SECTION 26 2213

TRANSFORMERS

PART I GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 0100: Common Work Results for Electrical

B. Section 26 0526: Grounding and Bonding for Electrical Systems

C. Section 26 0529: Supporting Devices

D. Section 26 0533: Raceways, Fittings, and Boxes

E. Section 26 0553: Identification for Electrical Systems

F. Section 26 0560: Concrete Pads for Electrical Equipment

G. ANSI/NEMA ST20 Standards - Dry type transformers for general applications.

H. DOE 2016 Standards

I. Minnesota Energy Code section of the MN State Building Code

J. Transformers (NEC Article 450).

K. Comply with UL 1561.

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 0105: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Include outline and support point dimensions of enclosures, unit weight, voltage, kVA, impedance, loss data, efficiency (at 25, 50, 75 and 100 percent of rated load), tap configurations, insulation system type and rated temperature rise.

C. Submit certified audible sound level test reports for each size and type of transformer.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store and protect equipment in a warm, dry location with uniform temperature. Cover ventilation openings to protect from dust and water.

B. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, and snow if handled in inclement weather.

PART 2 EQUIPMENT

2.1 STANDARD DISTRIBUTION TRANSFORMERS

A. Provide ventilated, indoor, dry-type distribution transformer with the capacity and voltage characteristics indicated on the Drawings. Provide transformers 15 kVA and above designed to operate with a maximum 150 degrees C. Temperature rise above 40 degrees C. ambient. Provide all insulating materials for a 220 degrees C. insulation system.

B. Provide transformers meeting or exceeding DOE 2016 efficiency requirements. Provide transformers with efficiencies listed below:

KVA (Three Phase)	DOE 2016 Standards
15 kVA	97.89
30 kVA	98.23
45 kVA	98.40
75 kVA	98.60
112.5 kVA	98.74
150 kVA	98.83
225 kVA	98.94
300 kVA	99.02
500 kVA	99.14
750 kVA	99.23
1000 kVA	99.28

Note: All efficiency values are at 35 percent of nameplate-rated load, determined according to the DOE Test Method for Measuring the Energy Consumption of Distribution Transformers under Appendix A to Subpart K of 10 CFR part 431.

C. Provide voltage taps as indicated below:

1. Provide two 5% FCBN taps for all single and 3 phase transformers 9 kVA and below.
2. Provide two 2 1/2% FCBN and two 2 1/2% FCAN taps for all 3 phase transformers 15 kVA and below.
3. Provide four 2 1/2% FCBN and two 2 1/2% FCAN taps for all 3 phase transformers above 15 kVA.

D. Provide sound ratings not exceeding the following levels:

1. 0 to 15 kVA, 40 dBA.
2. 15 to 50 kVA, 45 dBA.
3. 50 to 150 kVA, 50 dBA.
4. 151 to 300 kVA, 55 dBA.
5. 301 to 500 kVA, 60 dBA.
6. 501 to 750 kVA, 62 dBA.

E. Provide continuous copper or aluminum coil conductors with brazed or welded terminations.

F. Isolate transformer core and coil from the enclosure using vibration - absorbing mounts.

G. Provide transformers 75 kVA or less with enclosures suitable for wall, floor or trapeze mounting. Provide transformer larger than 75 kVA with enclosures suitable for floor or trapeze mounting.

H. Provide maximum case temperatures not exceeding a 35C temperature rise above a 40 degree C ambient.

I. Acceptable manufacturers:

1. Cutler Hammer
2. General Electric
3. Sorgel
4. Sola Hevi-Duty

5. Jefferson Electric
6. Siemens
7. Square D
8. Hammond
9. Pre-approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide all brackets, hangers, and trapezes required to mount the unit. Support all suspended and all bracket mounted units from the building structure. Coordinate strength of wall for all wall mounted units. Refer to Section 26 0529: “Supporting Devices” for additional requirements.

B. Transformers over 50kVA shall not be mounted above ceilings.

C. Place all transformers on elastomer isolator pads.

D. Make all connections to transformer using flexible conduit and maintain grounding continuity.

E. Provide terminal lugs listed for use with conductors rated 75° or higher.

F. Provide 6” clearance around transformers.

G. Do not obstruct transformer ventilation openings nor mount within 12" of a roof deck. Maintain at least 12” space around transformer, or more if recommended in the manufacturer’s installation instructions.

H. Provide grounding of the transformer per Section 26 0526: “Grounding and Bonding for Electrical Systems”.

I. Provide concrete pad for all floor-mounted transformers per Section 26 0560: “Concrete Pads for Electrical Equipment”.

3.2 IDENTIFICATION

A. Provide permanently-installed nameplates on each transformer per Section 26 0553 “Identification for Electrical Systems”.

B. Where the installed transformer is located remotely from its primary disconnecting means, provide permanent labeling indicating location of primary disconnect per NEC 450.14. Provide lockable disconnecting means as required per NEC 450.14.

3.3 FIELD QUALITY CONTROL

A. Check for damage and tight connections prior to energizing transformer.

B. Measure primary and secondary voltages and make appropriate tap adjustments.

3.4 WARRANTY

A. Provide one (1) year warranty on standard transformers and K-Rated transformers.

END OF SECTION

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SECTION 26 2413

SWITCHBOARDS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Switchboards and Panelboards (NEC Article 408)

B. Section 26 0100: Common Work Results for Electrical

C. Section 26 0526: Grounding and Bonding for Electrical Systems

D. Section 26 0529: Supporting Devices

E. Section 26 0533: Raceways, Fittings, and Boxes

F. Section 26 0553: Identification for Electrical Systems

G. Section 26 0560: Concrete Pads for Electrical Equipment

H. Section 26 2414: Generator Docking Station

I. Section 26 2416: Panelboards

J. Section 26 2713: Electricity Metering Cabinets

K. Section 26 2813: Low Voltage Fuses

L. Section 26 4313: Surge Protection Devices

M. Comply with Nema PB2, NFPA 70 and UL 891

1.3 SUBMITTALS

A. Provide switchboards and panelboards from the same manufacturer.

B. Submit shop drawings and descriptive data in accordance with Section 26 0105: "Submittals, Closeout Documents, Training and Spare Parts".

C. Submit "time-current data" with shop drawings for main switchboard overcurrent device, all distribution fuses, and all ground-fault intemtpters. Proper trip settings will be indicated on the shop drawings during review. Adjust "trip settings" as indicated by the Engineer.

D. Submit the manufacturer's recommended/proposed testing procedures associated with the initial performance testing of the Ground-Fault Protection system with the shop drawings.

E. Submit the arcing current calculation at the main switchboard bus on the line side of the main circuit breaker with the shop drawings. Include the proposed value/setting of the associated main circuit breaker Energy-Reducing Maintenance Switch along with proof that the proposed setting will operate at less than the available arcing current.

F. Submit the manufacturer's recommended/proposed testing procedures associated with the initial performance testing of the Energy-Reducing Maintenance Switch system with the shop drawings.

G. Submit shop drawings of the utility metering provisions to the Utility Company for approval prior to submittal to the Architect/Engineer.

PART 2 EQUIPMENT

2.1 SERVICE ENTRANCE EQUIPMENT - CIRCUIT BREAKER TYPE MAIN

A. Provide a 480/277 volt, 3 phase, 4 wire switchboard with bolt-on tin-plated aluminum bus bars braced to withstand a 65,000 ampere RMS symmetrical fault.

B. Provide 100%-rated main service disconnect switch.

C. Provide service section containing the following:

1. A main disconnect switch consisting of a stationary mounted, electronic trip circuit breaker, with LSIG trip settings and a minimum UL listed interrupting rating of 65,000 RMS symmetrical pickup. Provide main device with Arc Energy Reduction Device as required by National Electric Code.

2. Provide switchboards, panelboards and overcurrent devices with full interrupting ratings. Reducing the interrupting rating of downstream ratings through the use of series-rated equipment is not permitted.

3. Utility metering equipment (see "UTILITY METERING" paragraph below).

D. Disribution Sections

1. Provide separate distribution section(s) with full height bussing and suitable for mounting 3 pole circuit breakers. Provide full bussing for all space so that no additional work will be required to add devices or sections in the future.

2. Circuit Breakers

a. Provide all distribution breakers with LSI ammeter trip unit with adjustable continuous current and time settings, adjustable short time pickup and time settings, and adjustable instantaneous trip setting.

b. Provide fully rated circuit breakers. Series rated circuit breakers are not allowed.

c. All load conductor terminals must be listed for use with copper or aluminum conductors rated 90°C. All terminals must be the box lug or clamp-type design. Screw-head terminals are not acceptable for conductor terminals.

d. 600 ampere and larger frame sizes shall be available for application of 100% of frame rating per NEC exception when installed in a properly listed enclosure in conjunction with using 90°C conductors.

e. Circuit breakers shall be listed with Underwriters ' Laboratories Inc. (UL 489), conform to the applicable requirements of NEMA Standards Publication No. AB-1-1975, and meet the appropriate classifications of Federal Specifications W-C-375a.

f. Line side terminals shall be bolted to switchboard bus.

g. Circuit breaker frame and trip ratings, modifications, etc. shall be as indicated on the drawings.

E. Acceptable manufacturers

1. Eaton
2. General Electric
3. Siemens
4. Square D
5. EMI
6. AMP (American Midwest Power)
7. States Electric
8. Pre-approved equal.

2.2 GROUND FAULT PROTECTION

A. Provide main circuit breaker with adjustable ground fault current and time settings and test switch.

B. Provide ground-fault protection equipment consisting of a ground sensor (encircling all phase conductors and the neutral) connected to a solid-state ground relay and an electrically active shunt-trip for the main disconnect. Provide field adjustable ground-fault current pick-up from 200 to 1200 primary amperes; set at 400 amperes. Time-delay characteristics of 0.1, 0.2, 0.3 and 0.5 seconds. Operate circuit interrupter shunt trip and relay from an internal 120 volt a.c. control source. Provide access to the equipment without opening up the switchboard. Provide a test panel to test the equipment both with and without tripping its related switch.

2.3 UTILITY METERING

A. Refer to Section 26 2713: "Electricity Metering Cabinets" for metering requirements if metering is located at connection cabinet remote from the service switchboard.

2.4 SURGE PROTECTION DEVICES

A. Refer to Section 24 4313.

2.5 CUSTOMER METERING

A. Main Device (Main Circuit Breaker Metering):
   1. Mounted in Switchboard Main Section.
   2. Current transformers, 5A secondary.
   3. Microprocessor based monitor panel to provide the following readings, voltage (L-L, L-N), amperage, power (KW), power demand, power factor, and energy consumption. Provide KWH pulse output. Provide a data port for connection to the Owner's LAN.
   4. Provide all required control power provisions.
   5. Approved manufacturers
      a. Square D PM5000 series
      b. Siemens Approved Equal
      c. ABB Approved Equal
      d. Electro-Industries Approved Equal
      e. Crompton Instruments Approved Equal
      f. Pre-approved equal.

B. Feeder Breaker Metering (Main Circuit Breaker Metering):
   1. Mounted in Switchboard at feeder breaker position.
   2. Current transformers, 5A secondary.
   3. Microprocessor based monitor panel to provide the following readings, voltage (L-L, L-N), amperage, power (KW), power demand, power factor, and energy consumption. Provide KWH pulse output. Provide a data port for connection to the Owner's LAN.
   4. Provide all required control power provisions.
   5. Approved manufacturers
      a. Square D PM3500 series
      b. Siemens Approved Equal
      c. ABB Approved Equal
      d. Electro-Industries Approved Equal
      e. Crompton Instruments Approved Equal

f. Pre-approved equal.

C. Power Metering Software

1. Aggregate and connect all metering into a site-wide metering software platform.
2. Provide all network components as required for meter/software interface and connect complete to Owner's network.
3. Coordinate and install software on an Owner-provided server (TBD).
4. Approved manufacturers
   a. Schneider Electric EcoStruxure™ Power Monitoring Expert (PME)
   b. Siemens Approved Equal
   c. ABB Approved Equal
   d. Electro-Industries Approved Equal
   e. Crompton Instruments Approved Equal

PART 3 EXECUTION

3.1 INSTALLATION OF SERVICE ENTRANCE EQUIPMENT

A. Provide service entrance equipment in accordance with the rules and regulations of the Power Company. Electrical energy will be received as indicated on the drawings.

B. Transformer and primary provided by the Utility.

C. Provide transformer pad per Utility requirements. Refer to Section 26 0560: "Concrete Pads for Electrical Equipment".

D. Verify that the neutral to ground bond is in place at the service entrance equipment prior to energizing.

3.2 SERVICE CONDUCTORS

A. Provide the service feeder, wire in conduit, from the transformer or cable termination cabinet to the main distribution switchboard.

B. Provide Type XHHW zsservice conductors.

C. Refer to Section 26 05 33: "Raceways, Fittings, and Boxes" for approved raceway system for underground service entrance conductors.

3.3 GROUNDING

A. Provide grounding per Section 26 05 26: "Grounding and Bonding for Electrical Systems".

3.4 FIELD QUALITY CONTROL

A. Provide on-site services of a manufacturer's certified field service engineer/technician to inspect, adjust, and calibrate the main switchboard and all associated circuit breakers prior to energizing.

B. Inspect for damage prior to energizing.

C. Inspect for proper connections prior to energizing.

D. Upon installation, all electrical equipment shall be connected, switched and energized according to the requirements of applicable State and Federal OSHA Standards.

E. Provide minimum of four (4) hours of initial equipment startup time. This is in addition to the required performance testing indicated below.

3.5 PERFORMANCE TESTING

A. Ground-Fault Protection System:

1. Provide on-site services of a manufacturer's certified field service engineer/technician to perform the initial performance testing of the Ground-Fault Protection system to satisfy NEC 230.95.
2. Follow the manufacturer's performance testing procedures that have been approved by the Engineer.
3. Utilize primary current injection to perform the testing of the ground-fault functions.
4. Provide all necessary test equipment to perform the testing
5. Conduct testing in the presence of the Engineer.

B. Submit written record of the testing including the testing procedures, test equipment used, and test results. Include the written record of the testing with the 0 & M Manuals at project closeout.Arc Energy Reduction Protection System:

1. Provide on-site services of a manufacturer's certified field service engineer/technician to perform the initial performance testing of the Energy-Reducing Maintenance Switch system to satisfy NEC 240.87.
2. Follow the manufacturer's performance testing procedures that have been approved by the Engineer.
3. Utilize primary current injection to perform the testing of the instantaneous function.
4. Provide all necessary test equipment to perform the testing
5. Conduct testing in the presence of the Engineer.
6. Submit written record of the testing including the testing procedures, test equipment used, and test results. Include the written record of the testing with the 0 & M Manuals at project closeout.

3.6 IDENTIFICATION

A. Provide identification nameplates on all switchboards, and on each overcurrent device in the switchboard per Section 26 0553: "Identification for Electrical Systems"

END OF SECTION

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SECTION 26 2416

PANELBOARDS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Switchboards and Panelboards (NEC Article 408)

B. Section 26 0100: Common Work Results for Electrical

C. Section 26 0526: Grounding and Bonding for Electrical Systems

D. Section 26 0529: Supporting Devices

E. Section 26 0533: Raceways, Fittings, and Boxes

F. Section 26 0553: Identification for Electrical Systems

G. Section 26 0560: Concrete Pads for Electrical Equipment

H. Section 26 2413: Switchboards

I. Section 26 4313: Surge Protective Devices

1.3 SUBMITTALS

A. Provide switchboards and panelboards from the same manufacturer.

B. Submit shop drawings and descriptive data in accordance with Section 26 0105: “Submittals, Closeout Documents, Training and Spare Parts”.

C. Submit "time-current data" with shop drawings for all distribution panel overcurrent devices.

PART 2 EQUIPMENT

2.1 DISTRIBUTION PANELBOARDS

A. Provide distribution panelboard assemblies adhering to the following specifications:

1. Compliant to Article 408 of the NEC: “Switchboards and Panelboards”.
2. Enclosures constructed of galvanized sheet steel of thickness as required by Code, with enameled steel trim, distributed busing, hinged steel doors latches, locks and adjustable trim clamps. Provide NEMA 3R enclosures for exterior locations.
3. Provide 90” high enclosure with full busing where “full height” panels are indicated on the plans.
4. Provide welded metal frame with typed circuit directory for each panel.
5. Compliant to the following standards: UL 50, UL 67, NEMA PB-1, NFPA 70 and Fed. Spec W-P-115C
6. Provide panelboards with interrupting ratings as shown on the plans. Provide switchboards, panelboards and overcurrent devices with full interrupting ratings. Reducing the interrupting rating of downstream ratings through the use of series-rated equipment is not permitted.
7. Provide 600 volt rated panelboards.
8. Provide sub feed or feed through lugs as indicated on the plans.

9. Provide tin plated aluminum bus bars.
10. Provide proper lugs (75° C. minimum temperature rating) and gutter space for cable size indicated on the plans.
11. Provide all panels by the same manufacturer.
12. Circuit Breaker Distribution Family
    a. Provide bolt on type circuit breakers with LSI Ammeter Trip Unit with adjustable continuous current and time settings, adjustable short time pick-up and time settings and adjustable instantaneous trip setting. Refer to the schedules on the plans for sizes and quanties.
    b. Compliant to the following standards: UL 489, NEMA AB-1, Fed. Spec. W-C-375B/GEN, IEC 157-1 and BS 4752.
    c. Series rating of circuit breakers is not allowed.
    d. Acceptable Manufacturers:
        1) Square D type I-Line series
        2) Siemens type P4 and P5 series
        3) Eaton P3D series
        4) General Electric CCB series
        5) Pre-approved equal

2.2 BRANCH CIRCUIT PANELBOARDS

A. Provide lighting and appliance panelboard assemblies adhering to the following specifications:

1. Enclosures constructed of galvanized sheet steel of thickness as required by Code, with enameled steel trim, distributed busing, hinged steel doors latches, locks and adjustable trim clamps. Provide NEMA 3R enclosures for exterior locations.
2. Provide welded metal frame with plastic-covered typed circuit directory for each panel. Directory card must be removeable to allow updating off-site if necessary. Permanently adhered panel directories are not allowed.
3. Compliant to the following standards: UL 50, UL 67, NEMA PB-1, NFPA 70 and Fed. Spec W-P-115C , UL 489, NEMA AB-1, Fed. Spec. W-C-375B/GEN, IEC 157-1 and BS 4752.
4. Provide panelboards with interrupting ratings as shown on the plans. Provide panelboards and overcurrent devices with full interrupting ratings. Reducing the interrupting rating of downstream ratings through the use of series-rated equipment is not permitted.
5. Provide 240 volt AC rated panelboards for 208/120 and 240 volt AC systems. Provide 480/277 volt rated panelboards for 480/277 volt systems.
6. Provide double main or feed through lugs as indicated on the plans.
7. Provide tin-plated copper bus bars or tin-plated aluminum bus bars.
8. Provide proper lugs (75° C. minimum temperature rating) and gutter space for cable size indicated on the plans.
9. Provide all panels by the same manufacturer.
10. Provide molded case, non-adjustable, thermal-magnetic, quick-make, quick-break, bolt-on type circuit breakers. Refer to the schedules on the plans for sizes and quantities.
11. Provide muli-pole breakers where indicated on the schedules. Handle ties on single pole breakers are not acceptable.
12. Tandem breakers are not allowed.

13. Provide circuit breakers with engraved ratings on the handle that are visible without removing the panel cover.
14. Series rating of circuit breakers is not allowed.

B. Acceptable Manufacturers:
   1. 240 Volt
      a. Square D type NQOD or NF
      b. Siemens type P1 series
      c. Eaton P31A series
      d. General Electric AQ series
      e. Pre-approved equal
   2. 480 volt
      a. Square D type NF
      b. Siemens type P1 series
      c. Easton P2D series
      d. General Electric AE series
      e. Pre-approved equal

2.3 PANELBOARDS – SURGE PROTECTION (SPD)

A. Refer to section 26 43 13.

2.4 PROTECTIVE DEVICE COORDINATION STUDY

A. The complete Life Safety Branch of the Standby Power System is required to be selectively coordinated per NEC 700.

B. Provide a complete facility Protective Device Coordination Study of the electrical distribution system performed by the panelboard manufacturer. Study to include all new electrical “S” branch distribution equipment (SHP-X-X panels) being provided as part of this project and all associated upstream normal and emergency overcurrent devices.

C. Submit study to the Engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacture. If formal completion of the study may cause delay in equipment manufacture, approval from the Engineer may be obtained for a preliminary submittal of sufficient study data to ensure that the selection of device ratings and characteristics will achieve the required coordination.

D. Perform Protective Device Coordination Study to provide the necessary calculations and logic decisions required to select or to check the selection of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low voltage breaker trip characteristics and settings. Perform studies in accordance with the latest applicable IEEE and ANSI standards.

E. Provide the time-current characteristics of the specified protective devices on Keuffel and Esser log-log paper. Include on the plots complete titles, representative one-line diagram and legends, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breaker trip curves and fuses. Indicate on the coordination plots the types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, transformer magnetizing inrush and ANSI transformer withstand parameters, cable thermal overcurrent withstand limits and significant symmetrical and asymmetrical fault currents. Adhere to all restrictions of the National Electrical Code and maintain proper coordination intervals and separation of characteristic curve. Provide the coordination plots for phase and ground protective devices on a system basis. Provide a sufficient number of separate curves to clearly indicate the coordination achieved.

F. Provide the selection and settings of the protective devices in separately tabulated forms listing circuit identification, IEEE device number, current transformer ratios and connection, manufacturer and type, range of adjustment and recommended settings. Provide a tabulation of the recommended power fuse selection for the medium voltage fuses where applied in the system. Promptly identify any discrepancies, problem areas, or inadequacies to the Engineer's attention.

G. Include in the study recommended settings and time functions for the ground fault protection system devices.

H. Summarize the results of power system study in a final report.

I. Include the following sections in the report:

1. Description, purpose, basis and scope of the study and a single line diagram of that portion of the power system which is included within the scope of the study.

2. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.

J. Provide the services of a qualified, 3rd Party field engineer and the necessary tools and equipment to test, calibrate and adjust the protective relays and circuit breaker trip devices as recommended in the power system study.

K. Refer to overall one-line diagrams of the distribution system for additional information.

PART 3 EXECUTION

3.1 INSTALLATION

A. Distribution Panelboards

1. Mount panels and cabinets to building structure or interior wall construction. Mount independent of conduit and raceways entering boxes.

2. Provide 1" empty conduits from each flush mounted panel. When the floor is on grade, provide three (3) conduits into the ceiling cavity above. When the floor has accessible space below, provide two (2) conduits into the ceiling space above and two (2) conduits into the accessible space below the floor. Ends shall be capped and shall be tagged at both ends with permanent tags.

3. Provide concrete pads under all floor-mounted or free-standing distribution panelboard per Section 26 0560: “Concrete Pads for Electrical Equipment”.

B. Branch Circuit Panelboards

1. Mount panelboards and cabinets to building structure or interior wall construction. Mount independent of conduit and raceways entering boxes.

2. Mount panelboards with topmost overcurrent device no higher than allowed by the NEC (6’-7”) above finished floor.

3. Provide 3/4" empty conduits from each flush mounted panelboard. When the floor is on grade, provide three (3) conduits into the ceiling cavity above. When the floor has accessible space below, provide two (2) conduits into the ceiling space above and two (2) conduits into the accessible space below the floor. Ends shall be capped and shall be tagged at both ends with permanent tags.
4. Provide each circuit in the panel(s) with a circuit number securely fastened to the breaker for identification purposes.
5. Provide a circuit directory completely typed on the interior of each panel door.

