to ensure product functionality has been correctly configured.
3. Perform individual functionality and system level regression testing to ensure compliance with product specifications. Perform single and multiple unit system tests to mimic end-user installation configurations. Utilize automated hardware and software testing to evaluate system performance under published operational loads and compare to published system capabilities.

B. Bidder Qualifications:

1. At the time of the bid, the bidder shall have satisfactorily completed projects of a similar size, scope and complexity as the system detailed in this specification. The bidder shall furnish written proof of experience from three (3) references and proof of current accreditation or certification by the manufacturer for required training for sales or installation or service of the SMS and associated devices.
2. Bidder shall be a Microsoft Certified Partner
3. The bidder shall also be a factory authorized local service organization that shall carry a complete stock of parts and provide maintenance for the SMS and related systems under this contract. Local shall be defined as an area in a 75 mile radius of installed location.

1.10 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging.

B. Store components and equipment in temperature and humidity controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50 and 85 degrees Fahrenheit (10 and 29.4 degrees Celsius), and not more than 80 percent relative humidity, non-condensing.

C. Open each package; verify contents against packing list; and file copy of packing list, complete package identification, for inclusion in operation and maintenance data.

D. Mark packing list with the same designations assigned to materials, components, and equipment for recording in the system labeling schedules that are generated by software.

E. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

1.11 PROJECT CONDITIONS

A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
   1. Equipment and Components: Rated for continuous operation in ambient conditions of 60 to 85 degrees Fahrenheit (15.5 and 29.4 degrees Celsius) and a relative humidity of 20 to 80 percent, non-condensing.
   2. Indoor, Controlled Environment: NEMA 250, Type 1 enclosure. System components, except the central-station control unit, installed in [air-conditioned] [temperature- controlled] indoor environments shall be rated for continuous operation in ambient conditions dry bulb and 20 to 90 percent relative humidity, non-condensing.
   3. Indoor, Uncontrolled Environment: NEMA 250, [Type 3R] [Type 4] [Type 12] [Type 12K] enclosures. System components installed in [non-air-conditioned] [non-temperature-controlled] indoor environments shall be rated for continuous operation in ambient conditions dry bulb and 20 to 90 percent relative humidity, non-condensing.

1.12 WARRANTY

A. Guarantee equipment and labor and provide maintenance and services as follows: WARRANTY REQUIREMENTS FOR ALL SYSTEM COMPONENTS (LABOR and MATERIAL): 5 year (60 month) warranty on parts and labor for the access control system shall be included with bid.

B. This 60-month warranty shall include the following elements:

   1. 8-5, M-F Service, Service Provider must be same as bidder.
   2. Web Portal for creating service tickets and tracking service requests.
   3. Priority queue for service requests.

4. Electrical Surge Protection coverage.
5. Guaranteed Emergency Response - four (4) hours.
6. Guaranteed Non-Emergency Response - six (6) business hours.
7. Remote System Help Desk Support for Technical Support - 1 time per quarter.
8. Software License Technical support agreements and Installation of annual software updates 1 per year for 5 years.
9. On-Site System Review and Audit of System Functionality - 1 time per year.
10. Component Integrity Inspections - 2 times per year.
11. Replacement of Disposable Parts as needed (batteries, bulbs, connectors, etc.).
12. Training for office personnel on system functionality - 2 times per year.

1.13 SMS STARTUP AND COMMISSIONING

A. Entire security management system shall be commissioned by the manufacturer or manufacturer's representative.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: The security management system is based on products of Lenel Systems International, Inc., 1212 Pittsford-Victor Road, Pittsford, NY 14534; telephone: 585-248-9720, fax: 585-248-9185; Web site: www.lenel.com.

B. Honeywell Integrated Security, 135 West Forest Hill Avenue, Oak Creek, WI 53154; Phone: 414-766-1700, Fax: 414-766-1798; Web site: www.HoneywellIntegrated.com.

C. Software House, 6600 Congress Avenue, Boca Raton, FL 33487; Phone: 800 507 6268; Web site: www.swhouse.com.

2.2 ACCESS CONTROL CREDENTIAL READERS

A. Proximity Card Readers P Single-Gang Box Mounting (Thinline II)

1. Provide surface mounting style 125 KHz proximity card readers suitable for wall or US 2-S single-gang box mounting, and for mounting configurations as shown on the project plans.
2. The reader shall be capable of reading access control data in standard Wiegand formats up to 84 bits in length from any HID Proximity card or equivalent, outputting the data in one of the following configurations:
   a. The card reader shall output credential data in compliance with the SIA AC-01 Wiegand standard, compatible with all standard access control systems.
   b. The card reader shall output credential data using a Clock and Data interface, and be compatible with systems requiring a magnetic stripe reader.
3. The reader shall be capable of outputting a periodic reader supervision message at a configurable time interval, enabling the host system to signal an alarm condition based on the absence of this message.
4. The Proximity card reader shall provide the ability to change operational features in the field through the use of a factory-programmed command card. Command card operational programming options shall include:
   a. Reader beeps and flashes green on a card read, LED normally red, single line control of LED.

b. Reader flashes green on a card read, LED normally red, single line control of LED.
c. Reader beeps on a card read, LED normally red, single line control of LED.
d. Beeper and LED are controlled by host only, LED normally red, single line control of LED.
e. Reader beeps and flashes green on a card read, LED normally off, red and green LED's controlled individually.
f. Reader flashes green on a card read, LED normally off, red and green LED's controlled individually.
g. Reader beeps on a card read, LED normally off, red and green LED's controlled individually.
h. Beeper and LED are controlled by host only, LED normally off, red and green LED controlled individually
i. Change from Wiegand to Mag Stripe output format
j. Change from Mag Stripe to Wiegand output format
k. Reset to Factory Defaults

5. Proximity card readers shall provide the following programmable audio/visual indication:
a. A piezoelectric sounder shall provide an audible tone upon successful power up/self test, good card read, or whenever the beeper control line is asserted by the host.
b. A bi-color, red/green LED shall light upon successful power up/self test, good card read, or whenever the LED control line(s) are asserted by the host.
c. The reader shall have individual control lines for the sounder, and for red and green LED indication. When the LED control lines are asserted simultaneously, an amber LED indication will occur.
6. The reader shall have a configurable hold input, which when asserted shall either buffer a single card read or disable the reader, until the line is released. This input may be used for special applications or with loop detectors.
8. The reader shall require that a card, once read, must be removed from the RF field for one second before it will be read again, to prevent multiple reads from a single card presentation and anti-passback errors.
9. Typical proximity card read range shall be:
a. 5.5” (14cm) using HID Proxcard II card.
b. 2” (5.1 cm) using HID ProxKey II key fob
c. 3” (7.6 cm) using HID Microprox Tag
d. 1.5” (3.8 cm) using HID Prox/Wiegand Card
10. Proximity card readers shall meet the following physical specifications:
a. Dimensions: 4.70 x 3.0 x 0.68” (11.9 x 7.6 x 1.7 cm)
b. Weight: 3.3.oz (94 g)
c. Material: UL94 Polycarbonate
d. Two-part design with separate reader body and cover.
e. Color: Black, Gray, White or Beige as approved by the project architect.
11. Proximity card readers shall meet the following electrical specifications:
a. Operating voltage: 5P 16 VDC, reverse voltage protected. Linear power supply recommended.
b. Current requirements: (average/peak) 20/115mA @ 12 VDC 13. Proximity card readers shall meet the following certifications:

a. UL 294
b. Canada/UL 294
c. FCC Certification

14. Proximity card readers shall meet the following environmental specifications:
a. Operating temperature: -22 to 150 degrees F (-30 to 65 degrees C)
b. Operating humidity: 0% to 95% relative humidity non-condensing
c. Weatherized design suitable to withstand harsh environments The reader shall be of potted, polycarbonate material, sealed to a NEMA rating of 4X (IP55).

15. Warranty of Proximity card readers shall be lifetime against defects in materials and workmanship.

2.3 PROXIMITY CARDS

A. Furnish 150 proximity cards for owner's use.

2.4 PANIC BUTTONS

A. Panic buttons at clerical stations shall be United Security Products HUB-ES emergency switch mounted to casework.

B. Wall mounted panic buttons shall be a mushroom style push-button located at 48" AFF with plexiglass cover.

2.5 DOOR CONTACT SWITCHES

A. Door contact switches shall be GE Security 1072 recess mounted magnetic contacts. Coordinate exact location with door hardware supplier.

2.6 SERVER AND WORKSTATION REQUIREMENTS

A. Contractor shall furnish Cisco switches (exact model to be approved by DHR) for all Security Management System needs.

B. Database Servers
1. Servers for Windows 2008 or 2003 Access Control and Alarm Monitoring Systems
a. Dell PowerEdge R710
b. Intel® Xeon® E5520, 2.26Ghz, 8M Cache, Turbo, HT, 1066MHz
c. 4GB Memory (2x2GB), 1066MHz Dual Ranked UDIMMs for 1 Processor, Adv ECC
d. 24X IDE CD-RW/DVD ROM Drive
e. 160GB 7.2K RPM SATA 2.5" Hot Plug Hard Drive for Operating System
f. 160GB 7.2K RPM SATA 2.5" Hot Plug Hard Drive for Database
g. RD1000 Backup, Internal SATA Drive Bay for 2.5" Chassis
h. RD1000 Internal Removable Hard Disk for RD1000, 160GB Native / 320GB Comp
i. Four 10/100/1000 Ethernet Network Ports
j. 17 in. Flat LCD Monitor
k. Onboard VGA
l. 1 serial port
m. 6 USB 2.0 ports
n. Speakers

o. USB Keyboard
p. USB Optical Mouse
q. Surge Suppression Strip
r. Microsoft Windows Server 2008 or 2003 Operating System
s. Microsoft SQL Server 2008 or 2005 Relational Database Management System
t. SMS Server Software for Windows 2008 or 2003

2. Servers for Windows 2008 or 2003 PRO Access Control and Alarm Monitoring Systems
a. Dell PowerEdge R710
b. Intel® Xeon® E5520, 2.26Ghz, 8M Cache, Turbo, HT, 1066MHz Max Mem
c. 4GB Memory (2x2GB), 1066MHz Dual Ranked UDIMMs for 1 Processor, Adv ECC
d. 24X IDE CD-RW/DVD ROM Drive
e. 160GB 7.2K RPM SATA 2.5" Hot Plug Hard Drive for Operating System
f. 160GB 7.2K RPM SATA 2.5" Hot Plug Hard Drive for Database
g. RD1000 Backup, Internal SATA Drive Bay for 2.5" Chassis
h. RD1000 Internal Removable Hard Disk for RD1000, 160GB Native/320GB Comp
i. Four 10/100/1000 Ethernet Network Ports
j. Onboard VGA
k. 17 in. Flat LCD Monitor
l. 1 serial port
m. 6 USB 2.0 ports
n. Speakers
o. USB Keyboard
p. USB Optical Mouse
q. Surge Suppression Strip
r. Microsoft Windows Server 2008 or 2003

s. Microsoft SQL Server 2008 or 2005 Relational Database Management System
t. SMS Server Software for Windows 2008 or 2003

3. Servers for Windows 2008 or 2003 Credential Management Systems
a. Dell PowerEdge R710
b. Intel® Xeon® E5520, 2.26Ghz, 8M Cache, Turbo, HT, 1066MHz Max Mem
c. 4GB Memory (2x2GB), 1066MHz Dual Ranked UDIMMs for 1 Processor, Adv ECC
d. 24X IDE CD-RW/DVD ROM Drive
e. 160GB 7.2K RPM SATA 2.5" Hot Plug Hard Drive for Operating System
f. 160GB 7.2K RPM SATA 2.5" Hot Plug Hard Drive for Database
g. RD1000 Backup, Internal SATA Drive Bay for 2.5" Chassis
h. RD1000 Internal Removable Hard Disk for RD1000, 160GB Native/320GB Comp
i. Four 10/100/1000 Ethernet Network Ports
j. Onboard VGA
k. 17 in. Flat LCD Monitor
l. 1 serial port
m. 6 USB 2.0 ports
n. Speakers
o. USB Keyboard

p. USB Optical Mouse
q. Surge Suppression Strip
r. Microsoft Windows Server 2008 or 2003 Operating System
s. Microsoft SQL Server 2008 or 2005 Relational Database Management System
t. SMS Server Software for Windows 2008 or 2003 4. Servers for Windows 2008 or 2003 Integrated Systems
a. Dell PowerEdge R710
b. Intel® Xeon® E5520, 2.26Ghz, 8M Cache, Turbo, HT, 1066MHz Max Mem
c. 4GB Memory (2x2GB), 1066MHz Dual Ranked UDIMMs for 1 Processor, Adv ECC
d. 24X IDE CD-RW/DVD ROM Drive
e. 160GB 7.2K RPM SATA 2.5" Hot Plug Hard Drive for Operating System
f. 160GB 7.2K RPM SATA 2.5" Hot Plug Hard Drive for Database
g. RD1000 Backup, Internal SATA Drive Bay for 2.5" Chassis
h. RD1000 Internal Removable Hard Disk for RD1000, 160GB Native/320GB Comp
i. Four 10/100/1000 Ethernet Network Ports
j. Onboard VGA
k. 17 in. Flat LCD Monitor
l. 1 serial port
m. 6 USB 2.0 ports
n. Speakers
o. USB Keyboard
p. USB Optical Mouse
q. Surge Suppression Strip
r. Microsoft Windows Server 2008 or 2003 Operating System
s. Microsoft SQL Server 2008 or 2005 Relational Database Management System
t. SMS Server Software for Windows 2008 or 2003

B. Client Workstations PC Specifications

1. Client Workstations for Windows 2008 or 2003 SYSTEMS

a. Intel Pentium 4 Dual Core E2180, 2.0GHz, 1M L2 Cache, 800FSB
b. 1GB non-ECC, 667MHz DDR2 1x1GB (1DIMM)
c. 24X CD-RW/DVD Combo Drive
d. 80GB SATA II 3.0Gb/s, 8MB Cache, 7200 RPM hard drive
e. 10/100/1000 Ethernet Network Port
f. 1 serial port
g. 1 parallel port
h. 8 USB 2.0 ports
i. 17 in. Flat LCD Monitor
j. 64 MB Video Card
k. Speakers
l. USB Keyboard
m. USB Optical Mouse
n. Surge Suppression Strip
o. Microsoft Windows XP or Vista
p. Microsoft SQL Server 2008 or 2005 Client License

q. SMS Client Software for Windows XP or Vista
2. System Administration only
a. Dell OptiPlex 780 Small Form Factor
b. Intel® Pentium® Dual Core E5300 with VT (2.60GHz, 2M, 800MHz FSB)
c. 4GB DDR3 Non-ECC SDRAM, 1066MHz, (4 DIMM)
d. 8X Slimline DVD+/-RW
e. 160GB 7,200 RPM 3.5" SATA, 3.0Gb/s Hard Drive with NCQ and 8MB Cache
f. 10/100/1000 Ethernet Network Port
g. 1 serial port
h. 1 parallel port
i. 8 USB 2.0 ports
j. 19 in. Flat LCD Monitor
k. Integrated Video, Intel® GMA 4500
l. Internal Chassis Speakers
m. USB Keyboard
n. USB Optical Mouse
o. Surge Suppression Strip
p. Microsoft Windows 7
q. Microsoft SQL Server 2008 Client License
r. SMS Client Software for Windows 7
3. High Performance Video Viewing
a. Dell T3500 Precision Workstation
b. Intel® Quad Core Xeon® W3520 2.66GHz, 8M L3, 4.8GT/s, Turbo
c. 4GB, 1066MHz, DDR3 SDRAM, NECC (4 DIMMS)
d. 16X DVD+/-RW
e. 250GB SATA 3.0Gb/s with NCQ and 8MB DataBurst Cache
f. 10/100/1000 Ethernet Network Port
g. 1 serial port
h. 8 USB 2.0 ports
i. 19 in. Flat LCD Monitor
j. Dual 256MB NVIDIA® Quadro® NVS 295, 4MON, 4DP w/ 4DP to DVI Adapt k. Internal Chassis Speakers
l. USB Keyboard
m. USB Optical Mouse
n. Surge Suppression Strip
o. Microsoft Windows 7
p. Microsoft SQL Server 2008 Client License
q. SMS Client Software for Windows 7

2.7 COMPONENTS

A. SMS Software Capabilities: Support an unlimited number of card readers, input points, video cameras, intrusion detection points, and relay outputs. The SMS database server shall support an unlimited number of cardholders, visitors, and assets limited only by the available memory on the ISC. The database server shall also support an unlimited number of system events and

System Operator transactions in the history file limited only by available hard disk space. Client Workstations shall be limited only by the limitations of the operating system server software. The SMS functions are catergorizedinto nineteen primary "system modules" which shall include:

1. Access Control
    a. One of the SMS's primary purposes shall be to provide access control. The SMS shall be able to make access granted or denied decisions, define access levels, and set timezones and holidays. An input or output linkage feature shall allow linking of monitor zone points to output control points within Intelligent System Controllers (ISCs). The SMS shall support features such as area control (two man control, hard, soft, and timed anti-passback), database segmentation, and timezone or holiday overrides.
2. Alarm Monitoring
    a. The main Alarm Monitoring window shall provide information about the time and location of the alarm, along with its priority. The main Alarm Monitoring window must be able to sort pending and/or insert new alarms based on any of the following attributes: priority, date or time, alarm description, Intelligent System Controller, Card Reader, Input Control Module, asset name, or cardholder. Date or time sorts must be System Operator selectable to be either ascending or descending and must have the option of displaying the seconds of the minute in which the alarm arrived into the SMS. All columns of information in the main Alarm Monitoring window shall be able to be arranged in any order by the System Operator.
    b. The SMS must allow unique emergency instructions to be specified for each type of alarm. It shall also allow for the automatic sending of alphanumeric pages or e-mail messages upon alarm arrival. A real-time graphical system status tree on the screen shall indicate if card readers, alarm panels, digital video recorders, video cameras, intrusion detection panels, or Intelligent System Controllers are secured, unsecured, in alarm, or offline. Output control operations must be available to lock, unlock or pulse control points as a standard feature. An automatic cardholder call-up feature shall allow the quick search and display of images in the database. A System Operator journal shall be available to log important daily events. A trace function shall be available for System Operators to locate and track activity on specific cardholders, assets, video cameras, or card readers. An image comparison feature must be provided for use in conjunction with a CCTV interface. All alarms and hardware icons MUST have the ability to control the associated hardware via right-mouse clicks.

    c. The SMS must provide the option to be used as a UL 1981 Classified Central Station Automation System. This option must be classified by Underwriters Laboratories for use as a Commercial Burg Central Station Automation System, to allow the monitoring station where it is used to be made compliant with the UL 1981 standard and listed by UL. This classification shall apply to alarm panels monitored through a connected, UL approved Central Station Alarm Receiver.
3. Credential Management

a. The SMS shall include a seamlessly integrated credential management module. The credential management functionality must allow the enrollment of cardholders into the database, capturing of images, biometric data, and signatures, as well as the import or export of employee data. This functionality shall also allow the System Operator to assign and/or modify the access rights of a cardholder.
b. The SMS shall include a seamlessly integrated state-of-the-art, 32-bit, credential creation and production system. This shall allow for the creation of different badge types based on a database field, the linking of that field to a badge type to automate the process of credential production, and the use of security colors, chromakey, and ghosting, to allow officers to quickly identify personnel access authority.
c. The SMS shall have capabilities for biometric verification. Through the enrollment and comparison of hand geometry (the size of an individual's hand and fingers), or fingerprints, the identity of an individual shall be verified.
d. The SMS shall have the ability to crop and rotate an image automatically based on the orientation of the eyes found in the image. This shall include photographs captured from digital cameras, live cameras, scanned images and imported images.

4. Visitor Management
   a. The SMS shall include a visitor management module. The visitor management module shall be an application utilizing technology that allows a CUSTOMER to enroll and track visitors of the organization.
   b. The visitor management module shall allow a CUSTOMER to enroll visitors, sign them in or out, capture a photo, and capture a driver's license or passport. The visitor management module shall allow System Operators to enter and preschedule visits. The visitor management module shall allow System Operators to print visitor badges.
5. Remote Access Level Management
   a. The SMS shall include a seamlessly integrated remote access level management module.The remote access level module shall be a desktop-based application technology that allows CUSTOMER managers to assign and remove access levels to and from cardholders in the existing SMS database. All transactions relating to the adding and/or removal of access levels shall be recorded complete with a time and date stamp and the System Operator who made the change.
6. System Administration
   a. System Administrative tasks such as defining client workstation and System Operator permissions set-up, access groups, timezones, reports, maps, etc. shall be provided from any client workstation on the network. Initial setup of the cardholder screen layout shall occur on the database server. The SMS shall support the use of strong passwords.
7. Badge Layout Creation
   a. The SMS shall provide a Badge Layout Creation and Editing Module to allow for the creation of custom badge designs to be created by the CUSTOMER. The SMS shall support credit card, government, and custom credential sizes in

either a landscape or portrait format and shall support double sided and edge-toedge printing.

8. Screen or Forms Creation
    a. The SMS shall provide a Forms Designing and Editing Module that gives System Administrators the ability to modify any standard field to customize any or all of the cardholder, asset, or visitor forms. The SMS shall also allow System Administrators to add custom fields in addition to any standard fields on a minimum of 32 pages each of information for cardholder, visitor, and visit related data. User-defined fields absolutely shall not be pre-defined, meaning only the labels can change while the properties cannot. System Administrators shall have a minimum of 96 pages of which to design their cardholder, visitor, and visit screens with standard and custom fields.
9. Graphical Map Creation
    a. The SMS shall provide Graphical Map Creation and Editing Software that must allow System Administrators to import customized map backgrounds of their facility and to attach custom icons to those maps.
10. Application Programming Interfaces
    a. The SMS shall provide a set of standard Application Programming Interfaces (API's) and supporting documentation that allows hardware manufacturers and software application developers to integrate their products into the SMS. The Application Programming Interfaces shall allow requests from CUSTOMER to integrate a third- party hardware or software solution based on SMS open architecture and SMS device independence.
11. Data Import
    a. The SMS shall support an import utility that will allow the CUSTOMER or VAR to import cardholder information into the SMS database. This shall allow the CUSTOMER or VAR to pre-populate the SMS database with existing cardholder data and/or add new records to the existing SMS database.
12. Bi-Directional Data Exchange
    a. The SMS shall support a real time, bi-directional data interface to external databases such as Human Resources, Time and Attendance, Food Service Systems. The interface shall allow data to be imported into or exported out of the SMS in real-time or in a batch mode basis. Data used for import shall be retrieved directly from an external database or through an import file. Data provided for export shall be applied directly to an external database or through an export file. Any data shall be imported or exported including image data. The file used for import or created by export shall have the ability to be structured in a wide variety of ways, but shall always be in ASCII text format.
    b. The SMS shall also support a one step download and distribution process of cardholder and security information from the external database to the SMS database, all the way down to the Intelligent System Controller (ISC) database. This shall be a guaranteed process, even if the communication path between the SMS database server and the ISC is broken. If the communication path is broken, the data shall be stored in a temporary queue and shall be automatically downloaded once the communication path is restored.
13. API Development Toolkit

a. The SMS shall allow, through API toolkits, System Administrators to expose specific SMS data and events that are relevant to IT information or other thirdparty systems. Conversely, the SMS shall allow, through these same API toolkits, System Administrators to accept and process information exposed from the IT information or other third-party systems. This shall permit System Administrators to develop scripts and applications that allow events in either the IT domain to cause appropriate actions in the Security domain, and vice versa.

14. Server Redundancy
    a. The SMS shall support a fault tolerant server and redundant database architecture. The SMS shall also allow for a server clustering architecture. The SMS shall allow for normal operations to occur in the event that the Database Server fails. In the event of a server failure, the switch over to a backup server from a primary server shall be automatic and not impede the operation of the SMS.

B. SMS Software Functionality:

1. Timezones:
   a. The SMS shall be capable of creating and storing up to 255 timezones. Each timezone shall have a minimum of six (6) intervals. Each interval shall be assignable to any day of the week.
   b. Each timezone shall be assignable to an alphanumeric name of up to 64 characters. Timezones shall be applied to access levels, card reader modes, alarm inputs, alarm outputs, and alarm masking and logging functions. Timezones shall be allowed to belong to any or all access levels so that the timezone only has to be defined once.
2. Access Levels:
   a. Capable of defining a minimum of 32,000 access levels with a minimum of 128 access levels per cardholder per database segment. Access levels shall consist of a combination of card readers and timezones.
   b. Each access level shall be assignable to an alphanumeric name using up to 64 characters.
   c. Card readers shall have the ability to be assigned to any or all access levels defined in the SMS. Individual card readers shall be capable of having a distinct timezone assigned to it.
   d. Allow an ‘Allow User Commands’ option to be assigned on a per access level basis where keypad readers are in use.
   e. Allow a ‘First Card Unlock’ option to be assigned on a per access level basis.
3. Temporary Access Levels:
   a. Capable of assigning Temporary Access Levels inclusive of the 32,000 assignable Access Levels.
   b. Each Temporary Access Level shall be assignable to an alphanumeric name using up to 64 characters.
   c. Each Temporary Access Level shall be definable with a start and end date.

   d. Temporary Access Levels shall be stored in the ISC and functionality shall be maintained in the event of disconnection with the ISC.
4. Access Groups:
   a. The SMS shall be capable of assigning Access Groups with a maximum of 32 Access Levels per Access Group.
   b. Each Access Group shall be assignable to an alphanumeric name using up to 64 characters.
5. Precision Access Levels:
   a. The SMS shall be capable of assigning Precision Access Levels in addition to the 32,000 Access Levels with the ability to assign unlimited card reader and timezone combinations.
   b. Each Precision Access Level shall be assignable to an alphanumeric name using up to 64 characters.
6. Holidays:
   a. The SMS shall provide a minimum of 255 Holiday assignments using an embedded calendar. Holidays shall be assigned an alphanumeric name using up to 64 characters and shall be grouped into eight (8) types of holidays, and shall be assignable to individual timezones. Access rights, card reader modes, and alarm masking schedules must be able to be altered when the current date is designated a Holiday.
   b. Dates for Daylight Saving Time changes shall be definable and shall take effect automatically.
   c. The SMS shall support Holiday Ranges that allow a single holiday to span across multiple calendar days.
7. First Card Unlock: Feature that when configured retards a pre-determined timezone activated unlock command until a valid credential has been presented and granted access to the portal.
8. Database Segmentation: Support data segmentation whereby each segment shall have its own set of cardholders, field hardware and system parameters (timezones, access levels etc.). This segmentation shall expand the limitations of the SMS parameters (that is, access levels and timezones) to the maximum capacity of each parameter multiplied by the number of segments.
9. Field Hardware Communications:
   a. The SMS shall communicate with the ISCs by the following protocols: 1) RS-232
      2) RS-485
      3) TCP/IP
      4) Dialup via Modem
   b. Communication baud rate shall be system selectable with a range between 1,200 to 115,200 bits per second.
   c. Download communication between the SMS and the ISC shall be fully multi-tasking and shall not interfere with operational functions.
   d. Upon loss of communications between the SMS Server and the ISC an alarm shall be created with a time stamp. Upon re-established communication the SMS and the ISC shall automatically re-synchronize from the point of communication loss without operator intervention.
10. Multi-Drop Panel Support:

a. Support a multi-drop Intelligent System Controller architecture whereby up to eight (8) ISCs shall be multi-dropped on a single RS-485 communications line and whereby all eight panels communicate back to a single serial communications port.
b. The multi-drop panel support shall be used in conjunction with other ISC wiring support such as the star wiring configuration, home-run wire architecture, and advanced distributed network architecture.