3.2 GROUNDING

A. Provide grounding per Section 26 0526: “Grounding and Bonding for Electrical Systems”.

3.3 IDENTIFICATION

A. Provide typed circuit directories in the inside cover of all panelboards and distribution panels.

B. Provide identification nameplates on all panelboards and distribution panels, and on each overcurrent device (including spares) in distribution panelboards per Section 26 0553: “Identification for Electrical Systems”.

END OF SECTION

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SECTION 26 2713

ELECTRICITY METERING CABINETS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 0100: Common Work Results for Electrical

B. Section 26 0533: Raceways, Fittings, and Boxes

C. Section 26 0560: Concrete Pads for Electrical Equipment

D. Section 26 2413: Switchboards

E. Section 26 2813: Low Voltage Fuses

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of meters and auxiliaries whose products have been in satisfactory use.

B. NEC Compliance: Comply with NEC as applicable to wiring methods, construction and installation of meters.

C. UL Compliance: Provide meters and components which are UL listed and labeled.

1.4 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 0105: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Submit shop drawings of the connection cabinet meters/sockets/enclosures to Utility for approval prior to submittal to the Engineer. Include data substantiating that units comply with utility requirements.

PART 2 EQUIPMENT

2.1 CABLE TERMINATION CABINET

A. Provide UL listed cabinet that meets Utility requirements.

B. Provide fully-assembled, free standing, NEMA type 3R cabinet. Provide minimum 12 gauge (min.) galvanized steel structure with 14 gauge (min.) panels.

C. Provide 3-point latch, padlock hasps and wind stops on doors.

D. Paint the enclosure transformer green.

E. Provide 600 volt rating, 3 phase 4 wire.

F. Provide electrical grade aluminum (max. 750 A/sq.in.) or copper (max 1000 A/sq.in.) busing. Support bus bars on plastic insulators with provisions for utility current transformers.

G. Provide lugs in sufficient quantity and size to terminate all conductors. Provide 75 degree C rated lugs, minimum.

H. Size cabinet for the service entrance conductors. Provide minimum short circuit withstand rating of 85,000 amperes RMS without cable lashing required.

I. Provide busing with at least the same ampacity as the main switchboard if not specifically sized otherwise on the plans.

J. Provide a metering compartment containing only Utility's current transformers with approved means of locking and sealing.

K. Locate meters per Utility requirements, following the recommended clearance requirements from Utility.

L. Acceptable Manufacturers

1. EMI
2. States Electric
3. American Midwest Power
4. Pre-approved equal.

PART 3 EXECUTION

3.1 INSTALLATION OF SERVICE ENTRANCE EQUIPMENT

A. The service is to be installed in strict accordance with the rules and regulations of the Power Company. The Electrical Contractor is responsible for all negotiations with the Power Company with regard to the service connections, and shall initiate the necessary request to the Power Company for the work which will be performed by the Power Company.

B. The Electrical Contractor is to pay all fees and charges submitted by the Power Company for their part of the service installation and connections. Provide all work required by the Power Company to facilitate the complete installation of the services. No extras will be allowed because of the failure of the Electrical Contractor to contact the Power Company and determine what will be required by the Contractor in order to complete the service installation.

3.2 CABLE TERMINATION CABINET

A. Install on same contiguous concrete pad as the utility transformer. Refer to Section 26 0560: "Concrete Pads for Electrical Equipment"

B. Provide raceway between transformer and connection cabinet per the Utility company requirements.

C. Terminate secondary service entrance conductors.

D. Install the current transformers (furnished by Utility). Make line and load side bolted connections of the current transformers at the removable bolted links on the bussing.

E. Provide 3/4" (minimum) conduit from connection cabinet to meter location(s). Provide conductors between CT's and meters.

F. Provide and make terminations to the service entrance conductors on the load side of the connection cabinet busing. Refer to the Power Riser Diagram for sizes and quantities.

3.3 IDENTIFICATION

A. Provide identification in accordance with Section 26 0553.

END OF SECTION

SECTION 26 2716

ELECTRICAL CABINETS AND ENCLOSURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 0100: Common Work Results for Electrical

B. Section 26 0529: Supporting Devices

C. Section 26 0533: Raceways, Fittings, and Boxes

D. Section 26 0553: Identification for Electrical Systems

E. Section 26 0921: Contactors

F. Section 26 2813: Low Voltage Fuses

1.3 DESCRIPTION OF WORK

A. Furnish and install where shown electrical cabinets and enlcosures. The electrical cabinets and enclosure shall contain the electrical equipment, metering, and control equipment as detailed on the drawings.

B. The cabinet shall be fabricated and assembled as complete units, complete with all components in place and internally prewired with terminals and terminal strips provided for connections to be made in the field.

C. Refer to other Division 26 sections for cable, wire, connectors, electrical raceway work, motor starters and supervisory control required in conjunction with electrical cabinets and enclosures.

1.4 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical cabinets and enclosures of types, ratings and characteristics required, whose products have been in satisfactory use.

B. NEC Compliance: Comply with NEC as applicable to wiring methods, construction and installation of electrical cabinets and enclosures.

C. UL Compliance: Provide equipment and components which are UL listed and labeled.

D. NEMA and ANSI Compliance: Comply with applicable requirement so NEMA and ANSI standards as referred herein.

1.5 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 0105: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Product Data: Submit manufacturer’s data including specifications, installation instructions and general recommendations for each type of cabinet required. Include data substantiating that units comply with requirements.

PART 2 EQUIPMENT

2.1 CONTACTOR CABINETS

A. Provide surface mounted lighting and power contactor cabinets that adhere to the following minimum specifications:

1. 16 gauge steel housing

2. Provide cabinets sized for all contactors and future contactors.
3. Continuous recessed LH or RH hinge (field-verify).
4. Recessed “T” handle with single point latch.
5. Provisions for ¾” knockouts on top, sides or back of box for conduit connections.
6. Provide mechanically-fastened, engraved nameplates under each contactor
7. Grounding lug

B. Approved Manufacturers:
1. Hoffman A1 series
2. Pre-approved equal

2.2 PULLBOXES

A. Refer to Section 26 0533: “Raceways, Fittings, and Boxes” for pullbox requirements.

2.3 SPARE FUSE CABINET

A. Provide 16 gauge (min.) spare fuse cabinet with spare fuse cabinet and fuse pulling tool

B. Single latch, lockable handle operator

C. Provide 30”H x 24”W x 12”D cabinet with two shelves.

D. Approved manufacturers
1. Bussman SFC series
2. Hoffman A302412UC series
3. Littelfuse LSFC series
4. Pre-approved equal

PART 3 EXECUTION

3.1 INSTALLATION

A. Install electrical cabinets and enclosures as indicated, in accordance with equipment manufacturer’s written instructions, and with recognized industry practices.

B. Coordinate with other electrical work including, wiring and raceway work, as necessary to properly interface installation of electrical cabinets and enclosures.

C. Verify mounting heights for cabinets installed in finished areas with Architect prior to installation.

D. Provide recessed cabinets in areas of finished construction.

E. Touch-up scratched or marred surfaces to match original finishes.

F. Grounding: Provide equipment grounding connections, sufficiently tight to assure permanent and effective ground.

G. Flush-mount telephone boxes no higher than 50” above finished floor to center of cabinet.

H. Mount spare fuse cabinet(s) on wall adjacent to the main distribution switchboard or as indicated on the plans.

3.2 IDENTIFICAITON

A. Equipment/System Identification: Provide equipment/system identification nameplates complying with Section 26 0550: Electrical Identification.

END OF SECTION

SECTION 26 2726

WIRING DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 0100: Common Work Results for Electrical

B. Section 26 0526: Grounding and Bonding for Electrical Systems

C. Section 26 0533: Raceways, Fittings, and Boxes

D. Section 26 2719: Multi Outlet Assemblies

E. Section 26 2723: Indoor Power Poles

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

PART 2 PRODUCTS

2.1 WIRING DEVICES

A. Provide new wiring devices in each outlet indicated on the drawings.

B. Provide devices from one manufacturer.

C. Provide gray wiring devices for receptacles connected to normal utility power.

D. Provide toggle gray switches that adhere to the following specifications:

1. Federal Specification WS896-E.
2. Rated for 20 amperes, 120-277 volts unless noted otherwise.
3. NEMA WD1 standards.
4. UL listed.
5. Side and back wiring options.

E. Provide momentary contact gray switch that adhere to the following specification:

- Heavy duty toggle
- Low voltage momentary contact
- 3 amp, 24-AC/DC rating
- Design to match conventional switches
- P&S #1081GRY

F. Approved toggle switch manufacturers/model numbers:

Mfr.	20A/120-277V Wall Switches						
	1-pole	1-pole w/Pilot	2-pole	3-way	4-way	Keyed 1-pole	Mom. Contact
Eaton	1221	1221PL	1222	1223	1224	1221L	1995
Hubbell	1221	HBL1221PL	HBL1222	HBL1223	HBL1224	HBL1221L	HBL1557

P&S	PS20AC 1	**PS20AC1-RPL**	PS20AC 2	PS20AC 3	PS20AC 4	**PS20AC1 -L**	1251
Leviton	1221-2	1221-2PL	1222-2	1223-2	1224-2	1221-2L	1257

G. Provide receptacles that adhere to the following specifications:

1. Federal Specification WC596.
2. UL listed.
3. Side and back wiring options.
4. One piece solid brass ground strap with integral ground, except GFI receptacles.
5. NEMA 5-20R configuration, rated for 20 amperes at 125 volts, unless noted otherwise. Provide special purpose receptacles rated for the equipment used.
6. Provide SPD (Surge Protective Devices) receptacles that adhere to UL 1449 (second edition), UL 498 and ANSI/IEEE 62.41-1991.

H. Approved standard receptacle manufacturers/model numbers:

Mfr.	**20A/125V Standard Receptacles**					
	Simplex	Duplex	GFI	IG	DUP W/ USB	SPD
Eaton	5361	5362	TRGF20	IG5362	TRUSB5A20	5362S
Hubbell	HBL5261	5362	GRF20	IG5362	USB20AC5W	HBL5360SA
P&S	**5361**	**5362**	**2095**	**IG5362**	**TR536IUSB**	**5362SP**
Leviton	5361	5362	X7899HG	5362-IG	T5832-HGG	7380

I. Approved tamperproof receptacle manufacturers/model numbers:

Mfr.	**20A/125V Standard Receptacles**					
	Simplex	Duplex	GFI	IG	DUP W/ USB	SPD
Eaton	5361	5362	TRSGF20	TRG5362	TRUSB5A20	TR5362S
Hubbell	HBL5261	HBL5362	GFR5352A	IG5362	USB8300GY	SNAP53625
P&S	**TR5361**	**TR5362**	**2095TR**	**TRIG5362**	**TR5361USB**	**TR5362SP**
Leviton	5361	5362	X7899HG	5362-IG	T5832-HGG	7380

J. Provide specification grade special purpose receptacles as indicated on the plans.

2.2 CEILING SERVICE RETRACTABLE REEL RECEPTACLE

A. Provide recessed, 120 volt, service reel with twist lock receptacle and 20' - 3#12 AWG cable per reel. Hubbell #23002 G or pre-approved equal. Protect all branch circuits with GFI circuit breaker. Provide necessary mounting hardware, brackets, etc. to the building structure for a secure installation.

B. Provide recessed plenum rated cord reels. Provide white enclosure, mounting accessories to securely mount cord reels in accessible ceiling. Provide with 120 volt white cord reel with two (2) duplex receptacles in black outlet box. Hubbel HBL1RPRBOX Series enclosure with cord reel. Protect all branch circuits with GFI circuit breakers.

2.3 COVERPLATES

A. Interior Coverplates: Provide new coverplates over all boxes with the following minimum specifications:

1. All finished areas and unfinished areas with recessed boxes: Provide stainless steel type with smooth satin finish P&S SB Series.
2. Unfinished areas over surface mounted boxes: Provide raised metal cover to match the surface metal box.
3. Provide appropriate covers over special purpose receptacles.

B. Exterior Coverplates: Provide new 2-gang, "while in use", weatherproof coverplates for outlets and switches as indicated on the Drawings. Provide weatherproof boots for all dropcords as indicated on the Drawings.

1. Weatherproof switch coverplates: Cast aluminum or Lexan with cover and vinyl gasket for weatherproofing switch; or cast aluminum with lever and weatherproof gasket.
2. Weatherproof receptacle coverplates: Cast aluminum or Lexan with cover and vinyl gasket for weatherproofing receptacle.
3. Approved manufacturers:
   a. Red Dot 2CKD Series
   b. Leviton 5977-CL series
   c. Pass and Seymour WPH series
   d. Pre-approved equal
4. Weatherproof boots: Yellow rubber, with overlapping design to seal out water and dirt. Rubber boot shall keep weatherproof seal intact when plug is used with wall mounted receptacles.

PART 3 EXECUTION

3.1 WIRING DEVICES

A. Provide new devices for outlets indicated. Provide individual GFI, isolated ground and surge suppression device for each duplex receptacle in ganged outlets.

B. Wire each device by wrapping the conductors around the terminals and torquing the screw terminal tight.

C. Mount all receptacles with the ground lug on the top.

D. Replace receptacles and plates that have been damaged, burned or discolored during construction, prior to Substantial Completion.

E. Install wall plates after all painting has been completed.

F. Mount wall mounted dimmers in separate boxes from switches.

G. Test wiring devices for continuity, proper polarity connections and grounding.

3.2 GFCI RECEPTACLES

A. Provide all exterior GFCI receptacles with point of use weatherproof covers.

B. Provide GFCI receptacles in mechanical and electrical rooms and all locations required by N.E.C.

END OF SECTION

SECTION 26 2813

LOW VOLTAGE FUSES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 0100: Common Work Results for Electrical

B. Section 26 2413: Switchboards

C. Section 26 2414: Generator Docking Station

D. Section 26 2416: Panelboards

E. Section 26 2716: Electrical Cabinets and Enclosures

F. Section 26 2816: Safety Switches

G. Section 26 2913: Motor Control

H. Section 26 2923: Variable Frequency Drives

I. Section 26 56 13: Lighting Poles and Standards

J. Comply with Nema FU 1 for cartridge fuses.

K. Comply with NFPA 70.

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 0105: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Submit "time-current data" with shop drawings for all fuses.

PART 2 EQUIPMENT

2.1 FUSES

A. Provide fuses of the following types (Bussman used as reference):

1. 601 amps and larger: Time-delay type designed to hold 500% of rated current for a minimum of 4 seconds and clear 20 times current in 0.01 seconds or less with interrupting ratings of 200,000 amperes RMS symmetrical and peak let-through current and energy let-through values established by U.L. Standard for Class L fuses. Provide KRP-C fuses.

2. 600 amps and smaller: Dual-Element construction with interrupting rating of 200,000 amperes RMS symmetrical and peak let-thru current established by U.L. Standard for Class RK-1 fuses. Provide LPN-RK/LPS-RK.

3. Motor circuits: Protect all individual motor circuits with full load ampere rating (FLA) of 480 amperes or less with dual-element time-delay fuses. Provide LPN-RK/LPS-RK. Protect larger horsepower motors with time-delay fuses. Provide KRP-C fuses. Provide U.L. Class RK1, dual-element time-delay for all other motors.

4. Motor Controllers: Protect NEMA and IEC style motor controllers with dual-element, time-delay fuses to provide Type 2 coordination for the controller. Provide LPS-RK fuses.

5. Protect circuit breaker panels with U.L. Class RK1, Class L fuses. Provide LPN-RK, LPS-RK, or KRP-C fuses.

B. Class J fuses are not allowed.

C. Acceptable manufacturers:

1. Bussman
2. Ferraz-Shawmut
3. Littelfuse
4. Pre-approved equal.

2.2 IN-LINE FUSEHOLDERS

A. Provide in-line fuseholders with fuses for parking lot light poles, walkway light poles and bollard type light fixtures.

B. Provide dual fuse holders for multi-pole applications

C. Provide load-side breakaway style fuseholders.

D. Provide proper size crimp type connection for load and line side connetions.

E. Provide 200,000 AIC rated Class CC fuses.

F. Approved manufacturers:

1. Ferraz-Shawmut FEC-BA (single pole) & FEY-BA (two pole)
2. Littelfuse LEC-S (single pole) & LEY-S (two pole)
3. Pre-approved equal

PART 3 EXECUTION

2.3 FUSES

A. Provide fuses for all equipment utilizing fused switches or fused safety switches.

B. Verify proper size fuses for all equipment prior to ordering fuses.

2.4 SPARE PARTS

A. Provide spare fuse cabinet per Section 26 2716: “Electrical Cabinets and Enclosures”.

B. Provide three (3) spare fuses of each size used at each spare fuse cabinet location shown on the project. Place inside spare fuse cabinet.

END OF SECTION

SECTION 26 2816

SAFETY SWITCHES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 14 0000: Conveying equipment (Elevators)

B. Section 26 0100: Common Work Results for Electrical

C. Section 26 0533: Raceways, Fittings, and Boxes

D. Section 26 0553: Identification for Electrical Systems

E. Section 26 2813: Low Voltage Fuses

F. Section 26 2913: Motor Control

G. Section 26 2923: Variable Frequency Drives

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 0105: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Submit a table (see Forms at the end of this section), listing all components by equipment tag with the following information indicated:

1. Safety Switch type, size, rating, enclosure type, switches poles, solid poles, HP rating
2. Fuse size and type (if fused)
3. Identification tag/nameplate

PART 2 PRODUCTS

2.1 SAFETY SWITCHES (DISCONNECT SWITCHES)

A. General requirements:

1. Provide safety switches as disconnects for all utilization equipment as indicated on the Drawings.
2. Provide lockable handle with multiple hasps to allow proper lockout-tagout procedures.
3. Provide NEMA 3R enclosures when mounted outside. Provide bolt-on hub kit(s) for conduit connections in order to maintain NEMA 3R rating.
4. Provide NEMA 4X non-metallic KRYDON™ switch enclosure for all pool equipment.
5. Unless specifically noted otherwise, provide 3-pole with solid neutral bus for landing line and load side neutral conductors.
6. Provide proper size and quantity of lugs to terminate all phase conductors and neutral conductor. Neutral conductors may require more lugs, and a larger size.
7. Provide interior ground lug.
8. Provide auxiliary contacts in safety switches when used for the following situations:
   a. When used in conjunction with VFD’s remote from the equipment: To signal the VFD to shut off to avoid voltage spikes.

B. Fused or unfused switch type:

1. Provide heavy duty switch with quick-make, quick-break mechanism with positive interlock.
2. Hinged door with mechanical interlock in the ON position, with defeat mechanism.
3. Provide switch with switch mechanism suitable for the type and size fuses specified in Section 26 28 13: “Low Voltage Fuses”, whenever fused switches are required.
4. Provide horsepower rated disconnects, fully rated for load-break and load-make operation.
5. Provide service entrance rated switches where required.
6. Provide 200% neutral connection in the switch when serving a SPD grade technology panelboard. Refer to the panelboard summary schedule on the plans, power riser diagram and/or Section 26 43 13: Surge Protective Devices.
7. Approved manufacturers:
   a. Eaton DH series
   b. General Electric TH series
   c. Siemens Type VBII series
   d. Square-D Class 3110 series
   e. Allen Bradley 1494 series
   f. Pre-approved equal.

C. Molded case circuit breaker switch type:

1. Provide molded case type switch where recessed safety switches are shown. Provide switch in a NEMA 1 with flush mounting enclosure.
2. Approved manufacturers:
   a. Eaton
   b. General Electric
   c. Siemens
   d. Square-D

PART 3 EXECUTION

3.1 INSTALLATION

A. Install safety switches with operator handle no higher than 6’-7” above finished floor in front of the safety switch. All safety switches (fused or otherwise) serving as a motor disconnecting means shall be READILY ACCESSIBLE from the ground level, regardless of any NEC exception, variance, or interpretation.

B. For the purposes of this specification, a circuit breaker or fused switch in a panelboard, distribution panel, or switchboard shall not serve as a motor disconnecting means.

C. Mount safety switch as close to the equipment as possible. Provide unistrut rack if necessary.

D. Do not mount safety switches on removeable panels on the equipment served. Coordinate location of safety switches with the equipment provider prior to installing the switch.

E. Install safety switches with proper working clearances about the switch.

3.2 IDENTIFICATION

A. Provide engraved nameplates as specified in Section 26 0553: “Identification for Electrical Systems” on all safety switches. Label per the name of the device controlled unless noted otherwise on the plans.

3.3 FORMS

A. Fill out the attached form with the information for each safety switch.

END OF SECTION

SAFETY SWITCHES FORM

Tag/ID or Equipment served by Safety Switch	Volts	Ampacity	Fused, Nonfused or Circuit breaker	NEMA Enclosure	Location of Safety Switch (Room #)

SECTION 26 2913

MOTOR CONTROL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 0100: Common Work Results for Electrical

B. Section 26 0553: Identification for Electrical Systems

C. Section 26 0560: Concrete Pads for Electrical Equipment

D. Section 26 2726: Wiring Devices

E. Section 26 2813: Low Voltage Fuses

F. Section 26 2816: Safety Switches

G. Section 26 2923: Variable Frequency Drives

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 0105: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Submit a table, listing all components by equipment tag with the following information indicated:

1. Starter type and size
2. Disconnect type and size
3. Combination motor starter type and size and if it has a phase failure relay in the enclosure.
4. Control station type and mounting type (surface or flush mounted)
5. Motor starter switch type and mounting type (surface or flush mounted)
6. Phase failure relay.

C. Indicate short circuit current ratings for all equipment.

1.4 RELATED WORK SPECIFIED ELSEWHERE

A. All motors will be provided by the Contractor providing the equipment to be driven.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide equipment with a short circuit current rating equal to or larger than the available fault current at the source panel.

2.2 MANUAL STARTER SWITCHES - TYPE MSS

A. Provide "on-off" toggle type manual starter switch with thermal overload protection for single phase motors.

B. Provide each switch with a red pilot light indicating when motor is on.

C. Provide switches located outdoors in a NEMA 4 enclosure and switches located indoors in a NEMA 1 enclosure unless indicated otherwise.

D. Approved Manufacturers (surface mounted):

1. Allen-Bradley bulletin 600 TAX4/TAX5, with pilot light bulletin 600 TAX216/TAX109
2. Square D equivalent
3. Eaton equivalent
4. General Electric equivalent
5. Siemens equivalent

E. Approved manufacturers (flush mounted):

1. Allen-Bradley bulletin 600 TXQ4/TXQ5, with pilot light bulletin 600 TQX216/TQX109
2. Square D equivalent
3. Eaton equivalent
4. General Electric equivalent
5. Siemens equivalent

2.3 MANUAL STARTERS

A. Provide full voltage type starters and thermal overload protection for three phase motors, requiring manual starters, unless indicated otherwise. Provide each switch with a red pilot light indicating when motor is on.

B. Provide starters located indoors in NEMA 1 enclosure, and starters located outdoors in NEMA 3R enclosure unless indicated otherwise.

C. Acceptable Manufacturers for manual starters:

1. Allen-Bradley bulletin 609 series with pilot light
2. Square D equivalent
3. Eaton equivalent
4. General Electric equivalent
5. Siemens equivalent
6. pre-approved equal.

2.4 MAGNETIC STARTERS

A. Provide full voltage type starters and thermal overload protection and external manual reset for all three phase motors, unless indicated otherwise.

B. Provide starters located indoors in NEMA 1 enclosure, and starters located outdoors in NEMA 3R enclosure unless indicated otherwise.

C. Equip each starter with 120 volt coil, control power transformer, secondary fuse block and fuses, 1 set of spare N.O and 1 set of spare N.C. auxiliary contacts, red "ON" pilot light, and "HAND-OFF-AUTO" control switch.

D. Provied additional aux contacts as required to allow power factor correction capacitors to be installed properly without modifications to the starter.

E. Provide phase failure relays for all three-phase motors 3 HP and larger.

F. Acceptable Manufacturers for magnetic starters:

1. Allen-Bradley Bull. 509 &512
2. Square D Class 8536
3. Eaton equivalent
4. General Electric equivalent

5. Siemens equivalent
6. Pre-approved equal.

2.5 COMBINATION MAGNETIC STARTERS

A. Provide unit with fused disconnect and magnetic starter as specified in paragraph 2.4. Provide disconnect with quick make-quick break mechanism and interlock so switch must be in off position before covers can be open. Provide disconnect handle capable of accepting padlocks.

B. Provide phase failure relays for all three-phase motors 3 HP and larger.

C. Acceptable manufacturers: As specified in paragraph 2.4.

2.6 PHASE FAILURE RELAYS

A. Provide motor protection relay that sense phase loss, phase reversal, low voltage and voltage unbalance conditions for all three phase motors three (3) HP and larger.

B. Provide auto-reset with time delay.

C. Provide octal base plug-in type relays.

D. Verify proper voltage for all relays.

E. Approved manufacturers:

1. TimeMark Model #A-258 series
2. Allen Bradley #8135
3. Square D #8430MPS
4. SymCom Model 201A
5. Eaton D65VMLP
6. pre-approved equal.

2.7 CONTROL STATIONS

A. Provide HP rated toggle switches per Section 26 2726 where toggle switches are called out to control equipment.

B. Provide standard duty control stations in NEMA 1 enclosures, unless indicated otherwise.

C. Provide flush mounted devices and plates in all finished areas.

D. Acceptable manufacturers (surface mounted):

1. Allen Bradley (number indicated for reference)
   a. Momentary start-stop - 800S-2SA.
   b. Maintained start-stop - 800S-2SCM.
   c. Momentary start-stop with pilot light - 800S-2SAP.
   d. Maintained start-stop with pilot light - 800S-2SBMP.
   e. Momentary 3 unit - 800S-3S series.
   f. Hand-Off-Auto - 800S-R44SX.
   g. Hand-Off-Auto with pilot light - 800-R3SXP.
2. Eaton equivalents
3. General Electric equivalents
4. Siemens equivalents

5. Square D equivalents
6. Pre-approved equal.

E. Acceptable manufacturers (flush mounted):
1. Allen Bradley (number indicated for reference)
a. Momentary start-stop - 800S-2ASQ.
b. Maintained start-stop - 800S-2BSMQ.
c. Momentary start-stop with pilot light - 800S-2ASPQ.
d. Maintained start-stop with pilot light - 800S-2BSMPQ.
2. Eaton equivalents
3. General Electric equivalents
4. Siemens equivalents
5. Square D equivalents
6. pre-approved equal.

2.8 DISCONNECTS

A. Provide disconnect switches as specified in Section 26 2816: Safety Switches.

B. Provide NEMA-3R enclosures for safety switches mounted outside.

C. Provide NEMA 4X non-metallic safety switches when used in exposed unprotected exterior locations, or for pool equipment.

PART 3 EXECUTION

3.1 LOCATION

A. Install all controllers and disconnecting means no higher than 6'7" A.F.F. to top of controller unless otherwise explicitly shown on the Electrical Drawings, regardless of any NEC exception,variance, or interpretation. Controllers and disconnecting means shall be READILY ACCESSIBLE from said ground level, regardless of any NEC exception, variance, or interpretation.

3.2 WIRING

A. Make connections to all motors and power equipment and leave equipment in working order. Check all motors for proper rotation. Tighten connectors and terminals in accordance with manufacturers' recommendations.

B. Coordinate motor location, controls, wiring, etc. with other Divisions as required for proper interface.

C. Make connections to control devices as indicated in the Drawings. Install all control devices in starter covers unless indicated otherwise. For remote mounted control devices and manual starter switches, surface mount devices in unfinished areas and flush mount devices in finished areas.

D. Extend power and/or control wiring for roof mounted equipment to the equipment within the unit curb. Separate roof penetrations are not allowed.

3.3 OVERLOAD PROTECTION

A. Provide properly sized overcurrent and overload protection for each motor called out to have overcurrent and overload protection.

B. Measure the full load current and provide motor overload elements accordingly. Indicate the overload element manufacturer, type, and size of the inside cover of each starter.

C. Submit complete list of “Motor and Starter Installation Data” to the Engineer prior to final completion. Include as a minimum the following information: Motor Name, Motor Location, Starter Location, Starter Type, Starter Manufacturer, Starter Model, Overload Type, Overload Size and Control Station Type and Model.

3.4 PHASE FAILURE RELAYS

A. Install phase failure relays inside the starter enclosure including manual starter enclosures, magnetic motor starter enclosures, motor control center starter tubs, and combination starter/disconnect enclosures.

B. Provide all required control wiring between relay and the starter.

3.5 SAFETY SWITCHES (DISCONNECTS)

A. Provide a lockable disconnect mounted on or adjacent to each motor starter (including VFD’s) as required by NEC Article 430.102(A).

B. Provide a lockable disconnect mounted on or adjacent to each motor as required by NEC Article 430.102(B).

3.6 IDENTIFICATION

A. Provide engraved nameplates as specified in Section 26 0553: “Identification for Electrical Systems” on all motor starter switches, magnetic starters, combination starters, contactors, disconnects, and control devices. Label per the name of the device controlled unless noted otherwise on the plans. Provide “SPARE” nameplates over spare equipment.

3.7 FORMS

A. Fill out the attached form with the information for each motor control device.

END OF SECTION

MOTOR CONTROL SCHEDULE

Tag/ID or equipment served	Volts	HP	RLA	Starter Type • MSS • FVNR • VFD	Starter Size (NEMA)	Starter Location (Room #)	Combination Starter/Disc?	
							Yes / No	Fused / NF

SECTION 26 3355

CENTRAL BATTERY LIGHTING INVERTER

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section

1.2 REFERENCES

A. Section 26 0100: Common Work Results for Electrical

B. Section 26 0120: Testing and Adjustments to Electrical Systems

C. Section 26 0526: Grounding and Bonding for Electrical Systems

D. Section 26 0529: Supporting Devices

E. Section 26 0533: Raceways, Fittings, and Boxes

F. Section 26 0553: Identification for Electrical Systems

G. Section 26 0560: Concrete Pads for Electrical Equipment

H. Section 26 5113: Lighting

I. UL 924 Emergency Lighting and Power Equipment.

J. Provide equipment designed and tested in accordance with the latest ANSI, UL, NEMA, IEEE, NFPA, and NEC standards.

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 0105: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Indicate electrical characteristics and connection requirements. Provide battery rack dimensions; battery type, size, dimensions, and weight; detailed equipment outlines, weight, and dimensions; location of conduit entry and exit; single line diagram indicating metering, control, and external wiring requirements; heat rejection and air flows.

C. Submit catalog sheets and technical data sheets showing physical data and electrical performance, electrical characteristics, and connection requirements.

D. Test Reports: Indicate results of all performance testing.

E. Manufacturer’s Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of the Product. Include equipment installation outline, connection diagram for external cabling, internal wiring diagram, and written instruction for cabling.

F. Manufacturer’s Certificate: Certify that Products meet or exceed the specified requirements.

G. Submit a factory test log of the CENTRAL BATTERY LIGHTING INVERTER indicating 100 percent of continuously rated load, voltage and frequency stability and transient response at ¼, ½, ¾ and full load conditions. Record any corrections made during the tests. Verify operation of all auxiliary devices. Verify calibration and polarity of all meters and instruments.

1.4 WARRANTY

A. Provide a complete parts and labor warranty on the system and all related accessories, commencing on the date of final acceptance and continue for a period of two (2) years. Provide all materials and labor required to correct any system malfunction or failure (determined not to be the result of negligence, abuse, or misuse) at no charge to the Owner during this time period.

B. Provide a battery warranty, on a pro-rata basis, for ten 10 years, after initial startup, provided that the prevailing ambient temperatures of the battery area does not exceed 77 degrees F. Battery to deliver a minimum of 80 percent of its capacity at the end of the warranty period.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Crucial Power Products-WaveRider 1

B. Dualite – Approved Equal

C. Surelites – Approved Equal

D. On Line Power – Approved Equal

E. LOTA – Approved Equal

F. Pre-approved equal.

2.2 CENTRAL BATTERY LIGHTING INVERTER

A. System Configuration: Pulse-width modulated, online double-conversion.

B. System Components:

1. Battery Plant.
2. Rectifier/charger to maintain battery charge and to provide input to inverter when utility power in available.
3. Inverter to provide power to load during normal operation.
4. Input and output transformers and filters to provide appropriate isolation and disturbance attenuation.
5. Input and output circuit breakers, sized for available fault current (minimum 480V of 35 KAIC, 120V of 10KAIC).
6. Monitors, sensors, control circuits, and remote annunciator.

C. Modes of Operation:

1. Normal: During normal operation, utility (or generator) power is Rectify to DC, drawing sinusoidal input AC current at unity power factor under all load conditions. The DC Rectifier supplies DC power to the Inverter and Battery Charger sections. The Inverter shall supply the load at all time without using the energy stored in the battery using high frequency PWM (min.10 kHz) power technology.
2. Emergency: Upon loss of input power or when power exceeds the specified input limits, the control logic shall allow the inverter to draw energy from the battery without interruption to the load and disconnect the input line. The transfer to battery shall be uninterrupted - "no break" power transfer. The inverter shall supply power from the batteries to the critical load through. The output voltage shall be sinusoidal and within specified limits 5% regulation. If power is not restored before the batteries have been exhausted, the UPS shall completely shut down - protecting the batteries from possible damage.

3. Recharge: When utility power is restored and before the batteries are completely exhausted, the UPS shall automatically return to normal operation. This retransfer to normal operation shall be uninterrupted. The battery charger shall automatically recharge the batteries to full capacity. Recharge characteristics must strictly comply with UL924 requirements.
4. Bypass: In the event of a component malfunction in either the Rectifier/Charger or the Inverter sections, the unit's Static Bypass Switch shall transfer the load to the utility power with no interruption. Bypass mode shall cause alarm indication and initiate output relay dry contacts closure for customer use.
5. Off-Battery: When the battery is removed for maintenance or the battery breaker is off, the unit will continue to function, meeting the specified performance parameters with the exception of the power back up time capability.

2.3 AC INPUT SPECIFICATIONS

A. Input Voltages: 120 VAC, 2 wires plus ground

B. Frequency: 60 Hz +/- 5%

C. Input Current: sinusoidal, close to unity PF under all line/load conditions (power factor correction)

D. Input Protection: contactor, optional input circuit breaker

E. Input Surge Protection: Surge Protection Devices (SPD)

F. Transfer Time: zero no break transfer (unit static transfer must not switch upon input power loss)

G. Slew Rate: 0.4 Hz/second, maximum

H. Input Power Connections: hard wired terminal block, optional input cable

I. Number of Wires: 2 wires plus ground

J. Cable Installation: conduit entries on the top and both sides of enclosure

2.4 AC OUTPUT SPECIFICATION

A. Output Ratings: 5 kW

B. Output Voltage: 120 VAC

C. Frequency: 60 Hz +/- 0.5 Hz

D. Voltage Regulation: +/- 3% No Load to Full Load, High Line to Low Line (typical)

E. Output Waveform: pure sinusoidal; square and modified sine is not allowed

F. Voltage Distortion: < 5% THD; < 3% Single Harmonic

G. Inverter Overload Capability: 125% for 10 minutes, 150% surge for 10 seconds

H. Bypass Overload Capability: 150%

I. Protection: fault current limited

J. Non-Linear Load Capability: 100%

K. Crest Factor: 1 to 2

L. Output Power Connections: hard wired terminal block, optional output receptacle panel board with NEMA type receptacles and over current protection (max 30 CBs)

M. Output Distribution: unit shall have an internal 14 pole, single phase load center, eliminating the need for additional distribution

N. Number of Wires: 2 wires plus ground

2.5 BATTERY SPECIFICATIONS

A. Standard Run Time: 90 min at full load

B. Extended Run Time: as required

C. Battery Type: sealed, maintenance-free, lead-acid, VRLA (Standard); optional other types are available.

D. Expected Life: 10 years

E. Charger Ampacity: per UL 924

F. Float Voltage: 2.25 V per cell

G. Protection: circuit breaker in each battery cabinet

H. Wiring: power cables from the UPS to the battery cabinet shall be provided by the customer, per local code. With multiple battery cabinets, interconnecting cables shall be provided.

I. Nominal DC Link Voltage: kVA/kW, (dependent on number of batteries). See chart next page

J. Battery Cabinets: matching battery cabinets, UL 924 listed, NEMA 1, consult factory for other types. The specific UPS and batter cabinet shall be a CSA listed system per UL924, with a minimum of 90 minutes of battery operation under full load conditions.

2.6 INVERTER SPECIFICATION

A. Inverter Type: Pulse Width Modulated (PWM) with variable frequency and pulse width, transistorized-type design. Construct of modular rack assemblies to facilitate maintenance.

B. Rectifier/Charger: Six pulse, solid state, full-wave bridge rectified, sufficient to supply full load to inverter while recharging fully-discharged battery to 95 percent of full capacity within 10 times the discharge time; and within input current limits specified.

C. Static Switch: Solid state transfer device rated for continuous duty operation to provide uninterrupted transfer.

D. Manual Bypass Switch: Configured to bypass the CENTRAL BATTERY LIGHTING INVERTER output to permit servicing the static switch without interrupting the critical load. Mount unit in CENTRAL BATTERY LIGHTING INVERTER cabinet.

E. Mean Time Between Failures: 150,000 hours minimum.

F. Cooling: Forced air cooling with replaceable filters and redundant fans. Exhaust air from top of unit.

G. Front Access: Provide modular design for major components accessible/replaceable from the front.

2.7 FABRICATION

A. Enclosure: Free standing enclosure with dead front construction. Designed with front access for servicing adjustments and connections. Access through hinged doors equipped with latch handle and lock. Equip cabinet for fork truck lifting.

B. Enclosure Finish: Primed and painted inside and outside with semi-gloss enamel.

C. Identify internal wiring at each end of conductor. Provide cabinet grounding lug.

2.8 CONTROLS AND ACCESSORIES (EDIT)

A. Front Panel LCD Display: Standard, 4 lines x 20 characters back lit, blue LCD display on the UPS for instant indication of UPS status, metering, alarms and battery condition. The display provides easy read-out on 2 standard and 2 optional screens, providing continuous information with scrolling update:

B. Status Display

1. System Status
    a. Standby: System is performing self-diagnostic.
    b. Start up: Inverter is being starter.
    c. Normal: All parameter are acceptable.
    d. Problem: Lost of utility power over load.
    e. Failure: System requires service.
2. System Rating in KVA
3. Battery Buss Voltage Status
    a. Battery ok: Battery voltage is within acceptable range.
    b. Battery bad: Battery voltage is out of range.
4. Input Voltage Status
    a. Input ok: Input voltage and frequency are within acceptable range.
    b. Input bad: Input voltage and/ or frequency is within acceptable range.
5. Battery Charger Status
    a. Charger on: Battery charger is charging or keeping batteries at float voltage.
    b. Charger off: Battery is being charged.
6. System Internal DC Buss
    a. DC ok: DC buss is within acceptable range.
    b. DC bad: DC buss is out of acceptable range.
7. Static By Pass Status
    a. On inverter: Critical load is being powered and protected by inverter.
    b. On by pass: Critical load is being powered from utility power.
8. Inverter Output Status
    a. Out ok: Output is within acceptable range critical load is being power by inverter.
    b. Out bad: No output is available from inverter and critical load is being powered from utility power.
9. Metering Display
    a. Output voltage
    b. Output power
    c. Input voltage
    d. Input current
    e. DC buss
    f. Battery voltage
    g. Battery current (+) Charging (-) Discharging

C. Alarm Relays: Standard, dry contacts signal relays closing for each of the following alarm conditions: Input Fail, On Bypass, Inverter ON, Low Battery, Summary Alarm

D. Communication Ports: Standard, Two com ports are available, configured for RS232 and 1 for RS485 data transfer. All parameters displayed on front panel shall be available on these ports for remote monitoring

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instruction.

B. Provide 4" concrete pad. Set unit square and level on pad. Refer to Section 26 05 60: Concrete Pads for Electrical Equipment.

C. Provide all necessary control wiring and conduit required to interconnect CENTRAL BATTERY LIGHTING INVERTER systems to distribution equipment for proper operation.

3.2 DEMONSTRATION

A. Fully instruct the Owner's personnel as to the proper operation of the equipment. Provide a minimum of eight hours of training.

B. Describe loads connected to the CENTRAL BATTERY LIGHTING INVERTER system and restrictions for future load additions.

C. Simulate a power outage by interrupting the normal source and demonstrate that the system operates to provide uninterruptible power.

3.3 FIELD QUALITY CONTROL

A. Perform IEEE capacity test on all cells prior to placing battery plant into service. Any cell that does not pass the test may only be retested once, if cell fails after retest it must be replaced. Monitor each cell individually and replace any cell falling below the final cutoff voltage of 1.67 vpc (plus or minus .04 volts).

B. Before the CENTRAL BATTERY LIGHTING INVERTER unit is subject to full load testing, complete battery testing, check all alarms and protective devices, as specified by the Engineer, as to their proper operation. After checking the CENTRAL BATTERY LIGHTING INVERTER equipment, the entire system will be tested to ensure proper operation of the system. Provide manufacturer's field service personnel to supervise installation, start up, and testing of their equipment.

C. Perform load tests to demonstrate conformance with the specification. Test unit to show it is free from any defects and it will operate properly according the specifications.

D. Provide a full load test utilizing a portable load bank for a minimum of one hour. House load may be used as part of the full load requirement.

E. Test all alarm and shutdown circuits by simulating conditions. Verify that all conditions appear at the remote annunciator.

END SECTION

SECTION 26 4313

SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.1 REFERENCES

A. Section 26 0100: Common Work Results for Electrical

B. Section 26 0526: Grounding and Bonding for Electrical Systems

C. Section 26 0529: Supporting Devices

D. Section 26 0533: Raceways, Fittings, and Boxes

E. Section 26 0553: Identification for Electrical Systems

F. Section 26 2413: Switchboards

G. Section 26 2416: Panelboards

H. Switchboards and Panelboards (NEC Article 408)

I. Surge-Protective Devices (SPDs) (NEC Article 285)

J. ANSI/IEEE STD C62.41.1 - 2002 Categories A, B, C.

K. ANSI/IEEE STD C62.41.2 - 2002

L. ANSI/IEEE STD C62.45 - 2002

M. UL 1449 4th Edition

N. MIL-STD 220B

O. Canadian Standards Association (CSA).

P. Federal Information Processing Standards Publication 94 (FIPS PUB 94).

1.2 SYSTEM DESCRIPTION

A. Surge Protective Device (SPD) equipment includes the following:

1. Service entrance SPD protection at the service switchboard panel(s) as shown on the plans.

2. TLP-X-X Panelboard SPD protection (“technology panels”).

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Indicate electrical characteristics and connection requirements. Provide necessary component dimensions; type, size, dimensions, and weight; detailed equipment outlines, weight and dimensions; location of conduit entry and exit; single-line diagram indicating external wiring requirements.

C. Submit catalog sheets and technical data sheets to indicate physical data and electrical performance, electrical characteristics, and connection requirements.

1.4 TESTING

A. Provide listed minimum repetitive surge current limiting capacity rating (as listed in part 2 of this specification) after all duty cycling and life tests have been performed as per ANSI/IEEE C62.41.1-2002, C62.41.2-2002 and C62.45-2002.

B. Life cycle test each unit to protect against and survive a minimum of 5000 open circuit Category C3 surges (20kV, 1.2x50μs) and 6500 short circuit Category C3 surges (10kA, 8x20μs) at 1 minute iuntervals.

C. The UL 1449 3rd Edition surge suppression rating shall not deviate by more than 10 percent between the first Category C3 test and the last Category C3 test.

D. Provide UL 1449 Listed Suppression let through voltage rating (including the unit disconnect if specified) listed in part 2 of this specification.

E. Provide UL 1283 Listed Electromagnetic Interference Filter with the attenuation rating obtained utilizing MIL-STD-E220A 50 ohm insertion loss methodology.

F. Test the SPD equipment for proper operation prior to leaving the factory.

G. Provide a certified record of these tests as part of the permanent documentation package that travels with each unit.

PART 2 PRODUCT

2.1 MANUFACTURERS

A. Eaton

B. Square D

C. Siemens

D. GE

E. Current Technologies

F. Liebert

G. Lea

2.2 VOLTAGE SURGE SUPPRESSION – GENERAL

A. Electrical Requirements

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.

2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.

3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.

4. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	●	●	●	●
Delta	N/A	●	●	N/A
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

5. Nominal Discharge Current (In) – All SPDs applied to the distribution system shall have a 20kA In rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an In less than 20kA shall be rejected.

B. ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

MODES	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

2.3 SPD DESIGN

A. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

B. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.

C. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.

D. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

E. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:

1. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.

    a. For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.

    b. For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.

    c. The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

2. Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.

3. Audible Alarm and Silence Button – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.

4. Surge Counter – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.

    a. The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.

5. Overcurrent Protection

    a. The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

F. Sidemount SPDs shall be factory sealed in order to prevent access to the inside of the unit. Sidemount SPDs shall have factory installed phase, neutral, ground and remote status contact conductors factory installed and shall have a pigtail of conductors protruding outside of the enclosure for field installation.

2.4 SYSTEM APPLICATION

A. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.

B. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
CATEGORY	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	300 kA	150 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120 kA	60 kA

C. SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

2.5 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

A. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.

1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.

2. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
3. The panelboard shall be capable of re-energizing upon removal of the SPD.
4. The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a 60A or 100A circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the 30A circuit breaker.
5. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.

B. Sidemount Mounting Applications Installation (SPD mounted external to electrical assembly)

1. Lead length between the breaker and suppressor shall be kept as short as possible to ensure optimum performance. Any excess conductor length shall be trimmed in order to minimize let-through voltage. The installer shall comply with the manufacturer's recommended installation and wiring practices.

2.6 SWITCHBOARD REQUIREMENTS

A. The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.

B. Locate the SPD (Type -1) on the line side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.

C. The SPD shall be connected through a 60A or 100A circuit breaker. The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.

D. All monitoring and diagnostic features shall be visible from the front of the equipment.

2.7 ENCLOSURES

A. All enclosed equipment shall have NEMA 1 general purpose enclosures, unless otherwise noted. Provide enclosures suitable for locations as indicated on the drawings and as described below:

1. NEMA 1 – Constructed of a polymer (units integrated within electrical assemblies) or steel (sidemount units only), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).
2. NEMA 4 – Constructed of steel intended for either indoor or outdoor use to provide a degree of protection against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (dirt and windblown dust); to provide a degree of protection with respect to the harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); and that will be undamaged by the external formation of ice on the enclosure. (sidemount units only)
3. NEMA 4X – Constructed of stainless steel providing the same level of protection as the NEMA 4 enclosure with the addition of corrosion protection. (sidemount units only)

PART 3 EXECUTION

3.1 INSTALLATION

A. Install SPD equipment in accordance with the manufacturer’s recommendations.

B. Make all necessary field measurements to verify that equipment will fit in the allocated space in full compliance with the minimum required clearances specified in the NEC.

C. Install SPD equipment where shown on the Drawings, per manufacturers instructions.

D. Install factory supplied conductors as short and straight as possible, no greater than one meter in length. Twist input conductors to reduce impedance for high frequency filtering.

E. Provide all required safety labels.

3.2 FIELD QUALITY CONTROL

A. Verify the optimal mounting location of the SPD unit(s) prior to rough-in to minimize the lead length of the SPD unit(s). Mount SPD unit to the side of the incoming switchboard section or immediately adjacent on the wall.