11. Intelligent System Controller Remote Dialup Support:
    a. Support Remote Dialup operations to and from the Intelligent System Controller (ISC). The dialup connection shall be either a constant connection or a scheduled connection. If the connection is constant, then every panel shall have its own modem at the host. If the connection is scheduled, then all panels using remote dialup shall have the ability to share the same host modem(s).
    b. The LNL-2220 and LNL-3300 shall have native 10/100 Ethernet.
    c. System Administrators shall have the ability to define the modems available in the pool. For each modem, System Administrators shall be able to define the modem type and the client workstation that it is installed to.
    d. Dialup sessions shall occur under any of the user-defined scenarios:
       1) On Demand Connection: A System Operator shall have the ability to automatically initiate a dial in session to an ISC via the Alarm Monitoring application. 2) Scheduled Connection: System Administrators shall have the ability to configure the SMS so that the ISC dials into the SMS at a pre-determined times through use of timezones.
       3) Critical Alarm Activated: System Administrators shall have the ability to configure the SMS so that the ISC initiates a dialup session with the SMS when a critical alarm is activated in the field.
       4) Buffer Threshold: System Administrators shall have the ability to configure the SMS so that the ISC initiates a dialup session with the SMS when a pre-determined number of events are stored in the ISC memory buffer.
12. SMS to Intelligent System Controller Encryption
    a. Data security for encrypted connections between SMS and Intelligent System Controllers shall be provided by the full implementation of the Federal Information Processing Standard, FIPS-197, utilizing the 128-bit Advanced Encryption Standard (AES), also known as Rijandael, a symmetric encryption algorithm. The 128-bit AES encryption MUST be certified by the National Institute of Standards and Technology (NIST). FIPS-197 supersedes the aging Data Encryption Standard (DES) defined in FIPS-46-3. Implementation of FIPS-197 shall solve the data security requirements for open network connections by providing a means to secure the data over the non-secure network by encryption.
    b. The Intelligent System Controllers shall also support a 32-bit issue code. This shall only be used when implementing a Physical Access Control Systems (PACS) low and medium security profile enhancement.
13. Intelligent System Controller to Reader Interface and I/O Module Encryption
    a. Data security for encrypted connections between Intelligent System Controller and downstream modules (Reader interface and I/O Modules) shall be provided by utilizing the 128-bit Advanced Encryption Standard (AES), also known as Rijandael, a symmetric encryption algorithm.

b. The encryption between the ISC and downstream modules must support use of a diversified session key derived from a shared secret master key algorithm. The shared secret master key must be settable to insure uniqueness, and to authenticate connected modules prior to activating them for the session.

14. Area Control: Provide eight (8) area control features: Global Hard Anti-passback, Global Soft Anti-passback, Timed Anti-passback, Two Person Control, Designated One Person Control, Designated Two Person Control, Tail Gate Control, and Occupancy Limit. Area control shall be a security method of preventing a person from passing their badge to another person for dual entry into a single location utilizing one (1) card.
    a. The following summary criteria shall apply under Global Hard or Soft Anti-passback:
        1) Initially (Time 0) all cardholders are reset to Area 0.
        2) Any cardholder shall enter a controlled area any time after Time 0 by presenting a badge to a SMS entry card reader.
        3) A cardholder shall not exit the controlled area unless he or she has entered the area presenting a badge to the SMS entry card reader.
        4) A cardholder shall not enter the controlled area a second time unless the cardholder has exited that area previously.
        5) A cardholder shall be able to enter through any entry card reader and exit through any exit card reader of a single controlled area.
        6) These options shall include a "forgiveness" Administrator to reset the anti-passback of all cardholders to Time 0 Area 0, either through a manual override or a timezone command.
        7) The SMS shall provide an anti-passback exempt option for privileged or VIP (Very Important Person) cardholders. Cardholders with this option will not have anti-passback rules applied to them.
        8) The SMS shall also have a "forgiveness" feature that will allow the System Administrator to reset the anti-passback of an individual cardholder to Time 0 Area 0.
    b. Timed Anti-passback Feature: Permits the System Administrator to decide how long after a cardholder has swiped their badge that they will have to wait before the same badge will be accepted again at the same card reader. This helps prevent multiple swipes by an individual to allow access to others through turnstile doors.
    c. Two Person Control Feature: Provided to restrict access to certain areas unless there are two (2) cardholders present. This restricts individuals from being alone in restricted or highly secure areas. When an area is configured for Two Person Rule, the following criteria shall prevail:

        1) The card reader shall grant access only if two (2) valid cardholders (with authorized access levels) swipe their badges one after the other. In the event that a second authorized card is not presented within 10 seconds of the first authorized badge, the card reader shall reset and the first card will have to be swiped again. 2) Once two (2) people occupy an area, individual access shall be granted. 3) Individual exit shall be permitted until an area is occupied by only two (2) cardholders at which point the Two Person Rule applies for exit.
    d. Designated One Person Control: The SMS shall allow for a special One Person Mode. This mode shall require that a designated cardholder is present before anyone else is allowed to access a certain area. This restricts individuals from accessing a restricted or highly secure area when not accompanied by the designated cardholder. When an area

is configured for One Person Mode, the following criteria shall prevail: 1) The card reader shall grant access only if the designated cardholder (with authorized access level) swipes their badge.

2) Once the designated cardholder occupies an area, individual access shall be granted normally.
3) Individual exit shall be permitted until an area is occupied by only the designated cardholder, once the specific cardholder leaves, the area will again require the specific cardholder to be present before any other individual is allowed to gain access.

e. Designated Two Person Control: The SMS shall allow for a special Two Person Rule to restrict access to certain areas unless there are two (2) cardholders present and they are 78F<:A4G87 4 FC86<4? R-84@ &8@58ES 7<FG<A6G<BA. -;<F Eestricts individuals from being alone in restricted or highly secure areas as well as restricting the type of personnel allowed in a certain area. When an area is configured for the Designated Two Person Rule, the following criteria shall prevail:

1) The card reader shall grant access only if two valid cardholders (with authorized access levels and special Team Member distinction) swipe their badges one after the other. In the event that a second authorized card is not presented within 10 seconds of the first authorized badge, the card reader shall reset and the first card will have to be swiped again.
2) Once two (2) people occupy an area, individual access shall only be granted to other cardholders who have been designated the Team Member special distinction.
3) A Second designation, “Supervisor” can be assigned to other cardholders. Cardholders with the Supervisor designation shall be announced by means of a contact closure then their card is presented at the entry reader of the restricted area. The occupants of the restricted area may then choose to grant access to the supervisor by closing an external contact connected to the reader interface module, which will in turn energize the door strike output. Closing this contact at any other time shall not open the door.
4) Individual exits shall be permitted until an area is occupied by only two (2) cardholders with special Team Member distinction at which point the Designated Two Person Rule applies for exit.

g. Occupancy Limit Feature: Restricts the number of cardholders that shall be present in an area at any given time. The Occupancy Limit area shall be able to be defined by the System Administrator to limit up to 65,000 cardholders to be in that area at any given time. Once the occupancy limit has been reached, a cardholder must swipe out of the exit card reader before the next cardholder may enter. Each area for which Occupancy Limit is enabled shall be definable with up to 64 entry or exit card readers. Multiple Occupancy Limit Areas shall be definable.

15. Interlock group readers
16. The SMS shall have Interlock support. In the Anti-passback area, there shall be an option to make an area an interlock area. Interlocked areas shall be able to be configured, allowing only one door to be opened at a time within the area. This function shall only be able to be enabled for local anti-passback and shall be unavailable for global anti-passback.
17. The SMS shall support interlocking group readers. As soon as one door's strike is energized or door is open in the group, all other doors will be denied access until a condition is met.

When the SMS USER creates an area with the Interlock set, when one door strike of the area is active or if the door is open, then no door shall be allowed to open and there shall be an alarm.

18. There shall be an alarm for when access is denied due to interlock reader group. There shall be the alarm, "interlock Area Busy," that shall show up when trying to get access from a card. There shall be the alarm, "Exit Request Denied: Interlock Area Busy," that shall show up when pressing the REX button on the panel. There shall be the alarm, "Cannot Open Door: Interlock Area Busy," that shall show up when opening a door from the SMS's Alarm Monitoring application. All alarms shall have a priority of 100 in the SMS's System Administration application.
19. Field Hardware Configuration: All field hardware configuration windows shall be accessed from either the SMS Icon Toolbar or from menu options in the menu bar within the SMS configuration module of the software. When a field hardware device is configured, the device shall appear in the graphical system overview tree and in all appropriate forms.
    a. Configuration of Intelligent System Controllers (ISCs), Input Control Modules (ICMs), Output Control Modules (OCMs), and card readers shall be provided in a Windows format and shall include the following features:
    b. A tab format to logically group information into a series of forms within an icon or menu option. This shall allow for ease of configuration. For example, all forms that relate to the configuration of card readers shall be grouped together in the 'Card reader' icon.
    c. Drop-down lists to define features
    d. Check boxes
    e. Spin buttons
    f. Browse Buttons for ease of locating client workstations
    g. Sortable Lists
    h. Graphical System Overview Tree controls for ease of navigation and use
    i. The SMS shall have the ability for bulk add, modify, and delete privileges for ISCs and card readers to allow for the ease of addition and maintenance of these field hardware devices.
20. The SMS shall provide the ability to search large lists of devices for a string or substring in the device name.
21. Alarm Masking Groups: Support a group alarm masking feature whereas System Administrators shall be able to create groups of alarm inputs that enable them to mask or unmask multiple Input Control Module inputs and card reader inputs simultaneously. The following events shall have the ability to be part of an alarm masking group:
    a. Input Control Module Events
        1) Alarm Input Active
    b. Card Reader Events

1) Auxiliary Input Active
    2) Denied Count Exceeded
    3) Door Contact Tamper
    4) Door Forced Open
    5) Door Held Open
    6) Card Reader Input Tamper

c. Alarm Masking Groups shall be able to be masked as a group or as individual points.

d. Alarm Masking Groups must support the ability to be masked multiple times. Alarm Masking Groups shall be able to be masked and/or unmasked via alarm monitoring commands by guards, via card reader keypad function keys, or via global linkage commands.
e. The SMS shall support "Two Man Control" for masking Alarm Masking Groups.
f. The SMS shall support an Alarm Masking Group status change (Masked to Unmasked or Unmasked to Masked) action to be linked to a function list that is capable of performing many system actions, such as activating a relay output. The SMS shall support a minimum of 64 Alarm Masking Groups per Intelligent System Controller with a minimum of 200 alarm inputs per Alarm Masking Group.

22. Global Input or Output or Event Linkage:
    a. Support a global linkage feature whereby any input or output or event shall be linked to any other input or output or event in the SMS. Input or Output Linkages shall be able to span across Intelligent System Controllers.
    b. System Administrators shall be able to create global I/O function lists, each consisting of a sequence of actions to be performed, such as changing card reader modes, activating outputs, and opening or closing anti-passback areas. Each function list may include up to six (6) actions.
23. Cardholder Use Limits: Support a Cardholder Use Limit feature that shall allow System Administrators to specify the maximum number of times that a cardholder may use their credential at card readers in the SMS.
24. Extended Individual Door Held Open Times: The SMS shall support Extended Individual Door Held Open Times that allows a card reader's door to be held open for an extended period of time beyond the pre-determined standard held open time on a per cardholder basis. The extended held open time shall be user-definable up to 131,070 seconds. Extended held open times shall be set on a card reader by card reader basis.
25. Extended, on Demand, Door Held Open Times:
    a. Support extended, on demand, door held times via a command keypad. The Extended Held Open command configuration shall consist of a command key sequence that shall be from 3 to 6 keys used to enter the number of minutes to extend the door held open time (up to 999 minutes) and a pre alarm time (from 0 to 30 minutes).
    b. Only those cardholders having Command Authority at a given card reader configured for 'Allow User Commands' shall have the ability to execute the Extended Held Open command at that card reader. The Extended Held Open command shall be available after a valid cardholder has received an Access Grant at the card reader. The cardholder shall have a period of fifteen seconds after the Access Grant to enter the extended held open command sequence.

26. Graphical System Overview Tree: Displays a graphical representation of all field hardware (including ISCs, fire panels, intrusion detection devices, personal safety devices, intercom systems, and central station alarm receivers), digital video hardware, access levels, timezones, access groups, holidays, and card formats that have been configured in the SMS. System Administrators shall be able to modify a device that is depicted on the graphical system overview tree or see its properties by double-clicking on the icon and the SMS shall bring them to the appropriate form.

27. Pre-Alarm: The SMS shall support a pre-alarm feature at the card reader. The pre-alarm will sound a tone at the card reader prior to the door held open alarm. The pre-alarm setting shall be configurable for up to a maximum of 131,070 seconds (2,184.5 minutes or 36.4 hours).
28. Alarm or Event Logging:
    a. All alarms and events in the SMS shall by default, always be recorded in the database. The SMS shall give System Administrators the ability to select on a timezone basis, the times that they require the SMS to log specific events to the database.
    b. System Administrators shall have the option for Alarm or Events to be set to log or not to log particular alarms or events on any individual reader and or input.
29. Scheduling Utility:
    a. An integral Scheduling Utility shall be provided. The Scheduling Utility shall allow System Administrators to schedule actions to occur on a one-time or a recurring basis. Recurring schedules shall be configured to begin immediately, last indefinitely, or have optional start and end dates.
    b. The Scheduling Utility shall be available from both the System Administration and Alarm Monitoring applications.
    c. The types of actions that shall be schedulable include but are not limited to:
        1) Action Group
        2) Event Archiving or Purging
        3) Arm or Disarm Area
        4) Start of Guard Tour
        5) Execution of Data Exchange Scripts
        6) Activate, Deactivate, Pulse Device Output and Device Output Groups
        7) Global Anti-Passback Reset
        8) Download Firmware to ISCs and IP Cameras
        9) Download Firmware to Lenel Network Video Recorders (LNVR)
        10) Download Database to ISCs
        11) Execute Function List
        12) Mask or Unmask Inputs, Input Groups, Alarm Mask Groups, Door Forced Open or Held Open
        13) Open Door, Open Door Group
        14) Change Reader Mode
        15) Automatic Reports
        16) Reset Use Limit
        17) Move Bulk Badges from an Area
        18) Deactivate Badges
        19) Logout Visitors
        20) Schedule PTZ Presets
    d. The Scheduling Utility shall maintain a history log in the database for actions that it executes.
30. Multiple Card Formats: Support an unlimited number of card formats. Magnetic stripe and Wiegand card formats shall be supported. Each ISC shall support a minimum of eight (8) access control card formats and if applicable, eight (8) asset formats. As such, each card reader shall also be able to support a minimum of eight (8) access control card formats. If applicable, asset readers shall be able to support a minimum of eight (8) access control card formats and eight (8) asset management card formats. The SMS shall support any magnetic

stripe format that uses card number, facility code, and issue code combinations with a maximum of a nine digit card number and two digit issue code. The SMS shall support any industry standard Wiegand card format.

31. Card Reader Cipher Mode: Support a card reader Cipher Mode that shall allow authorized cardholders to enter their Badge ID by typing it into a card reader keypad, thus emulating the presentation of the credential to the card reader.
32. Denied Access Attempts Counter: Support a denied access attempts count on a per card reader basis. The "Denied Attempts Count" value shall be configurable from 0 to 255. The following access denial types shall cause the current denied count to be incremented: a. Unknown PIN entry at a card reader configures as 'PIN or Card' mode
    b. Invalid cipher entry at a card reader in Cipher Mode
    c. Invalid PIN entered for a given card at a card reader configured 'Card and PIN' mode
    d. Non-matching biometric presented for a given card at a card reader in biometric verify mode.
33. Card Reader Timezone Overrides:
    a. Allow for the pre-defined default card reader settings to be overridden or temporarily changed on a timezone basis. At the beginning of a selected timezone, the selected card reader's operational mode shall be modified from its default mode to any one of the following modes: locked, unlocked, facility code, card only, card or PIN, card and PIN, card and Biometric, card or PIN and biometric, and/or card and PIN and biometric. The aforementioned options shall be available depending on the type of card reader utilized.
    b. Each card reader shall have the ability to have multiple timezone setting overrides assigned to them as required by the System Administrator.
34. Online Context-Sensitive Help: Provide online context-sensitive help files to guide System Administrators and System Operators in the configuration and operation of the SMS. The help menu shall be available from any window in the SMS by pressing the F1 function key or clicking on the Help icon in the toolbar. Help windows shall be context-sensitive so System Administrators can move from form to form without leaving the help window. The SMS shall also come with complete online documentation on the product disc.
35. Monitor Zones:
    a. The SMS shall provide System Administrators the ability to segment their access control SMS field hardware devices into various zones or areas where alarm monitoring client workstations will monitor. These zones shall be assigned an alphanumeric name using up to 128 characters.
    b. The SMS shall allow subset relationship devices (such as card readers or ICMs to Intelligent System Controllers) to be automatically part of the monitoring zone when an ISC is selected AND it shall allow the System Administrator to define which subset devices (card readers, ICMs, etc.) belong to that monitor zone.
    c. Updating of monitor zones shall take place in real time and without requiring operators to re-login.
36. Advanced Field Device Control: The SMS shall allow a System Operator to monitor all alarms in their assigned monitor zone, but only be capable of performing field device control actions on specified devices in the assigned monitor zone. The SMS shall allow System Administrators to set permission control for individual devices within a monitoring zone for command override. The list of permissions for control under the monitor permission groups shall include the following: a. Access modes

b. Open doors
c. Relay and reader outputs
d. Set panel clock
e. Mask alarms and inputs
f. Unmask alarms and inputs
g. Mask alarm mask groups
h. Unmask alarm mask groups

i. Execute function lists
j. Paging
k. E-mail
l. Panel dialup
m. Standalone test mode
n. Download firmware
o. Arm areas
p. Disarm areas
q. Silence area alarms

37. Alarm or Event Routing:
    a. The SMS shall be capable of allowing System Administrators to route alarms and events to various alarm monitoring client workstations on the network. The SMS shall allow any alarm or event to be routed to one or multiple client workstations on the network regardless of where the alarm is generated in the field. Alarms shall be routed to client workstations on a device by device level.
    b. The SMS shall be capable of automatic re-routing of an alarm from workstation X to workstation Y if the alarm is not responded to within a user-definable time period.
    c. The SMS shall implement network synchronization that in the event alarm or event is routed to multiple client workstations, once the first client workstation 'grabs' the alarm, the alarm or event shall be cleared from all other client workstations. As such, alarms that are routed to an alarm monitoring client workstation which does not have a System Operator logged in shall be queued so that all unacknowledged alarms will report to that client workstation once a System Operator has logged into the SMS. Alarms or Events shall be routed based on default settings or timezone control.
38. Text Instructions: Allow for a set of text instructions to be associated with each alarm that arrives into the SMS. The text instruction function shall allow the System Administrator to enter a minimum of 32,000 characters of text for procedures to follow for each alarm that arrives at the alarm monitoring client workstations. Each alarm or event in the SMS shall have its own unique set of text instructions should the System Administrator desire. 39. Alarm Attributes: The System Administrator shall have the ability to configure how the SMS handles the annunciation of alarms on an individual basis. Each alarm and/or event shall have the option(s) to:
    a. Display at one or more alarm monitoring client workstation.
    b. Allow higher priority alarms to be displayed on the alarm monitoring client workstation ahead of lower priority alarms.
    c. Require the field device, which generated the alarm to be restored to its normal state before the alarm is cleared.
    d. Print the alarm to the local event printer.
    e. Have a customized voice message annunciate at the client workstation.

f. Have the alarm breakthrough to the alarm monitoring window should the System Operator be working in another application.
g. Allow System Operators to change the journal entry once the alarm has been acknowledged.
h. Insure that the alarm will not be able to be deleted from the alarm monitoring window upon acknowledgment.
i. Display text and audio instructions outlining the procedures to follow when responding to the alarm.
j. Automatically call-up associated maps.
k. Automatically call up the associated cardholder record.
l. Automatically call up the associated cardholder photo using the video verification function.
m. Require a password to view the alarm.
n. Require a password to acknowledge the alarm.
o. Require acknowledgment to clear.
p. Allow mandatory journal entry upon acknowledgment.
q. Use pre-defined journal entries for alarms.
r. Select the option for journal entry based upon the specific alarm.
s. Automatically send an e-mail message.
t. Automatically send an alphanumeric page.
u. Have the alarm appear on the alarm monitoring window with a flashing colored coded bar across the alarm for high priority alarms.
v. Have the alarm, when acknowledged, display an alternative flashing color coded bar across the alarm than for the original alarm color.
w. Trigger a function list(s) when the alarm is acknowledged. x. Require User Logon for Acknowledgment

40. Alarm-Event Mappings: The SMS attributes in Alarm Attributes shall be assignable on a 'global' basis to all devices that share an alarm description. Thus, the 'door force open' alarm attributes shall apply to any door with a card reader that is forced opened in the SMS. The SMS shall have the capability to assign a unique group of alarm attributes to specific device or alarm combinations to override the global settings for specific case settings. For example, System Administrators may assign a different set of attributes to be applied to a 'door force open' at a bank vault or research facility than they would if the front door was forced open. The SMS must include this type of flexibility. Each device or alarm combination shall have the ability to have its own unique attribute set if the System Administrator desires.
41. System Downloads:

a. The SMS shall provide for the downloading of data to the ISCs. Downloads shall load SMS information (timezones, access levels, alarm configurations, etc.) into the ISCs first, followed by cardholder information and card reader configurations.
b. All ISCs on the SMS shall be capable of either full or selective downloads to individual Intelligent System Controllers and bi-directionally so that alarms will still report to their respective alarm monitoring client workstations as cardholder information is being downloaded.
c. A complete database download of 10,000 cardholder records to all ISCs (regardless of the number of ISCs) must be complete within ten (10) minutes.

d. Information on cardholder status, badge status, timezones or access levels shall download in real time as they are added, modified, or deleted from the SMS.

42. Card Reader Options: Include the following options for each reader on the system:

a. Allow User Commands
b. Rename Auxiliary Inputs
c. Rename Auxiliary Outputs
d. Independently Supervise REX and DPS
e. Configure REX and DPS as Normally Open or Normally Closed
f. Deny if Duress
g. Assume Door Used h. Alarm Masking
i. Activate Outputs
j. Two Card Control
k. Checkpoint
l. Do Not Activate Strike on REX
m. The ability to allow System Administrators to determine on a timezone basis to log or not to log on a card reader by card reader basis:
    1) Access Grants
    2) Access Denied
    3) Card Reader Status Alarms.
n. Allow for user-definable door strike functionality for each card reader in the SMS.
o. Allow for each card readed to be selected as either an ‘in’ reader, ‘out’ reader, or ‘none’ to allow for ease of reporting time and attendance basic ‘time in’ and ‘time out’ data.
p. Enforce Use Limit: This option shall enable Card Use Limits at the card reader limiting the number of times that cardholders may use their credential to gain access at the card reader.
q. Alarm Shunt: The SMS shall have the ability to shunt a door contact of separate intrusion detection systems. When the SMS provides an access granted a dedicated auxiliary output shall first trigger and bypass the door contact of the separate intrusion detection system, and then the door locking mechanism shall unlock. Once the door returns to a secure state the door contact of the separate intrusion detection system shall return to its normal state.
r. Supervise Door: Sets the SMS so that the card reader door contact is wired as a supervised input.
s. Relaxed door forced open detection: The SMS shall provide an option that when selected shall allow for the door to be opened for an additional three (3) seconds time period after the request-to-exit sensor has been returned to the normal state.
t. Allow for one (1) or more access points in a specified area to be armed and disarmed directly from the Command Control Keypad.

43. Input Control Module (ICM) Options: Provide the following options for the Input Control Modules:

a. Alarm Masking: The ability to mask the alarm input on a timezone basis.
b. Local Linkage: The ability to locally link outputs with inputs that are attached to the same ICM or Output Control Module (OCM).
c. Activate Output: The ability to activate an output tied to the ICM or OCM on a timezone basis.
d. Activate Output Always: The ability to activate an output always.

e. Configuration of Debounce Times: The ability to control the amount of time that an input state change must remain consistent in order for it to be considered a real change of state.
f. Configuration of Hold Times: When configuring an Alarm Input, a hold time setting shall be settable from 0-15 seconds.
g. Checkpoint: The ability to configure an input as a designated stop on one or more guard tours.
h. Supervised Input: The ability to specify if a specific alarm contact on the ICM is a supervised or unsupervised contact.

44. Entry or Exit Delay: The ability to set up entry or exit delays for inputs that are attached to any ICM, SRI, or DRI. System Administrators shall have three options for entry or exit delay:

a. Non-Latched Entry: When an input activates, the alarm will not be reported until the Entry delay expires. If the input is still active when the entry delay expires, the alarm will be reported. If the input is not active when the entry delay expires, then the alarm will not report.
b. Latched Entry: When an input activates, the alarm will not be reported until the Entry delay expires. If the input is still active when the entry delay expires AND the alarm has NOT BEEN MASKED, the alarm will be reported. If the input has been masked when the entry delay expires, then the alarm will not report.
c. Exit Delay: When an input activates, the alarm will not be reported (operates as if masked) until the Exit delay expires. If the input is still active when the exit delay expires, the alarm will be reported. If the input is not active when the exit delay expires, the alarm will not be reported.

45. Intelligent System Controller Options: System Administrators shall have the ability to group add, modify, and delete Intelligent System Controllers (ISCs) in the SMS. The SMS shall have a copy command, allowing System Administrators to easily and efficiently add ISCs. The copy command will copy all information configured for an ISC selected and apply those same characteristics to the new ISC being added. System Administrators shall apply those same characteristics to the new ISC being added. System Administrators shall also have the ability mark ISCs as ‘online’ or ‘offline’ depending on whether those panels are online. The SMS shall also prompt the System Administrator if the System Administrator attempts to configure the number of cardholders (and assets, if applicable) that will be downloaded to an ISC to a number greater than that which the ISC’s memory can handle.
46. Strike Follower
47. An output for a reader can be overridden so that it is configured to activate and deactivate timed with a door strike. It can be set for a delay time and/or pulse.
48. There shall be a mode called "Strike Follower". The mode shall be optional and mutually exclusive with alarm shunt and tailgate. Strike Follower shall override the auxiliary 1 output and shall allow the output to follow the strike pulse. It shall be configurable with a delay and a pulse time.
49. The settings shall include:

a. Activation delay
b. Mode: Pulse or Follower
c. Pulse time: When pulse is used, a pulse time can be specified.