B. Verify all connections and the voltage at the connecting bus prior to energizing unit. Make corrections necessary if the voltage at the SPD is above the MCOV specification listed elsewhere in this specification.

C. Inspect installed SPD equipment for anchoring, alignment, grounding and physical damage.

D. Check tightness of all mechanical and electrical connections. Torque all connections per manufacturer's recommendations.

E. Test equipment in the field by a factory representative after installation to meet the required specifications.

F. Follow the SPD panelboard manufacturer's recommendations prior to energizing each SPD panelboard. Verify system voltage, grounding integrity, neutral-to-ground bonding connections, etc., before placing panelboard in service.

3.3 GROUNDING

A. Provide grounding per Section 26 0526: "Grounding and Bonding for Electrical Systems".

3.4 WARRANTY

A. Provide a complete parts and labor warranty for the system, commencing on the date of final acceptance and continue for a period of ten (10) years for Service Entrance SPD protection, five (5) years for SPD Panelboards. Provide all materials and labor required to correct any system malfunction or failure (determined not to be the result of negligence, abuse, or misuse) at no charge to the Owner during this time period.

END OF SECTION

SECTION 26 5113

LIGHTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 0100: Common Work Results for Electrical

B. Section 26 0120: Testing and Adjustments to Electrical Systems

C. Section 26 0519: 600 Volt Conductors and Cables

D. Section 26 0921: Contactors

E. Section 26 0529: Supporting Devices

F. Section 26 0533: Raceways, Fitting and Boxes

G. Section 26 0923: Occupancy Sensors

H. Section 26 0924: Daylight Sensors

I. Section 26 0926: Miscellaneous Lighting Control Devices

J. Section 26 0925: Emergency Lighting Control Relay

K. Section 26 0943: Lighting Control Equipment

L. Section 26 2726: Wiring Devices

M. Section 26 5200: Emergency Lighting

N. Section 26 5300: Exit Signs

1.3 DEFINITIONS

A. The term ‘lighting fixtures’ shall be considered the same as Luminaires per the definition Luminaires in the NEC, Article 100-Definitions.

1.4 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Submit shop drawings in booklet form with separate sheet for each fixture assembled in alphabetical order by ‘type’. Submit manufacturer’s data including dimensioned drawings and photometric data prepared by an independent nationally recognized testing lab.

C. Additional requirements for indirect linear lighting:

1. Submit scaled plan of each room or areas where the above types are used. Indicate fixture lengths, anchoring locations, feed points, internal wiring diagram of each fixture that shows all switchleg wiring any all low voltage dimming ballast wiring.

2. Identify each light fixture with type and room number used. Provide shipping label that identifies the room number and installation location of each light fixture. Include the plan described above in #1, inside each fixture box shipped to the site.

PART 2 PRODUCTS

2.1 LIGHT FIXTURES

A. Provide fixtures with lamps, and drivers, for each outlet shown on the Drawings and as specified herein. Refer to light fixture schedule on the drawings.

B. Provide U.L. approved fixtures.

C. Provie 80 CRI for all interior light fixtures.

D. Provide 70 CRI for all exterior light fixtures.

E. The type fixtures required are as noted by a capital letter on the Drawings. Contractor is solely responsible for the exact quantities.

F. For linear light fixtures on this project, fixture types shown on the plans do not necessarily equate to an exact length or quantity of fixture; rather, the fixture designation shown on the plans refer to the type of fixture. It is the Contractors responsibility to provide the proper length and switching configuration in each room.

G. Provide color stabilized clear virgin acrylic diffusers for interior fixtures. **Provide a minimum thickness of 0.156"** for troffer lenses.

H. Provide required disconnects at each light fixture as required under the NEC 410.130(G).

I. Provide all fixtures as plenum rated, suitable for installation location, even if at variance with fixture schedule model numbers.

J. Where required in insulated ceilings, provide insulated ceiling (IC) rated fixtures.

2.2 LED FIXTURES

A. LED fixtures shall be provided as a complete luminaire.

B. Driver

1. The driver's maximum case temperature shall not be exceeded at the maximum operating ambient. Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.

C. Housing

1. The electronics/power supply enclosure shall be internal to the luminaire and be accessible per UL requirements.

D. Technical

1. Fixtures shall be tested and rated per most recent edition of IESNA LM-79 and IESNA LM-80, with rated life of 50,000 hours or greater.
2. LED fixture shall be qualified with DLC (Design Lights Consortium).
3. Each luminaire shall be designed to operate at an average operating temperature of 25°C.
4. The operating temperature range shall be 10°F to 104°F.
5. Parameters and tests shall be conducted at different ambient temperatures.
6. Thermal management shall be of sufficient capacity to assure proper operation of the luminaire over the rated life.
7. The maximum junction temperature for the rated life shall not be exceeded at the average operating ambient.
8. The maximum junction temperature for the catastrophic failure shall not be exceeded at the maximum operating ambient.

9. The individual LEDs shall be connected such that a catastrophic loss or the failure of one LED will not result in the loss of the entire luminaire.
10. Power Factor: The luminaire shall have a power factor of 0.90 or greater at all standard operating voltages.
11. THD: Total Harmonic Distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 20 percent at any standard input voltage.
12. Surge Suppression: The luminaire shall include surge protection to withstand high repetition noise and other interference.
    a. The surge protection which may reside within the driver shall protect the luminaire from damage and failure for transient voltages and currents as defined in ANSI/IEEE C64.41 for Location Category A-Low. Where failure does not mean a momentary loss of light during the transient event.
    b. Surge protection performance shall be tested per the procedures in ANSI/IEEE C62.45 based on ANSI/IEEE C62.41 definitions for standard and optional waveforms for Location Category A-Low.
13. Operational Performance: The LED circuitry shall prevent perceptible flicker to the unaided eye over the voltage range specified above.
14. RF Interference: The luminaire and associated on-board circuitry must meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.
15. Dimming is required. The luminaire shall be capable of continuous dimming without perceivable flicker over a range of 100% to 10% of rated lumen output unless a lower low end level (e.g. 5% or 1%) is specifically noted in the fixture description on the Drawings. Dimming shall be controlled by a 0-10V signal.
16. Lumen Management (where indicated): The luminaire shall be capable of continuously monitoring system performance to allow for constant lumen management/compensation function.
17. Output Color: Minimum CRI 80, and color temperature 4000 K (+/- 100K) unless noted otherwise.
18. Manufacture shall provide a minimum of five year warranty of coverage. Warranty shall include, fixture construction, LED light engine and driver.
19. Energy Star Rated.
20. LED's shall be manufactured by CREE or PHILLIPS.

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide 100 hour initial burn in for fluorescent lamps connected to dimmers or daylight sensors. Refer to Section 26 0924: "Daylight Sensors".

B. Provide hangers, rods, mounting brackets, supports, frames, etc. for proper and safe fixture installation. Install fixtures in accordance with manufacturers' recommendations and instructions. Refer to Section 26 0529: "Supporting Devices" for approved supporting methods.

C. Provide fixtures complete with all auxiliaries required for proper, safe and distortion free installation in the various ceiling constructions in which they appear. Coordinate ceiling types with the Architectural drawings and provide compatible fixtures.

D. Where master/slave or inboard/outboard switching is indicated, provide tandem-wired ballasts between light fixtures as required by the Minnesota Energy Code.

3.2 CONDUCTORS

A. Wire recessed lay-in fixtures with 6 feet of flexible metal conduit with Type "THHN/THWN" conductors to the outlet box. Provide grounding type connectors for conduit and cable.

B. Provide outlet boxes adjacent to each recessed fixture outlet in suspended ceilings to permit each fixture to be adjusted to fit ceiling pattern and to permit "Feed Through" wiring.

C. Provide conduit for conductors to exterior site fixtures including but not limited to parking lot, walkway, athletic field and/or bollards.

3.3 QUALITY CONTROL

A. At the time of substantial completion, fixtures must be installed and lamped with new lamps. Install fixtures complete with lenses, diffusers, reflectors, louvers and other required accessories. Furnish a minimum of one case of replacement lamps for each type and size lamp used. Deliver replacement stock to the Owner’s storage space as directed by the Owner.

B. Replace any damaged reflectors, diffusers, louvers or other components at no expense to the Owner.

C. Clean fixtures free of dust, finger prints, paint, etc..

D. Perform aiming and adjustment of lighting fixtures in accordance with instructions issued by the Engineer. Adjust directional type fixtures (interior and exterior) after dark under the direction of the Architect, Engineer, and/or Owner.

E. Replace defective ballasts within the guarantee period at no cost to the Owner.

3.4 LIGHTING REBATE PROGRAM

A. Contractor shall coordinate with the local utility company and the owner as required to obain all lighting and lighting control rebates offered by the local utility company for this project.

B. All rebates shall be made directly to the owner.

C. Contractor to obtain all necessary paperwork and include all negotiations and subsantiantions required.

D. Retain samples of existing lamps and/or ballasts for proof of energy savings when required by the local utility company

END OF SECTION

SECTION 26 5300

EXIT SIGNS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 0100: Common Work Results for Electrical

B. Section 26 0120: Testing and Adjustments to Electrical Systems

C. Section 26 0519: 600 Volt Conductors and Cables

D. Section 26 0529: Supporting Devices

E. Section 26 0533: Raceways, Fitting and Boxes

F. Section 26 5113: Lighting

G. Section 26 5200: Emergency Lighting

H. Emergency Systems (NEC Article 700)

I. Life Safety Code (NFPA 101)

1.3 SHOP DRAWINGS

A. Submit shop drawings and descriptive data in accordance with Section 26 0105: “Submittals, Closeout Documents, Training and Spare Parts”.

PART 2 PRODUCTS

2.1 EXIT SIGNS

A. Provide exit signs that adhere to the following minimum specifications:

1. 120 and 277 volt operation.
2. Multiple LED lamp source.
3. NFPA 101 and EPA/DEP Energy Star Compliant.
4. Green or red stenciled letters (refer to light fixture schedule)
5. Black or white housing (refer to light fixture schedule)
6. Brushed aluminum face (refer to light fixture schedule)
7. Cast aluminum housing, snap together design.
8. Universal mounting: right side (canopy), left side (canopy), top (canopy) and back.
9. Knockouts for chevrons, right and left.
10. Snap-in wiring connections to allow replacement of components without removing housing.

B. For exit signs with battery back-up, provide the following additional minimum specifications:

1. Nickel cadmium batteries sized to provide 2 hours backup.
2. Integral solid state battery charger.
3. Low battery voltage protection
4. Provide pilot light and test switch. [Self-testing diagnostics.]

5. AC “ON” indicator
6. UL 924 listed

C. Approved Manufacturers
1. Refer to the light fixture schedule.

2.2 VANDAL GUARDS

A. Provide vandal guards where indicated on the plans, that adhere to the following minimum specifications:
1. Provide polycarbonate enclosure, mounts to wall. Shields that mount directly to exit signs are not acceptable.
2. Provide 9 gauge welded steel mesh wire guards, mounted to wall. Guards that mount directly to exit signs are not acceptable.

B. Approved manufacturers
1. Safety Technology International, Inc.
2. Pre-approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Prior to installation of exit signs, contact the Building Official and Fire Marshal to arrange a walk-through to discuss exit sign placement, approximately at the mid-point of construction.

B. Provide exit signs at each exit and along the egress path.

C. Mount exit signs to walls wherever possible. Where exit signs are shown to be installed to a lay-in ceiling, provide additional support from the building structure. Refer to Section 26 0529: Supporting Devices for supporting requirements.

D. Connect exit signs to life safety circuit fed from the emergency lighting inverter. Provide handle lock on breaker.

3.2 VANDAL GUARDS

A. Securely mount guards to structure using standard hardware with dedicated anchors. Refer to Section 26 0529: “Supporting Devices”.

B. Provide a minimum of four anchors (one (1) per corner), or additional if recommended by the guard manufacturer.

3.3 WARRANTY

A. Provide a complete parts and labor warranty for the system, commencing on the date of final acceptance and continuing for a period of one year. Provide all materials and labor required to correct any system malfunction or failure (determined not to be the result of negligence, abuse or misuse) at no charge to the Owner during this time period.

B. Provide these additional manufacturers warranties:
1. Provide a lifetime warranty on exit sign LED’s.
2. Provide five (5) year warranty on the exit sign unit and electronics.
3. Provide ten (10) year pro-rated warranty on exit sign batteries.
4. Provide lifetime warranty on vandal wire guards.

END OF SECTION

SECTION 27 0000
GENERAL TECHNOLOGY REQUIREMENTS

Part 1 - GENERAL

1.01 PROJECT SUMMARY

A. Scope: Successful bidder shall provide, install, configure, and provide warranty service for technology systems described herein.

1.02 RELATED DOCUMENTS

A. Documents: Provisions of General Conditions, Supplementary Conditions, and the sections included under Procurement & Contract Requirements are included as part of this section as though bound herein.

1.03 RELATED WORK

A. Section 27 05 00 – Communications General Requirements

B. Section 27 05 26 – Grounding and Bonding for Technology Systems

C. Section 27 05 28 – Pathways for Technology Systems

D. Section 27 05 37 – Firestopping for Technology Systems

E. Section 27 11 00 – Communications Equipment Rooms

F. Section 27 13 00 – Communications Backbone Cabling

G. Section 27 13 23 – Interbuilding OSP Pathways

H. Section 27 15 00 – Communications Horizontal Cabling

I. Section 27 60 00 – Physical Security General Requirements

J. Section 27 62 00 – Electronic Access Control System

K. Section 27 64 00 – Video Surveillance System

1.04 DEFINITIONS

A. Approved or Approval: Where approval is called for, only persons with the authorized authority may grant approval. Owner reserves all rights to govern over and grant approval and will appoint authority of agents acting on their behalf.

B. As Required: Contractor shall provide the quantity of said item that is necessary. Owner and Consultant reserve the right to make the final determination of necessary quantities to provide for a complete system.

C. Basis of Design: The documentation of the concepts, calculations, decisions, and product selections used to meet the Owner's project requirements. These Consultant produced documents are not shop drawings. Product selections depict minimum functionality and overall quality and are open to substitution requests.

D. Consultant: True North Consulting Group.

E. Contractor: The qualified party responsible to provide all items and perform services as described within these documents. The Contractor referred to within a specific specification section shall be the successful qualified party contracted to perform and complete that work.

F. Documents: The complete package of Bid and Contract Requirements, General Technology Requirements, related Division 27 sections, drawings, schedules, and addenda that make up this Request for Bid.

G. End-User: Individual(s) who will ultimately operate the completed system.

H. ETR: Existing to Remain. Item is to remain in current location and maintain current functionality.

I. Furnish: To supply and deliver to project site, ready for installation.

J. Install: To place in a position of service or use.

K. NIC: Not in Contract. Item will be the responsibility of others.

L. Notice to Proceed: Formal communication from Owner to Contractor stating the date the Contractor can begin work subject to the conditions of the contract. The performance time of the contract starts from the Notice to Proceed date.

M. OFCI: Owner Furnished Contractor Installed. Item will be provided by Owner and shall be installed by Contractor.

N. OFE: Owner Furnished Equipment. Item will be provided and integrated by Owner.

O. OFOI: Owner Furnished Owner Installed. Item will be provided and installed by Owner.

P. Owner: The party named in the Procurement and Contract Requirements as the advertising party.

Q. Provide: To furnish and install, complete and ready for intended use.

R. Substantial Completion: The stage in the progress of installation when the systems described herein are sufficiently complete, in accordance with the Contract Documents, so that the Owner can utilize such systems for their complete intended use.

S. Turnkey: Of or involving the provision of a complete product or service that is ready for immediate use.

T. Work: The provision of products and/or services to meet the requirements specified in these documents.

1.05 REFERENCE STANDARDS AND CODES

A. Standards and other procedures referenced by this bid package are as follows:

1. ADA – Americans with Disabilities Act of 2010
   www.ada.gov/2010ADAstandards_index.htm
2. AIA – American Institute of Architects
   www.aia.org
3. ANSI – American National Standards Institute
   www.ansi.org
4. ASTM – American Society of Testing and Materials
   www.astm.org
5. BICSI – Building Industry Consulting Service International, Inc.
   (RCDD Standards)
   www.bicsi.org
6. CFR – Code of Federal Regulations
   www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR
   (Available from the Government Printing Office)
   (Material is usually first published in the Federal Register)
7. U.S. Copyright Law, December 2011
   www.copyright.gov/title17
8. ECIA – Electronic Components Industry Association
   ESC – EIA Standards Council
   www.eciaonline.org
9. IACS – International Annealed Copper Standard
   www.ndt-ed.org/GeneralResources/IACS/IACS.htm
10. IEC – International Electrotechnical Commission
    www.iec.ch
11. IEEE – Institute of Electrical and Electronics Engineers
    standards.ieee.org
12. ISO – International Organization for Standardization
    www.iso.org
13. ITU-T – International Telecommunication Union – Telecommunication
    www.itu.int
14. NEC – National Electrical Code (NFPA 70)
    maintained by NFPA – National Fire Protection Association
    www.nfpa.org
15. NECA – National Electrical Contractors Association
    www.necanet.org
16. NEMA – National Electrical Manufactures' Association
    www.nema.org
17. OSHA – Occupational Safety and Health Administration
    (U.S. Department of Labor, OSHA)
    www.osha.gov
18. TIA – Telecommunications Industry Association
    www.tiaonline.org/standards

19. UL – Underwriters' Laboratories
    www.ul.com

B. Standards: Referenced standards and/or procedures shall be binding on the Contractor and work shall be judged against such standards and procedures unless otherwise stated in writing.

C. Local/State Codes: Contractor shall comply with all local and state code requirements as determined by the authority having jurisdiction (AHJ).

D. Owner Standards: Contractor shall obtain and abide by all published Owner standards as they pertain to the work described herein.

E. Contractor shall use the latest versions of all standards and codes unless otherwise directed by the authority having jurisdiction (AHJ) or expressly noted herein.

1.06 QUALIFICATIONS

A. Refer to related sections for specific requirements.

1.07 PERMITS AND INSPECTIONS

A. Responsibility: Obtain permits and inspections required for the work. Contractor is responsible for all permit and inspection costs.

B. Performance: Perform tests required herein, or as may be reasonably required to demonstrate conformance with the specifications or with the requirements of any legal authority having jurisdiction.

C. Review: Obtain approvals from authorities responsible for enforcement of applicable codes and regulations to establish that the work is in compliance with all requirements of reference codes indicated herein and required by the appropriate jurisdiction. Make corrections, changes or additions as required and deliver certificates of acceptance, operation, and/or compliance with the Operation and Maintenance Manuals described herein.

1.08 DRAWINGS AND BASIS OF DESIGN

A. General: Work, equipment, or material delineated on any drawing in this package is expected to be provided by Contractor unless noted otherwise.

B. Interpretation: Work shall be installed in accordance with the basis of design diagrammatically expressed on the drawings and described in the written specifications and equipment schedule(s). Contractor shall not make limiting interpretation that provides for incomplete work or a non-functioning system.

1.09 PRODUCT SUBSTITUTION PROCEDURES

A. Requests for Substitutions: Should the Contractor request a change in the material that is to be supplied, from that which was specified in the contract, the Contractor shall provide the Owner and the Consultant with a written request for said change.

B. Substitutions for Non-specified Products: Where no product specification is provided, Contractor may use manufacturer's specification for the identified product as a guide for suggesting appropriate substitutions.

C. Requirements: The Request for Substitution shall include:

1. Reason for substitution.

2. Material data sheets for both the proposed item(s) and the item(s) to be replaced.

3. Any cost impact to the Owner.

D. Changes: Proposed changes to Contract Documents shall be clearly identified in the pre-construction submittals.

E. Approval: The Owner may approve or deny any Requests for Substitution. The Owner reserves the right to govern over and proclaim whether proposed products are equal to the specifications. The Contractor shall not procure any substitute materials until the Owner has approved and signed the Request for Substitution and passed copies to the Contractor and the Consultant. Any procurement or work performed prior to this approval is at the Contractor's own risk.

F. Deviation: Products provided or installed that deviate from the products specified in make, model, color, or other significant characteristic (i.e., non-approved substitutions) shall be removed and replaced with specified products at no additional expense to Owner.

1.10 SOFTWARE

A. Versions: Consultant used the following software versions for this project:

1. Autodesk Revit MEP 2024 (floor plans)

2. Autodesk AutoCAD MEP 2024 (detail sheets)

1.11 SUBMITTAL CONDITIONS

A. The Contractor shall not consider the Consultant or Owner's review of submittals to be exhaustive or complete in every detail. Approval of shop drawings or submittals including substitutions indicates only the acceptance of the Contractor's apparent intent to comply with general design or method of construction and quality as specified. The finished product shall meet functional requirements, operations, arrangements, and quantities and comply with the contract documents unless specifically approved otherwise.

B. The Contractor shall be held responsible for delivery of systems as specified. Any errors or omissions in the submittals shall not relieve Contractor of responsibility to deliver complete systems as specified.

1.12 PRE-CONSTRUCTION PROCEDURES

A. Pre-Construction Submittal Meeting: Contractor shall schedule web conference (Microsoft Teams or similar) with Consultant to review basis of design and submittal expectations.

B. Prior to Work: Pre-construction submittals shall be provided to Consultant with appropriate promptness as to cause no delay to the work.

C. Project Timeline: Project timeline will not be altered due to lateness of submittals. Contractor is bound to deliver a timely, complete, and finished project as stipulated in their contract and specified herein.

D. Format and Distribution: Contractor shall provide one (1) electronic copy in PDF format to Consultant of all pre-construction submittals. The Contractor shall provide hard copies sets as required up to five (5) sets.

E. Provision: Contractor shall submit pre-construction submittals including any corrections or additions to Consultant prior to the procurement of equipment or commencement of work.

F. Review: Pre-construction submittals shall be received and formally approved by Consultant prior to the procurement of material or the commencement of work. Any procurement or work performed prior to this approval is at Contractor's own risk.

G. Failure to Provide: The failure of Contractor to provide pre-construction submittals as required herein may result in the withholding of payment for work and/or the cancellation of the contract.

1.13 PRE-CONSTRUCTION SUBMITTALS

A. Pre-construction submittals are intended to document the details of installation. Exact copies of original drawings and specifications are not acceptable as pre-construction submittal drawings. Consultant schematic diagrams describe the basis of design as defined herein.

B. Contractor shall provide to Consultant the following pre-construction submittals for approval in addition to specific requirements identified in subsequent sections.

1. Qualifications: Shall include documentation of all required certifications and qualifications.

2. Shop Drawings:

a. Title: Each drawing shall have a descriptive title and all subparts of each drawing shall have unique identifiers.

b. Floor Plans: Shall include device locations, Contractor provided furniture and installation notes.

c. System Drawings: Shall include functional diagrams for each system detailing system flow including all equipment, routing, inputs/outputs, wiring signal type, cable identification detail, connectors, adapters, intra/inter-rack power distribution, installation notes and any other information required to convey the complete turnkey system design.

d. Equipment Rack and Cabinet Elevations: Shall include placement of all mounted equipment.

e. Structurally Mounted Elements: Shall include both plan view of placement as well as a detail of structural mounting techniques to be used.

f. Furniture: Shall include all Contractor provided furniture showing dimensional drawings, cable management and finishes with samples for Owner approval.

3. Product Data:

    a. Equipment Schedules: Shall include manufacturers, part numbers, quantities and unit pricing.

    b. Product Cut Sheets: Shall identify (highlight, arrow, etc.) actual part numbers to be utilized including but not limited to equipment, mounting hardware, cabling, connectors, software and power distribution equipment.

4. Manufacturer's Recommendations:

    a. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, copies of these recommendations shall be provided prior to installation. Installation of the items will not be allowed to proceed until the recommendations are received and approved.

1.14 PRE-INSTALLATION PROCEDURES

A. Refer to individual sections for additional information.

1.15 CONSTRUCTION PROGRESS PROCEDURES

A. Meeting Attendance: Contractor is required to attend job progress meetings in accordance with requirements set by Owner or Consultant.

B. Additional Coordination: Contractor shall request additional job construction coordination meetings it deems to be necessary to ensure coordination of their responsibilities with other parties.

C. Progress Inspection: Consultant may perform periodic progress inspections. At Consultant's request, Contractor shall make Project Manager and/or Lead Technician available.

D. Test Plan: Ten (10) business days prior to the proposed Contractor test date, Contractor shall provide a test plan defining the tests required.

    1. The test plan shall be approved by Consultant prior to any testing.

1.16 CONSTRUCTION PROGRESS SUBMITTALS

A. Completion: Contractor shall complete and submit via email all construction progress documentation in PDF format as requested by Owner and Consultant.

B. Contractor shall provide to Consultant the following construction progress submittals in addition to specific requirements identified in subsequent sections.

    1. Weekly Report: Weekly written report to be submitted to Consultant through appropriate project channels in PDF format outlining progress from previous week, plans for progress in the current week, and any coordination issues that may require Consultant or Owner attention.

    2. Test Plan: Shall ensure the system meets Owner operational and performance specifications and include the following:

        a. Identification of the capabilities and functions to be tested.

b. Detailed instructions for the setup and execution of each test.

c. Procedures for evaluation and documentation of the results.

C. Failure to Complete: Failure to complete requested construction progress documentation may result in the withholding of payment by Owner.

1.17 CLOSEOUT PROCEDURES

A. Notification: Contractor shall provide written notification to Consultant and Owner when Contractor is satisfied that the work has reached Substantial Completion and is ready for inspection.

B. Pre-Inspection Submittals: Contractor shall submit an electronic copy of all closeout submittals to Consultant in accordance with the requirements found in these documents no less than ten (10) business days prior to the scheduled Final Inspection.

1. Test Results

2. As-built drawings (full-size sheets)

3. Operation and Maintenance Manuals

4. End User Software

C. Photos that demonstrate complete system installation.

D. Punch List: Work or materials found to be incomplete, of unsatisfactory quality, failing to meet the specifications in these documents, and/or unacceptable to Consultant or Owner shall be documented by Consultant and provided to Contractor to rectify at no additional cost. Contractor shall provide written notification to Consultant and Owner when all punch list items have been completed.

E. Final Inspection: At Consultant's request, Contractor shall make Project Manager and/or Lead Technician available.

F. Re-Inspection: If more than one (1) re-inspection is necessary, the costs of the additional travel, time, and expenses of Owner and Consultant may be deducted by Owner from the contract amount due to the Contractor.

G. Punch List Approval: Once all punch list items are complete, the Contractor shall return an initialed punch list to the Consultant and Owner for verification. Punch list shall be considered complete only after having been signed by Owner and Consultant.

H. Closeout Submittals: Upon approval of closeout submittals and prior to final acceptance, Contractor shall provide three (3) electronic copies to Owner and Consultant in format(s) noted below.

1. Record Drawings – AutoCAD 2020 editable .dwg format AND PDF.

2. Operation and Maintenance Manuals – USB flash drive.

3. End User Software – USB flash drive.

4. Documentation of testing and system certification.

5. Completed Minnesota Department of Revenue IC-134 Form.

I. Closeout Submittal Format and Distribution: Upon approval of closeout submittals and prior to final acceptance, Contractor shall provide one (1) digital copy with labeled bookmark dividers of all record drawings (full-size sheets) and operation and maintenance manuals, one (1) digital copy to Consultant. Title on cover page shall be "Operation and Maintenance Manual – [Project Name]". The following additional items shall be identified on the binder cover:

1. Client Name

2. Contractor Name and Contact Information

3. Consultant Name and Contact Information

4. Date

J. All documentation prepared by the Contractor, including hard copy and electronic forms, shall become the property of the Owner.

K. Payment Authorization: Final payment will be authorized only after all closeout procedures and requirements have been followed and fulfilled by Contractor and approved in writing by Owner and Consultant, including punch list(s) and/or re-inspection(s) and delivery of closeout deliverables.

1.18 CLOSEOUT SUBMITTALS

A. Closeout submittals are intended to document the details of the final installation that substantially conforms to the construction documents and functions as intended to meet the Owner's needs.

B. Contractor shall provide to Consultant the following closeout submittals for approval in addition to specific requirements identified in subsequent sections.

1. As-built drawings: As-built drawings are prepared by the Contractor. They show, in red ink, on-site changes to the Consultant-approved pre-construction submittal documents. As-built drawings shall be submitted to Consultant for approval prior to submitting record drawings and include:

a. Changes made by Addenda, Change Orders, Requests for Information (RFIs), Architect's Supplemental Instruction (ASIs), or Requests for Proposal (RFPs) in addition to any other changes to the original documents.

b. Actual device locations, conduit routing, wiring and relationships as they were constructed.

c. Nomenclature showing as-built wire designations and colors.

d. Room numbers coinciding with Owner space planning numbering.

2. Record drawings: Record drawings are the final drawings prepared by the Contractor and incorporate all as-built drawing changes previously approved by Consultant. Record drawings should be electronically produced without any handwritten, red ink, or clouded changes.

3. Operation and Maintenance Manuals: Notwithstanding requirements specified elsewhere, submit one (1) copy of each of the following per binder:

    a. A final Bill of Materials for each system.

    b. A Microsoft Excel (.xlsx format) spreadsheet for each device that resides on the network, provide the following:

        i. IP Address

        ii. MAC Address

        iii. Serial Number

        iv. Manufacturer

        v. Model Number

        vi. Device Username

        vii. Device Password

        viii. Telecom Closet or Rack Location

        ix. Patch Panel Port Number

        x. Switch Port Number

        xi. Any other relevant information as requested by Owner

    c. Manufacturers Instruction Manuals: Specification sheets, operation manuals and service sheets published by the manufacturers of the components, devices and equipment provided.

    d. Information for testing, repair, troubleshooting, assembly, disassembly, and recommended maintenance intervals.

    e. Replacement parts list with current prices. Include list of recommended spare parts, tools, and instruments for testing and maintenance purpose.

    f. Performance, Test, and Adjustment Data: Comprehensive documentation of performance verification according to parameters specified herein.

    g. Warranties: Provide an executed copy of the Warranty Agreement and copies of all manufacturers' Warranty Registration papers as described herein.

    h. Sufficient information, (detailed schematics of subsystems, assemblies, and subassemblies to component level) clearly presented, shall be included to determine compliance with drawings and specifications.

    i. Any other items defined herein.

4. Local Reference Diagrams: Within each equipment rack, enclosure, or cabinet, the Contractor shall place a functional diagram of the system(s) in a clear plastic sleeve secured to the equipment rack, cabinet, or enclosure.

5. Intellectual Property: Provide all required items and written release as described herein.

6. Training Program: Proposed training materials and program outline.

7. Spare Parts and Remote Controls: Contractor shall submit record of Owner sign-off of turnover of spare parts and remote controls.

1.19 PROJECT MANAGEMENT

A. Project Manager: Contractor shall appoint a Project Manager who will be the main point of contact for Owner and Consultant regarding the project.

B. Responsibility: Project Manager is responsible for the following:

1. Successfully completing the contract in a timely manner.

2. Overseeing work and performance of all employees and Subcontractors who have been hired by Contractor, and ensuring compliance with specification.

3. Completing and submitting required documentation.

4. Attending project coordination meetings as required by Owner, Consultant, and Contractor. Contractor is responsible for taking minutes of these meetings and distributing copies to all participants in a timely manner.

5. Coordinating with Owner, Consultant, Architect, General Contractor, and other Contractors involved in the project to ensure smooth flow of work and on-time project completion.

6. Providing a written weekly progress update to the Owner and Consultant in a PDF format emailed to the project team.

7. Reporting all unexpected conditions and problems that may result in delay or expense to Owner and Consultant immediately upon discovery.

C. Change of Project Manager: If Contractor seeks to change Project Manager during the course of the Project, such change is subject to prior written approval from Owner.

D. The Owner reserves the right to request a change of project manager at any time for any reason.

1.20 EXAMINATION OF EXISTING CONDITIONS

A. Examination: Contractor shall examine the facility and construction documents to the extent necessary to plan for efficient installation strategies prior to the delivery of materials to the site or the commencement of work. Other documents (Architectural Drawings, hardware schedules, etc.) may be made available upon request. Failure to adequately complete the examination shall not result in change order requests.

B. Acceptance of Conditions: Commencement of work by Contractor shall indicate acceptance of existing conditions, unless a written notice of exceptions has been provided to Owner prior to commencement.

C. Observation: If Contractor observes—during preliminary examinations or subsequent work—existing violations of fire stopping, electrical wiring, grounding, or other safety- or code-related issues, Contractor shall report these to Owner in a timely manner.

D. Pre-Existing Damage: If Contractor observes damage to finished surfaces before they begin installation in any area, Contractor shall document by taking digital photos

of the damaged area(s) and immediately notify Construction Manager and Consultant via email with attached photos.

E. Damage during Installation: Any damage caused by, or reasonably believed by the Construction Manager to be caused by the Contractor shall result in back-charges for said damages. Repairs shall match preexisting color and finish of walls, floors, and ceilings. Any Contractor damaged ceiling tiles, floor, and carpet shall be replaced to match color, size, style, and texture.

1.21 CONTRACT MODIFICATION PROCEDURES

A. Changes: Changes to the contract may be initiated by Owner, Consultant or Contractor.

B. Request for Information (RFI): If a change originates with Contractor, the Contractor shall submit an RFI for Consultant review. If it is deemed a change is necessary, the Consultant shall issue a PR to address the change.

C. Proposal Request (PR): If a change originates with Owner or Consultant, Consultant shall issue a Proposal Request to Contractor.

D. Change Proposal (CP): If a change originates with Contractor, or if Contractor receives a Proposal Request from Consultant, Contractor shall submit a Change Proposal to Consultant to review.

1. References: A Change Proposal shall reference the work to be performed, and shall include the cost change to the Project (if any) and the time change to the scheduled completion (if any).

2. Additional Information: Consultant may request additional information to be supplied with the Change Proposal for consideration.

3. Acceptance: Owner reserves the right to accept or reject Change Proposals.

E. Change Order: A Change Order is a modification of the contract.

1. If a Change Proposal is approved, Owner will issue a Change Order that references PR and/or CP. Change Order is not valid until it has been signed by Owner.

2. Work performed or equipment supplied outside of contract without a valid Change Order is done at Contractor's own risk.

1.22 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Storage: Contractor shall provide secure material storage. If Contractor chooses to store cabling or equipment at project site, that Contractor shall receive written approval from GC or Owner to identify acceptable location. All equipment provided by the Contractor remains the responsibility of that Contractor until Owner has beneficial use of the equipment.

B. Protection: Contractor shall take all necessary precautions to protect materials from the following:

1. Theft

2. Vandalism/Tampering
3. Dents
4. Scratches
5. Dust
6. Temperature
7. Weather
8. Cutting
9. Paint
10. Other hazardous conditions

C. Replacement: Contractor shall replace any damaged or lost material as required by Owner or Consultant.

D. Installed Materials: Installed materials remain the responsibility of the Contractor until Acceptance. Contractor shall take necessary precautions to ensure the safety and security of installed materials.

1.23 INTERFERENCE WITH THE FACILITY

A. Transportation and storage of materials at the facility, work involving the facility, and other matters affecting the habitual use by the Owner of the Owner's buildings, shall be conducted to minimize interference, and at times and in a manner acceptable to the Owner.

1.24 ON-SITE CONDUCT

A. Conduct: Any demonstration of rudeness, use of profanity, or lack of respect by Contractor Personnel to a building tenant will be cause for immediate removal from the premises, and such Personnel will not be allowed to return. Contractor and Contractor's Personnel are to remain in project area.

B. Vandalism: Graffiti or vandalism will not be tolerated. Any Contractor/Personnel caught in the act shall be immediately removed from the premises and will not be allowed to return.

C. Hazardous Conditions: No one shall be allowed to endanger the building, its premises, or its occupants in any manner whatsoever. In the event that a situation occurs which threatens the building or its occupants in any manner, Contractor, Contractor Personnel, Subcontractor, etc. shall take immediate steps to correct the hazardous condition. In the event that Contractor's Personnel fail to correct hazardous condition, Owner reserves the right to immediately take steps to correct the situation at Contractor's expense.

1.25 SAFEGUARDS AND PROTECTION

A. Barriers: Provide and maintain suitable barriers, guards, fences and signs where necessary to accommodate the safety of others relative to and/or for the protection of this work.

B. Regulations: Comply with OSHA, Federal, State, Local, and Owner regulations and standards pursuant to this work.

C. Protection: Protect all materials and equipment to prevent the entry or adhesion of any and all foreign material. If necessary, cover equipment with temporary protective material suitable for this purpose.

D. Finishing: Check, clean and remove defects, scratches, fingerprints and smudges if necessary from all equipment and devices immediately prior to Acceptance of the Installation.

E. Damage: Replace all damaged or defective material or work at no additional cost prior to Final Acceptance.

F. Documentation: Provide written description of accidents by workers, staff, and general public of any incident occurring on the project. Report incident in writing to Owner's representative immediately and to the Project Manager for follow up.

1.26 OWNER-FURNISHED PRODUCTS

A. Delivery: Owner is responsible for delivery of Owner-furnished products to the project site, unless otherwise specified in this document.

B. Placement: Contractor is responsible for locating, inspecting, and moving Owner-furnished products to their final installation position.

C. Inspection: Contractor shall report any damage, discrepancies in quantity, type, or function to Owner and Consultant immediately upon discovery.

D. Warranty: Contractor assumes no responsibility for any material warranty for Owner-furnished products. Contractor shall be responsible for integrating, cabling, and installing Owner-furnished products under the same warranty conditions as other products furnished by Contractor.

1.27 QUALITY ASSURANCE

A. Assurance: It is the intent of these specifications to describe and provide for a complete, professional, and reliable installation.

B. Qualifications: Contractor employees who are engaged in installation shall be adequately trained in the tasks they are expected to perform.

C. Acceptability: Owner shall determine the acceptability of work.

D. Regulatory Requirements: Contractor shall comply with code requirements that apply to the work being performed.

E. Certifications: Where manufacturer certifications are required for warranty or for authorized resale, installation personnel shall have received such certification prior to the start of installation of those manufacturers' materials.

1.28 QUALITY CONTROL

A. Installation: During installation period, when connections are made to the Owner's existing infrastructure, Contractor shall use care to ensure that such connections will not have a negative impact which could reduce or hamper existing systems.

1.29 OWNER'S RIGHT TO USE EQUIPMENT

A. The Owner reserves the right to use equipment, material and services provided as part of this work prior to Acceptance of the Work, without incurring additional charges and without commencement of the Warranty period.

1.30 INTELLECTUAL PROPERTY OWNERSHIP

A. All intellectual property shall remain in escrow for an unlimited period of time. All supporting documentation including but not limited to: software, firmware, programming, uncompiled source code, graphic files, diagrams, written and electronic files, including all latest versions of the documentation and software necessary to edit and adapt the system(s), shall be provided to the Owner on a USB flash drive for all spaces and all systems. The integrator and/or programmer shall also maintain a current live copy incorporating all system modifications to be provided at the Owner's request and for system restoration upon a failure.

B. A written release shall be given by the Contractor and all other required parties for all programming and configuration done by the Contractor and/or Subcontractors. This release will acknowledge the Owner's ownership and right to modify the intellectual property directly, or to have the intellectual property modified by any party of the Owner's choosing.

Part 2 - PRODUCTS

2.01 BASIC EQUIPMENT AND MATERIALS REQUIREMENTS

A. Standards: Equipment and materials used to accomplish the goals of this project shall meet standards for good engineering practice as defined within this document.

B. Quality: Products specified in these documents are intended to establish a baseline or operational, functional, and performance-based standards that all proposed products shall meet or exceed by functionality and quality.

2.02 FACTORY-ASSEMBLED PRODUCTS

A. Manufacturer: Reference to specific equipment manufacturers does not imply that all products produced by that manufacturer meet the specification requirements.

B. Age of Equipment: Equipment shall be new and unused with full manufacturer's warranties. Contractor shall supplement such warranties as required by the specification. Contractor shall immediately notify Consultant of any product that will be or is expected to be discontinued by the end of the project for resolution.

C. No Modification: Where a product is available from a factory/manufacturer to meet the needs as outlined, that product shall be used without modification to ensure the full factory warranty is maintained.

D. Like Materials: Like materials used shall be of the same manufacturer, model, and quality unless otherwise specified.

E. Software/Firmware: No software or firmware is to be used unless specifically authorized by Owner or its appointed representative.

2.03 RACKS, CABINETS, HARDWARE

A. Equipment Racks and Cabinets: Provide racks and cabinets as specified herein and/or described in accompanying documents, appendices, or drawings. Verify that any existing racks and/or cabinets provided by others are complete, bringing any discrepancies to the attention of Owner and Consultant prior to beginning the installation.

B. Shelves and Mounts: Contractor shall supply necessary mounting hardware to install rack-mounted equipment. Mounting hardware shall be a product of the manufacturer of the equipment to be mounted, or manufacturer of the rack system, or approved by either for use with their product. Provide supporting channels, shelves, rack mounts, and/or rack ears as recommended by equipment manufacturers.

C. Screws and Washers: Contractor shall provide screw head types appropriate to the level of security required for the equipment and racking. Screws shall include polyethylene or nylon washer.

1. Public Access Areas: Star post or square post security screws shall be used for hardware and equipment mounted in equipment racks and consoles in areas that are accessible to the public.

2. Restricted Access Areas: Philips head screws may be used where a secure room entrance or locked rack/console door prevents public access.

2.04 POWER DEVICES

A. Power Strips: Unless otherwise specified, power strips shall be UL listed and rated for 20 amp continuous electronic loads. Outlets shall be 125 volt, 20 amp, three-wire, grounded, and NEMA 5-20R compliant. Cords shall be 12/3 SJT with molded plug.

B. Power Distribution Panels: Unless otherwise specified, power distribution panels shall be UL listed, rack mounted, rated for 20 amp continuous electronic loads, with switch and pilot light. Up to eight outlets shall be mounted to the back, each rated 125 volt, 20 amp, three-wire, grounded, and NEMA 5-20R compliant. Switch and pilot shall be mounted to the front. Cords shall be 12/3 SJT with molded plug.

C. Contractor shall provide acceptable power distribution units as required in order to provide sufficient outlet connectivity for Contractor-furnished and Owner-furnished equipment indicated on drawings and equipment schedules, plus up to 20% additional capacity for future growth. This may be in addition to any power distribution equipment indicated on equipment schedules.

2.05 CABLE AND CONNECTORS

A. Cable: Cable shall be selected and applied in a manner defined by signal type, consistent with best industry practices. Highest quality products shall be used with attention given to transmission characteristics, termination methods, resistive and complex impedance at operating frequencies, and insulating material characteristics.

Where required by the NEC, substitutions of air handing plenum cable shall exactly match the normally applied product and shall meet the standards of UL Standard #900 and the NEC Articles 800 and 820.

B. Connectors: Highest quality products shall be used with attention given to transmission characteristics, termination methods, resistive and complex impedance at operating frequencies, and insulating material characteristics. Strain reliefs and cable clamps shall be sized for the connector and the cable.

C. Color: Cable and connector color shall be coordinated with Consultant to maintain consistency with cable and connector color schemes used by other trades.

2.06 CABLE MANAGEMENT

A. Plastic Cable Ties: Single use white nylon plastic cable ties, appropriate screw fittings, or mounting clips may be used for AC power cable management within racks and enclosures. Plastic/nylon cable ties shall not be used for signal and DC cables.

B. Velcro Cable Ties: Velcro straps shall be used for all signal and DC cables. Velcro straps shall be black, with no logo or decoration, except as authorized by Consultant.

2.07 ANCILLARY HARDWARE

A. General: Contractor shall provide ancillary and required accessory items necessary to provide a complete and fully functional system to Owner.

B. Interpretation: Exclusion of or limitation in the language used in the drawings or specifications shall not be interpreted as meaning that ancillary or accessory items of work or equipment necessary to complete or make the installed system fully functional can be omitted.

2.08 GROUNDING HARDWARE

A. Refer to Section 27 05 26 for specific Grounding and Bonding requirements.

B. Provide data/telecommunication grounding systems indicated in the project drawings and specifications. Products shall include, but are not limited to, cables/wires, connectors, terminals, compression lugs, grounding rods/electrodes and plate electrodes, bonding jumper braid, surge arresters, and additional accessories needed for a complete installation. Where materials or components are not indicated, provide products complying with NEC, UL, IEEE, ANSI/TIA and established industry standards for applications indicated.

2.09 COMPATIBILITY OF RELATED EQUIPMENT

A. Existing Equipment: Equipment and systems specified in these documents shall be assumed to be compatible with the systems already installed at Owner site(s) and as identified in this document as related to this project.

B. Installed Equipment: Specified equipment and systems shall be compatible with all other equipment and systems as offered by Contractor, thus placing the responsibility on Contractor to ensure proper interaction.

2.10 LICENSES

A. Any and all licenses required for system functionality shall be provided.

2.11 MAINTENANCE MANUALS

A. Contractor shall produce a maintenance manual showing interconnection of equipment and any special procedures necessary for proper operation and maintenance of the systems.

Part 3 - EXECUTION

3.01 GENERAL

A. Contractor shall provide, furnish, deliver, transport, erect, install, connect and configure all of the material and equipment described herein or depicted on any bid package document or drawing, as required for a turnkey solution.

3.02 COORDINATION

A. General: Contractor shall cooperate with other Contractors for proper provisioning, anchorage, placement, and execution of all work. Interference between the work of various Contractors shall be resolved before installation. In the event of conflict on space requirements or location of devices, refer the matter to Owner and Consultant for decision.

B. Related Work: References to the following related work do not limit or release Contractor from the responsibility of coordination with other trades or from having the necessary knowledge of other non-referenced work.

1. Work by General Contractor.
2. Work by other Technology Contractors.
3. Work by Electrical Contractor, including electrical rough-ins and surface-mounted raceway.

C. Delays: Contractor shall coordinate with all other trades to avoid causing delays in the installation schedule.

D. AC Power: Contractor shall coordinate with General Contractor its requirements for proper AC power to service all equipment installed by Contractor.

E. Low Voltage Sleeving: Contractor shall provide openings through walls as necessary, with sleeving and fire-stopping materials installed in a professional manner to meet local and national codes.

F. Grounding and Bonding: Contractor shall coordinate with General Contractor its requirements for proper grounding and bonding to their equipment.

G. Surface-Mounted Raceway Coordination

1. General and Electrical Contractors: Contractor shall coordinate with General Contractor and Electrical Contractor the installation of surface-mounted-raceway where not provided but made necessary by non-penetrable wall.

2. Verification: Contractor shall field verify and coordinate the proposed use of surface-mounted raceway at any location with Consultant and Owner.

3.03 BASIC EXECUTION REQUIREMENTS

A. General: Contractor is responsible for following industry standards of good practice for telecommunications and networking equipment.

B. Aesthetic Factors: With the installation of equipment and cables, consideration shall be given not only to operational efficiency but also to overall aesthetic factors. Contractor shall redo, at no cost to Owner, any work deemed by Owner to appear sloppy, hastily done, or unprofessional. Owner shall make final decision over whether work shall be redone.

C. Manufacturers' Recommendations: Manufactured items, materials, and equipment shall be applied, installed, connected, erected, used, and adjusted as recommended by the manufacturers or as indicated in their published literature unless otherwise noted herein.