50. Alarm Monitoring - Alarms Monitored: When the SMS is configured, the System Administrator shall assign a default monitor zone to be monitored. The monitor zone shall include default alarm types with default timezones of which the alarm type will be monitored. These monitor zones will then be assigned to an alarm monitoring client workstation. The SMS shall allow for the monitoring of a combination of one or more ISCs, ICMs, alarm inputs, alarm outputs, and card readers. If applicable, the SMS shall also allow the monitoring of a combination of digital video recorders, video cameras, fire alarm panels, intrusion detection devices, central station alarm receivers, intercom exchanges, intercom stations, and personal safety panels. System Administrators shall have the option to define monitor zones to include all sub devices of an ISC and/or digital video recorders or to choose which sub devices of an ISC and/or digital video recorder belong to that monitor zone. Alarm monitoring client workstations shall be configured to annunciate any or all of the following types of alarms: access granted alarms, access denied alarms, system alarms, emergency alarms, and/or area control alarms.
51. The SMS shall allow for automatic update of the list of hardware devices as they are added, modified or deleted from the SMS. Newly configured devices and changes to existing devices shall be reflected in the hardware list automatically. The SMS shall indicate a deleted device by changing the icon and text associated with the device. Upon the next login, the SMS shall remove the device from the hardware tree.
52. Alarm Annunciation Configuration: The System Administrator shall have the capability to configure how the SMS handles the annunciation of alarms on an individual alarm or event basis. Each alarm and/or event shall have the option(s) to: a. Display on the alarm monitoring client workstation.
    b. Allow higher priority alarms to be displayed on the alarm monitoring client workstation ahead of lower priority alarms.
    c. Require the field device that generated the alarm to be restored to its normal state before the alarm shall be cleared from the alarm monitoring window.
    d. Print the alarm to the local event printer.
    e. Have a customized voice message annunciate at the client workstation.
    f. Have the alarm breakthrough to the alarm monitoring window should the System Operator be working on another application on the alarm monitoring client workstation.
    g. Allow System Operators to change the journal entry once the alarm has been acknowledged.
    h. Require that the alarm not be deleted from the alarm monitoring window upon acknowledgment.
    i. Display text and audio instructions outlining the procedures to follow when responding to the alarm.
    j. Automatically call-up associated maps upon arrival.
    k. Automatically call up the associated cardholder record with photo when the alarm displays.
    l. Automatically call up the associated cardholder photo in the video verification function when the alarm displays for comparison to a live video image at the card reader.
    m. Automatically call up live video from a digital CCTV camera to view the area in alarm
    n. Allow the System Operator to control digital CCTV camera functions including pan, tilt, zoom, focus, and iris controls.
    o. Require System Operators to enter in a password to view the alarm.
    p. Require System Operators to enter in a password to acknowledge the alarm.

q. Require System Operator acknowledgment to clear.
r. Allow mandatory journal entry upon acknowledgment.
s. Have pre-defined "canned" journal entries for alarms in the SMS.
t. Allow non-essential events to be cleared without requiring System Operator journal entry, while other alarms shall require System Operator journal entry.
u. Automatically send an e-mail message to one or more e-mail recipients.
v. Automatically send an alphanumeric page to one or more pagers.
w. Have the alarm appear on the alarm monitoring window with a flashing colored bar across it for high priority alarms based on its priority. Each priority in the SMS shall have its own unique color assigned to it. A minimum of 255 colors must be available for assignment to a minimum of 255 priority levels.
x. Have the alarm, when acknowledged, display a different flashing colored bar across the alarm than for the original alarm color. Each acknowledged priority in the SMS shall have its own unique color assigned to it. A minimum of 255 colors must be available for assignment to a minimum of 255 priority levels.
y. Insert and display alarms based on sort order. System Operators can sort on alarms based on alarm priority, time, date, alarm description, card reader, alarm input device, ISC, cardholder, and if applicable, asset scan ID, asset name, intercom station, central station alarm receiver, transmitter, or transmitter input. All sorts MUST be able to be accomplished in one mouse click.
z. Allow the System Operator to be able to find the location of the alarm by using a graphical map, the real-time graphical system status tree, or an alarm menu. A map callup feature must be provided that will show the map associated with the alarm. aa. Have a function list(s) assigned to it that will trigger when the alarm is acknowledged.
bb. Require User Logon for Acknowledgment P This feature shall require a user ID and password to be entered when the given alarm is acknowledged. This ID shall be different than the User ID that is currently logged onto the SMS.
cc. Activate an Action Group P This feature shall allow the System Operator to execute an action group, which shall include one or more actions.

53. Alarm Handling: The handling of alarms shall resemble the following steps.

a. The System Operator shall select the alarm or event by any one of the following procedures:
    1) Clicking with the mouse on the system device map icon representing the alarm
    2) Choosing acknowledge from the menu bar
    3) Highlighting the alarm or event in the alarm list by clicking the mouse
    4) Double-clicking on the alarm or event in the alarm list box
b. Any of the above choices shall put the System Operator in the acknowledgment window. The acknowledgment window shall display the time, date, and a user-defined description of the alarm, as well as any emergency procedures. The acknowledgment window shall present the System Operator with the following choices:
    1) Review instructions or procedures to follow for the alarm
    2) Make a journal entry
    3) Acknowledge the alarm
    4) Listen to audio instructions
    5) Print the alarm and instructions to a local printer
    6) Review any previous journal entries for this alarm.

54. Until the alarm is acknowledged, the alarm shall remain in the Main Alarm Monitoring Window and be counted in the alarm status line.
55. System Operators shall have the ability to mark an alarm as 'In Progress', meaning that a System Operator has recognized the alarm and is working on a response. When an alarm is marked as 'In Progress', the SMS shall silence any repeating audio notifications on any Alarm Monitoring Workstation in which the alarm was routed and also remove the alarm sprite notification on any graphical maps that may be displaying the alarm. Other System Operators shall be notified that an alarm has been marked as 'In Progress' by an icon next to the alarm in the Main Alarm Monitoring Window.
56. Control of the associated field hardware device from which the alarm was generated through a right-mouse click operation shall be available. For example, a System Operator can open a door via a card reader alarm. All field hardware device icons on any screen can control the associated field hardware through a right-mouse click operation. A right-mouse click will invoke a menu item with all available control options for that hardware device.
57. System Operators shall have the ability to delete the alarm from the alarm monitoring window without acknowledging the alarm. This feature is useful when guards are monitoring access grants to track where cardholders are moving throughout the facility, but do not necessarily want to acknowledge the alarm.
58. The SMS shall provide a text entry field for the System Operator to enter a journal detailing the cause of specified alarms and the actions taken. The journal shall be mandatory for certain alarms or events per the System AdministratBEUF 7<F6E8G<BA. -;8 journal shall allow System Operators to enter an unlimited amount of notes. Choosing Acknowledge from this window shall clear the alarm indicator and store the alarm information and journal to the database.
59. Other alarms shall be displayed by the SMS while any alarm is being addressed. If another alarm occurs, the alarm pending counter shall increase by one and the new alarm shall enter into the alarm list box prioritized in a sort order as defined by the System Operator. Up to 255 alarm priorities shall be available.
60. The SMS shall allow journals to be retrieved, viewed, and edited on screen to provide the System Operator with the ability to complete unfinished journal entries. Journals shall be saved to the database and to a tape during database backups for a permanent record as required by CUSTOMER regulations.
61. For card reader alarms, the SMS shall allow System Operators to activate, deactivate, or pulse any or all of the card reader outputs configured and associated with the card reader. The System Operators shall also have the ability to mask or unmask each individual card reader door forced open alarms, door held open alarms, and either or both or the auxiliary alarm inputs configured and associated with the card reader.
62. Current Status Indication: The alarm monitoring window shall provide a visual status that displays the current status of all devices in the device tree including child devices downstream from the primary device. Additionally there shall be a numeric display of card readers, ISCs and ICMs that are offline.
63. Pending Alarm Windows: The SMS shall support a Pending Alarm Window in the Alarm Monitoring Workstation. This shall be a separate window from the Main Alarm Monitoring Window that shall be opened at any time to view a list of only pending alarms. The Pending Alarm Window shall be optionally displayed in conjunction with the Main Alarm Monitoring Window. The Pending Alarm Window shall continuously update as new pending alarms are generated and as existing pending alarms are acknowledged or deleted.

Pending alarms shall also display in the Main Alarm Monitoring Window. The Pending Alarm Window shall operate and function in the same manner as the Main Alarm Monitoring Window described throughout this document.

64. Device Group Support: Support device grouping for uniform command and control of groups of devices within the system. Four types of homogeneous device groups shall be supported:
    a. Card Reader Groups
    b. Input Groups
    c. Relay Output Groups
65. Color Coding for Alarm Priorities: Display alarms in the active alarm monitoring window with a flashing colored bar across the alarm based upon priority. Acknowledged alarms may be set with alternate color-coding. A minimum of 255 colors must be available for assignment to a minimum of 255 priority levels.
66. Highlighting of Unacknowledged Alarms: The SMS shall allow for unacknowledged alarms to automatically be displayed in a pop-up window after a user-defined amount of time. The user-defined amount of time shall be set in System Administration.
67. Pre-Defined “Canned” Alarm Acknowledgement Responses: Have the capability for pre-defined alarm acknowledgment responses for alarms in the SMS. An unlimited number of pre-defined responses shall be able to be configured for each alarm in the SMS.
68. Cardholder Record Call-up: From the alarm monitoring window, the System Operator must be able to display a cardholder record with the stored cardholder’s image This feature shall be user configurable to be automatic meaning that the Cardholder Window will automatically appear on the Alarm Monitoring client workstation on cardholder activity and will display the current cardholder’s information with photo. The Cardholder Window will automatically update with updated cardholder information as additional cardholder activity is generated. This feature shall be provided at all alarm monitoring client workstations to assist the System Operator in determining the access rights of an employee who may have forgotten his or her badge or to verify that the individual presenting the card is the correct individual cardholder. Utilizing a database search via the input of the cardholder's name or other key search field, or by selecting a cardholder record call-up from the main monitoring window on a cardholder alarm, the SMS must access the employee's personnel file, containing pertinent information and the employee's image for identification by the System Operator. The System Operator shall not be required to exit alarm monitoring to view this information and this operation must not restrict the operation of monitoring alarms.
69. In the event of an access denied or access granted card reader alarm signal to the alarm monitoring client workstation, this function shall be available as a menu or mouse selection, based on the alarm event. Data input by the System Operator shall not be required. 70. Inactive Badge Alarm: The SMS shall provide an alarm, indicating current badge status, if An attempt to gain access is made with a badge that’s status is set to any other value other than “Active” in the card holder record. Typical inactive badge status values include “Lost” and “Terminated”. Access shall come with this feature disabled, the System Administrator has the ability to enable this functionality.
71. Request to Exit Event: The SMS shall provide an event when a Request to Exit (REX) is used. By default, the SMS shall come with this feature disabled, the System Administrator has the ability to enable this on a reader by reader basis.

72. Cardholder Photo Verification: From the alarm monitoring window, the SMS shall optionally display the stored cardholder photo for each credential presented at the user specified reader(s). This function shall allow an operator to verify that the person using the credential matches the stored photo. The system operator shall be able to select from a list of readers. As the cardholder badges through the selected reader their photo shall appear in the Cardholder Verification window. The system operator shall be able to open multiple Cardholder Verification windows to cover multiple readers at the same time. If the Cardholder Verification window is open when the Alarm Monitoring application is closed then the Cardholder Verification window shall open automatically next time the application is launched.
73. Cardholder, Card Reader, or any Field Hardware Device Trace: From the alarm monitoring window, the System Operator must be able to initiate several traces of cardholders, assets, and/or field hardware devices while monitoring alarms. This information shall be continuously accumulated in the dedicated trace window until the trace is stopped. The trace operations must not interfere with the operation of the alarm monitoring, and be continuous while alarms are monitored. The results of each trace shall be printable on the report printer or displayed on the screen. The traces shall operate independently, such that one trace may stop and start without interfering with another.
74. Trace windows operate independently of each other and the Main Alarm Monitoring Window. Thus, different Alarm Filter sets shall be settable for each alarm window (Main Window and Trace Windows) open in Alarm Monitoring. For example, the Main Alarm Monitoring Window may not monitor Access Grants Events, while one or more of the trace windows are monitoring Access Grants Events.
75. The operator of the SMSUF A?4E@ &onitoring application shall be able to acknowledge alarms from any alarm view window (even if they are no longer present in the Main Alarm Window). The alarm view windows shall include Main Alarm Monitor, Trace Monitors, Pending Alarms, and Video Verification. The SMS shall allow for individual alarm acknowledgement and fast or group acknowledgement.
76. The SMS shall support historical traces. Historical traces shall allow System Operators to specify the date and time range that they would like displayed for the particular device that is being traced. For example, a System Operator may perform a historical trace that shows the last seven days activity at a particular card reader. Events are then added in real-time during and after the database has been searched for historical events. Historical traces shall also have the ability to be run against restored (previously archived) data.
77. The SMS shall allow System Operators to filter alarm types from the history trace window. Alarms that shall be filtered from the trace window are access granted alarms, access denied alarms, system alarms, duress alarms, and area control alarms. If applicable, alarms that shall also be filtered are asset alarms, fire alarms, intercom alarms, central station receiver alarms, video clips, and transmitter alarms.
78. The SMS shall allow for a trace on any ISC, ICM, Alarm Input, Credential, Intrusion Detection Device, Monitor Zone, or card reader to be performed. If applicable, the SMS shall allow for a trace on any asset, intercom, or camera to be performed.
79. Single-Click or Double-Click Device Command Execution: The SMS shall support the ability to execute a device command based on either a single-click or double-click on the field device icon in the System Hardware Status Tree or Graphical Map. For example, double-clicking a card reader icon shall pulse open the door for the configured strike time.

Whether a single-click or double-click is used to activate the command shall be determined on a System Operator basis.

80. 'On the Fly' New Login of System Operators: Allow a System Operator to login over another System Operator who is already logged into the same client workstation. This process shall log the first System Operator off of alarm monitoring and log the new System Operator on, changing any permissions necessary for that System Operator.
81. Auto Exit to Windows 7 or 2008 or 2003 or XP or Vista Login Window: Configurable to automatically exit the Alarm Monitoring application and log the System Operator out of the Windows 7 or 2008 or 2003 or XP or Vista Operating System when a System Operator logs off an alarm monitoring client workstation. The SMS shall then bring the System Operator to the Windows Login Window for the next System Operator to log on.
82. Grant or Deny Popup Window: The SMS shall have the ability to launch a pop-up window when a request for access is made through global input or output activity, such as when an intercom station is linked to a door. Upon activating the intercom, the pop-up window shall be displayed in the Main Alarm Monitoring Window and the System Operator shall then have the ability to issue a grant or a deny for the open door request.
83. Alarm Monitoring P Column Display and Configuration: Allow System Administrators and System Operators to define which columns are displayed in the Main Alarm Monitoring Window and in which order. System Administrators and System Operators shall also be able to determine the column order.
84. Test Mode: Support a Test Mode for Alarm Inputs, Door Forced Open, Access Grants. Tests on Input Device Groups shall be available to verify that all inputs within the group are operational. Upon entering into Test Mode and for the duration of the test, alarms from members of the group shall either be displayed in a separate window or view on test alarm monitoring client workstations or on all Alarm Monitoring client workstations in which the alarms are usually routed. During the test (the duration of the test shall be set by the System Operator), all inputs within the group are manually activated in the field. At the end of the time duration, a report shall be generated flagging any inputs for alarms that were not received. During the Test Mode, all alarm operations carry on as programmed (that is, Global I/O functions, CCTV commands, printer activity, etc.) so that all functions are tested.
85. Manual Control: Provide the System Operator the option to manually control over all output points or input points connected to the SMS. Control points are defined as any door strike, auxiliary card reader output, or any other relay output point of an Output Control Module (OCM).
86. Destination Assurance: Provide the ability to alert the system operator when a cardholder does not reach a required location and present their credential after entering at a designated checkpoint in a designated period of time.
87. Real-Time, Dynamic Graphical Maps:
    a. Support graphical maps that display device or group status, function lists and video cameras dynamically in real-time. The maps may be configured to appear on command or when specified alarms are selected for acknowledgment. Map device icons shall have the ability to dynamically change shape and/or color to reflect the current state of the device. The SMS shall indicate if the field hardware is not operating with the most current version of firmware.
    b. Support all map formats listed below:
        1) Adobe Photoshop (.psd)

2) AutoCAD DXF (.dxf)
3) CALS Raster (.cal)
4) Encapsulated Post Script (.eps)
5) GEM or Ventura (.img)
6) IBM IOCA (.ica)
7) JPEG (.jpg)
8) JIFF (.jif)
9) Kodak Photo-CD (.pcd)
10) Kodak Flashpix (.fpx)
11) LEAD (.cmp)
12) Macintosh PICT (.pct)
13) MacPaint (.mac)
14) Microsoft Paint (.msp)
15) Port Net Graphics (.png)
16) Sun Raster (.ras)
17) Targa (.tga)
18) TIFF (.tif)
19) Windows Metafile (.wmf, .emf)
20) Windows Bitmap (.bmp, .dib)
21) WordPerfect Raster (.wpg)
22) Zsoft PCS or DCX (.pcx, .dcx)

c. Support user-defined icons for field hardware devices. The SMS shall also give System Operators the ability to affect the mode of card readers, open doors, start a trace on a device, mask or unmask alarm inputs, and activate or deactivate or pulse an output from the map icons.
d. The graphical maps shall have the ability to be printed to a local printer.

88. Real-Time Graphical System Status Tree and List Window: The SMS shall support a real-time graphical system status tree or list window that graphically depicts all field hardware devices that are configured in the SMS. The real-time graphical system status tree or list window shall list all ISCs, ICMs, alarm inputs, relay outputs, and card readers. The SMS shall display if the ISCs, alarm input panels, alarm output panels, or RIMs are not currently operating with the most current version of firmware. If applicable, the graphical system status tree or list window shall also list all digital video recorders, video cameras, and intrusion detection devices, zones, and areas. The tree or list window shall show the real time status of all these devices (online vs. offline, alarms activated, masking status, etc.).
89. The graphical system status tree or list window shall include three counters:
    a. Active Counter- a counter of the number of active points in the Monitoring Zone.
    b. Offline Counter - a counter of the number of offline devices in the Monitoring Zone.
    c. Masked Counter - a counter of the number of masked points in the Monitoring Zone.
90. System Operators shall be able to display both list window(s) and graphical system status tree(s). The List Window shall display all hardware devices separately in their own row in the window. The following columns shall exist in the list window: a. Device Name
    b. ISC or ICM or OCM Name c. Current Device Status
91. System Operators shall be able to sort any column in ascending or descending order. System Operators shall also have the ability to choose what types of devices to display in the graphical system status tree or list window. The following choices shall be available: a. Include All Devices

b. Include Specified Devices
   1) Active devices
   2) Offline devices
   3) Masked devices

92. A status bar indicator shall identify the current selections for the list window or graphical system status tree. System Operators shall be able to display multiple graphical system status trees and/or list windows on a single Alarm Monitoring Workstation.
93. The SMS shall give System Operators the ability to acknowledge alarms from the real-time graphical system status tree or list window without going back into the Main Alarm Monitoring Window. The SMS shall also allow System Operators to affect the access mode of card readers, open doors, start a trace on a device, mask or unmask alarm inputs, and activate or deactivate or pulse an output from the tree icons. The system hardware status tree or list window shall have the ability to be printed to a local printer. The SMS shall also allow System Operators to launch a video player to view live video at the video camera selected.
94. Function List icons shall be able to be placed onto the System Status Tree and thus, System Operators shall have the ability to control and activate function lists from the tree.
95. Alarm Masking Group icons shall be able to be placed onto the System Status Tree and thus, System Operators shall have the ability to view the status of the alarm masking groups and control the groups from the System Status Tree.
96. Anti-passback area icons shall be able to be placed onto the System Status Tree and thus, System Operators shall have the ability to control area status (open or closed) from the tree.
97. Automatic Credential Deactivation by Lack of Use: Have an automatic credential deactivation function where a cardholder's credential will automatically deactivate after an extended period of inactivity based upon a predetermined time period. The credential status may be reset by authorized System Operators.
98. Alarm Filtering: Have the capability for filtering out alarm types from the alarm monitoring window. Alarms that may be filtered are access granted alarms, access denied alarms, system alarms, duress alarms, and area control alarms. If applicable, fire alarms, asset alarms, intercom alarms, central station receiver alarms, intrusion detection alarms, video event alarms, and transmitter alarms may also be filtered.
99. Manual Override of Card Readers: Support System Operator overrides of card readers from the alarm monitoring window, graphical maps or the real-time system status tree. Also support the ability to manually set a reader back to default mode.
100. Alarm Masking:
   a. Support the masking of alarms to be controlled on a timezone basis or by manual control.
   b. Support the ability to configure inputs to be "Unable to Mask".
101. Manual Overrides of Alarm Points and Relay Outputs: The SMS shall support System Operator overrides of alarm points and relay outputs configured in the SMS. System Operators shall have the ability to manually mask or unmask an alarm point and/or activate, deactivate, or pulse a relay output from the alarm monitoring window, the graphical maps, or the real-time graphical system status tree.
102. Online Context-Sensitive Help: Provide online context-sensitive help. The help menus shall be available from any window in the SMS by pressing the F1 function key or clicking on the help icon in the toolbar.

103. Sorting Capabilities: Allow System Operators to arrange the way that alarms and/or events in the alarm monitoring window are listed by sorting the alarms and events. Sort criteria shall be based on priority, time or date, ISC, Card Reader, ICM, Input Device, or Cardholder. Additionally alarms and events can be sorted based on asset scan ID, asset name, intercom station, intrusion panel, transmitter, or transmitter input.
104. Alarm aggregation: Alarm aggregation is a mechanism of combining several alarms into a single item (group) based on certain criteria. The SMS's System Administration application shall have an Aggregate option. A user that has permissions to modify alarms shall be able to enable or disable alarms for aggregation. Alarms shall be aggregated in the Main Alarm Monitoring window if the following criteria are met: a. Alarms are of the same type
    b. Alarms are for the same device
    c. The aggregation option is enabled for the alarm type
105. The group of aggregated alarms shall display the number of alarms in the group as a part of the Alarm Description column if the group contains more than one alarm. Additionally, the alarm description shall be displayed using a bold font. All other columns for the group shall display information for the most recent alarm in the group.
106. The SMS's Alarm Monitoring application's operator shall be able to acknowledge or delete a group of aggregated alarms. When acknowledging or deleting a group of aggregated alarms, all alarms in the group shall be acknowledged or deleted. Acknowledge action shall also involve marking in progress. In case of acknowledgment, the progress bar shall be displayed to indicate the progress of the operation.
107. There shall be a Fast or Group Acknowledge command. If the command is applied to one or more groups of aggregated alarms, all alarms from the selected groups shall be acknowledged or marked in progress depending on what option the user selected.
108. Masking of Successful Command Acknowledgements: The SMS shall support the removal of 'success acknowledgements' that are shown in the Main Alarm Monitoring Window after a command has been successfully executed. The SMS shall allow the successful acknowledgements to be removed on a per System Operator basis.
109. Hardware Update Timer: The SMS shall utilize a hardware update timer whereas the System Administrator can set how often system status updates take place. These updates are reflected in the status bar and the real-time graphical system status tree. This frequency shall be defined in one minute increments and shall be changed 'on the fly' by System Operators. Immediate changes in hardware status are reflected immediately in the real-time graphical system status tree.
110. E-mail Interface Option: Support an e-mail interface seamlessly integrated within the SMS Alarm Monitoring application. System Operators shall have the ability to manually or automatically send ASCII text e-mail messages from the Alarm Monitoring application on demand regarding any alarm currently displayed in the Main alarm monitoring window. E-mails shall have to ability to be sent to multiple e-mail accounts if desired. Integrate with Microsoft Exchange Server.
111. Personnel Management and Enrollment:
    a. The SMS shall generate and store personnel records, as well as monitor badge or credential use throughout the facility. These credentials shall be fabricated at any of the SMS enrollment and badging client workstations configured based on data and images that are input and captured at the time of enrollment. Credential images are to be digitized using industry standard JPEG image compression, and printed using a high quality and direct card printing process.

b. Create and Maintain Cardholder Database: A record for each cardholder shall be created in the badging module of the SMS by entering the required data into appropriate data fields. The System Administrator shall be able to define drop-down list box fields for repetitive entered text (for example: Department, Division, Title, Building Number, etc.). Drop-down list boxes shall allow the System Operator a variety of pre-defined choices for data input. The screen design shall be configurable to allow the entry of data in any format desired. The tab order shall be configurable, and the cardholder ID field of up to 18 digits shall be optionally generated by the SMS from either manual System Operator entry, automatic selection of the next available ID, or by use of the cardholder's social security number.
c. Once all fields have been entered, the SMS shall store the applicant's record to the SMS database. These records must be stored in a central database. Updating cardholder data shall be possible at any time by any authorized System Operator. The SMS shall havea field that allows System Administrators to view the last date and time that a cardholder's record has been modified, without running a report. The cardholder form must be user-definable to allow System Administrators to layout the cardholder form.
d. A SMS data import function shall be available to pre-load the SMS with personnel records and industry standard image formats. This import function shall be capable of adding records to the database at any time.
e. The database shall have key fields that are sorted in an index to allow for faster searches. The System Administrator shall be able to designate fields as required and/or unique fields. No record shall be added to the database that does not contain information within the required fields. No record shall be added to the database that contains a duplicate value in a field that was designated as a unique field.
f. Only System Operators with delete privileges (assigned by the System Administrator) shall be able to delete records. Deleting a record shall permanently remove the record from the database (including image files) to free up the disk space for further use.
g. The System Operator shall have the following functions available when enrolling cardholders: choose a badge type, select access levels, enter personal identification numbers (PIN), and/or any other user-defined fields. The SMS shall allow System Administrators the ability to set a default issue code for all first time prints of credentials. The SMS shall also allow System Administrators the ability to auto increment the issue code each time a new Badge is created or to have the System Operator manually enter in a unique issue code each time a new Badge is created. The SMS shall support a minimum of two digits for the cardholder ID issue codes.
h. The SMS shall utilize keyboard or mouse commands that allow System Operators to quickly create a record for any person. The System Administrator shall be able to define drop-down list box fields for the badge type being issued and default values for the other fields based on the badge type.
i. The cardholder form shall also have the option of displaying a cardholder's signature for the record. The cardholder's current Badge information shall also be displayed on the cardholder form complete with Badge ID number, issue code if applicable, activation and deactivation date and time, and the number of times the current badge has been printed.
j. The cardholder form shall also have the ability to display the cardholder's stored images in one of two ways.

1) Photo Display - This option displays the optimum quality photo using the JPEG compressed image stored in the SMS database.
2) No Photo - This option does not show a cardholder photo.

k. The cardholder form shall also display cardholder 'Last Access' information. This field will show the last card reader that the cardholder accessed or attempted to access, complete with a time and date stamp.

112. Modify Existing Field Names of SMS Cardholder Form: The SMS shall provide a method of defining basic user-defined fields. It shall allow System Administrators to rename the standard database fields in the cardholder form of the SMS and move the fields to different locations on the form. Additional functionality shall be available in the advanced Forms Designing and Editing Module.
113. Cardholder Active Badges: A cardholder may possess one or many badges at any one time.
114. If a badge is updated or re-issued, the SMS shall guide the System Operator to first change the existing badge's status to the appropriate classification (de-activate) before a re- issue of the new badge occurs.
115. By utilizing the previously captured image and employee record, the SMS must allow for fast and efficient re-issuance of a badge. As this re-issued badge is printed, the SMS shallupdate its database to remove access rights from the old badge number and activate the new badge number.
116. Each cardholder record shall offer a user-definable activation and expiration date field. The activation date shall be changed by a System Operator to establish a future activation date. A System Operator shall be able to re-activate a card that has been previously de- activated.
117. When issuing a new badge to a cardholder, System Operators shall be able to assign the pre-existing badge deactivation date and time to the badge instead of the default deactivation date and time for new badges. The deactivation date and time may be assigned on a per badge type basis.
118. A badge form will keep a complete history of every badge that was assigned to the cardholder's issue code, badge type, badge status, activation and deactivation dates and times, PIN numbers, embossed numbers, and anti-passback information.
119. Badge status deactivate
120. All active badges can be configured to change to another badge status when the deactivate date has passed. It is possible to configure this system-wide or per badge type. The badge status shall change 24-48 hours after the deactivate date.
121. Multiple Active Badges: The SMS shall support a user configurable Multiple Active Badge feature. This shall allow cardholders in the System to have up to a user-defined pre-determined number of badges active in the SMS at any one time. System Administrators shall have the ability to set the maximum number of active badges allowed in the SMS.
122. Assign Access Levels: At the time a badge is created it shall be possible to have up to 128 access levels assigned to the cardholder's convenience, the System Administrator must be able to define default access levels to be assigned for given badge types. If a System Operator has proper authorization, cardholder access levels shall be modified. When a badge is created with access rights, or modified, that change shall be downloaded to all ISCs immediately upon completion of the change. Record changes for access rights shall affect only the modified record, and shall not require a download of the entire cardholder database.