D. Protection of Work Area: Work shall be properly protected during construction; including shielding soft or fragile materials, protecting against dust and dirt, protecting and supporting cable ends off of the floor and from other traffic, protecting floor box lids, and temporarily plugging open conduits during construction. Upon completion, installation shall be thoroughly cleaned and all tools, equipment, obstructions, or debris present as a result of work shall be removed from the premises.

E. Protection of Cable and Equipment: Contractor shall make appropriate preparations to protect all cabling and equipment from foreign material. Foreign material is defined as any substance or material that would void the manufacturer's performance warranty, impact ratings (UL, Plenum, etc.), or cover up markings needed for inspection. Foreign material includes, but is not limited to, paint overspray (intentional or not), fire-stopping material, drywall compound, or any other chemical, liquid, or compound that could come in contact with cables, cable jackets, cable termination points, or other equipment.

   1. Cleaning of cables or equipment with harsh chemicals from a failure to comply with Protection of Cable and Equipment clause is unacceptable. Contractor shall replace any affected cable, cable components, or equipment in their entirety at Contractor's sole cost.

F. Waste Materials: Contractor shall keep work area neat, orderly, and free from accumulation of waste materials. Remove trash and debris from the building and job site as required to maintain a clean work environment at all times. Rubbish shall be moved to a common trash point or receptacle on the job site as determined and directed by General Contractor or Owner.

G. Dumpsters: No construction debris shall be placed in building's dumpsters. Contractor shall provide a dumpster for construction waste and debris at own expense. Said dumpster shall be emptied on a regular schedule. Location of dumpster shall be arranged through Building Management. Appropriate measures shall be taken to protect asphalt or other ground surfaces.

H. Ceiling Grid: Contractor shall not hang cable supports from ceiling grid wire.

I. Roof Deck: Contractor shall not shoot into the roof deck for mounting cable hangers.

J. Mounting: Equipment and enclosures shall be mounted plumb and square in relation to the structure.

K. Raised Floor: All cabling installed below the raised floor shall be placed in the provided cable trays with appropriate means to hold cable in place. If no cable tray exists, Contractor shall provide J-hooks to hold cables in place. Sleeves shall be utilized for cable egress.

L. Motorized Furniture: Care shall be taken to properly dress all cables placed within motorized furniture and provide sufficient cable length and strain relief to allow motorized elements to operate within their full range of travel.

M. Flexible Furniture: Care shall be taken to properly dress all cables placed within flexible or re-configurable furniture to provide sufficient cable length and strain relief to allow full range of travel for flexible furniture configurations.

3.04 PREPARATION

A. Existing Equipment: Prior to any installation, the Contractor shall prepare the site by removing any remaining debris, leveling equipment racks (where appropriate), and verifying information and systems stated to be in-place are ready for use.

B. Equipment for Installation: Prior to installation, Contractor shall ensure that required major equipment has been secured and is ready for installation.

3.05 CLEANING

A. Tool Clean-up: Contractor is not permitted to use restrooms for tool clean-up. A slop-sink may be provided in janitorial closet on each floor for cleaning of tools and equipment and as a source of water. Janitorial closet or maintenance area or shop shall be kept clean at all times. Contractor or Contractor's Personnel found using restrooms for clean-up or other similar purposes shall be subject to removal from building.

B. Daily: At the end of each work period or day, Contractor shall remove excess packing, drilling remnants, and other non-equipment related parts, materials, or debris to ensure a clean, safe, and professional working environment.

C. Carpet: Contractor shall ensure that no damage to carpeting occurs as a result of their work. Contractor shall cover carpets in areas of work to prevent wire and other debris from entering the carpet.

3.06 FIRE STOPPING

A. Contractor is responsible for applying fire-stopping material in and around all openings that it creates or are created for it, whether or not specifically indicated in specifications or project drawings, where code requires the use of fire stopping material.

B. Contractor shall ensure that all fire-stopping materials meet appropriate codes and are installed in a neat and workman like manner.

3.07 WATERPROOFING

A. Contractor is responsible for creating a waterproof seal in and around any openings to the outside environment that are created by Contractor or for systems being installed.

B. Contractor shall ensure that all waterproof materials meet appropriate codes and are applied according to good engineering practice.

3.08 RACKS, CABINETS, AND HARDWARE

A. Racks and Cabinets: Contractor shall assemble and install racks and cabinets.

B. Installation Hardware: Install hardware in a secure manner. Screws shall be tightened to a torque just sufficient to secure equipment without deforming washers beyond their original diameter.

C. Considerations: Rack mount equipment shall be secured as recommended by the manufacturer with consideration to airflow, power, and in/out connections.

D. Cross Connections: Where cross connections are required between equipment, interconnections shall be installed using cable management devices to secure cables in a neat and workmanlike manner, applying best industry practices.

3.09 INSTALLATION REQUIREMENTS

A. Cable pulling shall be done in accordance with cable manufacturer's recommendations and ANSI/IEEE C2 standards. Recommended pulling tensions and pulling bending radius shall not be exceeded. Any cable bent or kinked to radius less than recommended dimension shall not be installed.

B. All cable shall be pulled by hand unless installation conditions require mechanical assistance. Where mechanical assistance is used, care shall be taken to ensure that the maximum tensile load for the cable as defined by the manufacturer is not exceeded. This may be in the form of continuous monitoring of pulling tension, use of a "break-away", or other approved method.

C. Qualified personnel utilizing state-of-the-art equipment and techniques shall complete all installation work. During pulling operation, an adequate number of workers shall be present to allow cable observation at all points of pathway entry and exit.

D. All cable shall be free of tension at both ends.

E. PLENUM rated cable shall be used in areas used for air handling or where required by code.

F. Contractor shall replace any cables that have been damaged or abraded during installation.

G. Pulling lubricant may be used to ease pulling tensions. Lubricant shall be of a type that is non-injurious to the cable jacket and other materials used and will not harden or become adhesive with age.

H. A pull cord (nylon; 1/8” minimum) shall be co-installed with all cable installed in any conduit or surface mount raceway.

3.10 CABLE

A. Cable treatment: Cable shall be stored and handled to assure that it is not stretched, kinked, crushed, or abraded in any way. Bend radiuses shall meet manufacturer specifications and/or recommendations. Cable shall not be installed in ambient temperatures or moisture conditions above or below the rating of the manufacturer.

B. Splicing

1. Voice, data, and other twisted pair cables: No splices shall be installed in any voice, data or twisted pair cables.

2. Technology systems: No splices shall be installed in any cable less than five hundred (500) feet in length.

3. Digital multimedia/video cables: No splices are allowed in any digital multimedia/video cable.

4. Overhead paging systems: Cable splices for constant voltage overhead paging system shall occur only at speaker, amplifier or volume control knob locations.

C. Lengths

1. Variations: Where cables are to be of the same length, variations in the length shall be less than plus or minus ½ inch. Lengths of cables are based on the length of the unterminated signal conductors.

2. Labeling: Cables, regardless of length, shall be marked with a labeling scheme approved by Consultant.

3. Service Loops: A surplus of cable, located at or near the point of termination to facilitate potential future changes, shall be provided where appropriate. Cables shall have a minimum cable slack of 10ft (3m) at the telecommunication room(s) and 3.28ft (1m) at each telecommunications outlet in the suspended ceiling unless noted otherwise. Service loops shall be stored in an extended loop or in a figure-eight configuration, not in bundled loops.

D. Grouping

1. Cables shall be separated into like groups according to signal or power levels.

2. Power Cable Group: Power cables shall be secured to one side of the rack separate from any low-energy signal cable groups. Separation shall be a minimum of 4” in all directions.

3. Signal Cable Group: Signal cables shall be grouped according to signal type and secured to one side of the rack separate from any power cable groups. Separation shall be a minimum of 4” in all directions.

E. In Equipment Racks

1. Equipment rack wiring and cabling shall be neatly dressed.

2. Fastening: Rack cabling shall be adequately supported with Velcro wire wraps and horizontal support cable managers fastened to rack frame.

F. Support for Cables Outside of Equipment Racks

1. External wire and cables shall be supported at least every 5 feet (1.5m) from the structure and as required to maintain less than 12 inches of cable sag between supports without over-tensioning the cables. Contractor shall vary the precise distance between cable supports on long runs to avoid harmonics issues.

2. Hardware: Cables shall be supported by J-hooks, cable tray, or ladder rack. Hardware shall be secured to building structure using 3/8” threaded rod supports.

a. Right Angles: Cables are to run at right angles to the structure, placed above ceiling in halls or corridors.

b. Height: Cables shall not run above red iron joist.

G. Concealment: Contractor shall make every effort to conceal wiring and other apparatus into walls, floors, and ceilings, assuming code and good engineering practice allows and suggests. Cabling systems installed in public areas shall be installed within walls, ceiling, or floors or within surface wiring pathways, as dictated by codes and good engineering practice.

H. Velcro Straps for Horizontal Cabling: Straps shall be installed snugly without deforming cable insulation. Straps shall be spaced at uneven intervals not to exceed 4 feet.

I. Cable Ties and Velcro Straps within Equipment Racks and Cabinets: Ties and straps shall be installed snugly, without deforming cable insulation, at uneven intervals not to exceed 8 inches. Cable ties shall only be used for non-signal carrying cables. No sharp burrs shall remain where excess length of the cable tie has been cut.

J. Obstruction: Contractor shall notify Owner immediately if any obstruction or hazard is discovered in a pathway provided by others.

3.11 CONNECTORS

A. Preparation: Cables shall be carefully prepared and connectors installed as directed by the manufacturer. Proper stripping devices and crimping tools shall be used.

B. Terminations: Connectors shall be carefully fitted to mating devices on equipment to avoid damage to mating contacts, inserts, or bodies. Specialized terminations shall be made in a neat and secure manner suited to the service of the wire and as directed by the manufacturer. Contractor shall use manufacturer specified terminations when those specifications exist.

C. Soldering: A person skilled in that practice shall execute soldered terminations. Any excessive insulation displacement resulting from soldering shall be grounds to require the Contractor to re-terminate the connector.

D. Adapters: Adapters shall be used only where the identity of the necessary type of connector is unknown at the time of installation, such as for Owner-provided equipment or in anticipation of future equipment upgrades, with Consultant’s approval.

3.12 SPARE PARTS AND REMOTE CONTROLS

A. Keys: Contractor shall turnover all keys, tagged and organized by type on individual key rings, to Owner upon project completion.

B. Refer to individual sections for spare parts and remote control requirements.

3.13 EQUIPMENT INSTALLATION

A. General: Contractor shall make system properly operational and physically secure by mounting equipment and related accessories into furniture, consoles, and racks as required. Manufacturer's guidelines for installation shall be followed. Discrepancies in installation procedure or inability to complete a given task due to a shortage of materials or malfunctioning equipment shall be reported to Consultant immediately upon discovery.

B. Equipment Placement: Contractor shall locate equipment as indicated on drawings and as specified herein. Where such information is not provided, Contractor shall follow industry best practices and locate operable devices at convenient positions; heat generating devices at the top and seldom-accessed equipment below.

1. Unless otherwise specified, end user-operable devices shall be positioned within the range of front wheelchair access per ADA standards.

C. Equipment Installation: Equipment shall be installed as directed by the manufacturer using equipment manufacturer's desktop mounting frames, equipment tubs, installation hardware, and techniques. Contractor shall be responsible for moving equipment from storage and for providing necessary personnel or devices to carry and lift equipment around obstacles and into operating position.

3.14 SOFTWARE AND FIRMWARE

A. At the completion of the project the Owner shall have the option to receive final software updates and firmware updates to the latest versions before the project is paid in full at no cost to the Owner.

3.15 ROUGH-IN

A. Scheduling: Contractor shall make every effort to install systems per this specification in a timely manner including rough-in of cabling and other apparatus where appropriate to stay on schedule.

B. Protection of Environment: Where cabling and/or equipment is installed prior to other trades completing their work in an area, Contractor shall take necessary precautions to cover, wrap, or otherwise protect to reduce possible damage which may result from plastering, painting, cleaning, or other such work completed after installation and before substantial completion of the project.

3.16 CUTTING, DRILLING, PATCHING, AND PAINTING

A. Coordination: Contractor is responsible for coordinating with the General Contractor and other trades when any cutting or drilling is required for the installation or proper performance of the specified systems.

B. Restoration: Contractor is responsible for returning all surfaces (including walls, floors, and ceilings) to their previous condition after any cutting including painting.

C. Painting: Contractor is responsible to paint all new work including exposed pathway to match the conditions.

3.17 LABELING

A. General: Rack-mounted equipment and hardware shall be labeled as required herein. Connectors, jacks, receptacles, outlets, cables, cable terminations, terminal blocks, rack mounted equipment, active slots of card frame systems, etc. shall be clearly, logically, and permanently labeled in a manner acceptable to Consultant.

B. Approval: Proposed wording and/or numbering schemes for labeling shall be provided to Consultant for review and written approval prior to procurement or installation.

C. Labels used shall be permanent and secure. Provide labeling as follows unless otherwise noted in a specific section:

1. Like Size: All labels, including engraved labels, shall be sized to match other labels used for same purpose.

2. Equipment Racks: For enclosed racks containing equipment, provide labels on each equipment rack rear door or console rear panel reading “No user serviceable parts. Refer service to qualified technician.”

3. Installer and Consultant Identification: Position at the front top center section of each equipment rack a label that states the names of system Installer and Consultant.

4. Custom Panels: Custom panel nomenclature shall be engraved, etched, or screened. Markings are to be designed to ensure consistency and clarity within and without of system. Verify markings and placements by submitting label sample layouts to Consultant for approval prior to procurement.

5. Documentation: Labeling information shall appear on the as-built drawings.

3.18 FIRE-STOPPING

A. If Contractor removes anything from an opening in a fire-rated wall, Contractor shall restore the fire-rating condition of the wall to the same condition as before Contractor started its work. Depending on the size of the opening, this may involve sheetrock patching, in addition to use of other appropriate fire-stopping materials

3.19 ADDITIONAL ENGINEERING SERVICES

A. General: Contractor is responsible for securing necessary engineering services were needed to meet the needs of the installation.

B. Change Orders: Only when Contractor can show that additional engineering services are needed as a result of changes to the scope of the services being requested in the contract documents will Owner entertain a Change Order Request for these services.

3.20 TESTING

A. Procedure: Contractor shall develop a rigorous testing procedure to ensure full functionality and durability of installed systems under heavy-use conditions.

B. Supplies: Contractor shall supply testing equipment needed to verify compliance with specifications found in these documents.

C. Schedule: Contractor shall complete required testing prior to the substantial completion inspection by Owner and Consultant.

D. Data: Test data shall be properly documented and recorded so that it is available for final inspection.

E. Quality Control: Testing may be repeated during the inspection process at the request of Owner or Consultant.

F. Prior to energizing or testing the system, Contractor shall ensure the following:

1. Installation: Products are installed in a proper and safe manner per the manufacturer's instructions.

2. Cleanliness: Products are neat, clean, and unmarred, and parts securely attached. Dust, debris, solder, splatter, etc., is removed.

3. Cables and Connections: Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.

4. Grounding: Electronic devices are properly grounded.

5. AC Power: Each AC power receptacle is tested with a circuit checker for proper hot, neutral, and ground connections prior to connecting equipment.

3.21 GROUNDING

A. Refer to Section 27 05 26 for specific Grounding and Bonding installation requirements.

3.22 TRAINING PROGRAM

A. Contractor shall provide training in the manner delineated below in addition to specific requirements identified in subsequent sections.

B. Contractor shall provide audio-video recording of each training session to Owner.

C. Prior to scheduling or delivering End User training, Contractor shall confirm that:

1. Closeout submittals have been accepted by Owner and Consultant.

2. Final closeout inspection has been completed and punch list items rectified.

3. Training schedule dates have been coordinated with and approved by Owner and Consultant.

D. Training shall include:

1. Approved handouts.

2. Practical and comprehensive operation of systems.

3. Basic system troubleshooting techniques.

4. Basic system maintenance.

E. Training Blocks

1. Training time is defined as those hours specifically set aside for the sole purpose of training end users. Credited time will not be given for any time spent providing instructions to the Owner's staff for a system not completed or that has not passed final acceptance by the Owner and Consultant, or training performed outside of the approved training program.

2. This training will be divided into training session "Blocks" as coordinated with the Owner.

a. The first training session block shall consist of training intended for the common system operators. Such training, at a minimum, shall include the day to day use of the system.

b. The second training session block shall consist of training administrators of the day to day administration of the system. Such training, at a minimum, shall include use of the administration control functions of the systems, user setup, and filtering and pulling reports.

c. The third training session block shall consist of training administrators on system troubleshooting, maintenance, and updates. Such training, at a minimum, shall include using the system tools to diagnose issues, diagnosing common physical equipment issues, performing simple maintenance, and performing system updates.

d. The fourth training session block shall consist of a training session structured for high-level users, for example staff trainers who will provide instruction to other users and will include advance system configuration and operational knowledge needed to maintain and manage all specified technology systems. The Contractor may elect to engage the Manufacturer(s) in certifying the high-level end users in the systems at no cost to the Owner.

F. The Contractor shall issue a certificate of training completion to the trainees upon completion of their training. Such certificates must be signed by both the trainer and trainee(s) for the Contractor to receive training credit.

3.23 WARRANTY AND MAINTENANCE PROGRAM

A. Contractor shall provide a warranty conforming to the stipulations below in addition to specific requirements identified in subsequent sections.

B. As part of the base proposal cost, the Contractor shall include a 1-year turnkey warranty period with full support costs.

C. The Warranty period shall begin after all punch list items have been rectified. The Contractor shall receive a letter of completion from the Consultant and Owner indicating project completion and starting the warranty period.

D. The warranty and support work included in this contract shall cover the following materials, software, and services, without additional cost to the Owner:

1. Inspections, preventative maintenance, and testing of equipment and components. The Contractor shall schedule a 10-month on-site preventative system review 10-months into each year of warranty and support including system inspections, preventive maintenance, software upgrades/patches, and testing of equipment and components.

2. Regular Service, Emergency Service, and Normal Service.

3. Labor, travel, equipment, materials, and transportation cost for all services covered by this warranty.

E. Response Time: Contractor shall respond to calls for warranty services in a timely manner as delineated below.

1. The Owner reserves the right to make the final determination of emergency or normal service calls and the right to coordinate the best times for service of any system failure.

2. Emergency service calls are defined as failures which prohibit the use of a typical system function(s) and pose a life safety concern, or such failures which cause a major impact to the Owner's daily operations.

a. The Contractor shall provide remote service diagnosing the impact within two (2) hours after notification by the Owner.

b. If remote service does not correct the reported issue, the Contractor shall provide on-site service correcting the impact within forty-eight (48) hours after notification by the Owner.

3. Normal service calls are defined as failures which prohibit the use of typical system function(s) but which do not inhibit critical system usage, do not pose life safety concerns, and do not create a major impact to Owner's daily operations.

a. The Contractor shall provide remote service correcting the impact within twenty-four (24) hours after notification by the Owner.

b. If remote service does not correct the reported issue, the Contractor shall provide on-site service correcting the impact within forty-eight (48) hours after notification by the Owner.

4. The Contractor shall supply Service Request forms and or proper contact procedure to the Owner with instructions for proper notification of the Contractor for warranty service. By following said instructions, the Owner shall constitute proper notification for any needed warranty service

F. Repair Time: Contractor shall locally stock critical parts in sufficient quantities such that emergency repair or replacement shall be guaranteed within twelve (12) hours. Temporary replacements within this time period shall be acceptable, provided temporary replacements do not compromise system functionality and provided permanent replacement is achieved within ninety-six (96) hours. Contractor may contact the Owner for use of Owner supplied spare parts where delay of system repair will have negative impact on system performance.

G. Transmittal: A copy of this Warranty shall be delivered to and signed for by the Owner's representative whose primary responsibility is the operation and care of these systems. A copy of the signed Warranty document shall be delivered for review as part of the Final Submittals.

H. Registration: Contractor shall register Warranty papers for all equipment and software in the name of the Owner and furnish reproductions of all equipment Warranty papers to the Owner with the Final Submittals.

I. Subcontracting: Warranty service work may not be subcontracted except with specific permission and approval by the Owner.

   1. Service/Warranty Procedures: Contractor shall submit a warranty service plan containing all contact information and Owner service call directions for Owner review with project close-out submittals.

J. Resolution of Conflicts:

   1. The Owner retains the right to resolve unsatisfactory warranty service performance at any time by declaring the work unsatisfactory and stating specific areas of dissatisfaction in writing.

   2. If the Contractor or his approved Subcontractor does not resolve such stated areas of dissatisfaction within ninety-six (96) hours, the Owner may appoint an alternative service agency or person to fulfill the terms of the Warranty at the expense of the Contractor. This action may be taken repeatedly until the Owner is satisfied that Warranty service performance is satisfactory. Satisfactory resolution of a malfunction shall be considered adequate when the device, equipment, system or component which is chronically malfunctioning is brought into compliance with the standards of performance as contained herein and published by the manufacturers of the equipment installed.

End of Section

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SECTION 27 0500
COMMUNICATIONS GENERAL REQUIREMENTS

Part 1 - GENERAL

1.01 SCOPE

A. Refer to Section 27 00 00 for additional project scope information.

B. This section describes the products and execution requirements related to furnishing and installing Category 6/6a Cabling and Termination Components and related subsystems as part of a Structured Cabling System.

C. Backbone system comprising copper and fiber optic cabling and horizontal (station) cabling is covered under this document.

D. Others will provide the network electronics for the LAN within the Telecom Rooms (TRs) and will be responsible for connecting the new cabling infrastructure to the LAN. The Contractor, however, shall supply the patch cords. The Contractor shall be available on site during the crossover to assist with any cabling issues that may occur during the connection.

E. The Electrical Contractor shall install conduits and surface raceway for new technology outlet locations unless otherwise noted.

F. The Telecommunication Contractor shall provide and install all sleeves through the wall penetrations as required whether or not specifically marked on Project Drawings, unless otherwise noted.

G. All cables and related terminations support, and grounding hardware shall be furnished, installed, wired, tested, labeled, and documented by the Contractor, as detailed in the following section(s).

H. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association, the Electrical Code in the state where the work is to be performed, and present manufacturing standards.

I. All materials shall be listed by UL and shall bear the UL label. 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.

1.02 RELATED WORK

A. Section 27 00 00 – General Technology Requirements

B. Section 27 05 26 – Grounding and Bonding for Technology Systems

C. Section 27 05 28 – Pathways for Technology Systems

D. Section 27 05 37 – Firestopping for Technology Systems

E. Section 27 11 00 – Communications Equipment Rooms

F. Section 27 13 00 – Communications Backbone Cabling

G. Section 27 13 23 – Interbuilding OSP Pathways

H. Section 27 15 00 – Communications Horizontal Cabling

I. Section 27 60 00 – Physical Security General Requirements

J. Section 27 62 00 – Electronic Access Control System

K. Section 27 64 00 – Video Surveillance System

1.03 DEFINITIONS

A. Refer to Section 27 00 00 for additional definitions.

1.04 REFERENCE STANDARDS AND CODES

A. Refer to Section 27 00 00 for additional requirements.

B. All references relate to the current version adopted by the city/county according to the authority having jurisdiction (AHJ). If the city/county has not adopted a version the latest version shall be utilized.