123. The access changes shall be downloaded to the field hardware as soon as the employee record change is complete. This badge record download shall not effect field hardware operations.
124. When a badge reaches its deactivation date or time the SMS shall automatically deactivate the access rights associated with the badge. All access rights of a badge shall be eliminated after the expiration date. Should the cardholder become authorized for access again, new access rights shall be applicable to the same badge, and re-issue shall not be required. Should an expired cardholder swipe his badge after his card has expired, access shall be denied and an "invalid credential" alarm event shall be generated to the alarm monitoring client workstation.
125. All cardholder information shall be stored for future retrieval or reporting.
126. An access level form shall show System Operators all access levels configured in the SMS and the associated access levels that are assigned to the cardholder's current badge. The SMS shall allow the System Operator to double-click the mouse on any access level to view all of the card reader and timezone combinations that are assigned to that access level.
127. The SMS shall also support access groups, which shall be assigned to cardholders. Access groups will consist of up to thirty two access levels of which shall be viewed by System Operators by clicking on the desired access group.
128. Bulk Assignment or Modification or Deletion of Access Levels: System Administrators or System Operators shall have the option for Bulk Assignment, Modification, and/or Deletion of Access Levels to active badges for a group of cardholders. This feature shall allow System Operators to perform a search of the cardholder database and then apply any additions, modifications, or deletions of access level assignments to all active badges for that group of cardholders.
129. Search Records: The SMS must allow the System Operator to search for records and images using search criteria on any field(s) in the database. The System Operator must be able to enter the search criteria for one or a combination of fields. In addition, partial searches shall be performed. For example, a partial last name search on "Fitz" might return "Fitzpatrick," "Fitzgerald," or "Fitzerbauch." Using a partial name or letter shall return every record in the database that contains that information in its last name field. The SMS shall support basic Boolean logic searches (greater than, greater than or equal to, less than, less than or equal to, equal to). For example, a last name Boolean Search ">B<F" will return to the System Operator all records whose last name begins with the letter C, D, and E. These records shall be viewable sequentially using search keys.
130. The SMS shall allow for the System Administrator the ability to limit the ability of a System Operator to search the database. Thus limiting System Operators, who are using Alarm Monitoring, from searching through records when pulling up the cardholder screen from an event.
131. In a query with no matching records, the SMS must display a message within three (3) seconds indicating that there is no match for the key field information supplied.
132. Bulk Deletion of Cardholder Records: System Administrators shall have the option to perform Bulk Deletion functions for a group of cardholders. This feature shall allow System Administrators to perform a search against the cardholder database and then delete that group of cardholders.
133. Credentials: Support the following credential types and allow for direct Thermal Dye Sublimation printing onto the credential surface.

a. Composite Credentials - 3.375 in. x 2.125 in., UPVC Composite credentials with an ISO standard 30 mil thickness.
b. Proximity credentials: Proximity shall be an access control or identification technology that utilizes radio frequency (RF) circuits in microchip form. The microchips are encoded and transmit the encoded information when activated. The proximity card shall be used with its associated proximity card readers. The SMS shall be provided with the following proximity card design options:
    1) The proximity card shall be a polycarbonate-based card that cannot be run through direct card printers. This card shall offer a clip slot pre-punched.
    2) The proximity card shall be a PVC dual technology card that employs both proximity and magnetic stripe technology. It shall comply with ISO standard for thickness (30 mil). This card shall allow the printing of cardholder record fields including photo directly on the card.
c. Smart Cards P Contact and Contactless:
    1) Contact smart cards shall be utilized for access control or identity verification technology. Through use of an embedded memory chip, protected electronic data shall be stored on the smart card. Standard card configuration shall include cardholder, biometric, and access information. Contact cards shall require insertion into a card reader which interrogates the card via physical contacts. When coupled with a smart card reader, the smart card shall have the processing power to serve as an access control device, for use in network security and physical access control. The SMS must posses the ability to integrate with the ActivIdentity Card Management System. This integration must allow the System Operator the ability to personalize contact smart cards during the badge issuance process. The integration also must allow for communication during such events as badge encoding, activation, deactivation, and deletion.
    2) Support MIFARE® contactless smart card technology. Contactless smart cards shall be utilized for access control and/or identity verification. MIFARE cards, developed by Philips Semiconductors, shall be presented to a card reader for a transaction to take place using wireless transmissions. They shall be passive devices, requiring no built-in power source. Power shall be supplied from energy generated in the coil of the card being places within the radio-wave field of the card reader.
    3) With MIFARE cards, security shall be handled with challenge and response authentication techniques, data ciphering, and message authentication checks. Uniqueness of cards shall be guaranteed through serial numbers that cannot be altered.
    4) Support shall be provided for encoding MIFARE badges with a custom encryption key. This capability will operate in conjunction with readers configured with a matching key, such that these customized credentials will not be recognized by standard MIFARE readers, and standard MIFARE credentials will not be recognized by these customized readers.
    5) The SMS shall support GemEasyLink680 and GemEasyAccess332 or GemProx P2 encoders. Using the GemEasyLink680 and GemEasyAccess332 or GemProx P2 encoders the SMS shall be able to support both 1kByte (8kBit) and 4kByte (32kBit) MIFARE smart cards.

6) The SMS shall support the input of a MIFARE serial number during standalone and inline printing. The SMS shall be able to read the serial number of the MIFARE card during the print process and have it automatically populate the badge ID field.
7) The SMS shall support the creation of genuine, licensed HID format MIFARE badges compatible with standard HID MIFARE readers, without the need to order customized readers from HID.
8) Support shall be provided for the encoding of genuine licensed HID Corporate 1000 format, including full HID Corporate 1000 parity structure, to the HID MIFARE formatted credential.
9) The SMS shall support the creation of vendor-independent Open Encoding Standard (OES) MIFARE badges from completely unprogrammed MIFARE cards. The system shall allow OES badges to be secured with a user-defined MIFARE authentication key for reading, and a different user-defined MIFARE authentication key for writing and modification. The encoding shall be compatible with OEScompliant readers from any manufacturer. In addition to the creation of OES badges, the SMS shall be capable of creating OES re-keying cards that will allow the authentication key of OES compliant MIFARE readers to be reprogrammed without vendor assistance.
10) Support DESfire® contact-less smart card technology. Contactless smart cards shall be utilized for access control and/or identity verification. DESFire cards shall be presented to a card reader for a transaction to take place using wireless transmissions. They shall be passive devices, requiring no built-in power source. Power shall be supplied from energy generated in the coil of the card being places within the radio-wave field of the card reader. With DESFire cards, security shall be handled with challenge and response authentication techniques, data ciphering, and message authentication checks. Uniqueness of cards shall be guaranteed through serial numbers that cannot be altered. The SMS shall support Integrated Engineering SmartID Pro and Phillips Pegoda encoders. Using the encoders the SMS shall be able to support 16k DESFire smart cards.
11) Support HID iCLASS® contactless smart card technology. Contactless smart cards shall be utilized for access control and/or identity verification. iCLASS cards, developed by HID, shall be presented to a card reader for a transaction to take place using wireless transmissions. They shall be passive devices, requiring no-in power source. Power shall be supplied from energy generated in the coil of the card being places within the radio-wave field of the card reader.
12) With iCLASS cards, security shall be handled with challenge and response authentication techniques, data ciphering, and message authentication checks. Uniqueness of cards shall be guaranteed through serial numbers that cannot be altered.
13) Support shall be provided for encoding iCLASS badges with a custom encryption key. This capability will operate in conjunction with readers that have been ordered with a matching key, such that these customized credentials will not be recognized by standard iCLASS readers, and standard iCLASS credentials will not be recognized by these customized readers.
14) Support shall be provided for the encoding of genuine licensed HID Corporate 1000 format, including full HID Corporate 1000 parity structure, to the iCLASS credential.

15) The SMS shall support HID OEM-100 and OEM-150 encoders. Using the HID OEM-100 and OEM 150 encoders the SMS shall be able to support 2k and 16k iCLASS smart cards.
16) US Government Smart Cards: The SMS shall support reading the access control data (FASC-N) from US Government issued Contactless smart cards, including PIV end point dual interface cards, as well as compatible cards such as CAC dual interface cards, so long as the cards conform to the requirements outlined in FIPS-201 and HSPD-12.
17) Support shall be provided for reading the 200 bit BCD FASC-N output of FASC-N readers, and concatenating the Agency Code, System Code, and Credential Code into a full, globally unique 14 character credential number. The concatenated credential number must be the human-readable equivalent of the three fields in a string. Alternative representations are not acceptable.
18) Support shall be provided for reading the 75 bit Wiegand Binary output of GSA approved FASC-N readers, and concatenating the Agency Code, System Code, and Credential Code fields into a full, globally unique 14 character credential number. The concatenated credential number must be the human-readable equivalent of the three fields in a string. Alternative representations are not acceptable.
19) The SMS shall support mapping and importing of the full FASC-N data contained on TWIC (Transportation Worker Identification Credential) and PIV cards. The "Full FASC-N (Hexadecimal)" shall be provided as a field in the FASC-N drop-down in the SMS forms designer tool to map to the full FASC-N data contained on TWIC and PIV cards. TWIC card values shall be mapped to the corresponding cardholder user-defined fields in order to make import possible. A TWIC or PIV import source shall be supported to import the data. If using a TWIC import source, the PIV data shall be imported along with the TWIC Privacy Key and the full FASC-N data. However, if using a PIV import source, only the PIV data shall be imported. A PIN shall be required to import the following PIV data fields: Fingerprints, Facial image, and Printed information. Without a PIN, only these PIV data fields shall be imported: FASC-N, GUID, and Card Expiration Date. The TWIC data shall not require a PIN. It shall be imported into the database for hardware integration use and shall be not visible to the user.

134. Enrollment and Credential Creation - Enrollment:
    a. System Operators shall be able to enroll cardholders on a one by one basis. System Operators will fill in all required fields including name and badge type. The SMS shall Determine a number of attributes based on the cardholder's badge type. These attributes shall be:
        1) Default Deactivation Date or Time - The deactivation date or time shall have the ability be set for a pre-determined number of days, months, or years; or for an exact specified date.
        2) Default Access Levels
        3) Badge Design Layout
        4) Which Printer will Produce the Badge
        5) Information and Encoding Format to be Encoded onto the Magnetic Stripe
135. Based on the badge type selected, additional fields shall be required for data entry above and beyond the standard required fields. For example, a Contractor badge may require the field "Company Representing" to be filled in before the badge can be saved and printed.

a. System Operators shall also enter a Badge ID of up to 18 digits for the cardholder. The cardholder Badge ID shall be determined in one of the following manners:
   1) Manually entered by the System Operator
   2) Automatically generated by the SMS
   3) Use of the Social Security Number as the Badge ID number
   4) Use of EMPID as the Badge ID number

136. Badge ID ranges shall be able to be pre-defined, if desired, by the System Administrator based on Badge Type. For example, the Employee Badge Type may allow Badge IDs to range from 1-49,999 while the Visitor Badge Type Badge IDs range from 50,000-50,999. Multiple Badge ID ranges may be configured for each Badge Type. System Administrators shall have the option of determining how Badge IDs are generated for each Badge Type. For example, the Employee Badge Type shall generate Badge IDs automatically while Visitor Badge IDs must be manually entered into the system at the time of enrollment. Badge ID ranges may be system wide. For example, all Badge IDs(regardless of Badge Type) must fall within a specific range.
137. System Operators shall have the option of utilizing PIN Codes of up to nine digits, embossed numbers, and anti-passback exemptions for each cardholder who is enrolled in the SMS. System Operators shall also assign any temporary access levels for each cardholder that is enrolled.
138. The SMS shall allow for fast and efficient re-assignment of Badge IDs for use for Temporary badges through use of Re-Assignment Wizards. Re-assignment shall be such that the Badge ID shall be stored in the Audit Trail and reported with the cardholder that was assigned to that Badge ID for the specified period of time.
139. Cardholder Image Capture:
    a. Compatible with flash lighting, RGB video cameras, composite input cameras, S-Video input sources, USB sources and digital cameras and allow the capturing of the cardholder image at a minimum resolution of 1024 x 968.
    b. SMS image capture, storage, and hardware compression techniques must be in compliance with the ANSI standard or JPEG (Joint Photographic Experts Group). Cardholder images must be stored as Binary Large Objects (BLOB) within the cardholder record.
    c. Provide the ability to capture a cardholder's image through the use of any industry standard scanner or digital camera that utilizes a TWAIN interface. Images shall be able to be scanned in at up to 16.7 million colors for a true color scanned image. When using a digital camera that supports multiple resolutions, the system shall allow the operator to select the desired resolution.
140. Image Import: Allow for System Operators to have the ability to import a cardholder's image at the time of enrollment. The SMS must support the following image formats:
    a. Bitmaps (.bmp, .dib);
b. JPEG (.jpg);
c. JFIF (.jif);
d. Zsoft PCX or DCX (.pcx, .dcx);
e. Adobe Photoshop (.psd);
f. CALS Raster (.cal);
g. GEM or Ventura IMG (.img);
h. IBM IOCA (.ica);

i. WordPerfect Raster (.wpg);
j. Macintosh PICT (.pct);
k. Portable Network Graphics (.png);
l. TIFF (.tif);
m. Windows Metafile (.wmf, .emf);
n. Targa (.tga);
o. Kodak Photo CD (.pcd);
p. Kodak Flashpix (.fpx);
q. Encapsulated Post Script (.eps).

141. Auto-crop the Enrollment Photograph: The SMS shall allow the image being captured or imported to be automatically cropped based on the location of the eyes in the captured or imported image. The SMS shall also allow the operator to override the auto-crop with a manual crop window.
142. Crop Window Attributes: The SMS shall allow for the image capture crop window to be both movable and sizable. System Administrators shall have the option to give System Operators the ability to size and/or move the crop window. System Administrators shall have the ability to have the SMS maintain the aspect ratio of the image if the captured image is smaller or larger than the pre-defined image object on the badge.
143. Business Card Scanner Enrollment: The SMS shall support an integrated business card scanner for automatic population of specific visitor information fields. The VMS shall support the Corex CardScan business card scanner.
144. Digital Certificate Management: The SMS shall support Digital Certificate Services to enable System Operators to securely obtain digital certificates for smart card cardholders. The SMS shall allow a System Operator to enroll and issue the smart card to each cardholder during enrollment process. This shall allow the issuing of a Smart Card Logon certificate (which provides authentication) or a Smart Card User certificate (which provides authentication plus the capability to secure e-mail) for the purpose of Smart Card Login to PCs. The Digital Certificate shall allow cardholders to log on to a computer with a smart card, instead of needing to type CTRL+ALT+DEL. The SMS shall be able to link a SMS cardholder account to the cardholder's Active Directory network account.
    a. Smart card readers: The SMS shall support any smart card reader(s) that have been tested by the Microsoft Windows Hardware Quality Lab and have obtained the Windows- compatible logo be installed on Windows 2003 or XP computers.
    b. Supported smart cards: The SMS shall support the Gemplus GemSAFE and Schlumberger Cryptoflex smart cards included in the default Windows 2003 installation.
    c. System Configuration or Network Account Allocation: The SMS shall enforce the allowable number of Network accounts per Cardholder
    d. Linking Network Account to Cardholder Accounts: System Administrators shall be able to link an existing Windows Active Directory Account to an SMS cardholder account. Conversely, System Administrators shall be able to unlink an existing Windows Active Directory Account to an SMS cardholder account.
    e. Manage Certificates: Through services such as DataConduIT, IT Administrators shall provide facilities to notify IT of events in the SMS that would potentially lead to certificates being revoked or suspended. Thus, SMS Certificate Services provide facilities to manually perform following actions on issued certificates:

1) View certificates. The System Administrator shall be able to view certificates issued to a particular cardholder by SMS.
2) Revoke Certificates.
3) Renew Certificates.
4) View Certificate Audit Trail. Each Certificate Authority shall maintain an audit trail of certificate requests and the certificates that are issued until they expire. The audit trail shall record all certificate transactions including failed requests and all of the information contained in each issued certificate. It also shall provide the information that is required to revoke a certificate and add it to the revocation list. System Administrators shall query the audit trail to locate and view information about any certificate request or any certificate that has been issued by the SMS.

145. Card Management System Support
    a. The SMS shall support any smart card reader that has been tested by the Microsoft Windows Hardware Quality Lab and has obtained the Windows-compatible logo to be installed on Windows 2003 or XP Computers.
    b. The SMS shall support ActivIdentity Server, and ActivIdentity Client.
    c. The SMS shall support issuing of a credential with the self-issuance and local issuance model. For self-issuance the credential will be issued a temporary pass code that will allow the cardholder to login to the ActivIdentity Self Service Portal to complete the issuance process. For local issuance the credential will be given a permanent pin number to secure the credential. The credential will also be completely personalized with all certificates and applications, based on the configuration of the CMS system.
    d. The SMS shall support verifying the cardholders fingerprint while the card is being issued. This option shall by configurable as a system wide setting.
    e. The SMS shall read the card serial number during issuance, either inline during the printing process or on a stand-alone PCSC compliant reader or encoder that is connected to the workstation
    f. The SMS shall support the issuance of a card that either has a pending request from a third-party IDMS (Identity Management Server) or create a new request. The issuance of a card based on a previous request, shall be configured as a system wide setting.
    g. The SMS shall support the issuance of a new card and a permanent replacement card. During the issuance of a permanent replacement card the certificates will be transferred to the new card, based on the configuration of the CMS system.
146. Badge Design: Support the ability to create and maintain badge designs. Features shall include the ability to support:
    a. Complete Badge design and Layout tools
    b. Chromakey
    c. Image Import
    d. Ghosting
    e. Signature Capture
    f. Bar code
    g. Smart chip support
147. ID Printers: The SMS shall support double-sided full color printing on those printers in which double-sided full color printing is available. The SMS shall also support edge to edge printing on those printers in which edge to edge printing is available. The SMS shall support high-speed printing on those printers in which high speed printing is available. The

SMS shall also support holographic overlays on those printers in which holographic overlay support is available.

148. Print Limits: The SMS shall allow System Administrators to limit the number of times A cardholder's credential can be printed.
149. Batch Printing: The System Operator must be able to print a credential immediately or continue enrolling cardholders with the intention of batch printing at a later time. The SMS Badging client workstation shall have the ability to print a large volume of badges with a single command using a search command. The System Operator must have the option of printing all badges, printing selected badges, or pre-viewing badges without printing.
150. The SMS shall have a 'log errors' feature for batch printing. This means that the SMS shall skip any Badges that cannot print due to missing information. For example, in a 200 card batch print job, there may be three cards that require information that is not available because the System Operator failed to enter the information. When printing, the SMS shall skip those three cards and print the other 197. A report can later be run to determine what information is missing for the remaining 3 cards.
151. In-line Magnetic Stripe Encoding: Utilizing an in-line magnetic stripe encoding device within the printer, the SMS must allow for magnetic stripe encoding of all its permanent credentials. This magnetic stripe shall conform to ABA Track II and ANSI specifications. The SMS shall allow System Administrators to define attributes for card number, facility code and issue code, as well as starting card number.
152. The SMS shall support a multi-track custom encoding feature. System Administrators shall be able to encode user-defined custom expressions on any of the three (3) tracks of the magnetic stripe of a credential.
153. The following information shall be able to be encoded on any of the three tracks of the magnetic stripe:
    a. Access Control Information
        1) Facility Code
        2) Card Number
        3) Issue Code
    b. ASCII Text
    c. Database Fields
    d. ISO or IEC 7812-1 Check Digit
154. The SMS shall support encoding data onto a JIS II magnetic stripe using JIS II-capable Fargo printers, including the Persona C30, Persona M30, DTC400, DTC550, HDP600, and HDP5000.
155. Image Export: Have the ability to export a captured and cropped cardholder image to an industry standard JPEG (.jpg) file format.
156. Real Time User-definable Image Compression: The SMS must support a real time user-definable image compression utility. The image compression utility shall give System Operators the ability to compare image quality versus compressed image size ratios. This process shall be done in real time and must not require System Operators or System Administrators to go to a program or .ini file outside the program to adjust the ratio. The SMS shall give System Administrators the ability to set SMS default compression settings and give System Operators, with proper permissions, the ability to override those settings. The better the image quality, the larger the image size (affecting hard drive space and speed

of records traveling across the network). 157. Bar code Support: Support the following bar codes: a. Code 3 of 9 (3:1)

b. Code 93
c. UPCA
d. EAN 13
e. EAN 8
f. Code 128 A
g. Code 128 B
h. Code 128 C
i. Codabar
j. PostNet (Zip +4 Postal)
k. Code 3 of 9 (2:1)
l. Interleaved 2 of 5 (2:1)
m. PDF-417 (2D)
n. Code 128 Auto
o. UCC-128
p. MSI Plessey
q. Extended Code 3 of 9
r. Extended Code 93

158. System Management Console: The SMS shall provide a utility that provides system information and access to log files that can be used to aid in troubleshooting SMS issues.
159. System User Feedback Tool: The SMS shall provide a tool to allow the SMS USER the ability to provide feedback from a menu item available in multiple SMS applications. The tool shall launch a Web feedback form that allows the SMS USER to send feedback about the SMS to the MANUFACTURER.
160. Device Discovery Utility
161. The SMS shall provide a Device Discovery Utility (UTILITY). The UTILITY shall allow the ability to discover IP cameras, device servers, access controllers, and wireless access points. The UTILITY shall discover devices in the local subnet as well as across the multiple subnets configured on the network.
162. The UTILITY shall allow searching and discovering IP cameras on a network, specifically for the purpose of identifying the IP cameras' IP addresses. The UTILITY shall be able to search and discover cameras produced by at least six (6) different camera manufacturers.
163. The UTILITY shall allow the ability to discover Lantronix® device servers, LNL-2210, LNL-2220, and LNL-3300 access controllers, and Lenel ILS wireless access points.
164. The UTILITY shall support the ability to turn on or off discovery based on device types and manufacturer. The UTILITY shall support displaying the devices grouped by Brand, Discovery Service, Device Status, and Device Type. The UTILITY shall support displaying the devices sorted by Brand, Model, Version, Command Status, IP Address and Port, Hardware Address, Discovery Service, and Device Type.
165. The UTILITY shall support performing functions (depending on the type of device selected) such as Ping Device, Reboot Device, Check for Default Password, Get Version, Launch Device Web Site, Save Credentials, and Change IP Address.
166. Hardware Devices Notes Field
167. The SMS shall allow users to enter text as notes for the following types of devices:

access panels, readers, video recorders, cameras, fire, intercom, personal safety, receivers, intrusion detection, PLC, POS, and SNMP. These notes shall be available from the SMS's Alarm Monitoring application. The Notes field shall be able to hold a maximum of 1999 characters. The Notes field shall not allow more text to be entered than can be saved. The Notes field shall support Unicode characters for SMS Language Packs.

168. System Administration
    a. System Configuration
169. The SMS shall provide system icons and/or menu selections for each function requiring configuration of SMS options or peripherals (client workstations, field hardware, network functions, communications, reports, etc.). Icon tools bars shall be sizable, movable, and removable. Each form must be in a tab format and shall provide point and click mouse functionality HF<A: R<6BAFS BE 7EBC-down menus to insure configuration is simple. As soon as a function is defined, it shall appear in any other configuration form list that requires that function. The SMS shall support sorting capabilities for multi-column lists. To sort on a multi-column list, the System Operator shall only have to click on the column that is to be sorted.
170. These forms shall be available only to the System Administrator to make system additions or changes to existing configurations. All SMS configuration options and forms shall be documented in the System Administrator's Manual to assist in the selection of options. a. Pre-defined Database
171. System Administrators shall have the option to install a pre-defined database onto their system complete with sample records and configurations. This sample database shall have a configuration that matches that of the VAR demo cases so that VARs can test and troubleshoot the SMS if necessary.
    a. System Configuration Setup Wizards
172. The SMS shall support SMS configuration setup wizards to guide System Administrators through the configuration of the access control module of the system. The setup wizards shall guide System Administrators step by step by asking a series of questions that, when answered, will allow the SMS to automatically configure itself. The setup wizards shall allow for multiple devices to be added in a single command to allow for easy and efficient SMS software setup. There shall be at minimum, setup wizards for Intelligent System Controllers and Card Readers. a. Single Sign-on Support
173. The SMS shall provide support for single sign on capability. Single sign-on shall allow System Administrators or System Operators to authenticate into SMS applications using their Windows domain account.
174. Sign sign-on shall support the following scenarios:
    a. Allow System Administrators or System Operators to interactively run SMS applications without having to enter a username or password. This shall make administration of the SMS easier since maintenance of separate SMS usernames and passwords is not required.
    b. Allow SMS API scripts to authenticate. These scripts shall be run using a Windows account allowing a seamless and secure way to authenticate the account and restricting the script to those actions that the user is permitted to perform.
    c. Password Privileges
        1) The SMS shall allow the System Administrator to configure each client workstation with those applications that may be run on that client workstation. Individual System Operator passwords will further restrict System Operator functions and shall

be specific to each System Operator. Specific System Operator restrictions shall include:

a) Access to screens or functions (for example: alarm monitoring, badge issue)

2) Specific tasks allowed (for example: modify data, view only)
3) Alarm Monitoring functions (for example: clear alarms, output control, traces, reports)

175. If a System Operator is denied access to specific functions, those functions shall not appear (or shall be ghosted) on the System Operator's client workstation or menu bar while that password is logged in. Passwords shall not print in any report.
176. System Administrators and Operators shall have the ability to change their password at any time in the SMS by logging into the SMS with their current password and then changing it through menu options. a. Strong Passwords
177. The SMS shall support the use of strong passwords. a. System Operators
178. The SMS shall support an unlimited number of System Operators at any time. Each System Operator shall be assigned a logon ID and password. Each System Operator shall be assigned permission levels for system administration and configuration functions, Credential Management functions, alarm monitoring functions, digital video management functions, asset management functions, visitor management functions, remote access level management functions, and database field viewing options.
179. The SMS shall be able to provide information on the date and time a new System Operator was created. The SMS shall also be able to provide information on the date and time the System Operator information was last modified. There shall also be a notes field when entering a new System Operator where information in regards to the System Operator can be stored.
    a. System Permissions
180. Every major feature, function, and cardholder page in the SMS shall be permission protected. Each System Operator shall be assigned permission or no permission to use or view or access each feature and function in the SMS. Permission groups shall be broken into three categories: System Administration, Credential Management, and Alarm Monitoring.
181. Every page in the Cardholder Form shall be permission protected. Each System Operator shall be assigned view permissions for each page of information in the Cardholder Form. 182. Every database field in the SMS shall be permission protected. Each System Operator shall be assigned view or edit permissions for each personnel database field in the SMS. 183. Ad-hoc Database Report Generator

184. The SMS must provide an ad-hoc customized report generator package integrated with the SMS's database. This program shall allow the System Administrator to create reports using the relational database structure. Among other reports, a tabular type report shall be configurable which will detail any information from the database in a columnar format with headings, breaks, sub-totals and totals. The report must also be able to be created to produce a flat ASCII export file. Access rights shall be provided to allow the System Administrator the privilege of creating, deleting, updating, saving, processing, viewing and printing reports. The reports are to be printed on a dot matrix printer or on a laser printer. Report configuration shall use menu options and drop-down list boxes to define that database fields are to be used, linked, or joined. They

shall also be used to specify conditions and column order, as well as describe the layout and headings. 185. Custom Report Writer

186. The SMS shall support an industry standard, off the shelf, custom report writer, such as Crystal Reports 11, or 11.5. The custom report writer shall support multiple report types including, but not limited to, multiple section reports, form style reports, conditional reports, query reports, and columnar reports. The custom report writer shall have BLOB Bitmap support and shall come standard with a formula editor with more than 160 built in functions for System Operators to manipulate data. It shall have export capabilities to ASCII files, Microsoft Mail, or ODBC file formats. The custom report writer shall be compatible with industry standard SQL databases, such as Microsoft SQL Server 2005 or Microsoft SQL Server 2008.
187. System Tape Backup
188. A mandatory requirement, the SMS shall provide tape backup and restore programs utilizing the multi-tasking capabilities of the SMS and operating system. These programs shall run concurrently with any other application. Database backup must occur dynamically while other alarm monitoring, badging, access control applications remain active.
189. The tape backup feature shall allow for three levels of tape backup; 1) Incremental, which will back up to tape all changes to data and images that have changed since the last incremental tape backup, 2) System, which will back up the operating system and application files only, and 3) Full, which back ups all files.
190. A database snapshot shall occur prior to a tape backup and the actual backup shall be performed in the background, utilizing the benefits of the multi-tasking operating system, without interfering with the ability of System Operators to exercise other functions.
191. Client workstations
192. System Administrators shall have the ability to configure each client workstation on the SMS to utilize any combination of event printers, CCTV controllers, and video capture boards. For each printer or CCTV controller, System Administrators shall be able to select the port that the device is connected to on the client workstation and the communications speed.
193. PIN Numbers
194. The SMS shall have the ability to support up to nine (9) digit PIN Numbers for each cardholder in the SMS. PIN Numbers shall be created either manually through System Operator entry or generated randomly by the SMS. The SMS shall have the ability to be configured to allow for unique PINs for each cardholder and the ability to modify cardholder's PIN numbers at a later date.
195. List Builder
196. System Administrators shall have the ability to pre-define information that will appear in each of the pre-defined drop-down lists. There shall be no limit to the number of items that shall be a part of a list. Lists can have items added to them or deleted from them at any time.
197. Archiving
198. The SMS shall allow System Administrators to archive offline history files to magnetic media. Offline files shall include access events and System Operator transactions that have been purged from the reportable database. The offline files MUST be in a "ready to import" format for easy insertion of information back into the online database. Different event types may remain in the database for different time periods according to the System Operator's specification.

199. Any record older than the specified dates shall be purged to the offline history file for archiving. Reports shall be generated from the archived files if necessary. Archiving shall be a scheduled, automatic function.
200. Remote Dial-In Capabilities
201. The SMS shall support remote dial-in capabilities for SMS troubleshooting, SMS configuration, and alarm monitoring capabilities.
202. VAR and/or System Administrators shall be able to dial in to the CUSTOMER Database server to troubleshoot the CUSTOMER's system. This will allow System Administrators to locate any problem areas and, many times, fix the error over the telephone from a remote location.
203. Remote dial-in shall also be used for SMS configuration and/or alarm monitoring from remote locations using a client workstation. The client workstation shall have the ability to operate on a Laptop PC that meets the client workstation minimum specifications.
204. Reader Groups

a. The SMS shall support reader groups. The SMS's Grouping form shall be used to: 1) Specify the group or groups to which the reader belongs.
    2) Search for readers by group (The search for readers button is available from all of the forms in the Readers folder.)
    3) Name and save lock group search criteria for future use.
b. Six (6) default reader group drop-downs are provided on the SMS's Grouping form.

205. The SMS shall support a multi-PC, multiple database synchronization architecture (herein after Mobile Enterprise Architecture) using a database server. The database server shall allow multiple wearable or mobile computers to be connected to it (via wired or wireless LAN or WAN architecture). In a stand-alone environment, connections shall occur only during synchronization.
206. The database server shall contain a master copy of all relevant system data. An unlimited number of mobile enterprise client workstations may be connected to the database server.
207. In a stand-alone environment the mobile enterprise computing PC shall contain a copy of all required core information obtained from the database server. This shall include, but not be limited to, cardholders, badges, badge types, and access permissions.
208. Screen Designer Tool

a. SMS Cardholder Standard Fields and Objects

209. The SMS shall support at a minimum the following standard fields for personnel information: 1) Last Name
2) First Name
3) Middle Initial
4) Social Security Number
5) Badge Type
6) Address 1
7) Address 2
8) City
9) State
10) Zip Code
11) Phone Number
12) Birth Date

13) Title
14) Department
15) Division
16) Location
17) Building
18) Floor
19) Office Phone Number
20) Extension
21) Signature
22) Last Reader Accessed
23) Record Last Changed
24) Badge ID
25) Issue Code
26) Number of Prints
27) Activation Date
28) Deactivation Date or Time
29) Badge Status
30) PIN Number
31) Embossed Number
32) Date of Last Badge Print
33) Photo

34) Photo Display

b. SMS Asset Standard Fields and Objects

210. SMS shall support at a minimum the following standard fields for asset information:

1) Scan ID
2) Asset Name
3) Acquired
4) Replace
5) Type
6) Subtype
7) Serial Number
8) Department
9) Assessed Value
10) Replacement Value
11) Last Inspection
12) Next Inspection
13) Record Last Changed
14) Photo
15) Photo Display
16) Last Reader Accessed
17) Assignment Button

b. User-definable Fields

211. Should the SMS standard fields not be suitable, System Administrators shall have the ability to modify any standard field to customize the cardholder, asset, and visitor forms as desired. The SMS shall also allow System Administrators to add custom fields in addition

to or replacement of any standard fields on a minimum of thirty two (32) pages each of information for the cardholder, visitor, and visit forms and one page of information for asset. User-defined fields absolutely shall not be pre-defined, meaning only the labels can change while the properties cannot. System Administrators shall have a minimum of sixteen pages of which to design their screens with standard and custom fields.

a. System Administrators shall have the ability to modify the pages of information in any combination as follows:
   1) Move standard database fields to different locations on the cardholder forms
   2) Delete standard database fields that are not desired
   3) Keep standard database fields in the same location as the factory ships them, but changing the label and/or any field attributes. For example, Zip Code may be changed to Postal Code and the attributes changed from a number field to text field for Canadian Installations
   4) Add new fields to the cardholder forms each with their own unique set of attributes b. Field Types

212. The SMS shall support, at a minimum, the following field types:
1) Text Fields
2) Date Fields
3) Numeric Fields 4) Drop-down Lists a. Field Attributes

213. System Administrators shall be able to assign any combination of the following attributes to each field defined:
1) Positioning of the field on the form
2) From which page the field can be viewed
3) From which page the field can be edited
4) The font to be used for the information that will appear in the field. The SMS shall support all standard Windows fonts
5) The style to be used for information that will appear in the field. The SMS shall support bold, italic, both, and regular typeface styles
6) Any effects to be used for the information that will appear in the field. The SMS shall support strikeout and underline
7) Whether the field is required
8) Whether the field is to be indexed
9) Whether the field is unique
10) If a template is to appear in the field
11) If a default value will appear in the field b. Field Styles

214. System Administrators shall be able to assign any combination of the following styles to each field defined: 1) Multi-line field
2) Horizontal Scroll
3) Vertical Scroll
4) Auto Horizontal Scroll
5) Auto Vertical Scroll
6) Enter means next line of text
7) Number
8) Uppercase
9) Lowercase

10) Read Only
11) Align Right
12) Password
13) Sunken
14) Border
15) Inside Edge
16) Raised 17) OEM Covert

b. Field Alignment and Width Tools

215. The SMS shall support the following field alignment tools to allow System Administrators to align fields and set uniform widths to fine tune the look and feel of the screens. The SMS shall allow System Administrators to select multiple objects simultaneously and align them to their desired position and/or set a uniform width. The following field alignment tools shall be able to be used in any combination:

1) Align all objects selected to the far left edge of the farthest left selected object
2) Align all right edges of selected objects to the right edge of the farthest right selected object
3) Align the tops of all selected objects to the top edge of the highest selected object
4) Align the bottom edges of all selected objects to the bottom edge of the lowest selected object
5) Align all selected objects to be vertically centered with respect to each other 6) Center all selected objects
7) Make all selected objects the same width as the smallest object selected
8) Make all selected objects the same width as the widest object selected
9) Make all selected objects the same height as the shortest object selected
10) Make all selected objects the same height as the tallest object selected
11) Evenly space all objects vertically between the two most outer objects
12) Evenly space all objects horizontally between the two most outer objects
13) Bring object to the front of the page 14) Send object to the back of the page a. Tab Ordering

216. The SMS shall allow System Administrators to set the TAB order (the order in which the cursor moves throughout the fields) of the SMS when System Operators utilize the TAB key to move throughout the cardholder form.

217. Map Editor Module

218. The SMS shall support graphical map creation software that shall allow the import of map backgrounds from any standard 'off the shelf' drawing package in the formats listed below:

a. AutoCAD DXF (.dxf)
b. Bitmaps (.bmp, .dib)
c. JPEG (.jpg)
d. JIFF (.jif)
e. Zsoft PCX/DCX (.pcx, .dcx)
f. Adobe Photoshop (.psd)
g. CALS Raster (.cal)
h. GEM/Ventura IMG (.img)
i. IBM IOCA (.ica)
j. WordPerfect Raster (.wpg)

k. Macintosh PICT (.pct)
l. Portable Network Graphics (.png)
m. TIFF (.tif)
n. Windows Metafile (.wmf, .emf)
o. Targa (.tga)
p. Kodak Photo CD (.pcd)
q. Kodak Flashpix (.fpx)
r. Encapsulated Post Script (.eps)

219. These architectural type maps must allow the detailed layout of an entire structure, part of a structure, a floor or department within a building, or layout of the periphery of a facility. Once a map has been drawn, the System Administrator must have the ability to place system level icons of card readers, input and output points, video cameras, and other access control field hardware in the appropriate area to indicate their respective location on the map. This is to be accomplished by simply dragging the icon with the mouse to the appropriate location on the map.
220. The SMS must allow various maps to be associated with each area to provide for the creation of hierarchy of maps. Overview maps of an entire facility shall be able to be viewed as requested and nested maps shall be accessed from the overview map to enlarge a specific area or facility on the screen. Maps shall also support user-defined text that shall be placed onto the map background.
221. The SMS shall allow hardware device icons to be either static or part of a device group. Icons that are part of a device group shall allow the hardware device icon to change shape and/or color based on the current state of the device.
222. Maps shall have the ability to be printed and/or previewed from the Map Editing Module or the Alarm Monitoring application.
223. The SMS shall also support custom device icons to be used with the maps (.ico) files.
224. Import Module: The SMS shall support an import utility, which shall allow the CUSTOMER or VAR to import cardholder information into the SMS database. This shall allow the CUSTOMER or VAR to pre-populate the SMS database with existing cardholder data and/or add NEW records to an existing SMS database. The Import Module only supports SQL Server; it does not support Oracle. For Oracle, DataExchange must be used for data import.
225. The Import Utility shall be a 32-bit Windows application that shall be used to import standard ASCII delimited text files into the SMS. The import utility shall be utilized at the initial SMS setup and anytime a large number of records need to be imported into the SMS after the initial import. For example, a large university may import 10,000 records into the SMS during the initial SMS setup and then import 2,000 additional records each semester thereafter. The SMS shall check for duplicate records during the import, so that multiple copies of the same record are not added into the SMS database.
226. The import utility shall allow System Administrators to choose the delimiter for the ASCII file. This delimiter may be, but is not limited to, a comma, vertical bar, semi-colon, or asterisk. Fields in the SMS database, such as Address 2, that the CUSTOMER does not wish to use, may be left blank in the ASCII file.
227. The import utility shall be able to select the source drive where the ASCII delimited file is located as well as the destination drive where the SMS database is located.

228. The import utility shall also be able to import photos as part of the record into the SMS database. The SMS shall support the following file formats for the import of cardholder photos:

a. Bitmaps (.bmp, .dib)
b. JPEG (.jpg)
c. JIFF (.jif)
d. Zsoft PCX/DCX (.pcx, .dcx)
e. Adobe Photoshop (.psd)
f. CALS Raster (.cal)
g. GEM/Ventura IMG (.img)
h. IBM IOCA (.ica)
i. WordPerfect Raster (.wpg)
j. Macintosh PICT (.pct)
k. Portable Network Graphics (.png)
l. TIFF (.tif)
m. Windows Metafile (.wmf, .emf)
n. Targa (.tga)
o. Kodak Photo CD (.pcd)
p. Kodak Flashpix (.fpx)
q. Encapsulated Post Script (.eps)

229. The SMS shall include a progress meter to show the System Administrator the percentage of the import complete when importing large quantities of records.

230. SMS Server Redundancy

a. The SMS shall support multiple levels of fault tolerance and SMS redundancy listed and described below: 1) Hot Standby Servers
    2) Clustering
    3) Disk Mirroring
    4) RAID Level 10
    5) Distributed Intelligence b. Hot Standby Server Solution

231. The SMS shall support a fault tolerant server and redundant database architecture. It shall allow for normal operations to occur in the event that the Database Server fails. In the event of a server failure, the switch over to a backup server shall be automatic. System Operator intervention for switch over shall not be acceptable.

232. The SMS shall utilize two servers, which shall be configured identically. One server shall be designated as the Primary Server and the other shall be designated as the Backup Server. The Primary Server shall be the main server that is in use when the SMS is operating under normal conditions.

233. The SMS shall mirror the database information from the Primary Server to the Backup Server. This mirroring shall be conducted through standard local area network (LAN) communications. There shall absolutely not be any proprietary communication links between the Primary and Backup Servers.

234. All access control field hardware shall be configured for both the Primary Server and the Backup Server. Both the Primary and Backup Servers shall recognize the same TCP/IP ISC address on the network.

235. If the Backup Server is not running or receiving the mirrored files from the Primary Server, the Primary Server shall save the changes locally. Upon restored communications to the Backup Server, this information shall be automatically sent to the Backup Server.

236. In the event that the Primary Server fails, the Backup Server shall sense that the Primary Server has failed and is no longer on the network. The Backup Server shall check to see if the Primary Server is online every five seconds.
237. Upon sensing Primary Server failure, the Backup Server shall automatically initiate itself as the Primary Server and shall begin communication with the Intelligent Fields Panels. ABSOLUTELY NO SMS OPERATOR INTERVENTION SHALL BE REQUIRED. A message shall be broadcast to all client workstations on the network that the Primary Server has failed and the Backup Server has taken control. This process shall take no longer than two minutes to accomplish.
238. Once the Primary Server comes back online with the SMS, the Primary Server and Backup Server shall be able to be re-synchronized though automatic operation and resume normal operations. The synchronization process shall be fast, efficient, and take no more than five minutes.

a. Clustering

239. The SMS shall support a fault tolerant cluster server architecture. It shall allow for normal operations to occur in the event that the Database Server fails. In the event of a server failure, the switch over to a backup server shall be automatic. System Operator intervention for switch over shall not be acceptable.
240. The SMS shall utilize two servers, which shall be configured identically. One server shall be designated as the Primary Server and the other shall be designated as the Backup Server. The Primary Server shall be the main server that is in use when the SMS is operating under normal conditions.
241. The SMS shall use shared-media technology. This shall incorporate a third piece of hardware (for example: Dell PowerVault), which shall house the hard disk to be referenced by both servers. Since accessible media is dependent upon a third piece of hardware, emphasis shall only be placed upon the health status of the shared-media device. If the status of the shared-media device remains healthy, server up time is of no consequence to data integrity.
242. The shared-media device provides only a single point of failure. If this device fails, then data cannot be accessed. A dual point of failure shall be achieved by incorporating two shared-media devices that are mirrored (for example: two stacked mirrored Dell PowerVaults).
243. All access control field hardware shall be configured for both the Primary Server and the Backup Server. Both the Primary and Backup Servers shall recognize the same TCP/IP ISC address on the network.
244. In the event that the Primary Server fails, the Backup Server shall sense that the Primary Server has failed and is no longer on the network. The Backup Server shall check to see if the Primary Server is online every 5 seconds.
245. Upon sensing Primary Server failure, the Backup Server shall automatically initiate itself as the Primary Server and shall begin communication with the Intelligent Fields Panels. ABSOLUTELY NO SMS OPERATOR INTERVENTION SHALL BE REQUIRED. A message shall be broadcast to all client workstations on the network that the Primary Server has failed and the Backup Server has taken control. This process shall take no longer than 2 minutes to accomplish.
246. Once the Primary Server comes back online with the SMS, the Primary Server shall resume normal operations. a. Disk Mirroring

247. The SMS database server shall protect data against failure of a hard disk or hard disk controller by providing a disk mirroring configuration. The disk mirroring configuration shall allow data to be stored on dual hard disks running simultaneously. When any client workstation or Intelligent System Controller sends data to the database server, it shall be stored to both sets of hard disk drives. In the event any component on one channel fails, the other disk drive continues to operate without data loss or interruption. The SMS shall also send a warning message indicating that one disk drive has failed.

a. RAID Level 10

248. The SMS shall offer a Fault Tolerant Redundant Array of Independent Disks Level 10 (RAID Level 10) with a hot standby disk. RAID Level 10 shall provide redundancy of disk storage, controller channels and power supplies. Each array must contain a disk drive, high efficiency power supply, and cooling fan. This technology shall use multiple drives to store data with distributed parity, thereby ensuring data protection in an environment in which data is safe and easily restorable in the event of a hard disk failure. In the event a single drive within the array fails, a "Hot Standby Hard Disk" shall be available online and automatically switched with the failed unit.
249. The network administrator shall be able to replace the failed drive without taking the database server down, and it shall then become the hot standby. The array software shall rebuild the lost data from parity information stored on the other drives in the array. This entire procedure shall have no effect on the operation of the SMS and shall be automated.
    a. Distributed Intelligence
250. In the event SMS communications is lost or the database server fails, Intelligent System Controllers shall provide complete control, operation and supervision of all monitoring and control points. The ISC shall be configured with a UPS battery, which shall support the ISC for a 24 hour duration. The ISC shall be installed with enough memory to support up to 10,000 cardholders/100,000 events in a minimum configuration and be expandable to up to 250,000 cardholders/1,000,000,000 events.
251. The SMS shall incorporate performance tests and precautions so as to avoid SMS failure. In the event of a failure, transactions are to be stored in an ISC First In First Out (FIFO) buffer until the ISC comes back online, at which time all data is uploaded to the database server. The ISC shall register as online with the database server when communications are re-established. Should the ISC buffer fill and events are overwritten, an event will appear in the Main Alarm Monitoring Window notifying the System Operator that events were overwritten. The ISC shall send a time/date stamp of the last record or table update in its memory and request any new data changes or cardholder records which have changed since that time or date stamp. A complete download of database and access tables shall not be required because of offline operation.
252. Open Protocol Interface
    a. The SMS shall provide a set of standard Application Programming Interfaces (API's) and supporting documentation that allows hardware manufacturers and software application developers to interface their products into the SMS. The Application Programming Interfaces shall allow requests to occur from CUSTOMER to interface a third-party hardware or software solution based on SMS open architecture and SMS device independence.
    b. There shall be two components to the Application Programming Interfaces. There shall be a device interface and an application interface.
    c. The device interface shall allow extensibility to the number and types of hardware devices supported by the SMS. Each individual piece of hardware shall have its own

"driver" that shall understand how to communicate with the SMS hardware. These "drivers" or "device translators" shall translate a set of generic commands into specific device commands.

d. The device translators shall be implemented as COM (Component Object Model) objects so that they shall be loaded and unloaded as needed. Each device translator shall support certain interfaces that support a specific set of commands or methods. Some examples of typical interfaces could include an Access Control Interface for access control hardware, a Video Interface for DVR and NVR hardware, an Intercom Interface for intercom systems, an Intrusion Interface to support alarm inputs, etc. A particular device translator shall support many interfaces.
e. The main application that shall be used to control the various device translators is the SMS Communication Server (SCS). The SCS shall be the application that manages and sends the commands to the device translators. Other modules including Alarm Monitoring or System Administration shall communicate with the hardware devices by sending commands to the SMS Communication Server, which shall then send the commands on to the correct device or devices.
f. The device interface shall allow the software interface of any hardware device to be controlled and monitored via the SMS Alarm Monitoring application. This shall preserve customer investments in existing equipment as well as allow for system expansion to occur through the interface of the latest hardware technologies.
g. The application interface shall allow information to be exchanged between the SMS and other applications. The application interface shall provide the functions for interacting with the SMS. This includes the ability to extract information from the SMS database as well the ability to download, control and monitor information for all field hardware including access control panels, digital video systems, fire panels, alarm panels, intercom system, etc.
h. All functions of the application interface shall be defined in such a way that any Windows application or development environment with the ability to make "C" calls should be capable of making use of the API.

263. Open Supervised Reader Interface

a. The SMS shall provide connectivity to proximity and smartcard readers which provide continuous supervision and monitoring of reader processor and wiring integrity by means of a non-proprietary communications protocol standard. Supervision methods that simply supervise wiring or measure current draw are not acceptable, since they do not insure that the reader's microprocessor is actually operational. Likewise, proprietary protocols which are sole sourced or licensed for a fee are not acceptable, since they limit potential future expansion options for the SMS.

C. The preferred protocol is the Open Supervised Device Protocol (OSDP), since it is non-proprietary and meets the requirements stated above. Alternative supervised reader interface protocols will be considered only if they meet all of the technical requirements of this section AND can be shown to be non-proprietary.

END OF SECURITY MANAGEMENT SYSTEM

SECTION 28 20 00

CCTV SURVEILLANCE SYSTEM - IP

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Extent of work is indicated by the requirements of this section. This specification describes the CCTV Surveillance System to be installed with the requirements and qualifications herein listed.

B. Furnish system complete.

C. Furnish all necessary components and hardware for a complete working system.

D. This specification is intended to provide the CCTV Equipment Contractors with the information and details to be used as the basis for the work described herein.

E. Systems shall be installed under Electrical Section with Electrical Contractor furnishing conduit and requirement power, wiring and pulling wire for CCTV Equipment Contractor, CCTV Equipment Contractor shall make all connections.

F. In many instances only major equipment items are specified and other components and hardware may be required to provide a complete working system.

1.2 SYSTEM DESCRIPTION:

A. This section describes the requirement for electronic surveillance. The system utilizes Closed Circuit Television Camera located as shown on the plans to survey designated areas. Video Signals are processed and displayed on monitors located in the control room and office.

1.3 APPLICABLE CODES AND STANDARDS:

A. U.L. Labels - Provide equipment which has been listed and labeled by Underwriter's Laboratories.

B. FCC Compliance - Comply with Federal Communications Commission Class "B" limits set forth in Subpart "J" of Part 15.

C. NEMA Compliance - Comply with National Electrical Manufacturers Association Standards as applicable.

D. NECA Standard - Comply with applicable portions of the National Electrical Contractors Association's Standard of Installation.

1.4 QUALITY ASSURANCE:

A. Equipment Supplier shall be authorized factory service representative for equipment supplied. Supplier shall maintain an office and service facility with factory trained personnel within fifty (50) miles of the site and provide service within twenty-four hours.

B. The Equipment Supplier's factory trained personnel shall directly supervise the entire installation, connections and tests. Supervision shall include on-the-job instructions for the installation and periodic testing. Final installation and connections for control consoles, equipment cabinets, cameras, etc., shall be made by the Equipment Supplier's trained personnel.

C. Before acceptance, manufacturer's representative will test and certify that the system is installed and functioning properly as intended by drawings and specifications. Test shall include operation of all devised and functions in entire system.

1.5 SHOP DRAWINGS AND CCTV CONTRACTOR WORK:

A. Unless otherwise indicated, provide items required for the complete CCTV Surveillance System as follows:
1. Install and connect all CCTV System equipment as indicated on the drawings.
2. Submit equipment/wiring floor plan layout, detailed terminal wiring diagrams, and equipment manufacturer data sheets prior to any installation of delivery of any equipment to the job site.
3. Provide approved copies of shop drawings which show correct device locations and quantities, correct conduit sizes, and cabling and conductor requirements to the other trades providing related work, supervise and work performed by these trades to assure a workable, completed system.
4. Upon completion of all work, a complete functional test of the entire system shall be performed, and if the system is fully operational, a final acceptance test shall then be scheduled with Owner's designated representative.
5. Provide personnel familiar with the installation and with full access to the system for the final acceptance test.
6. Correct punch list items resulting from the final acceptance test.
7. Provide a one (1) year test and inspection service contract as hereinafter defined.
8. Provide a one (1) year job site guarantee on all material and labor furnished.
9. Provide for any additional conduit of increase in conduit size which are required to make the proposed system functional, but which is not indicated on the design drawings.
10. Furnish all low voltage multi-conductor jacketed cables and low voltage central power conductors as required for a complete and workable system.

1.6 COMMON MANUFACTURER:

1. Equipment furnished in any one category shall be supplied from one manufacturer. For example, all cameras must come from the same manufacturer and all monitors, of the same size, shall be from one manufacturer.
2. Video equipment supplied with same model number shall be of the same series.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS:

A. All model numbers listed within this proposal are for equipment manufactured by Pelco. Equal products by Bosch will be acceptable.

2.2 IP VIDEO MANAGEMENT SYSTEM

A. The IP video management system shall consist of Digital Sentry® NVs version 7 software operating on an optimized Pelco-supplied hardware platform. The NVs software shall consist of

base software with individual, non-expiring licenses in the required quantity.

B. The IP video management system software updates shall be downloadable from a publicly available website.

C. The IP video management system shall support up to 128 combined IP and analog video streams, with up to 64 direct-attached analog cameras. Analog streams shall be supported using Pelco and/or third-party encoders.

D. The IP video management system shall provide 280 Mbps throughput for recording of analog and IP video streams, playback and export.

E. The IP video management system shall support recording of JPEG, MPEG-4 and H.264 IP streams.

F. The IP video management system shall support Pelco and third-party H.264 Megapixel video streams up to 10 Megapixel resolution with quantities based on a total system of 280 Mbps throughput for recording of analog and IP video streams, playback and export.

G. The IP video management system shall have a fully open architecture with support for both IP-specific camera as well as cameras with ONIVIF compliance.

H. The IP video management system shall support automatic detection of Pelco IP cameras. Third-party IP cameras shall be automatically detected dependent on IP driver versions and manufacturers specifications.

I. The IP video management system shall support up to 64 looping analog camera inputs with direct-attached 16-channel encoders; up to four direct-attached units. The direct-attached 16-channel encoders shall support H.264 compression, CIF, 2CIF, and D1 resolutions at maximum 30ips, 16 audio inputs and RS422/485 PTZ control with Pelco P and D protocols.

J. The IP video management system shall support an unlimited number of systems connected over a network. Each system shall contain two 1GB network ports; one for IP camera/encoder data, and one to connect to a network for client computer access.

K. The IP video management system shall be viewed, managed, and played back through a single user interface simultaneously with other Digital Sentry digital video management systems through supplied DS Admin or DS ControlPoint Client software.

L. The IP video management system shall operate on a 2nd Generation Intel® Core™ i7 processor and 8 GB of RAM.

M. The IP video management system shall utilize a Windows® 7 Ultimate 64-bit operating system.

N. The IP video management system shall support and have an option for an internal DVD+/-RW.

O. The IP video management system shall contain two DVI-D ports.

P. The IP video management system shall allow expansion of IP video channel capacity through a licensing without any hardware modification.

Q. The IP video management system shall support multiple models of IP cameras and encoders including Pelco cameras and encoders with Sarix technology and multiple third-party manufacturers.

R. The IP video management system shall support audio recording from Pelco cameras with Sarix technology in addition to third-party manufacturer's audio recording.

S. The IP video management system shall support recording the internal server with additional storage utilizing SCSI attached Pelco DX8100-HDDI storage.

T. The IP video management system shall be capable of continuous scheduled alarm/event and motion recording. Pre- and post- alarm recording shall also be available and shall be fully programmable on a per channel basis.

U. The IP video management system shall allow archival of video data to computers or SAN storage devices over a network connection with the optional DS Archive Utility. The archival schedule shall be either automatic at user-defined intervals or manual and shall be configurable per connected camera.

V. The IP video management system shall support network health and monitoring utilizing third-party SNMP monitoring tools.

W. The IP video management system shall indicate system performance and operation status utilizing a variety of HTML reports.

X. The IP video management system shall display system health monitoring data utilizing front panel LED displays and display popups.