C. ASTM B633: Specification for Electrodeposited Coatings of Zinc on Iron and Steel

D. ASTM A653: Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process

E. ASTM A123: Specification for Zinc (Hot Galvanized) Coatings on Iron and Steel

F. ASTM A510: Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel

G. ANSI/TIA 569-E: Telecommunications Pathways and Spaces

H. ANSI/TIA 568.0-E, ANSI/TIA 568.1-E, ANSI/TIA 568.1-E, ANSI/TIA 568.2-D, ANSI/TIA 568.3-D, ANSI/TIA 568.4-D: Commercial Building Telecommunications Standard

I. ANSI/TIA-598-C-2005 – Optical Fiber Cable Color Coding

J. ANSI/TIA 606-C: Administration Standard for Telecommunications Infrastructure

K. ANSI/TIA 942-B: Telecommunications Infrastructure Standard for Data Centers

L. ANSI/TIA 607-D: Generic Telecommunications Grounding (Earthing) and Bonding for Customer Premises

M. IEEE: National Electrical Safety Code® (NESC®)
standards.ieee.org/about/nesc

1.05 QUALIFICATIONS

A. Refer to Section 27 00 00 for additional requirements.

B. Premises Distribution System: Written certification that the premises distribution system complies with the ANSI/TIA 568.0-E, ANSI/TIA 568.1-E, ANSI/TIA 568.1-E, ANSI/TIA 568.2-D, ANSI/TIA 568.3-D, ANSI/TIA 568.4-D, EIA ANSI/TIA/EIA-569-E, and ANSI/TIA/EIA-606-C.

C. Materials and Equipment: Where materials or equipment are specified to conform, be constructed, or be tested to meet specific requirements, Contractor shall supply, upon request by Consultant or Owner, certification that the items provided conforms to such requirements. Certification by a nationally recognized testing laboratory that a representative sample has been tested to meet the requirements, or a published catalog specification statement to the effect that the item meets the referenced standard, will be acceptable as evidence that the item conforms. Compliance with these requirements does not relieve the Contractor from compliance with other requirements of the specifications.

D. Certifications

1. The Contractor shall have an RCDD (Registered Communication Distribution Designer) on staff assigned to manage this Project; documented proof shall accompany the proposal response.

2. All installing personnel shall have completed and be certified in manufacturer training or BICSI (Building Industry Consulting Service International) installation training for UTP infrastructure systems, or the Contractor shall contract with manufacturer for installation of all proposed components. Company Certifications shall accompany the proposal response.

3. The Contractor’s technicians shall be certified and trained in the connectivity hardware which is being installed.

4. The Contractor shall submit certification that installers are factory certified to install and test the provided products. No less than half of the crew to be used for the telecommunications installation shall be trained by that manufacturer for the work.

1.06 PRE-CONSTRUCTION SUBMITTALS

A. The following items shall be provided in a single, combined, comprehensive submittal package for all Communications work, including sections 27 05 26 Grounding and

Bonding for Technology Systems, 27 11 00 Communications Equipment Rooms, 27 13 00 Communications Backbone Cabling, and 27 15 00 Communications Horizontal Cabling. Partial submittals will only be considered in special circumstances, such as getting early approval of long-lead-time items or products requiring additional coordination with other trades.

B. Qualifications

1. Provide certificates for employees working on this project that show they meet the necessary qualifications described in the section above, including RCDD and manufacturer/connectivity-specific training, as well as any other certifications necessary to purchase and install the specified products.

C. Equipment Schedules

1. Provide a complete schedule of significant materials for the project, with columns for the following items: Manufacturer, Part Number, Description, Quantity, and Unit Pricing.

D. Color Selection List

1. Provide a list of all communications equipment that will be visible to staff and visitors. Include a simplified description of the equipment that a non-technical person (i.e. Architect) can understand. Examples of such items include but are not limited to wall plates, data jack inserts, decora style devices, and decora cover plates.

2. For each item on the list, include all available color/finish options, with a checkbox next to each option for the Architect or Owner to select.

3. The Communications Contractor must receive confirmation of color selection from the Architect or Owner in writing before ordering any materials that will be visible after installation. If the Contractor fails to complete this step, the Owner reserves the right to object to an installed device’s color and require that the Contractor replace it at no cost to the Owner.

E. Product Cut Sheets

1. Provide basic product data sheets (1-2 pages per product) for all products listed in the equipment schedule. Do not include longer documents such as installation manuals.

2. Identify (highlight, arrow, etc.) the actual version and part number of the product that will be utilized on the project. This applies to mounting hardware, cabling, connectors, software, and power distribution equipment in addition to major system components.

F. Shop Drawings in addition to requirements in Section 27 00 00:

1. Pre-construction submittals are intended to document the details of installation. Exact copies of the Consultant's drawings and specifications are not acceptable as pre-construction shop drawings. The Consultant's drawings are intended to outline the functional requirements, but do not provide install-level detail.

2. Exact requirements will vary depending on the project scope. Provide the following elements where applicable:

a. Floor Plans: Include device/equipment locations, cable routes, MDF/MER and IDF/TR zoning maps, maximum cable distance calculations, installation notes, and electrical coordination notes (specific conduit routing, etc.).

b. Equipment rack elevation details

c. Elevations of telecommunication room walls with planned mounted equipment

d. Outlet faceplate details for all outlet configurations, sizes, and cable types

e. Overhead telecommunication room enlargements, providing dimensions of room and clearance for maintenance and operation

f. A labeling plan must be submitted to and approved by the Owner prior to installation, and the completed labeling must meet the approval of the Owner. EIA/TIA-606 standards are to be met.

1.07 CONSTRUCTION PROGRESS SUBMITTALS

A. Final Patch Cord Schedule

1. Provide a final schedule of proposed patch cords for Owner review. The list shall include columns for each of the following: Intended use (location & device type), length, color, cable rating (plenum, indoor/outdoor, etc.), shielded or unshielded, and quantity.

2. Patch cords listed in the pre-construction submittal shall be considered placeholders only. Review of the pre-construction submittal does not indicate approval of the patch cords and does not exempt the Contractor from providing this later patch cord schedule for final review.

B. Communications Labeling Scheme

1. Provide an example of each type of cable or equipment label for Owner review. Examples include standard data outlets, decora data outlets, surface mount interface boxes, horizontal cable runs, Category 6/6a patch panels, voice patch panels, fiber patch panels, data racks, and grounding busbars.

C. Refer to Section 27 00 00 for additional requirements.

1.08 CLOSEOUT SUBMITTALS

A. Refer to Section 27 00 00 for requirements.

1. Data cable test results

2. USB flash drive containing:

a. As-built drawings (CAD format)

b. As-built drawings (PDF format)

c. Detailed test results in original tester format (e.g. Fluke Linkware)

d. Detailed cable test results in PDF format

3. Warranty certification from connectivity manufacturer

1.09 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall be responsible for all materials until completion of Project.

B. Cable shall be stored according to manufacturer's recommendations at minimum. In addition, cable shall be stored in a location protected from vandalism and weather.

C. If cable is stored outside, it shall be covered with opaque plastic or canvas with provision for ventilation to prevent condensation and for protection from weather. If air temperature at cable storage location will be below 40 degrees Fahrenheit, the cable shall be moved to a heated (minimum 50 degrees Fahrenheit) location. If necessary, cable shall be stored off site at the Contractor's expense.

D. If the Contractor wishes to have a trailer on site for storage of materials, arrangements shall be made with the Owner.

E. Commercial off-the-shelf manuals shall be furnished for operation, installation, configuration, and maintenance for all products provided as a part of the premises distribution system. Specification sheets for all cable, connectors, and other equipment shall be provided.

Part 2 - PRODUCTS

2.01 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

2.02 LABELS

A. All labels shall be permanent and be machine generated (e.g., Brady or Panduit). No handwritten or non-permanent labels shall be allowed. Labels shall be Brady "I.D. Pro" or XC-Plus or equivalent. Labeling on backboards and/or equipment racks may be pre-cut adhesive type.

B. Characters on all labels shall be black printed on a white background.

C. Label size shall be appropriate to the cable size(s), outlet faceplate layout, patch panel design, or other related equipment sizes and layouts.

D. All labels to be used on cables shall be self-laminating, white/transparent vinyl, and be wrapped around the cable sheath. The labels shall be of adequate size to accommodate the circumference of the cable being labeled and properly self-laminated over the full extent of the printed area of the label.

2.03 LABELS FOR BACKBONE CABLING

A. Labels used to identify fiber optic cable or innerduct carrying fiber optic cable shall be labeled with a durable yellow polyethylene tag that reads "CAUTION Fiber Optic Cable" and includes blank spaces for adding (1) fiber count and (2) destination information.

B. Labels must be rigid vinyl, self-laminating, slotted for fastening with nylon ties and intended for long-term outdoor use.

C. Manufacturers:

1. XpressTags TG-2109
2. Panduit PST-FOBLNK
3. VIP Products' "Caution Write-On Coverall Tag"
4. Or approved equal

Part 3 - EXECUTION

3.01 TESTING

A. Refer to Section 27 00 00 for additional requirements.

3.02 TRAINING

A. Refer to Section 27 00 00 for additional requirements.

3.03 WARRANTY

A. Refer to Section 27 00 00 for additional requirements.

B. The Contractor shall provide to the Owner a manufacturer's 15-year minimum warranty certificate for all materials, equipment, etc. Upon successful completion of the installation and subsequent inspection, the Owner shall receive the numbered certificate from the manufacturing connectivity hardware (patch panels, jacks, patch cords, 110 blocks, etc.) company registering the installation. This warranty shall include all labor, materials, and travel time.

C. The warranty shall ensure against product defects and guarantee that all approved cabling components exceed the specifications of TIA/EIA-568 and ISO/IEC IS 11801 for cabling links/channels, and that the installation will exceed the loss and bandwidth requirements of TIA/EIA 568 ISO/IEC IS 11801 for fiber links/channels for a fifteen (15) year period. The warranty shall apply to all passive structured cabling system components.

D. The warranty shall cover the failure of the wiring system to support the application that it was designed to support, as well as additional application(s) introduced in the future by recognized standards or user forums that use the TIA/EIA 568 or ISO/IEC IS 11801 component and link/channel specifications for cabling. Such warranty shall apply for a minimum of a fifteen (15) year period.

E. The warranty shall cover the replacement or repair of defective product(s) and labor for the replacement or repair of such defective products(s), labeling of the new components, and testing of the circuit(s) at no cost to the Owner.

3.04 EXAMINATION

A. Verification of Conditions: Contractor shall examine areas and conditions under which work is to be performed and identify conditions detrimental to proper and timely completion.

B. Contractor shall verify that cable lengths comply with published standards.

C. Contractor shall notify Owner of any proposed installation which is expected to exceed maximum lengths prior to installation of cable.

D. Contactor shall consult with Owner regarding alternative routing or location of cable.

E. Contractor shall not proceed until unsatisfactory conditions have been corrected.

3.05 SPARE PARTS

A. Suggested List: Contractor is requested to submit a list of suggested spare parts with an offered price, allowing Owner to select appropriate parts.

B. Means of Obtainment: Contractor shall state where spare parts can be obtained after the installation.

3.06 INSTALLATION REQUIREMENTS

A. Refer to Section 27 00 00 for additional requirements.

3.07 COOPERATION

A. The Contractor shall cooperate with other trades and General Contractor's personnel in locating work in a proper manner.

B. Should it be necessary to raise, lower, or move longitudinally any part of the work to better fit the general installation, such work shall be done at no extra cost to the Owner, provided such decision is reached prior to actual installation. The Contractor shall check location of electrical outlets with respect to other installations before installing.

3.08 LABELING

A. General

1. The Contractor shall match the Owner's standard labeling scheme.

2. Clean surfaces before attaching labels.

3. Install all labels firmly and permanently. Labels attached to terminating equipment such as backboards, faceplates, 110 blocks, and patch panels shall be installed plumb and neatly on all equipment.

B. Labeling of Cabling and Termination Components

1. Backboard and Equipment Racks

a. Backboards and equipment racks shall be labeled by the Contractor identifying the telecommunication room. Additionally, equipment racks shall

have an alpha character after the room number unique to that particular communications closet. For example, TR1-A would be the first rack in TR1.

b. Character height shall be 1-inch (minimum).

2. Cabling

a. Horizontal cables shall have a machine generated wrap around cable label within 4” of each end of the cable. Label shall be clearly legible and meet TIA-EIA 606 standards. Character height shall be .25” (minimum).

b. Voice/data/video backbone cables shall have a machine generated wrap around cable label within 12” of each end of the cable. Label shall be clearly legible and meet TIA-EIA 606 standard. Character height shall be .5” (minimum).

3. Fiber Optic Backbone, Riser Cables, and Termination Components

a. All fiber optic backbone and copper (inter-building, riser, and tie) cables shall be identified AT BOTH ENDS with a designation that identifies where the opposite end of the same cable terminates (e.g., equipment room or telecommunications room I.D.). In addition, labeling of all fiber optic cables shall include the number of fibers in the cable.

b. Each fiber optic termination panel shall be clearly labeled indicating the destination of the cable(s) and the fiber number of each fiber position. The cable identifiers are to be secured to (1) the side and (2) the front cover of the panel enclosure.

4. Standard Information Outlet (SIO) Faceplates

a. All faceplates shall be clearly labeled indicating the destination of the cable(s) (telecommunication room number), the data patch panel(s) letter designation, the data port number(s) on the data patch panel(s), and the voice cable number(s).

b. Telecommunications outlets are to be labeled (1) on the cover of the assembly and (2) on each cable terminated at that location.

c. Station cables shall be labeled within two inches of the cable end.

5. Surface Mount Boxes

a. All surface mount boxes shall be clearly labeled indicating the destination of the cable(s) (telecommunication room number), the data patch panel(s) letter designation, and the data port number(s) on the data patch panel(s).

b. Surface mount boxes are to be labeled (1) in the designation window of the box, (2) on each cable terminated at that location, and (3) on the ceiling grid directly below the box when installed above accessible ceiling.

c. Cables shall be labeled within two inches of the cable end.

6. Data Patch Panels

a. All data patch panels shall be clearly labeled indicating the telecommunication room number, the data patch panel letter designation, and the data port number on the data patch panel (ports 1 through 48). Each

telecommunication room shall start with data patch panel ‘A’ and continue through the alphabet.

b. A data port schedule for each telecommunication room shall be created in spreadsheet format (Excel) with the telecommunication room number, data patch panel letter designations, data port numbers, and room numbers identified in the spreadsheet. In addition, for each data patch panel port, a field shall be provided in the spreadsheet for the Owner to manage the cabling infrastructure by recording the device and any special notes pertaining to the room utilizing the data cable terminated to the port.

c. Refer to Telecommunication “T” Series Project Drawings for standard information outlet faceplate and data & voice patch panel labeling scheme requirements. A sample of the data and voice port schedules is to be provided to the Owner, in the cable record book and in electronic format (Excel spreadsheet), with final documents provided on the Project Drawings.

7. Fiber Optic Cables and Termination Components

   a. All fiber optic cables, termination enclosures and connector panels, and splice closures shall be clearly labeled.

   b. In addition, labeling of all fiber optic cables shall include the number of fibers in the cable.

   c. Each fiber optic termination panel shall be clearly labeled indicating (1) the destination(s) of the cable(s) and (2) fiber number of each fiber position. The cable identifiers are to be secured to (1) the side and (2) the front cover of the panel enclosure.

8. Labeling for Backbone Fiber and Outside Plant

   a. The size, color, and contrast of all labels should be selected to ensure that the identifiers are easily read.

   b. Descriptive identifiers shall include a combination of the following:

      i. Identify the item that the fiber is traveling to by name.

      ii. Identify the fiber count and mode.

      iii. Identify the direction the majority of the fiber optic cable travels from a handhole/manhole.

   c. Labels should be visible during the installation of and normal maintenance of the infrastructure. Labels should be resistant to the environmental conditions at the point of installation (such as moisture, heat or ultraviolet light) and should have a design life equal to or greater than that of the labeled component.

   d. Each cable shall be labeled within 18 inches from the end of the splice enclosure.

   e. Each cable is to be labeled within 18 inches from the end of the conduits. In addition, labels shall be affixed to conduit at every transition of a vault, hand hole, riser closet, or major pull box. Labels will be in the form of “HUB Location one-Location two- fiber strands#”. For example, cable sheath from

the Campus MDF to Manhole 8C would be labeled as "Campus MDF-MH8C-12." For example, in the assist handholes/manholes, the cables shall be labeled as “HH South to MH08 North for Veterans.”

f. The following provisions shall apply to labeling Fiber Distribution Components:

i. Label the front of the patch panels with the fiber optic cable number, direction, and fiber count.

ii. Each fiber optic strand shall be labeled with a unique identifier at the LC coupler in the fiber optic patch panel. Connectors shall be labeled on the identifying sheets on the front of the fiber optic patch panel.

iii. Label the front of the splice panels with the fiber optic cable number, direction, and fiber count.

iv. Label splice trays/splice wheels with the cable ID and fiber numbers contained in the tray/wheel.

9. Ground System Labeling

10. All grounds shall be labeled as close as practical to the point of termination (for ease of access to read the label). Labels shall be nonmetallic and include the following statement: “WARNING: If this connector or cable is loose or must be removed, please call the building telecommunications manger.” Refer to ANSI/TIA/EIA 606 for additional labeling requirements.

3.09 TESTING AND ACCEPTANCE

A. The Contractor shall perform acceptance tests as indicated below for each subsystem (backbone, station, etc.) as it is completed.

B. The Contractor shall supply all equipment and personnel necessary to conduct the acceptance tests. Prior to testing, the Contractor shall provide a summary of the proposed test plan for each cable type, including equipment to use, setup, test frequencies or wavelengths, results format, etc. The Consultant will approve the method of testing.

C. The Contractor shall visually inspect all cabling and termination points to ensure that they are complete and conform to the wiring pattern defined herein. The Contractor shall provide the Consultant with a written certification that this inspection has been made.

D. The Contractor shall conduct acceptance testing according to a schedule coordinated with the Consultant. Representatives of the Owner may be in attendance to witness the test procedures. The Contractor shall provide a minimum of one (1) week advance notice to the Consultant and Owner to allow for such participation. The notification shall include a written description of the proposed conduct of the tests, including copies of blank test result sheets to be used.

E. Tests related to connected equipment of others shall be done only with the permission and presence of Contractor involved. The Contractor shall ascertain that testing only as required to prove the wiring connections are correct.

F. The Contractor shall provide Consultant with test results and descriptions of the testing methodology, including the date of the tests, the equipment used, and the procedures followed. At the request of the Consultant, the Contractor shall provide copies of the original test results.

G. All cabling shall be 100% fault free unless noted otherwise. If any cable is found to be outside the specification defined herein, that cable and the associated termination(s) shall be replaced at the Contractor's expense. The applicable tests shall then be repeated.

H. Backbone voice cables shall be free of shorts within the pairs and be verified for continuity, pair validity and polarity, and conductor position on the termination blocks (e.g., 110). Any mispositioned pairs shall be identified and corrected. The percentage of "bad" pairs shall not exceed 1% in any backbone (riser or tie) cable based on total pair count. All bad pairs shall be identified and documented.

I. The Consultant or Owner may request that a 10% random field re-test be conducted on the cable system to verify documented findings.

   1. If requested, the Contractor shall test up to 10% of cable links at no cost to the Owner.

   2. Tests shall be a repeat of those defined above and under Testing and Acceptance. If findings contradict the documentation submitted by the Contractor, additional testing shall be performed to the extent determined necessary by the Consultant, including a 100% re-test. This re-test shall be at no additional cost to the Owner.

3.10 FIRE STOPPING

A. Contractor shall seal any openings created for cable pass-through between floors or through fire rated walls. Sealing material and application of this material shall be accomplished in such a manner that is acceptable to the local fire and building authorities having jurisdiction over this work.

B. Creation of such openings as are necessary for cable passage between locations as shown on the Drawings shall be the responsibility of the Contractor. Any openings created by or for the Contractor and left unused shall also be sealed as part of this work.

End of Section

SECTION 27 0526
GROUNDING AND BONDING FOR TECHNOLOGY SYSTEMS

Part 1 - GENERAL

1.01 SCOPE

A. Refer to Section 27 00 00 for additional project scope information.

1.02 RELATED WORK

A. Section 27 00 00 – General Technology Requirements

B. Section 27 05 00 – Communications General Requirements

C. Section 27 05 28 – Pathways for Technology Systems

D. Section 27 05 37 – Firestopping for Technology Systems

E. Section 27 11 00 – Communications Equipment Rooms

F. Section 27 13 00 – Communications Backbone Cabling

G. Section 27 13 23 – Interbuilding OSP Pathways

H. Section 27 15 00 – Communications Horizontal Cabling

I. Section 27 60 00 – Physical Security General Requirements

J. Section 27 62 00 – Electronic Access Control System

K. Section 27 64 00 – Video Surveillance System

1.03 DEFINITIONS

A. Refer to Section 27 00 00 for additional definitions.

1.04 REFERENCE STANDARDS AND CODES

A. IEEE C2 - National Electrical Safely Code

B. IEEE Std. 837-2002, or latest version – Standard for Qualifying Permanent Connections Used in Substation Grounding

C. ANSI/TIA-607 - Commercial Building Grounding and Bonding Requirements for Telecommunications

D. NFPA 70E - Standard for Electrical Safely in the Workplace

E. ANSI/NECA/BICSI-607 - Telecommunications Bonding and Grounding Planning and Installation methods for Commercial Buildings

F. UL 467 - Standard for Grounding and Bonding Equipment

G. Refer to Section 27 00 00 for additional requirements.

1.05 QUALIFICATIONS

A. Refer to Section 27 00 00 for additional requirements.

1.06 PRE-CONSTRUCTION SUBMITTALS

A. Provide a comprehensive Communications submittal package; refer to 27 05 00 Communications General Requirements for detailed requirements. Do not provide a separate submittal for this section on its own.

1.07 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

1.08 CLOSEOUT SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

Part 2 - PRODUCTS

2.01 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

2.02 GROUNDING AND BONDING CABLE

A. The grounding and bonding cable shall be stranded copper conductors.

B. The grounding and bonding cables shall have a green jacket color and riser or plenum rated as required.

C. Feeder and Branch Circuit Equipment Ground: Size as shown on drawings, specifications, or as required by NFPA 70, whichever is larger. Differentiate between normal ground and isolated ground when both are used within the same facility.

D. The TBB shall be sized in accordance to the following table:

Linear Length – ft.	Size (AWG)
Less than 13	6
14 - 20	4
21 - 26	3
27 - 33	2
34 - 41	1
42 - 52	1/0
53 - 66	2/0
Greater than 67’	3/0

2.03 GROUNDING AND BONDING BUSBARS

A. Primary Bonding Busbar (PBB)

1. Factory-drilled solid copper with holes to accommodate lugs. Field manufactured busbars are not acceptable.
2. 0.25” thick x 4” wide
3. Sized for current applications and future growth, no less than 20”
4. Insulated from its support
5. Shall be an electro-tin plated busbar
6. Maintain a minimum of 2” of clearance from wall
7. UL listed and BICSI certified

B. Secondary Bonding Busbar (SBB)

1. Factory-drilled solid copper with holes to accommodate lugs. Field manufactured busbars are not acceptable.
2. 0.25” thick x 4” wide
3. Sized for current applications and future growth, no less than 12”
4. Insulated from its support
5. Shall be an electro-tin plated busbar
6. Maintain a minimum of 2” of clearance from wall
7. UL listed and BICSI certified

C. Horizontal Equipment Rack or Cabinet Busbar

1. Mounts to standard 19” Rack or Frame
2. Capacity: 6 Double hole lugs
3. Shall be an electro-tin plated busbar
4. UL listed and BICSI certified

D. Vertical Equipment Rack or Cabinet Busbar

1. Mounts to vertical rail or inside of cabinet in 19” or 23” equipment rack or frame.
2. Capacity: 9 Double hole lugs
3. Shall be an electro-tin plated busbar
4. UL listed and BICSI certified

2.04 MECHANICAL CONNECTORS

A. Mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper alloy material. Bolts, nuts, washers, and lock washers shall be made of Silicon Bronze and supplied as a part of the connector body and shall be of the two bolt type.