Y. The IP video management system shall optionally support on-board video analytics in quantities of two or four channels with Active Alert software and the DS DataPoint interface. The DS DataPoint interface shall provide video analytics monitoring including tracking and counting objects and people.

Z. The IP video management system shall support Lightweight Directory Access Protocol (LDAP).

AA. IP Video Management Client Software requirements

1. The IP video management system shall provide the capability of running a client application in additional to the video management system.
2. A client computer with system compatible software shall be the user interface for viewing one or more systems. Live and recorded video and current event video shall be displayed on any client computer using a proper login and password. The client computer shall be able to connect to an unlimited number of recorders simultaneously to display live and recorded video.
3. Client Software shall be unlicensed and available to be installed on as many clients as required by the user.
4. Client Software shall be compatible with multiple DVR and NVR platforms to include all Pelco Digital Sentry®, Pelco DX8000/DX8100, and Pelco DX4100, DX4500/DX4600, DX4700/DX4800.

5. Client Software shall be password controlled such that password functionality set at each connected system will be recognized at the client. Password shall limit the ability to access live or recorded video as well as the ability to export video.
6. Client Software shall allow multiple monitor support for up to four displays per client workstation, providing virtual matrix functionality.
7. Client Software shall allow the connection of Pelco KBD5000 keyboard controllers to the client workstation to control PTZ operations and camera call-up.
8. Client Software shall allow video streams to be selectable from a system tree on an individual camera, individual system, client defined local groups, or from predefined recorder based groups.
9. Client Software shall be a tab based work environment with the ability to undock the tabs creating a virtual workspace on single or multiple monitor clients.
10. Client tabs shall include system management, live, and search options. Tabs can be displayed simultaneously on the client.
11. Systems Tab shall display and sort available systems, connection status, system names, system IP addresses, and custom categories. This tab shall additionally allow:
    a. Manual connect and disconnect of systems to the client
    b. Virtual systems naming
    c. Auto Connecting
    d. Adding, deleting, and editing available systems
    e. Live video tab shall have the ability to be created up to four times on a single client workstation providing for video display combinations and simultaneous video streams from as many different systems with consideration for maximum client bandwidth.
12. Live video tab shall provide the following functionalities:
    a. Quick Review which shall display recorded video from the last 1, 5, 15, 30, 60 or 90 minutes, providing near instantaneous review of recent events
    b. One week graphical display of recorded video
    c. Borderless display option
    d. Screen layout selection
    e. On the fly on-screen display changes including time, date, camera name, frame rate, frame size, alarm display, and border indicators
    f. Digital zoom
    g. User selectable in-video PTZ control or dashboard style control
    h. Drag and drop audio support associating any audio with any video
    i. Search video tab shall allow for the search of one or multiple cameras from one or multiple systems simultaneously. Search tab shall provide the following functionalities:
    j. Time and date search
    k. Advanced data search with DataPoint interfaced software to Active Alert Intelligent Video and POS
    l. Drag and drop audio support to associate audio with any video
13. Video export to any system accessible media including locally to HDD, CD/DVD, Flash USB device or to network storage
14. Video authentication of exported video via check sum verification
15. Alarm video tab shall allow for alarm pop-up and playback of active alarms. Alarms may be based on motion activity, an external software trigger from Active Alert analytics or a preset data alarm from DS DataPoint. An alarm list pane shall be displayed for playback of queued alarms.
16. The Client shall incorporate virtual matrix functionality whereby camera sequences may be created on the monitoring workstation with the following functionalities:

17. Each sequence shall have a maximum of 500 cameras
18. Each camera in the sequence shall have its own individual dwell time, from 1 to 60 seconds
19. Each entry in a sequence shall have the capacity to trigger PTZ camera presets, patterns, or auxiliaries
20. The Client shall have the capability to display recorded video with full VCR controls. This feature shall display video from multiple cameras simultaneously. The user shall be able to play video as fast as possible (all images), in real time, or by skipping a selectable number of seconds
21. The Client shall support simultaneous playback of up to sixteen cameras all synchronized with each other. Non-synchronous playback of multiple cameras shall not be acceptable
22. The Client shall support tours of multi-camera displays
23. Remote Client Minimum PC Requirements
    a. Processor: 2nd Generation Intel® Core i7 processor with integrated graphics
    b. Memory: 4 GB or higher
    c. Graphics Card: Graphics controller card with 512 MB (or greater) dedicated video memory
    d. Optical Drive: DVD
    e. Operating System: Windows 7 (32 or 64 bit)

BB. Network Server Video Recorder/CCTV Workstation
1. Shall be Pelco DSSRV-030-US
2. Supplied Accessories
    a. Power Cord
    b. USB Keyboard and Mouse
    c. Two (2) Bezel keys
    d. Rack Mount Kit (Brackets, rails, and hardware for rack mounting)
    e. DS-SRV-LIT (Documentation, resource and recovery disc)

CC. System Accessories
1. DS-SW-CAM: Includes eight IP licenses for Pelco and third-party IP cameras Additional DS-SW-CAM licenses can be purchased separately
2. ENC5416: Direct-attached analog encoder
3. DS-SRV-RAID: LSI 3Ware 9750-8i RAID controller card
4. DS-SRV-SCSI : Adaptec® SCSI Card 29320LPE
5. ENC5400-2PORT: 2-port host card (analog) connects 2 ENC5416
6. ENC5400-4PORT: 4-port host card (analog) connects 4 ENC5416
7. KBD5000 Keyboard: Desktop keyboard with control pods provides lens, iris and focus control; playback and menu navigation; and monitor control of one DS ControlPoint tear-off tab.

2.3 VIDEO ENCODERS

A. The video encoder shall be standards-compliant and provide a fully supported API that shall integrate with multiple video management systems.

B. The video encoder shall support 1, 2, or 4 camera inputs.

C. The 1- and 2- input video encoders shall support Power over Ethernet (PoE), 802.3af for the 1-input encoder and 802.3at for 2-input encoder. The 4-input encoder shall be powered by a

12VDC source.

D. The video encoder shall generate compressed H.264 video streams in standards-compliant baseline profile, main profile, or high profile. For 4CIF resolution, the encoder shall employ de-interlacing technology to support interlaced cameras while remaining compatible with standards-based decoders at baseline profile.

E. The video encoder shall provide for two independently configurable streams for each camera input. Each stream shall be capable of 4CIF resolution, 30 or 25 images per second (ips), NTSC or PAL. The settings of one stream shall not interfere or limit the settings for the second stream.

F. The video encoder shall be capable of generating 4CIF resolution, real-time video streams while also running intelligent video content analysis algorithms on each camera input. There shall be no need to degrade video resolution or frame rate to execute analytics algorithms.

G. The video encoder shall provide support for running any three Pelco video content analysis algorithms simultaneously on each channel. In addition, the encoder shall also be capable of processing video content analysis algorithms from Object Video.

H. The video encoder shall have provisions for a micro-SD card for each channel input. The video encoder shall be capable of recording JPEGs for alarm conditions on customer-supplied SD cards.

I. The video encoder shall support daisy chaining up to 4 encoders together to minimize the number of network ports utilized on a switch.

J. The video encoder shall provide for 1 line level audio input per video input. The 1- and 2-input encoders shall also provide for a single, line level audio output.

K. The video encoder shall provide for 1 alarm input per camera input. The encoders shall also provide a single relay output per unit.

L. The 1- and 2-input encoders shall support looping video outputs with software-controlled termination.

M. The video encoder shall support PTZ cameras by way of Coaxitron or Pelco D protocol through a serial connection to the RS422 port.

N. When used with Endura, the video encoder shall be capable of digitally signing each frame of video to guarantee the authenticity of digital video all the way back to its source.

O. The video encoder shall support SNMP diagnostic messages and traps and shall be compliant with SNMP versions 1 and 2.

P. The video encoder shall use a standard web browser interface for remote administration and configuration of encoder and camera settings. The browser interface shall support multi-screen remote monitoring for cameras attached to other encoders or Pelco cameras with Sarix technology on the same network subnet.

Q. The network camera shall provide an additional processor for running Pelco Video analytics.
1. Pelco Analytic Suites shall be configured and enabled using a standard Web browser.
2. Pelco Analytic Suites shall allow remote operation and alarm notification when used with an Endura system or a third-party system that supports Pelco's Analytics API.
3. Pelco Analytics for Network Encoders including:
   a. Abandoned Object: Detects objects placed in a defined zone and triggers an alarm if the object remains in the zone longer than the user-defined time allows. An airport terminal is a typical installation for this behavior. This behavior can also detect objects left behind at an ATM, signaling possible card skimming.
   b. Adaptive Motion: Detects and tracks objects that enter a scene and then triggers an alarm when the objects enter a user-defined zone. This behavior is primarily used in outdoor environments with light traffic to reduce the number of false alarms caused by environmental changes.
   c. Camera Sabotage: Detects contrast changes in the field of view. An alarm is triggered if the lens is obstructed with spray paint, a cloth, or a lens cap. Any unauthorized repositioning of the camera also triggers an alarm.
   d. Directional Motion: Generates an alarm in a high traffic area when a person or object moves in a specified direction. Typical installations for this behavior include an airport gate or tunnel where cameras can detect objects moving in the opposite direction of the normal flow of traffic or an individual entering through an exit door.
   e. Loitering Detection: Identifies when people or vehicles remain in a defined zone longer than the user-defined time allows. This behavior is effective in real-time notification of suspicious behavior around ATMs, stairwells, and school grounds.
   f. Object Counting: Counts the number of objects that enter a defined zone or cross a tripwire. This behavior might be used to count the number of people at a store entrance/exit or inside a store where the traffic is light. This behavior is based on tracking and does not count people in a crowded setting.
   g. Object Removal: Triggers an alarm if an object is removed from a defined zone. This behavior is ideal for customers who want to detect the removal of high value objects, such as a painting from a wall or a statue from a pedestal.
   h. Stopped Vehicle: Detects vehicles stopped near a sensitive area longer than the user-defined time allows. This behavior is ideal for airport curbside drop-offs, parking enforcement, suspicious parking, traffic lane breakdowns, and vehicles waiting at gates.
4. Pelco Analytic Suites shall be preloaded or configuration and alarm notification when used with an Endura® system or a third-party system that supports Pelco's Analytics API.
5. Multiple Pelco behaviors can be scheduled to work during a certain time or condition.

R. ObjectVideo® Analytics for EP High Definition Digital Network Cameras

1. ObjectVideo (OV) intelligent video analytics technology shall be embedded in Pelco EP network cameras with Sarix technology, enabling rule configuration and alarm notification when using OV Ready™ systems.
2. OV analytics shall be made available in three suites: OV Security Suite, OV Security Suite Plus and OV Event Counting Suite. These suites shall provide a spectrum of settings to allow use of the behaviors in a variety of applications. The technology shall help users identify situations of interest, such as surveillance and business effectiveness analysis.
3. OV Security Suite shall include Tripwire Detection, Inside Area Detection, and Camera Tamper Detection behaviors: Tripwire Detection shall identify objects that cross a user-defined line drawn within the camera's field of view; Inside Area Detection shall identify

objects entering, appearing, or moving within a user-defined area; and Camera Tamper Detection shall detect changes in the camera field of view, including obstruction of lens (such as by cloth, spray paint, or a lens cap cover) and unauthorized movement of the camera.

4. OV Security Suite Plus shall include (in addition to all behaviors of the Security Suite) Multi-Line Tripwire Detection, Loitering Detection, and Leave Behind Detection behaviors: Multi-Line Tripwire Detection shall track objects that cross two defined lines, which can be defined by parameters such as direction, sequential order, and the time it takes to cross both tripwires; Loitering Detection shall analyze how frequently people remain for a specified period of time within a defined area, allowing for real-time notification of suspicious behavior around ATMs, stairwells, and school grounds; and Leave Behind Detection shall detect objects placed in a defined zone and trigger an alarm if the object remains in the specified zone longer than the user-defined time allows.
5. OV Event Counting Suite shall use advanced object calibration and additional features for schedules, parameters, and multiple rules. The suite shall include behaviors for Tripwire Counting, Enters/Exits Counting, Loiter Counting, Occupancy Sensing, and Dwell-Time Monitoring: Tripwire Counting shall count people or objects that cross a user-defined line; Enters/Exits Counting shall calculate the number of people that enter and exit an area without using a tripwire; Loiter Counting shall calculate people who stop in front of a defined area of interest (such as a display or product); Occupancy Sensing shall count people, generating a new value every time the occupancy level changes and time stamping each occupancy output, allowing the data to be used to determine average occupancy levels or to correlate data to point-of-sale or other business scenarios; and Dwell-Time Monitoring shall determine the time between which an object enters and exits an area, provide queue size information, and allow assessment of wait times.

S. Model Number
   1. Pelco NET5400 series, Video Encoders

2.4 INDOOR DIGITAL (IP) NETWORK MINI DOME CAMERAS

A. Shall be Pelco IMS0LW10-1 Sarix indoor fixed IP mini dome camera with SureVision, 0.5 Mpxl, low-light, WDR, day/night, 2.8~10mm varifocal megapixel lens, clear dome

2.5 EXTERIOR (WEATHERPROOF) DIGITAL (IP) NETWORK MINI DOME CAMERAS

A. Shall be Pelco #IM10DN10-1E Sarix environmental, indoor/outdoor mini fixed dome IP camera 1.3 Mpxl, day/night, 2.8~10mm varifocal megapixel lens, clear dome with #WMVE-WR/IM-VEPM vandal-resistant wall-mount with pendant accessory

2.6 HIGH DEFINITION CCTV MONITOR

A. The CCTV monitor shall offer the following features: VGA, DisplayPort, and digital visual interface (DVI) inputs, looping BNC output, full high definition resolution, and 32” (minimum) LCD display.

B. The LCD monitor shall provide picture-in-picture (PIP) capability.

C. The Narrow Bezel LCD monitor shall be capable of providing a minimum of 1920 x 1080p native resolution.

D. Model Number
   1. Pelco PMCL532F with PMCL-WMT tilt/swivel wall mount

2.7 EQUIPMENT RACKS

A. All digital recorders, video encoders, patch panels and other similar equipment shall be mounted in standard data racks at telephone backboards. CCTV system supplier may utilize space within rack furnished by the Structured Cabling Contractor if available, or may furnish a separate wall-mounted, hinged rack meeting the requirements of the Structured Cabling System specifications section.

2.8 CABLING

A. All Ethernet cabling to cameras shall be yellow, Cat6.

B. Refer to plans and the following specifications sections for cabling requirements:
   1. Section 27 05 00: Auxiliary System Cables, 0-50V
   2. Section 27 10 00: Structured Cabling System

2.9 MISCELLANEOUS AND OTHER EQUIPMENT

A. Furnish all miscellaneous hardware, connectors, wire/cable and components required for complete functioning system.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Work under this section shall be of professional quality with emphasis on neatness and workmanship.

B. Guarantee workmanship and/or material executed under this division for three (3) years after final acceptance. In the event that project is occupied or systems placed in operation in several phases at Owner's request, guarantee will begin on date each system or time of equipment is accepted by Owner.

C. Focal length of lenses for various cameras shall be determined on site, as well as exact positions of camera. Contractors shall supply portable equipment, camera, monitor, and assorted lenses for field test to make determinations. Test shall be scheduled with, and made in the presence of, the Owner's Representative and the Engineer.

D. All Cat6 cabling shall be installed by the Structured Cabling Contractor per Specification Section 27 10 00. Refer to Specification Sections 27 05 00 and 27 10 00 for additional cable installation requirements.

3.2 OBSERVATIONS OF WORK AND DEMONSTRATION OF OPERATION:

A. Final inspections shall include, but are not limited to, a demonstration to the Engineer and Owner's Representative of all functions and controls of system being tested. Architect's column on test plan will be executed during final. Sufficient Sub-Contractor personnel shall be on site to demonstrate systems. Personnel shall be knowledgeable about all system hardware and software where applicable.

END OF SECTION 28 20 00

SECTION 28 31 00

FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. The Contractor shall furnish and install a complete low voltage, automatic and manual fire alarm system as specified herein and indicated on the drawings.

B. The system shall include a central control panel, power supply, signal initiating devices, audible and visual alarm devices, a conduit and wiring system and all necessary accessories required to provide a complete operating system.

C. The system shall be completely addressable.

D. The system shall comply with the applicable provisions of the National Fire Protection Association Standard Number 72 (National Fire Alarm Code) for fire alarm systems; N.E.C. Article 760; and meet all requirements of the local authorities having jurisdiction.

E. The system shall be provided by a local service organization located within 50 miles of the job site.

1.2 DESCRIPTION OF SYSTEM

A. Conduit, outlet boxes, cabinets, devices and wiring installation for complete fire detection and alarm system.

B. Each and every item of the Fire Alarm System shall be listed as a product of a SINGLE fire alarm system manufacturer under the appropriate category by Underwriter's Laboratories, Inc. (UL), and shall bear the "UL" label. All control equipment shall be listed under UL category UOBZ as a single control unit. Partial listing shall not be acceptable. System controls shall be UL listed for Power Limited Applications per N.E.C. Article 760. All circuits shall be marked in accordance with N.E.C. 760-23.

C. Wiring shown is diagrammatic to define system and is not intended to show every wire. Review drawings prior to bidding and inform Contractor of any additional wiring necessary for installation of systems. Wiring shall comply with pathway survivability requirements defined in NFPA 72. Include cost of all wiring in bid.

D. Submit complete shop drawings of system for review including terminal to terminal connection diagrams for system components and associated equipment interfaces, conduit diagrams, complete descriptive information on each item of equipment including UL listing for all system components, and any other information required by Architect to describe system. Identify color code and terminal numbers on shop drawings.

E. After completion of work, submit one set of record mylar sepias with items for Owner described above. Typical type drawings will not be accepted.

F. Manufacturer's trained technical representative shall supervise installation, connections and tests. The authority having jurisdiction shall be notified prior to installation or alteration of equipment or wiring. Before acceptance, manufacturer's representative will test and certify in writing that system is installed and functioning properly as intended by drawings and specifications. Test includes operation of all devices in entire system.

G. Guarantee entire system in writing for one year from date of acceptance by Owner. Guarantee will cover completely all components, equipment, wiring, etc. Repair any defects found in the system within the guarantee period without cost to owner.

H. Submit with bid a guaranteed price for complete maintenance and service of system for one year beginning at expiration of guarantee period. Price shall be guaranteed for acceptance by Owner until date of substantial completion of system.

1.3 SYSTEM OPERATION

A. Actuation of any alarm initiating device shall cause all audible alarm signals to sound, all visual indicating appliances to flash, activate an alarm LED and local tone-alert at control panel/annunciator, cause an LCD read-out of point in alarm including type of alarm (smoke detector, manual station, etc.), provide a signal to the mechanical controls to shut down or re-route air handling systems according to established plans. This shall include a suitable addressable relay at each air handling unit to shut down all air handlers in a given zone when system goes into alarm.

B. The general alarm devices may be silenced by authorized personnel only, by entering a locked cabinet and operating the proper silencing switch. A subsequent zone alarm shall reactivate the signals. Operation of the silencing switch shall be indicated by a trouble light and audible signal.

C. Operation of any sprinkler monitoring switch, power failure, opens, grounds, or any disarrangement of the system wiring or components shall be indicated by a visual and audible trouble signal. The audible trouble signal may be silenced; however, the trouble LED shall remain lit until the system has been returned to normal operating condition.

D. Analog Smoke Sensor Operation
1. The smoke sensor shall be a smoke density measuring device having no self contained alarm set-point. The alarm decision for each sensor shall be determined by the control panel. The control panel shall determine the condition of each sensor by comparing the sensor value to stored values.
2. The control panel shall maintain a moving average of the sensors smoke chamber value. Systems that do not automatically maintain a constant smoke obscuration sensitivity for each sensor by compensating for environmental factors and are deemed unacceptable.
3. The system shall automatically indicate when an individual sensor needs cleaning. When a sensor’s average value reaches a predetermined value, a “Dirty Sensor” trouble condition shall be audibly and visually indicated at the control panel for the individual sensor. Additionally, the LED on the sensor base shall glow steady giving a visible indication at the sensor location.
4. If a “Dirty Sensor” is left unattended, and its average value increases to a second predetermined value, an “Excessively Dirty Sensor” trouble condition shall be indicated at the control panel for the individual sensor.

5. The control panel shall automatically perform a daily self-test on each sensor. Checking the electronics in the sensor's base ensures the accuracy of the values being transmitted to the control panel. A sensor which fails the self-test will cause a "Self Test Abnormal" trouble condition at the control panel. A sensor self-test which must be manually initiated by the operator shall not be acceptable.

1.4 SYSTEM FEATURES

A. The fire alarm system shall include the following features as a minimum:
1. Supervision of all field wiring.
2. Microprocessor based solid state modular construction.
3. Ground fault detection and ground fault isolating & supervising circuitry.
4. 80 character LCD display to indicate alarms, supervisory service conditions and troubles.
5. Simultaneous test of all LED's and LCD's from a central point.
6. "Dead Front" design control panel/annunciator with field programmable LED alarm, status and trouble indicators, and all control switches located behind a locked tempered glass door.
7. Fully automatic battery charger and lead alkaline batteries. Batteries shall have capacity to maintain system operation for 24 hours in normal supervisory mode and shall have sufficient capacity remaining to operate in alarm mode for 15 minutes at conclusion of supervisory period. Batteries shall be supervised for connection to the system and for low voltage threshold. Ammeter and voltmeter shall be provided to indicate battery voltage and charging current.
8. Two (2) sets of 2 amp form C auxiliary alarm contacts fused with feedback.
9. One (1) set of 2 amp form C auxiliary trouble contacts.
10. Standard with 127 addressable points (expandable to 508 points) and four input/output (I/0) circuits (expandable to 20 circuits).
11. Basic four (4) amp power supply (expandable as required).
12. 600 event historical logging.
13. System shall be field programmable for offsite monitoring by remote station reverse polarity, local energy master box or shunt master box types.
14. System shall be field programmable for signal circuit type of operation; march time code, temporal code, selective code, zone code, general alarm, time limit cutout and alarm silence inhibit.
15. System shall be field programmable for waterflow/sprinkler supervisory operation on distinct zones as required.
16. Transient suppression protection shall be provided on the system power supply and on the municipal protection circuit to comply with UL 864 requirements. Additionally, surge suppression shall be provided within the control panel on all circuits that extend outside the building (including to roof-mounted HVAC units).
17. Supervised remote annunciator connection circuit.
18. System shall incorporate an alarm/trouble walk test.
19. Resident non-volatile programmable operating system memory for all operating requirements.

PART 2 - PRODUCTS

2.1 FIRE ALARM CONTROL PANELS/ANNUNCIATORS

A. Furnish and install Simplex type 4020-9101 fire alarm control panel(s) with options and accessories as required.

2.2 MANUAL ALARM STATIONS

A. Manual alarm stations shall be Simplex addressable type 4099-9002 break glass (double-action). The station body shall be so constructed that chips and scratches will not expose metal. All stations shall be master keyed with the control equipment. When actuated, the "Pull Lever" shall remain at right angle to the station body until reset.

B. Boxes:
1. Recessed, two-gang outlet boxes with Simplex type 2099-9813 red, semi-flush trim plates shall be used where possible.
2. Where surface-mount outlet boxes are required, boxes shall be red, cast aluminum Simplex type 2975-9022.

2.3 PHOTOELECTRIC SMOKE SENSOR

A. The smoke sensors shall be of the photoelectric addressable Simplex type 4098-9714 and shall communicate actual smoke chamber values to the system control panel. The smoke sensors shall operate on the light scatter principle. For maximum maintenance free service and low power requirement, light source for detection chamber and visual alarm indication shall be solid state photodiode.

B. Each sensor base shall be visually and electrically supervised.

C. The sensors shall be listed to UL Standard 268 and shall be documented compatible with the control equipment to which they are connected. The sensors shall be listed for both ceiling and wall mount applications.

D. Each sensor base shall contain integral addressable electronics and an LED that will flash each time it is scanned by the control panel (once every 4 seconds). The control panel shall be responsible for drift compensation. When the control panel determines that a sensor is in an alarm or a trouble condition, the control panel shall command the LED on that sensor's base to turn on steady indicating the abnormal condition. Sensors which do not provide a visible indication of an abnormal condition at the sensor location shall not be acceptable. Sensor bases shall be compatible with detachable photoelectric, ionization and heat sensors so that these various sensor types can be easily interchanged to meet specific location requirements. Sensor base shall be addressable type as required.

E. Where required, sensor bases shall be provided with a relay driver output and supervised relay, which are to be controlled either automatically or manually from the control panel.

F. Each sensor base shall be scanned by the control panel for its type identification to prevent inadvertent substitution of the wrong sensor type. The control panel shall operate with the installed device but shall initiate a "Wrong Device" trouble condition until the proper type is installed or the programmed sensor type is changed.

G. Each sensor shall contain a magnetically actuated test switch to provide for easy alarm testing at the sensor location.

H. The sensor's electronics shall be immune from false alarms caused by EMI and RFI.

I. Cover all smoke detection devices with plastic bags immediately after installation to maintain cleanliness, if field conditions so require.

J. Provide a U.L. listed sensor guard for sensors in areas subject to tampering. The guard shall be suitable for ceiling or sidewall mounting and hinged for easy access. The guard shall be securely mounted with tamper-proof screws.

2.4 PHOTOELECTRIC DUCT DETECTOR

A. The detector shall be an addressable, non-polarized 24VDC, Simplex type 4098-9755, which is compatible with the Fire Alarm Control Panel and obtains its operating power from the supervisory current in the fire alarm detection loop. It shall be of the same analog type as the ceiling smoke detectors. Detectors shall be of the solid state photoelectric type and shall operate on the light scattering, photodiode principle. To minimize nuisance alarms, detectors shall have an insect screen and be designed to ignore invisible airborne particles or smoke densities that are below the factory set alarm point. No radioactive material shall be used.

B. The detector head shall be directly interchangeable with an ionization detector type. The 24VDC detector may be reset by actuating the control panel reset switch.

C. Detector construction shall have a mounting base with a twist-lock detecting head that is lockable. The locking feature must be field removable when not required. Contract between the base and head shall be of the bifurcated type utilizing spring type, self-wiping contacts. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control panel.

D. Sampling tubes sized to match duct size as recommended by equipment manufacturer shall be provided with duct detectors as required.

E. Detector design shall provide compatibility with other normally open fire alarm detection loop devices (heat detectors, pull stations, etc.). It shall be possible to alarm the duct housing by using a test switch. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housings front cover.

F. To minimize false alarms, voltage and RF transient suppression techniques shall be employed as-well-as smoke signal verification circuit and an insect screen.

G. Separate auxiliary SPDT relays for fan shutdown shall be provided with each duct detector for fan shutdown, smoke evacuation or other purposes as indicated on plans.

H. Remote key operated test stations with LED alarm indicators shall be installed in an accessible, inconspicuous location for each duct detector.

I. Duct detectors shall be installed for the equipment as indicated on plans as follows (locations shown on plans are diagrammatical only):
   1. A minimum of six duct widths downstream from bends or inlets to avoid air turbulence.
   2. On the downstream side of filters to detect fires in the filters.
   3. In return ducts, ahead of mixing areas.
   4. Upstream of air humidifier and cooling coil.
   5. With accessibility for test and service.

J. The following duct detector locations shall be avoided:
1. Where dampers closed for comfort control would interfere with airflow.
2. Next to outside air inlets (unless the intent is to monitor smoke entry from that area).
3. In return air damper branch ducts and mixing areas where airflow may be restricted.

K. Where duct detectors are installed in exterior or wet locations, weatherproof duct housing enclosures shall be provided to protect the detectors. Enclosures shall be located to be in shaded areas rather than direct sunlight. Entire installation shall be as directed by the equipment manufacturer.

2.5 HEAT SENSORS

A. Heat sensors shall be U.L. listed, addressable Simplex type 4098-9733. They shall provide rate-of-rise temperature sensing, fixed temperature sensing (135 degrees F) and utility temperature sensing (32 degrees F to 155 degrees F range).

B. Each sensor base shall be visually and electrically supervised.

C. The sensors shall be listed to UL Standard 268 and shall be documented compatible with the control equipment to which they are connected. The sensors shall be listed for both ceiling and wall mount applications.

D. Each sensor base shall contain integral addressable electronics and an LED that will flash each time it is scanned by the control panel (once every 4 seconds). The control panel shall be responsible for drift compensation. When the control panel determines that a sensor is in an alarm or a trouble condition, the control panel shall command the LED on that sensor's base to turn on steady indicating the abnormal condition. Sensors which do not provide a visible indication of an abnormal condition at the sensor location shall not be acceptable. Sensor bases shall be compatible with detachable photoelectric, ionization and heat sensors so that these various sensor types can be easily interchanged to meet specific location requirements. Sensor base shall be addressable type as required.

E. Where required, sensor bases shall be provided with a relay driver output and supervised relay, which are to be controlled either automatically or manually from the control panel.

F. Each sensor base shall be scanned by the control panel for its type identification to prevent inadvertent substitution of the wrong sensor type. The control panel shall operate with the installed device but shall initiate a "Wrong Device" trouble condition until the proper type is installed or the programmed sensor type is changed.

G. Each sensor shall contain a magnetically actuated test switch to provide for easy alarm testing at the sensor location.

H. The sensor's electronics shall be immune from false alarms caused by EMI and RFI.

I. Heat sensor shall be automatically restorable.

2.6 MAGNETIC DOOR HOLDERS

A. Provide Simplex type 2088 series magnetic door holders as required where shown on plans.

2.7 ALARM SIGNALS (AUDIBLE)

A. Horns:
1. Alarm horns shall be Simplex type 4901-9820. The horns shall be polarized and shall be operated by 24 VDC. Each horn assembly shall include separate wire leads for in/out wiring for each leg of the associated signal circuit. T-tapping of signal device conductors to signal circuit conductors shall NOT be accepted. Where horns are shown as a combination audio-visual assembly, they shall be mounted as a combination unit in a single back box (4903 series) . Horns shall be capable of producing 95 dB.

B. Electronic Chimes:
1. Electronic chimes shall be Simplex type 2902 series. The chime shall be polarized and shall be operated by 24 VDC with a minimum of 82 dB at 10 ft. Adaptors shall allow surface, semi-flush, weather resistance, or audio/visual mounting as shown on the plans.
2. Chimes shall have field adjustable volume control. They shall be provided with four (4) connections to insure properly supervised in/out system connection. Chime shall be U.L. listed for its intended purpose. Where chimes are shown as a combination audible-visual assembly, they shall be mounted as a combination unit with an adapter in a single back box.

C. Devices required to be surface mounted shall be furnished with Simplex type 2975-9145 surface mounting box and 4905-9903 adaptor plate.

D. Devices installed in areas subject to mechanical damage (ie. gymnasiums) shall be furnished with suitable wire guards as indicated on plans.

2.8 ALARM SIGNALS (VISUALS)

A. Visual Flashing Lamps (Xenon Strobe):
1. Furnish and install per plans and specs Simplex type 4904 series visible appliance for fire alarm system notification. The appliance shall be 1HZ synchronized (15cd, 30cd, 110cd) with polar distribution or 75 cd illumination as required by the Americans with Disabilities Act (ADA). The appliance shall be U.L. listed to Standard 1971 and have a circumpolar light output allowing mounting in either vertical or horizontal positions or on the ceiling.
2. The light unit shall be of ABS polycarbonate and the lens of high grade, optical quality LEXAN. For optimized light distribution, the xenon flash tube shall be installed perpendicular to the appliance's back plane. A special compound reflector shall be utilized to maximize and best distribute the light pattern in key axis directions.
3. The effect of the illuminated visible appliance shall be observable in a circumpolar pattern. The visible appliance shall be labeled with the word "FIRE" in a contrasting color and the height of each character shall be a minimum of 5/8 inches. In its quiescent state, the word "FIRE" shall be visible.
4. Mounting heights of visual appliances shall in all respects comply with the Americans with Disabilities Act.
5. Visual indicating appliances shall be Simplex type 4904 series and comprised of a Xenon flashtube and be entirely solid state. These devices shall be U.L. listed and be capable of either ceiling or wall mounting. The LEXAN lens shall be pyramidal in shape to allow better visibility. Visual units shall be of the stand alone type.

2.9 REMOTE ANNUNCIATOR

A. Where shown on the plans, provide and install an LCD annunciator. The annunciator(s) shall have a stainless steel finish and shall provide the same functionality as the main control panel front panel display. The annunciator shall communicate to the control panel over one twisted shielded pair of wire and operating power shall be 24VDC and be fused at the control panel. Point-wired annunciators will not be considered as equal.

B. The serial annunciator shall provide a common alarm and trouble circuit consisting of:
1. Control push-button switches – for alarm silence, trouble silence, system reset and manual evacuation duplicating the control panel switches. A key "enable" switch shall be provided to activate or deactivate the control switches.
2. Tone Alert – Duplicates the control panel tone alert during alarm and trouble conditions.
3. System trouble LED.
4. Power on LED.

C. To accommodate and facilitate job site changes the control switches shall have the capability to be programmed on site to provide for manual switch input operation other than their standard purpose.

2.10 SPRINKLER FLOW SWITCHES

A. Sprinkler flow switches and supervisory switches are provided under another section of these specifications. This contractor shall be responsible for electrical connection of these devices to the fire alarm system.

2.11 SMOKE DAMPERS

A. Smoke dampers are provided under another section. This contractor shall be responsible for supplying a source of power and connecting them to the fire alarm system to close on alarm.

2.12 SYSTEM RECORD DOCUMENT CABINET

A. Furnish and install a documentation cabinet at the system control unit or other approved location. All final record documentation shall be stored in the cabinet. Cabinet shall be labeled as "SYSTEM RECORD DOCUMENTS". Cabinet shall include a 4 gigabyte digital flash drive interface with USB connector loaded with a digital copy of all system documentation including shop drawings and product data.

2.13 OFF SITE MONITORING

A. Furnish all material and labor to accomplish and coordinate with local company or fire department as necessary for off site monitoring of the Fire Alarm System. Transmission method(s) shall be as required by applicable codes and Authority Having Jurisdiction (AHJ). Off site monitoring shall be in operation prior to final acceptance. Exact type of off site monitoring (basic reporting or advanced reporting as described below) shall be provided by the contractor per the owner's direction.

B. Furnish and install serial digital alarm communicating transmitter (DACT), capable of reporting specific alarm points to the central station. DACT shall be universal in that it can be utilized to either provide basic reporting (alarm, trouble, supervisory conditions) or more advanced reporting (point-to-point reporting of specific alarm conditions) DACT shall be mounted integral to or beside fire alarm control panel.

2.14 FIRE ALARM CABLING

1. All fire alarm cabling shall:
   a. Have red outer insulation/jacket with ripcord.
   b. Be listed and labeled for the intended use in Fire Alarm systems.
   c. Where Level 2 or Level 3 pathway survivability is required by NFPA 72, cabling shall be 2-hour fire rated circuit integrity (CI) type.
   d. Be manufactured by West Penn, Allied, Belden or Superior Essex.

2.15 FIRE ALARM SYSTEM MANUFACTURER

A. All equipment shall be listed by UL. All panels and peripheral devices shall be the standard equipment of a single manufacturer and shall display the manufacturer's name on each component. Manufacturer's numbers specified in this section are those of Simplex Time Recorder Company to denote type, quality, material and desired operating features to be furnished.

B. Equipment shall be as manufactured by Simplex, Notifier or EST.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide and install the system in accordance with the plans and specifications, all applicable codes and the manufacturer's recommendations.

B. The contractor shall provide 120VAC power to all remote booster power supplies, control panels, transponder cabinets or other similar items as required. Where the project is provided with emergency power from an emergency generator, all power supplies shall be connected to an emergency source. Dedicated branch circuit(s) shall be provided to supply primary power to the fire alarm system. The associated branch circuit breakers shall be furnished with lock-on hardware and shall be identified with red marking as a fire alarm circuit. The location of the circuit disconnecting means shall be permanently identified at the fire alarm control unit.

C. All wiring shall be installed in strict compliance with all the provisions of NEC - Article 760 Parts I and III, Power-Limited Fire Protective Signaling Circuits or if required may be reclassified as non-power limited and wired in accordance with NEC-Article 760 Parts I and II.

D. All wiring shall be installed in strict compliance with pathway survivability requirements of applicable codes including NFPA 72.

E. Upon completion, the contractor shall so certify in writing to the owner and general contractor.

F. Front surface of all junction box covers in concealed areas (such as above lay-in ceilings) or within mechanical/electrical rooms (and other similar areas where appearance of boxes is not an issue) shall be sprayed red and labeled "Fire Alarm" or “F/A”. Covers in exposed areas shall be labeled “F/A” on interior of front cover. Wiring color code shall be maintained throughout the installation.

G. All fire alarm wiring shall be installed in conduit. Conduit shall be sized per manufacturer’s recommendations, but in no case shall conduit be smaller than 3/4”.

H. Installation of equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate subcontractors.

I. All raceways shall be concealed unless specifically shown or approved otherwise.

J. The contractor shall clean all dirt and debris from the inside and the outside of the fire alarm equipment after completion of the installation.

K. Install System Record Document cabinet adjacent to control panel unless alternate location is approved.

L. The manufacturer's authorized representative shall provide on-site supervision of installation and shall provide all system setup and programming services.

M. The manufacturer’s authorized representative shall have as a minimum, a NICET LEVEL III certification. The fire alarm contractor shall have a technician with a minimum Nicet Level III certification working in a position of responsibility. All technicians working for the certified contractor shall have a minimum Nicet Level II certification. Any fire alarm contractor wishing to bid on the fire alarm work shall show evidence of certifications at the pre-bid conference.

N. The fire alarm contractor shall be licensed as a certified fire alarm contractor by the state in which the work is to be performed in compliance with all requirements of state fire marshall or other AHJ’s as applicable.

O. The drawing/specifications included herein are to indicate contract intent only. The Fire Alarm contractor shall provide final design documents to include plans specifying exact device types/locations, circuitry, battery calculations, circuit/voltage drop calculations, etc. in accordance with all applicable code requirements. These final design documents shall be prepared under the supervision of an engineer licensed in the state where the work is to be performed, engaged/employed by the Fire Alarm contractor, and must bear the engineer’s licensure seal with signature and date.

3.2 TESTING

A. The completed fire alarm system shall be fully tested in accordance with NFPA-72H by the contractor in the presence of the owner's representative and the Local Fire Marshal. Upon completion of a successful test, the contractor shall so certify in writing to the owner and general contractor, and shall submit final testing results with O&M documentation..

B. The contractor shall test and demonstrate proper operation of all smoke detection equipment and associated HVAC controls to the satisfaction of the authority-having-jurisdiction and fire marshal.

3.3 WARRANTY

A. The contractor shall warrant the completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of one (1) year from the date of the completed and certified test or from the date of first beneficial use.

B. The equipment manufacturer shall make available to the owner a maintenance contract proposal to provide a minimum of two (2) inspections and tests per year in compliance with NFPA-72H

guidelines.

3.4 CERTIFICATION & ACCEPTANCE

A. A factory trained representative of the manufacturer shall supervise final testing of the system in accordance with N.F.P.A. Standard 72H-1984 in the presence of a representative of the authority having jurisdiction. Manufacturer's representative shall be NICET trained and shall have a level III NICET certificate. It shall be subject to the approval and acceptance of the responsible engineer. On completion of the acceptance tests, the Owner or his representative shall be instructed in the operation and testing of the system.

B. The fire alarm system shall be free from defects in workmanship and materials, under normal use and service, for a period of one year from the date of acceptance or beneficial occupancy whichever is earlier. Any equipment shown to be defective in workmanship or material shall be repaired, replaced, or adjusted free of charge.

C. The equipment manufacturer shall be represented by a local service organization, and the name of this organization shall be furnished to the Architect and Owner. The service organization shall be located within 50 miles of the job site. The service organization shall furnish, gratis to the Owner, a one year maintenance warranty contract, effective from the date of final acceptance.

END OF SECTION 28 31 00

SECTION 28 78 00

EMERGENCY RESPONDER RADIO COVERAGE SYSTEM

PART 1 - GENERAL

1.1 INITIAL RADIO SIGNAL SURVEY (INCLUDE IN BASE BID)

A. Include all costs in base bid for the Fire Alarm Contractor to conduct a radio signal survey immediately after building structure is complete, and prior to ceiling installation to determine signal coverage and strength of the municipality's emergency responder radio (public safety) system inside the project facility.

B. Conduct a survey using a RF Spectrum Analyzer, a calibrated, system-compatible radio or another suitable instrument with traceable certificate of calibration to analyze the RF signal strength. Both inbound and outbound signal strength shall be determined, measured, calculated and documented as required by code and AHJ. Survey shall be performed by FCC GROL certified technicians. Survey shall include measurements at a minimum of 20 readings per floor or 1,600SF if the floor area exceeds 32,000SF and in all critical areas or as otherwise directed by AHJ.

C. Survey report and drawing indicating measurements at each frequency band of interest shall be submitted to the AHJ for review. The report shall clearly indicate all areas that do not meet a minimum of -95dBm nominal uplink or downlink signal at 100% or a Delivered Audio Quality (DAQ) of 3.0.

D. If measured levels determined to be insufficient, a complete Emergency Responder Radio Coverage (ERRC) system shall be provided in accordance with these specifications below. Cost for the system and installation will be paid through allowance.

E. Contractor shall be responsible for scheduling survey so that all of the following is completed prior to the installation of ceilings:
1. Conduct initial survey
2. Submit survey results and report to the AHJ for review and determination of system requirements
3. Provide system design and submit shop drawings to architect and AHJ for review

1.2 SCOPE (SEE ALLOWANCES)

A. The contractor shall design, furnish, install, and warranty a complete Emergency Responder Radio Coverage (ERRC) system. The installed system shall include all hardware, bi-directional amplifiers, band-pass filters, surge suppressors, lightning protection, UPS, transmission lines, power cabling, antennas, and other components necessary for a complete operational system as specified and as acceptable to the local authorities having jurisdiction.

B. Equipment manufacturer name and model numbers specified are provided to establish quality of equipment and system operational features. Any proposed substitution of equipment from that specified must be approved by the Architect within ten (10) days prior to bid date.

C. The entire system shall be guaranteed for a period of one (1) year from the date of final

acceptance of the installation and the Contractor shall repair or replace defective equipment, during this period, at no cost to the owner.

D. Entire system shall be verified and approved by local AHJ to comply with all emergency responder radio network requirements including signal strength and frequency range.

1.3 DEFINITIONS

A. BDA: Bi-Directional Amplifier is a two-way signal booster that is used to amplify band-selective or multi-band RF signals in the uplink, to the base station and in the downlink from the base station to subscriber devices for enhanced signals and improved coverage.

B. DAS: Distributed Antenna System is a network of separate antenna nodes connected to a common transport medium.

C. ERRC: Emergency Responder Radio Coverage System is a complete in-building radio communication system that brings wireless signals into a structure from outside, amplifies those signals with a signal booster (BDA), and then evenly distributes the amplified signals throughout a structure via a Distributed Antenna System (DAS). The system also amplifies signals originating inside the building and transmits them outside.

D. Donor Antenna: Antenna that receives and transmits signal to radio system outside of facility.

1.4 STANDARDS

A. The system shall comply with all requirements of the latest edition of each of the following codes and standards. The latest edition of these codes and standards form a part of this specification:
1. U.L. Standard 2524.
2. International Fire Code Section 510
3. NFPA 1221
4. NFPA 72
5. All requirements of local Fire Department, Building Department and all other authorities having jurisdiction (AHJ)

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For headend and distribution system. Include plans, elevations, sections, details and attachments to other work.
1. Show fabrication and installation details for equipment.
2. Functional Block Diagram: Show single-line interconnections between components for headend and distribution system. Show cable types and sizes.
3. Dimensioned Plan and Elevations of Headend Equipment: Show access and workspace requirements.
4. Wiring Diagrams: For power, signal, and control wiring and transmission cable, include cross connects, taps, and other connections cords.

C. Design Calculations: Calculate signal attenuation budget and show calculated line and equipment losses for the system based on the functional block diagram, to show that proposed

system layout can be expected to perform up to specification. Calculate signal strength from sources to endpoints. Allowable losses between components and user interface shall be used to determine size and type of cable.

D. Coordination Drawings: Include dimensioned plan and elevation views of components and enclosures. Show access and workspace requirements.

E. Equipment List: Include each piece of equipment and include model number, manufacturer, serial number, location, and date of original installation. Insert testing record of each piece of adjustable equipment, listing name of person testing, date of test, and description of as-left set points.

F. Field quality-control reports.

G. Operation and Maintenance Data: For headend and distribution system to include in emergency, operation, and maintenance manuals.

H. Contract shall submit set of all drawings and product data to permitting agencies as required. These final design documents shall be prepared under the supervision of an engineer licensed in the state where the work is to be performed, engaged/employed by the system vendor, and must bear the engineer's licensure seal with signature and date.

I. Any permits necessary for the installation of the work shall be obtained prior to the commencement of the work. All permit costs and inspection fees shall be included.

J.

PART 2 - PRODUCTS

2.1 RADIO FREQUENCY (RF) BDA-BASED SIGNAL BOOSTER SYSTEMS

A. In-building signal booster systems shall receive and re-transmit the entire uplink/downlink frequency band utilized by the regional emergency service provider(s)**.** The contractor shall confirm with the regional emergency service provider(s) as to the specific frequencies used by the various agencies. This system shall be state-of-the-art, operating bi-directionally and in full duplex. The system shall be fully compatible with and function on Locality's Public Safety Radio System.

B. BDA shall be capable of providing in building coverage for all the cellular networks as identified by the owner.

C. Signal boosters (BDA)
1. Shall have Nema Type 4 enclosure
2. Shall be UL2524 listed
3. Shall be FCC certification.
4. Provide standby battery system capable of maintaining the system operational for a minimum of 12 hours or 2 hours if supplied by emergency generator circuit. Batteries system shall be completely enclosed in Nema Type 4 enclosure.
5. Signal Boosters shall have oscillation suppression circuitry to protect the public safety radio system in case of system malfunction or other causes. The oscillation suppression circuit

shall not disable the system operation. Systems that automatically disable the signal booster upon oscillation detection shall not be allowed

6. Signal Boosters shall have uplink noise suppression function to eliminate uplink noise while in standby (i.e. no radio transmission from within a building).
7. Include relays as required for monitoring system with fire alarm system.

D. DAS Antennas shall be architectural, dome or flush type where located in public areas. Stick type antennas are acceptable where located in back-of-house spaces. Finish shall be white unless directed otherwise by architect in submittal review.

E. A dedicated supervised monitoring panel shall be provided next to the fire alarm panel / annunciator or other location as designated by AHJ to annunciate the status of all signal booster locations. The monitoring panel shall provide visual and labeled indication of the following for each signal booster:

1. Normal AC power
2. Signal booster trouble
3. Antenna Failure
4. Loss of normal AC power
5. Failure of battery charger
6. Low battery capacity

F. Completed installations (including cabling) shall comply with all applicable codes and standards, including County Building and Electrical Codes, NFPA, ANSI, NEC, OSHA, EIA, IEEE, R-56, etc., as well as the FCC Rules and Regulations, as applicable. Equipment provided shall be UL listed and FCC type accepted for this specific application. Compliance to codes and standards shall extend to include proper grounding, bonding and surge.

G. All cabling shall be plenum rated.

2.2 DESIGN REQUIREMENTS:

A. The system shall provide digital signal strength coverage over 95% area on each floor/level of the equipped building, or in specific areas defined by Locality in a Scope of Work document for a particular building or site. Critical areas shall have 99% floor area coverage.

B. Systems shall provide a minimum digital and analog overage of Circuit Merit (CM) 3 and Delivered Audio Quality (DAQ) 3.0, with a reliability factor of 95%.

C. Antenna isolation shall be maintained between the donor antenna and all inside antennas (D.A.S.) to a minimum of 20dB under all operating conditions

D. A Coverage Acceptance Test shall be executed prior to final acceptance of an installed system. Coverage acceptance testing shall be based on audio quality performance in evenly spaced test grids in the defined service areas. A minimum of 20 tests will be taken per floor/level. Total number of test grids will be determined by the Owner, based on the size of the space per floor/level.

E. Design and appearance will be of “finished” construction, i.e. shall be concealed and/or unobtrusive in finished areas. DAS antennas shall be located in back-of-house areas where possible. If required to be located in visible public aeras, antennas shall be architectural, low-

profile type and located in corridors where possible. Unless indicated otherwise, wire mold and surface conduit installations will not be acceptable unless approved in writing by the Architect in advance.

2.3 MANUFACTURER

A. Equipment shall be as manufactured by Simplex, Notifier or EST or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wiring shall be in strict accordance with the National Electrical Code and all state and local regulations. Wiring shall be installed in accordance with manufacturer's wiring diagrams and shall test free from ground, opens and short circuits.

B. All connections shall be made under the direct supervision of a qualified technician.

C. Contractor shall provide dedicated power circuits as required for system operation. Where an emergency distribution system is provided, radio coverage system power shall be connected to the emergency branch.

D. All vertical riser cabling shall be installed in conduit within a 2-hour fire rated enclosure.

E. All copper circuits routed between or outside of buildings shall be provided with a surge protection device at each end.

F. Securely mount donor antenna on roof and aim towards direction of public safety city repeater antenna. All mounting and penetrations shall be coordinated with roofing contractor.

G. Contractor shall provide all devices and cabling as required to monitor system with building Fire Alarm System in accordance with all applicable code requirements.

H. Refer to Specification Section 27 05 00 for additional installation requirements.

I. During initial installation, each system shall be optimized to perform in accordance with the specifications set forth in the system design, manufacturer's specifications and FCC regulations. The contractor shall ensure that uplink and downlink levels are properly set and consistent with design expectations. The contractor shall further ensure that noise and spurious products are held within limits set forth in the system design, manufacturer's specifications and FCC regulations. Prior to system acceptance, for each active BDA, booster amplifier, etc., the contractor shall submit a Proof of Performance certification, that lists the design expectations, actual measurements, and if applicable, FCC specifications for the following parameters:
   1. Worst case BDA uplink input level, in dBm.
   2. Worst case BDA uplink output level, in dBm.
   3. BDA downlink input level, in dBm.
   4. BDA downlink output level, in dBm.
   5. Noise and spurious products, BDA uplink output, in dBc.
   6. Noise and spurious products, BDA downlink output, in dBc.

J. The original Proof of Performance report shall be submitted to Owner's project manager, and a copy of the Proof of Performance report shall be affixed to its associated equipment.

3.2 WARRANTY

A. The contractor shall provide a full one-year warranty to cover installation and all equipment, software, and components; the warranty shall commence upon the Owner's final acceptance of the facility. Under warranty coverage, the successful contractor shall provide same business day response time for system malfunctions.

B. The contractor shall perform optimization of each system during the initial warranty period, sixty (60) to ninety (90) days prior to warranty expiration. This optimization task is separate from the initial optimization performed during system installation. The contractor shall include pricing for annual system optimization to be included as part of post-warranty maintenance. Actual scope of work for annual optimization and maintenance will vary on a case-by-case basis, but typically will consist of the following:
   1. Optimize the system to perform in accordance with the specifications set forth in the system design, manufacturer's specifications and FCC regulations.
   2. Ensure that uplink and downlink levels are properly set and are consistent with design specifications.
   3. Ensure that noise and spurious products are held within limits set forth in the system design, manufacturer's specifications and FCC regulations.

C. Update the Proof of Performance records for the system, listing the design expectations, actual measurements, and if applicable, FCC specifications for the following parameters:
   1. Worst case BDA uplink input level, in dBm.
   2. Worst case BDA uplink output level, in dBm.
   3. BDA downlink input level, in dBm.
   4. BDA downlink output level, in dBm.
   5. Noise and spurious products, BDA uplink output, in dBc.
   6. Noise and spurious products, BDA downlink output, in dBc.

D. The updated Proof of Performance report shall be submitted to the Owner, and a copy of the updated Proof of Performance report shall be affixed to its associated equipment.

E. Visually inspect outside antenna installation. Correct any issues found with the antenna mounting hardware, grounding system, or outside cabling.

F. Visually inspect inside BDA or booster amplifier equipment installation. Correct any issues found with RF cabling, electrical connection, or equipment mounting.

G. Clean equipment fans, filters and other ventilation system components.

H. Inspect and replace any defective indicator lights.

I. Test battery system performance for proper fallback to battery power and the duration of battery operation.

J. Test fault reporting system for proper operation and reporting of system faults.

K. Submit a written Preventive Maintenance Report to the Owner, listing the results of the optimization and preventive maintenance effort. The report shall include the Proof of Performance report for active RF components, and details of any other discrepancies found and corrective actions taken.

L. All as-built drawings shall be submitted to the Owner at completion, which shall include antenna system layout and all associated hardware, along with specification sheets. Include RF measurements taken.

END OF SECTION 28 78 00

AIR DIRT SEPARATOR SCHEDULE

MARK	SYSTEM	TYPE	MAX FLOW (GPM)	MAX PRESSURE DROP (PSIG)	MAX VELOCITY (FPS)	MINIMUM FLANGE SIZE	ACCESSORIES	BASIS OF DESIGN (ARMSTRONG)
ADS-CH	CHILLED WATER SYSTEM	[A]	191	1.0 PSIG	6 FPS	4"	[1] [2] [3] [4] [5]	DAS-4-R

TYPE:

[A] STANDARD VELOCITY UNIT

NOTE:

1. UNIT SHALL BE ASME RATED (125 PSI)
2. REMOVE 99% DISOLVED OXYGEN AND 100% OF ENTRAINED AIR AFTER 10 PASSES

ACCESSORIES:

[1] BLOW DOWN WITH BRONZE BALL VALVE (STAINLESS STEEL BALL)

[2] SKIM VALVE WITH BRONZE BALL VALVE (STAINLESS STEEL BALL)

[3] STAINLESS STEEL COALESCING MEDIA

[4] HIGH CAPACITY AUTOMATIC AIR VENT

[5] REMOVABLE BOTTOM HEAD

FAN SCHEDULE

MARK	SERVES	LOCATION	TYPE	CFM	E.S.P. IN. W.G.	LIMIT	MOTOR HP	MOTOR V/Ø	ACCESSORIES	INTERLOCK	BASIS OF DESIGN (GREENHECK)
EF-1	SEE PLANS	CORRIDOR	A	2850	0.8	13.9 SONES	1.0	115/1	[1] [2] [3] [4] [5] [6] [7] [8] [9]	AHU-1/BAS	SQ-160-VG

FAN TYPES:

[A] INLINE CENTRIFUGAL EXHAUST FAN, DIRECT DRIVE

FAN ACCESSORIES:

[1] BACKDRAFT DAMPER

[2] FLEXIBLE CONNECTORS

[3] SPRING ISOLATORS

[4] MOTOR SIDE GUARD

[5] BEARING WITH GREASE FITTING

[6] THERMAL OVERLOAD PROTECTION

[7] PREWIRED DISCONNECT SWITCH

[8] ECM MOTOR WITH UNIT MOUNTED CONTROLLER (VARI-GREEN)

[9] ACOUSTICAL HOUSING

FAN SCHEDULE NOTES:

1. LIMIT = DESIGN CRITERIA: MAX. SONES

AHU SCHEDULE

MARK	SERVES	TYPE	SUPPLY FAN CFM	SUPPLY FAN E.S.P. IN. W.G.	SUPPLY FAN MIN. OSA CFM	SUPPLY FAN MOTOR HP	SUPPLY FAN MOTOR V/Ø	SUPPLY FAN MOTOR MCA	SUPPLY FAN MOTOR MOCP	COOLING COIL CFM	COOLING COIL AIR ENT. °Fdb	COOLING COIL AIR ENT. °Fwb	COOLING COIL AIR LVG. °Fdb	COOLING COIL AIR LVG. °Fwb	COOLING COIL GPM	COOLING COIL EWT (°F)	COOLING COIL MAX FACE VEL. (FPM)	COOLING COIL # OF COILS	HEATING COIL CFM	HEATING COIL KW	HEATING COIL MAX FACE VEL. (FPM)	HEATING COIL EAT (°F)	HEATING COIL LAT (°F)	HEATING COIL ELEC. HEATER MCA	HEATING COIL ELEC. HEATER MOCP	FILTERS	ACCESSORIES	BASIS OF DESIGN
AHU-1	OFFICES	I	38000	2.5	6100	(4) @ 15 HP EACH	460/3	89.9	110	38000	78.6	62.8	52.0	51.9	200.0	45.0	580	2	38000	180	607	25	40	226	250	[A]	[1] [2] [3] [4] [5] [6] [7] [8] [9] [10] [11] [12] [13] [14] [15] [16] [17]	CSAA066

TYPES:

I: MODULAR VARIABLE VOLUME, HORIZONTAL DRAW THROUGH WITH INTERNAL FAN ISOLATION. DIRECT DRIVE PLENUM FANWALL.

NOTES:

A. SCHEDULED SUPPLY FAN EXTERNAL PRESSURE DOES NOT INCLUDE THE FOLLOWING AIR PRESSURE DROPS IN, "WG":
PRE FILTER: ALL UNITS = 1.00" (CHANGEOUT)
FINAL FILTERS: ALL UNITS = 1.50" (CHANGEOUT)

B. MAXIMUM COOLING COIL WATER PRESSURE DROP = 15 FT.

C. MAX COIL FACE VELOCITY = 500FPM

D. COILS TO BE A MAX FPF = 120, UNLESS REQUIRED NUMBER OF ROWS EXCEEDS 8.

E. EXTERNAL STATIC PRESSURE DOES NOT INCLUDE COILS

F. COOLING CAPACITY BASED ON 45°F ENT. WATER W/ ΔT=15°F

FILTER TYPES: (SEE SPECS.)

[A] 2" THICK PLEATED MERV 8 (100%) FILTERS - ANGLE FRAME & SIDE ACCESS

GENERAL NOTES:

1. MAX DISCHARGE AIR TEMP. (LEAVING UNIT) = 54.5°F.

ACCESSORIES:

[1] VARIABLE FREQUENCY DRIVE (SUPPLY FAN) - UNIT MOUNTED

[2] 2" DOUBLE WALL CONSTRUCTION W/ R-13 INSULATION

[3] FLEX CONNECTIONS AT SUPPLY AND RETURN W/ COPPER JUMPERS

[4] DIRECT DRIVE SUPPLY FANWALL

[5] FAN WALL (EACH FAN CUBE TO HAVE INDEPENDENT BACKDRAFT DAMPER)

[6] COOLING COIL SECTION WITH TYPE 304 S.S. COIL CASING AND S.S. DOUBLE WALL DRAIN PAN

[7] HINGED ACCESS DOORS IN ALL SECTIONS

[8] EACH FAN SECTION TO BE SINGLE POINT WIRING CONNECTION.

[9] PIEZOMETER FAN INLET AFM WITH TRANSMITTER & LCD READOUT (SA)

[10] SERVICE LIGHTS IN ALL ACCESS SECTIONS SHOWN WIRED TO COMMON SWITCH WITH PILOT LIGHT AT FAN ACCESS DOOR.

[11] ALUMINUM TREAD PLATE FLOORING IN ALL ACCESS SECTIONS

[12] COOLING COIL SECTION TO BE PROVIDED WITH UV LIGHT (BY UNIT MFR.)

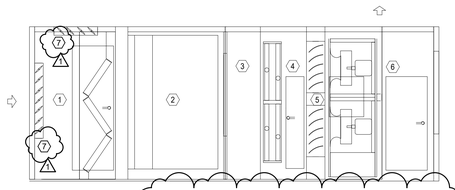
[13] FAN SECTION ACCESS DOOR SAFETY SWITCH

[14] FAN WALL MOTOR SAFETY SCREEN

[15] 6" HIGH BASE RAIL (MIN.)

[16] UNIT MOUNTED RETURN AIR CONTROL DAMPER

[17] UNIT MUST BE ASSEMBLED ONSITE BY MECHANICAL CONTRACTOR. ALL PIECES MUST FIT THROUGH A STANDARD 36" DOOR.



AHU SECTION DESIGNATION

SECTION	REMARK
1	MIXING SECTION W/ANGLE FILTER AND ACCESS DOOR
2	PRE-HEAT COIL SECTION
3	MIXING SECTION
4	CHILLED WATER COOLING COIL SECTION AND ACCESS DOOR
5	BACKDRAFT DAMPER
6	DIRECT DRIVE FAN SECTION WITH ACCESS DOOR
7	UNIT MOUNTED CONTROL DAMPER

NOTE: FACTORY PROVIDED & INSTALLED MARINE LIGHT IN ALL ACCESS SECTIONS.

AIR DEVICE LEGEND

MARK	TYPE	LEGEND	RUNOUT	REMARKS	MFG / MODEL
ACD(X) CFM	ARCHITECTURAL SQUARE PLAQUE DIFFUSER	X = ROUND NECK SIZE 4-WAY THROW	ROUND RUNOUT = NECK SIZE		TITUS / OMNI LAY-IN BORDER
E(X) CFM/FD	ALUMINUM CUBE CORE REGISTER (1/2"X1/2"X1/2")	E = EXHAUST R = RETURN T = TRANSFER X = SQUARE NECK SIZE	SEE PLANS	OBD OMIT OBD ON T'S AND UNDUCTED R'S	TITUS / 50F, ALUMINUM BORDER

AIR DEVICE SCHEDULE NOTES

1. CFM = AIR FLOW (TYPICAL ALL AIR DEVICES).
2. COORDINATE BORDER/FRAME TYPE WITH ARCH REFLECTED CEILING PLAN.
3. DIRECTION ARROWS ON DRAWINGS SHOW FLOW PATTERN.
4. USE SUPPLY DIFFUSERS WITH O.B.D. IN DRYWALL OR INACCESSIBLE CEILINGS.
5. USE SUPPLY DIFFUSERS WITHOUT O.B.D. IN LAY-IN OR ACCESSIBLE CEILINGS.

ONE LINE PIPE SYMBOLS

CHS	CHILLED WATER SUPPLY
CHR	CHILLED WATER RETURN
D	CONDENSATE DRAIN
	BALL VALVE
	BUTTERFLY VALVE (LEVER HANDLE)
	BUTTERFLY VALVE (GEAR OPERATOR)
	GLOBE VALVE
	CHECK VALVE (SWING CHECK)
	CHECK VALVE (BUTTERFLY CHECK)
	CALIBRATED BALANCING VALVE
	VALVE AT RISER
	STRAINER W/ DRAIN VALVE
	UNION
	AIR TERMINAL / FAN COIL UNIT/HOT WATER RETURN CONTROL VALVE (2-WAY) ELECTRIC OR ELECTRONIC
	AIR TERMINAL / FAN COIL UNIT CONTROL VALVE (3-WAY) ELECTRIC OR ELECTRONIC
	CONTROL VALVE (2-WAY) ELECTRIC OR ELECTRONIC
	CONTROL VALVE (3-WAY) ELECTRIC OR ELECTRONIC

ONE LINE PIPE SYMBOLS

	CONTROL VALVE (3-WAY) ELECTRIC OR ELECTRONIC
	EMERGENCY SHUT-OFF VALVE WITH FUSIBLE LINK
	FLEXIBLE PIPE CONNECTOR
	METAL BELLOWS PUMP CONNECTOR
H	AIR VENT (A - AUTO, H - HAND)
	PRESSURE AND TEMPERATURE TAP
	PRESSURE GAUGE
	PRESSURE GAUGE W/ SIPHON
	THERMOMETER W/ INSERTION WELL
	ANCHOR
	PIPE GUIDE
	FLANGE
	ELBOW, TURNED UP
	ELBOW, TURNED DOWN
	RISE OR DROP IN PIPE
	ELBOW
	TEE, SIDE CONNECTION
	TEE, OUTLET UP
	TEE, OUTLET DOWN
	CAPPED OUTLET
	CAPPED PIPE
	CONCENTRIC REDUCER
	ECCENTRIC REDUCER
	DIRECTION OF PITCH
TFD	PIPE TO FLOOR DRAIN
EMS	EMERGENCY MANAGEMENT SYSTEM INSERTION WELL

TWO LINE PIPE SYMBOLS

	ELBOW - FLANGED LONG RADIUS 45°
	ELBOW - FLANGED LONG RADIUS 90°
	ELBOW - WELDED LONG RADIUS 45°
	ELBOW - WELDED LONG RADIUS 90°
	END CAP
	FLANGES - SLIP ON
	FLANGES - WELD NECK
	REDUCERS - FLANGED CONCENTRIC
	REDUCERS - FLANGED ECCENTRIC
	REDUCERS - WELDED CONCENTRIC
	REDUCERS - WELDED ECCENTRIC
	TEE - FLANGED
	TEE - WELDED
	BUTTERFLY VALVE - LEVER OPERATOR
	BUTTERFLY VALVE - WORM GEAR OPERATOR
	BUTTERFLY VALVE - ACTUATOR
	CHECK VALVE - SWING CHECK
	CHECK VALVE - SILENT OR WAFER
	GLOBE VALVE
	STRAINER - Y
	FLEXIBLE CONNECTORS

DUCTWORK SYMBOLS

T	THERMOSTAT
	THERMOSTAT WIRING
H	HUMIDISTAT
TS	TEMPERATURE SENSOR
FM	GPM FLUID FLOW METER
SA	SUPPLY AIR DUCT
RA	RETURN AIR DUCT
EA	EXHAUST AIR DUCT
CFM	CUBIC FEET PER MINUTE
EMS	ENERGY MANAGEMENT SYSTEM
ATC	AUTOMATIC TEMP CONTROLS
CO2	CARBON DIOXIDE
PPM	PARTS PER MILLION
Ø	ROUND DIAMETER
	SHORT (1x) RADIUS ELL (RECTANGULAR OR ROUND) CENTERLINE RADIUS = 1d
	LONG (1.5x) RADIUS ELL (ROUND OR OVAL) CENTERLINE RADIUS = 1.5d
	SQUARE ELL
	ELL WITH TURNING VANES
	STREAMLINE TAP (RECTANGULAR)
Ø	STREAMLINE TAP (ROUND)
Ø	CONICAL TAP
	STRAIGHT TAP
	LATERAL TAP
	MANUAL VOLUME DAMPER
M	MOTORIZED VOLUME DAMPER
FD	FIRE DAMPER (FD)
FD	VERTICAL FIRE DAMPER (FD)
S	SMOKE DAMPER
S FD/S	COMBINATION FIRE / SMOKE DAMPER (FD/S)
20/12	RECTANGULAR DUCT (WIDTH/DEPTH)
	ROUND DUCT OFFSET
RISE	CHANGE IN ELEVATION ("R"-RISE, "F"-FALL)
	FLEXIBLE DUCT
	SUPPLY DUCT UP
	RETURN DUCT UP
	EXHAUST DUCT UP
	SUPPLY DUCT DOWN
	RETURN DUCT DOWN
	EXHAUST DUCT DOWN
	CEILING DIFFUSER
	RETURN AIR GRILLE
	EXHAUST AIR GRILLE
AP	ACCESS PANEL
AP	ACCESS PANEL IN ROUND OR OVAL DUCT

GMC
2400 5th Avenue South, Suite 200
Birmingham, AL 35233
T 205.879.4462
GMCNETWORK.COM
Bernhard TME Engineering

ISSUE | DATE | DRAWN BY: | CHECKED BY:
100% CD | 2024.09.09 | CBO | JDD
ADDENDUM 2 | 2024.10.07

TUSCALOOSA COUNTY DHR
PROJECT ADDRESS

GMC # ABHM220021

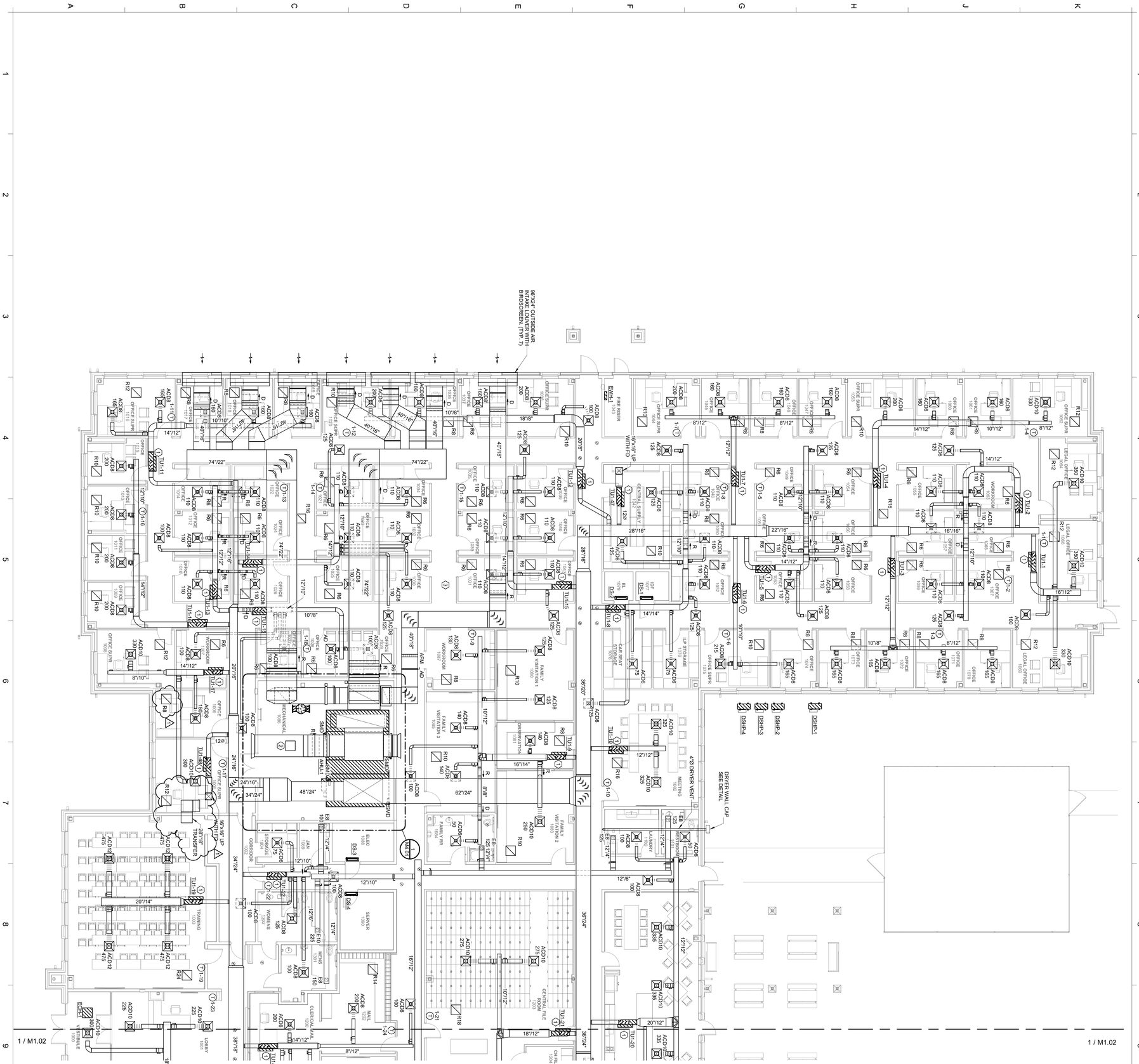
ALABAMA LICENSED No. 34357 PROFESSIONAL ENGINEER HAROLD D. DEERMAN
10/07/24

SCHEDULES AND LEGEND - HVAC

M0.01

sheet 1 of

10/3/2024 8:53:29 PM TEMPLATE VERSION: 2021.1



PARTIAL FLOOR PLAN A LEVEL 1 - HVAC DUCTWORK

SCALE: 1/8" = 1'-0"

TRUE NORTH

KEYED NOTES:

1. PROVIDE A MINIMUM CLEARANCE OF 5'-0" FOR MAINTENANCE ACCESSIBILITY AND ELECTRICAL CLEARANCE PER THE NATIONAL ELECTRIC CODE.
2. 24"/24" UP TO ATTIC WITH FD.
3. INDOOR BUILDING PRESSURE PICKUP LOCATION.

PARTIAL FLOOR PLAN A LEVEL 1 - HVAC DUCTWORK

M1.01

sheet of

10/07/24

ALABAMA LICENSED PROFESSIONAL ENGINEER JOHN D. DEERMAN No. 34057

TUSCALOOSA COUNTY DHR

PROJECT ADDRESS

GMC # ABHM220021

ISSUE	DATE
100% CD	2024.09.09
1 ADDENDUM 2	2024.10.07

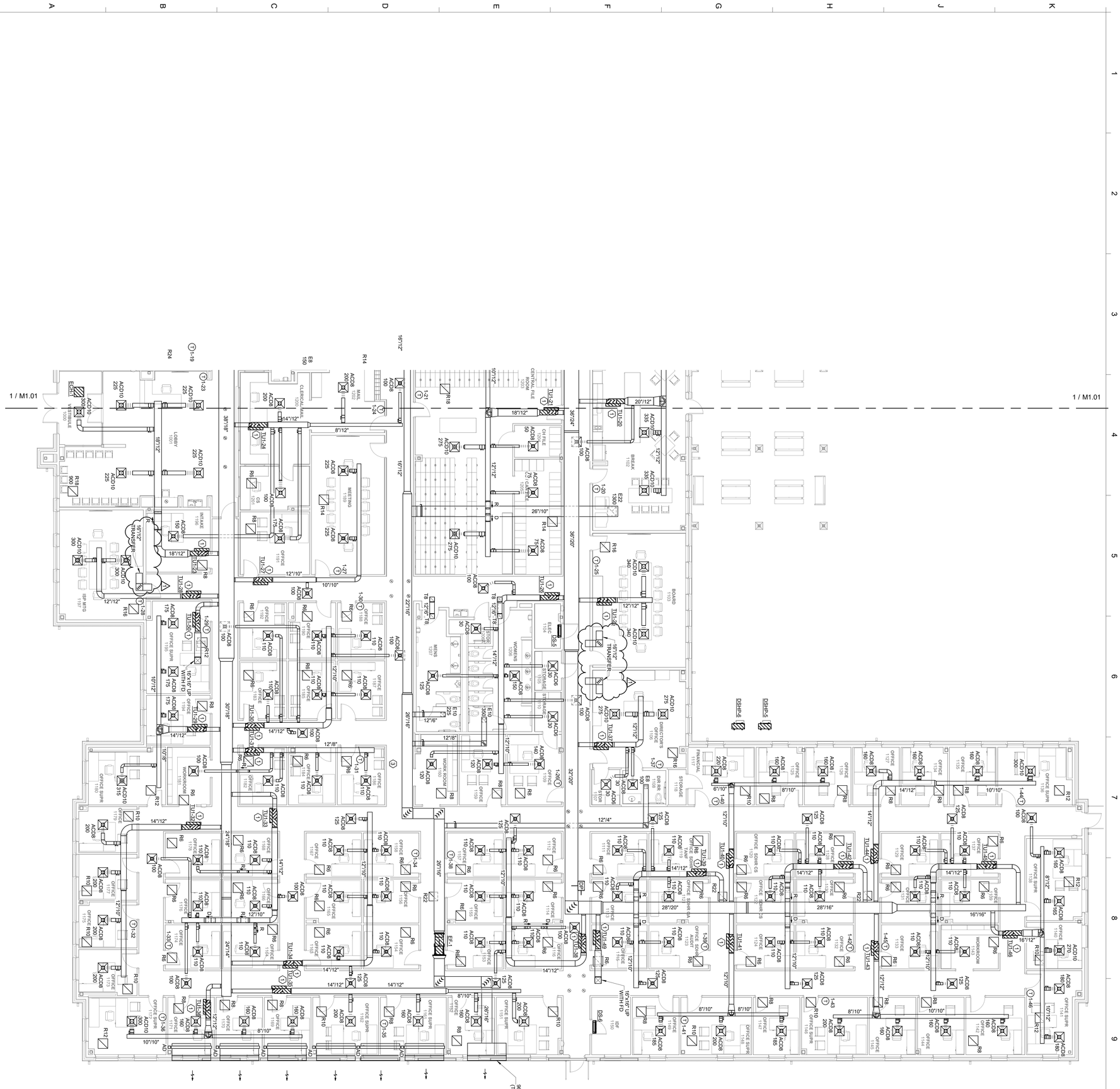
DRAWN BY: CBO

CHECKED BY: JDD

Bernhard TME Engineering

2400 5th Avenue South, Suite 200
Birmingham, AL 35233
T 205.879.4462
GMCNETWORK.COM

GMC



1 PARTIAL FLOOR PLAN B LEVEL 1 - HVAC DUCTWORK

SCALE: 1/8" = 1'-0"

TRUE NORTH

KEYED NOTES:

1. PROVIDE A MINIMUM CLEARANCE OF 3'-0" FOR MAINTENANCE ACCESSIBILITY AND ELECTRICAL CLEARANCE PER THE NATIONAL ELECTRIC CODE.
2. MAINTAIN A MINIMUM CLEARANCE OF 4'-0" IN FRONT OF CHILLER CONTROL PANEL
3. INDOOR BUILDING PRESSURE PICKUP LOCATION

PARTIAL FLOOR PLAN B LEVEL 1 - HVAC DUCTWORK

M1.02

sheet of

ALABAMA LICENSED PROFESSIONAL ENGINEER No. 34657 MARCO D. DEERMAN 10/07/24

TUSCALOOSA COUNTY DHR

PROJECT ADDRESS

GMC # ABHM220021

	ISSUE	DATE
	100% CD	2024.09.09
1	ADDENDUM 2	2024.10.07

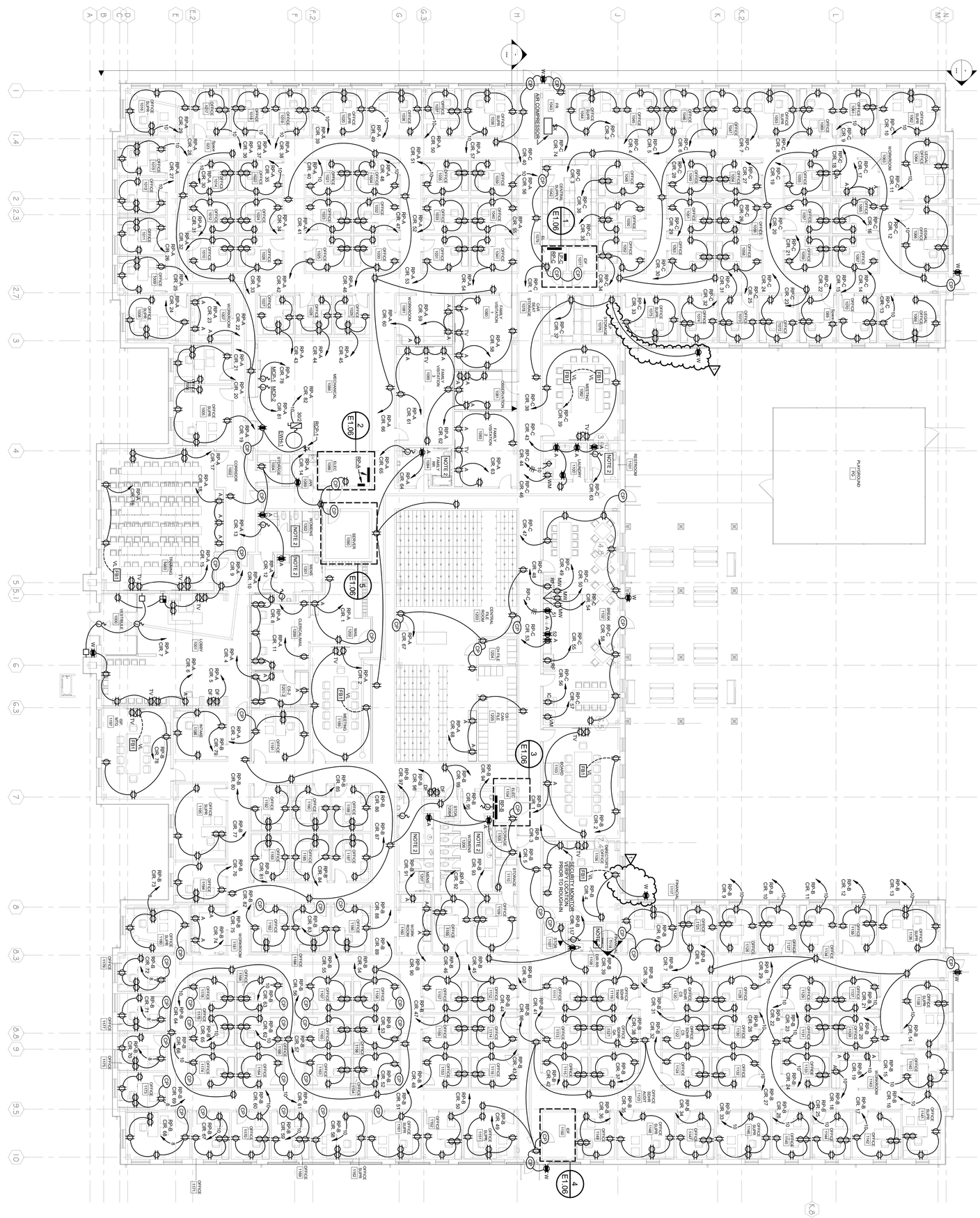
DRAWN BY: CBO

CHECKED BY: JDD

Bernhard TME Engineering

2400 5th Avenue South, Suite 200
Birmingham, AL 35233
T 205.879.4462
GMCNETWORK.COM

GMC



NORTH

LEVEL 1 POWER PLAN

SCALE: 3/32" = 1'-0"

NOTES THIS SHEET ONLY

1. CONTRACTOR SHALL CONNECT IRRIGATION CONTROLLER TO NEAREST 120V CIRCUIT. SEE LANDSCAPE DRAWINGS FOR EXACT LOCATION.
2. PROVIDE POWER TO ELECTRIC WATER HEATER. PROVIDE TIMER TRANSFORMER TO SUPPLY 12V LOW VOLTAGE POWER TO EACH FAUCET / SIGNAL AND TOILET. PROVIDE LOW VOLTAGE WIRING AS REQUIRED FROM TRANSFORMER TO EACH PLUMBING SENSOR. CONNECT TRANSFORMER PRIMARY DOWNSTREAM OF GFCI RECEPTACLE IN EACH RESTROOM.

JACKSON, RENFRO & ASSOCIATES, INC.
ENGINEERS • PLANNERS
141 TUSCALOOSA STREET • SUITE 1 • BIRMINGHAM, ALABAMA • 35242
ROBERT RENFRO, PE
TUSCALOOSA, AL
(O) 205.538.7207
(F) 205.538.7208
JRA JOB NO. 23246

POWER PLAN

E1.02

sheet of

PROFESSIONAL ENGINEER ROBERT C. RENFRO No. 24651 ALABAMA LICENSED 10.07.24

TUSCALOOSA COUNTY DHR

PROJECT ADDRESS

GMC # ABHM220021

SBC # [ENTER VALUE]

ISSUE	DATE
BID SET	09/09/2024
1 ADDENDUM 2	10/07/2024
DRAWN BY:	SNJ
CHECKED BY:	RCR

2400 5th Avenue South, Suite 200
Birmingham, AL 35233
T 205.879.4462
GMCNETWORK.COM

GMC