B. Split bolt connector types are not allowed.

C. Connectors shall meet or exceed UL 467.

2.05 COMPRESSION LUGS

A. Shall be UL & CSA listed

B. Shall meet or exceed the performance requirements of IEEE 837, latest revision

C. Compression type

D. Shall be manufactured from pure wrought copper. Conductivity of this material shall be no less than 99% by IACS standards.

E. Shall be electro-tin plated

F. Lugs shall be 2-hole. Single hole lugs are not allowed

G. Long barrel that will allow a minimum of two crimps with standard industry colors

H. Each connector shall be filled with an oxide-inhibiting compound

I. Crimped with a compression, tool and die system, according to manufacturer's recommendation

2.06 TAPS

A. Connections to the Conductor shall be made with irreversible compression connectors

B. Shall be UL & CSA listed

C. Requires a minimum of (2) crimps for C Tap or H Tap, 1 crimp for I-Beam and busbar Tap

D. Crimp according to manufacturer's recommendation

Part 3 - EXECUTION

3.01 GENERAL

A. Install products in accordance with manufacturer's recommendations.

B. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

C. Mechanical connections shall be accessible for inspection and maintenance.

D. No insulation shall be installed over mechanical ground connections.

E. Ground connection surfaces shall be cleaned and all connections shall be made so that disconnection or removal is impossible.

3.02 RESISTANCE MEASUREMENT

A. Measure ground resistance from system neutral connection at service entrance to convenient ground reference point using suitable ground testing equipment. Resistance shall not exceed 2 ohms.

3.03 TELECOMMUNICATIONS BONDING BACKBONE (TBB)

A. The intended function of a TBB is to reduce or equalize potential differences between telecommunications systems. While the TBB will carry some current under ac power ground fault conditions, it is not intended to provide the only ground fault return path.

B. The TBB shall:

1. Be connected to the PBB & SBB.

2. Be a continuous copper conductor that shall be sized no less than 6 AWG to a maximum of 3/0 AWG.

3. The TBB conductors shall be installed and protected from physical and mechanical damage.

4. The TBB conductors should be installed without splices.

a. Where splices are necessary, the number of splices should be kept to a minimum and they shall be accessible and located within telecommunications spaces or j-box labeled as a telecommunications bonding backbone splice.

b. Joined segments of a TBB shall be connected using exothermic welding, irreversible compression-type connectors or equal.

C. A metallic cable shield shall not be used as a TBB.

3.04 BACKBONE BONDING CONDUCTOR (BBC)

A. The GE shall be a continuous copper conductor that shall be sized no less than 6 AWG to a maximum of 3/0 AWG. The GE shall match the size of the TBB.

B. The GE shall connect to the telecommunications grounding busbar(s) in the same-floor telecommunications rooms on the first, top, and every third floor in a building greater than 4 floors.

C. A metallic cable shield shall not be used as a GE.

3.05 TELECOMMUNICATIONS EQUIPMENT BONDING CONDUCTOR (TEBC)

A. Connects the PBB/SBB to equipment racks and cabinets.

B. Shall be a continuous copper conductor that shall be sized per the length of cable.

C. Shall be separated from ferrous materials by 2” or be bonded to the ferrous metal.

D. May be routed within cable trays or suspended 2” under or off the side of the cable tray or ladder rack.

E. Shall be supported every 3ft.

F. 8” minimum bend radius.

G. May come cross other cable groups at a 90 degree angle only.

H. A metallic cable shield shall not be used as a TEBC.

3.06 RACK OR CABINET BONDING CONDUCTOR

A. A bonding conductor shall be used to connect the equipment racks and cabinets directly to the PBB, SBB or underfloor ground mesh network.

B. All metallic enclosures, including remote mounted equipment cabinets and racks for telecommunications, security or audio/visual shall be bonded to the nearest PBB or SBB using a minimum sized conductor of 6 AWG. Remote bonds shall be labeled on both ends stating the destination of the bond.

3.07 ELECTRICAL DISTRIBUTION PANEL (EDP)

A. The AC EDP serving the Telecommunications Room shall be bonded to the PBB or SBB using a minimum of a 6 AWG cable.

B. A qualified electrician shall make all connections within an AC electrical distribution panel.

3.08 OPTICAL FIBER CONDUCTIVE CABLES

A. Conductive fiber-optic cables should be bonded and grounded as specified in the NEC.

3.09 CONDUIT AND SLEEVE BONDING

A. All conduits and sleeves entering a telecommunications room shall be grounded.

3.10 LADDER RACK AND/OR CABLE TRAY

A. All low voltage cable runway sections shall be bonded together and bonded back to the nearest Telecommunications Room the runway is serving as close PBB or SBB as practical.

B. Maintain an 8” minimum bend radius on the TEBC.

C. Keep a 2” separation from other cables both power and telecommunications.

D. Remove any paint, oxidation, etc. from the runway surfaces that are being bonded.

E. Drill two holes as required to accommodate the 2-hole compression lug.

F. Apply a thin coat of antioxidant around the holes and on the surface where the lug will be in contact.

G. Attach straps to the runway using stainless steel hardware sized for the lug holes.

H. Wipe off any excess antioxidant after installation of the lug.

3.11 BUILDING STEEL

A. Each ground bus bar shall be bonded to building steel.

B. Remove any paint or fire stopping spray from the building steel.

C. Provide the appropriate bonding connector to connect to beams, trusses or other types of structure.

3.12 LABELING

A. Refer to Section 27 05 00 for additional requirements

B. Each grounding/bonding cable shall be labeled at the PBB or SBB.

C. All taps to the TBB shall be within an enclosure and labeled as to its purpose.

D. Mechanical connectors shall be clearly marked with the catalog number, conductor size, and manufacturer.

E. Compression lugs shall be clearly marked with manufacturer, catalog number, conductor size, and required compression tool settings.

3.13 TESTING

A. Refer to Section 27 00 00 for additional requirements.

B. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.

3.14 TRAINING

A. Refer to Section 27 00 00 for additional requirements.

3.15 WARRANTY

A. Refer to Section 27 00 00 for additional requirements.

End of Section

SECTION 27 0528
PATHWAYS FOR TECHNOLOGY SYSTEMS

Part 1 - GENERAL

1.01 SCOPE

A. Refer to Section 27 00 00 for additional project scope information.

1.02 RELATED WORK

A. Section 27 00 00 – General Technology Requirements

B. Section 27 05 00 – Communications General Requirements

C. Section 27 05 26 – Grounding and Bonding for Technology Systems

D. Section 27 05 37 – Firestopping for Technology Systems

E. Section 27 11 00 – Communications Equipment Rooms

F. Section 27 13 00 – Communications Backbone Cabling

G. Section 27 13 23 – Interbuilding OSP Pathways

H. Section 27 15 00 – Communications Horizontal Cabling

I. Section 27 60 00 – Physical Security General Requirements

J. Section 27 62 00 – Electronic Access Control System

K. Section 27 64 00 – Video Surveillance System

1.03 DEFINITIONS

A. Refer to Section 27 00 00 for additional definitions.

1.04 REFERENCE STANDARDS AND CODES

A. Refer to Section 27 00 00 for additional requirements.

1.05 QUALIFICATIONS

A. Refer to Section 27 00 00 for additional requirements.

1.06 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

1.07 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

1.08 CLOSEOUT SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

Part 2 - PRODUCTS

2.01 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

2.02 WIRE BASKET TRAY RUNWAY

A. As shown on the Project Drawings, the Contractor shall provide and install sufficient wire basket tray runway systems to support horizontal cable bundles.

B. The Contractor shall provide all necessary labor, supervision, materials, equipment, tests, and services to install complete wire basket tray runway systems.

C. Wire basket runway systems shall include, but are not limited to, straight sections of continuous wire mesh, field formed horizontal and vertical bends, tees, drop outs, supports, and accessories.

D. Specifications and Drawings are for assistance and guidance, but exact routing, locations, distances, and levels will be governed by actual field conditions.

E. Contractor shall ensure that all straight section longitudinal wires are installed with no bends, kinks, or twisting.

F. Wire basket runway 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. All wire ends along runway sides (flanges) shall be rounded during manufacturing to prevent damage to cables and injury to installers.

G. All fittings shall be field formed as needed.

H. All splicing assemblies shall be the bolted type using serrated flange locknuts. Hardware shall be either yellow zinc dichromate in accordance with ASTM B633 SC2 or AISI Type 304 stainless steel. Splicing assemblies shall provide a continuous ground connection.

I. Wire Basket Tray shall be grounded only at the Telecommunications Room ground bus bar.

J. Cable Drop Out/Waterfall

1. Where cables bundles transition from tray to tray or tray to conduit or sleeve of varying elevations the Contractor shall provide and install a radius control device. This device shall be a waterfall or drop out device and shall be properly sized to accommodate cable bundle plus 20% future growth.

K. T-sections of tray shall be made using T-section fittings.

L. Straight section splices shall be made using splice plates.

M. Wire basket runway supports shall be of the trapeze hanger type.

N. Trapeze hangers shall be supported by 3/8 inch diameter rods.

O. Tray shall have an electro zinc finish or a flat Black finish wherever finished installation will be visible to end users.

P. Accessories (connectors, splice plates…) shall be painted to match tray finish.

Q. Contractor shall refer to project drawings for cable tray sizing.

R. Manufacturer: Cable trays and accessories shall be of one of the following manufacturers

1. Cooper B-Line
2. Legrand Cablofil
3. Pentair Hoffman
4. Or approved equal

2.03 CABLE HOOK SYSTEMS

A. In the areas where the cables are required to be run in a “free-air” plenum, a cable hook system shall be used.

B. Cable hooks shall be capable of supporting a minimum of 30 lbs. with a safety factor of 3.

C. Spring steel cable hooks shall be capable of supporting a minimum of 100 lbs. with a safety factor of 3 where extra strength is required.

D. Cable hooks shall be Category 6a or better rated.

E. Follow manufacturer’s recommendations for allowable fill capacity for each size of cable hook.

F. Installation and configuration shall conform to the requirements of the ANSI/ EIA/TIA Standards 568A & 569, NFPA 70 (National Electrical Code), and applicable local codes.

G. Cable hooks shall:

1. Have a flat bottom and provide a minimum of 1 5/16" cable bearing surface.
2. Have 90-degree radiused edges to prevent damage while installing cables.
3. Be designed so the mounting hardware is recessed to prevent cable damage.
4. Have a steel cable latch retainer to provide containment of cables within the hook.
5. Have a retainer that shall be removable and reusable.

6. Be factory assembled for direct attachment to walls, hanger rods, beam flanges, purlins, strut, and floor posts, to meet job conditions.

H. Factory assembled multi-tiered cable hooks shall be used where required to provide separate cabling compartments, or where additional capacity is needed.

I. Cable hooks for non-corrosive areas shall be pre-galvanized steel, ASTM A653 G90. Where additional strength is required, cable hooks shall be spring steel with a zinc-plated finish, ASTM B633, SC3.

J. Cable hooks for corrosive areas shall be stainless steel, AISI type 304.

K. Cable hooks shall be B-Line series BCH21, BCH32 or other manufacturer that meets these specifications

2.04 SURFACE RACEWAY

A. In areas where surface raceway will be used as a cable path, no exposed cable shall be permitted.

B. With the agreement of the Consultant and Owner, where telecommunications outlets are to be located in areas where the walls cannot be fished, the station wire serving these outlets shall be covered with raceways. No exposed wire shall be permitted within offices, laboratories, conference rooms, or like facilities. Contractor shall attempt to fish hollow walls, use existing conduit, or exhaust all other options to conceal cabling prior to installing surface raceway.

C. The raceway shall originate from a surface mounted box located off the floor, be attached to the wall, and terminate above the ceiling. The outlet box height shall match existing electrical receptacle height. Raceway for wall-mounted phone locations shall originate from a surface mounted box with the top of the box located 48" off the floor.

D. Raceway finish shall match finish of project electrical raceway. All fittings including but not limited to extension boxes, elbows, tees, and fixture boxes shall match the color of the raceway.

E. Telecommunication outlet faceplates shall match electrical faceplate standards for finish.

F. The raceway and all system devices shall be UL listed, exhibit nonflammable self-extinguishing characteristics, tested to specifications of UL94V-0, and be Category Compliant as defined by TIA/EIA 568.

G. Raceway turns or bends shall conform to manufacturer specifications or recommendations and industry best-practices for UTP and fiber optic cable minimum bend radius.

H. All raceway systems shall be installed complete as specified herein and in manufacturer recommendations.

2.05 CABLE PATHWAY SLEEVES

A. The Contractor shall only provide when re-enterable sleeves are not possible.

B. The Contractor shall provide all necessary wall penetration for cable pathways whether or not specifically shown on Project Drawings.

C. All wall penetrations shall have metallic sleeve(s) as required to maintain a maximum 40% fill ratio and capacity for 25% future growth.

D. All sleeves shall be properly firestopped by this Contractor.

E. Contractor shall provide all core holes, pathways and sleeves (minimum 1.25" c).

F. Contractor shall install non-metallic threadless insulating bushings on end of all conduits.

G. Conduit Core Holes and Sleeves thru Floor: For all floor penetrations, Contractor shall provide IMC conduits with threaded steel couplings set flush with finish floor. Extend 6” above finish floor with IMC before any termination.

2.06 RE-ENTERABLE FIRESTOP SLEEVES

A. Device modules comprised of steel pathway with self-adjusting intumescent foam pads/membrane allowing 0 to 100 percent visual cable fill.

B. Refer to the drawings for required sizes. If not specifically identified, utilize 2” or greater as required for cabling counts with 20% additional capacity for future growth.

C. Manufacturer:

1. STI EZ Path
2. Hilti Speedsleeve
3. Or approved equal

2.07 METAL CONDUITS AND FITTINGS

A. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-E.
3. GRC: Comply with ANSI C80.1 and UL 6.
4. EMT: Comply with ANSI C80.3 and UL 797.
5. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
    a. Fittings for EMT:
        i. Material: Steel
        ii. Type: Setscrew
6. Expansion Fittings: Steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.

2.08 OUTLET BOXES

A. General Requirements for Outlet Boxes

1. Comply with TIA-569-E.

B. Metallic outlet boxes and device covers shall be galvanized steel not less than 1/16" thick.

C. The dimensions of the metallic outlet box shall be 2"x4", 4"x4" and 6"x4" with a minimum depth of 2.5". See drawings for details.

D. Metallic outlet boxes shall be equipped with single device cover (or two-device cover where needed).

E. Where installed in plaster, gypsum board, etc., covers shall be raised to compensate the thickness of the wall.

F. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

G. Where metallic outlet boxes are to be empty for future use, blank covers shall be used.

H. Gangable boxes are not allowed.

2.09 PAINTING

A. The Contractor is responsible for painting all exposed pathway, boxes, fittings, etc. The paint shall match the surrounding conditions and may change mid-run.

Part 3 - EXECUTION

3.01 TESTING

A. Refer to Section 27 00 00 for additional requirements.

3.02 TRAINING

A. Refer to Section 27 00 00 for additional requirements.

3.03 WARRANTY

A. Refer to Section 27 00 00 for additional requirements.

3.04 WIRE BASKET TRAY RUNWAY

A. Basket tray shall be installed in accordance with recognized industry practices, to ensure that the cable tray equipment complies with requirements of NEC, applicable portions of NFPA 70B and NECA's "Standards of Installation" pertaining to general electrical installation practices.

B. Coordinate installation of wire basket runway with other electrical work as necessary to properly interface installation of wire basket runway with other work.

C. Provide sufficient space encompassing wire basket runways to permit access for installing and maintaining cables.

D. Test wire basket runways to ensure electrical continuity of bonding and grounding connections and to demonstrate compliance with specified maximum grounding resistance.

3.05 CABLE HOOK SYSTEM

A. J-hooks fabricated to contain data/voice and video cables may be used to support 25 or fewer cables in each hook. J-hooks are to be fastened to building steel with beam clamps, suspended from ceiling slab with threaded rod, or anchored to the wall. All J-hooks shall be hung straight and level. No other installation technique will be authorized unless pre-approved.

B. Three tiered double-sided J-hook configurations shall contain a maximum of 25 cables per hook or 150 cables. Smaller configurations may be used as bundles decrease in size, maintaining no more than 25 cables per hook.

C. Bundles surpassing 150 cables shall be supported by hangers, fabricated of 3/8" threaded rod and 24" Unistrut. Hangers shall also be installed where the installation of a three-tiered J-hook system is not appropriate for the ceiling space, or where blocked by other trades' work.

D. Cable bundles consisting of fewer than 10 cables may be supported by single J hooks.

E. All cable support in the main cable path shall be installed every four feet. Small cable bundles (under 25) not in the main path may be supported every five feet.

F. A sag shall be maintained between supports of 6", to reduce cable strain. Velcro is an appropriate method of securing cables, when properly used and not over tightened.

G. Proper cable support is extremely important to the Owner, and care shall be taken by the Contractor to provide and install the appropriate supports. Supports found to be inadequate will be replaced.

H. Cable bundles including voice/data cabling shall not have plastic cable ties.

I. All cable trunks shall have radius controlled cable waterfalls where trunk drops from conduit, sleeve or tray from horizontal path to vertical path.

3.06 SURFACE RACEWAY SYSTEM

A. In areas where surface raceway will be used as a cable path, no exposed cable shall be permitted.

B. With the agreement of the Consultant and Owner, if a telecommunications outlet is required in an area where the walls cannot be fished, the station cable serving these outlets shall be covered with raceway. No exposed cable shall be permitted within offices, laboratories, and conference rooms, or like facilities. Contractor shall attempt to fish hollow walls, use existing conduit, or exhaust all other options to conceal cabling prior to installing surface raceway.

C. The raceway shall originate from a surface mounted box located off the floor and be attached to the wall and terminate above the ceiling. The outlet box height shall match existing electrical receptacle height. Raceway for a wall-mounted location shall originate from a surface mounted box with the top of the box located 48" off the floor.

D. Minimum bend radius shall be adhered to for UTP and fiber optic cable.

E. Where raceway is to be installed on painted, smooth, finished surfaces, the Contractor shall clean surface prior to installing raceway.

F. Where non-metallic raceway is to be installed on non-smooth surfaces such as wallpaper, unpainted brick, concrete, etc., the Contractor shall use flat-head screws in addition to the adhesive backing to fasten channel to surfaces.

G. Where Contractor is required to install metallic raceway, the raceway base shall be installed using flat-head screws and following all manufacturer's recommendations.

H. Where new outlet locations are indicated on Project Drawings as having existing Wiremold™ type raceway, the Contractor shall remove existing raceway from wall and install new specified raceway to cover any damage or markings caused from removing existing raceway product.

I. All surface raceway shall be mounted level and plumb. Where the Owner considers raceway channels to be installed unsatisfactorily, the Contractor shall remove and replace necessary channels at no additional cost to the Owner.

J. Suitable insulating bushings and inserts shall be used at connections to outlets and corner fittings. Dropped ceiling end fittings shall be utilized where raceway channel connects to dropped accessible ceiling tile. In rooms with drywall ceilings, open ceilings, or non-accessible ceilings, the Contractor shall extend raceway to the nearest location, hallway, or corridor that has accessible ceiling cavity. All cables shall be concealed.

3.07 PATHWAY APPLICATIONS

A. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT

2. Concealed in Ceilings and Interior Walls and Partitions: EMT

B. Minimum Pathway Size for Data: 1-inch trade size. Cable fill shall not exceed a 40% fill ratio.

C. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

2. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.

3.08 INSTALLATION

A. Comply with NECA 1, NECA 101, and TIA-569-E for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70

limitations for types of pathways allowed in specific occupancies and number of floors.

B. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

C. Complete pathway installation before starting conductor installation.

D. Arrange stub-ups so curved portions of bends are not visible above finished slab.

E. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

G. Support conduit within 12 inches of enclosures to which attached.

H. All conduit penetrations shall comply with all applicable fire codes. All conduit penetrations in fire-rated walls or floors shall be sealed and fire proofed to at least the rating of the penetration area.

I. Conduits shall be routed in the most direct route, with the fewest number of bends.

J. There shall be no continuous conduit sections longer than 100 feet. For runs that total more than 100 feet, insert junction or pull boxes (or gutters if appropriate) so that no continuous run between pull boxes is greater than 100 feet.

K. There shall be no more than two 90-degree bends (180 degrees total) between conduit pull boxes.

L. Changes in direction shall be accomplished with sweeping bends observing minimum bend radius requirements above. Do not use pull boxes for direction changes unless specifically designated otherwise in the Drawings.

M. Stub-ups to Above Recessed Ceilings:

1. Use EMT for pathways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

O. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

R. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb. tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.

3.09 OUTLET BOXES

A. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

B. Exact locations of the outlet boxes shall be coordinated with the electrical contractor and other trades.

C. The approximate locations of the outlets are indicated on the drawings. The exact locations shall be determined at the building. The right is reserved to change without additional cost, the exact location of any outlet, a maximum of 10' before it is permanently installed.

D. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a rain tight connection between box and cover plate or supported equipment and box.

E. Horizontally separate boxes by a minimum of 12" mounted on opposite sides of walls so they are not in the same vertical channel.

F. Outlet boxes installed back to back in fire-rated walls shall be separated horizontally by a minimum of 24".

G. Install all outlet boxes in finished areas flush with the wall. Maintain ¼" or less space between outlet box front and finished wall surface.

H. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

I. Outlet boxes shall be firmly anchored in place and shall not depend on the cover plate to hold it secure to the wall.

J. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

K. Any surface boxes shall have rounded corners and edges. Surface boxes must be approved by Owner prior to installation.

3.10 RISER CONDUITS

A. Conduits entering equipment rooms shall be reamed or bushed and terminated not more than 4" from a wall and within 12” of room corners.

B. Conduits entering equipment rooms from below floor shall be terminated not more than 4" above finished floor.

C. Conduits shall not be less than 4" trade size and be equipped with a measured pull line at 12” increments rated at a minimum 1200 pound test.

D. Provide restorable fire stops inside and around conduits as recommended by UL1479 or ASTM E814 for all conduits penetrating fire-rated construction.

E. Provide an insulating press fit bushing on all telecommunications riser conduits. Bushings must be rated to be used in an environmental air handling space (Plenum).

3.11 SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.12 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

End of Section

SECTION 27 0537
FIRESTOPPING FOR TECHNOLOGY SYSTEMS

Part 1 - GENERAL

1.01 SCOPE

A. All penetrations of walls shall be approved by the General Contractor before any penetrations are made. Should the Contractor find it necessary to penetrate any walls extending to the slab, it will be the responsibility of that Contractor to provide satisfactory sleeving and fire caulking both inside and outside of that sleeving. If existing sleeving is to be utilized, it will be the responsibility of the Contractor to fire caulk inside the sleeving.

B. Refer to Section 27 00 00 for additional project scope information.

1.02 RELATED WORK

A. Division 7 - Firestopping

B. Section 27 00 00 – General Technology Requirements

C. Section 27 05 00 – Communications General Requirements

D. Section 27 05 26 – Grounding and Bonding for Technology Systems

E. Section 27 05 28 – Pathways for Technology Systems

F. Section 27 11 00 – Communications Equipment Rooms

G. Section 27 13 00 – Communications Backbone Cabling

H. Section 27 13 23 – Interbuilding OSP Pathways

I. Section 27 15 00 – Communications Horizontal Cabling

J. Section 27 60 00 – Physical Security General Requirements

K. Section 27 62 00 – Electronic Access Control System

L. Section 27 64 00 – Video Surveillance System

1.03 DEFINITIONS

A. Refer to Section 27 00 00 for additional definitions.

1.04 REFERENCE STANDARDS AND CODES

A. ANSI/TIA-EIA-569-D “Telecommunications Pathways and Spaces”

B. ASTM E90, “Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements”.

C. ASTM E814, “Fire Tests of Through Penetration Firestops”.

D. ASTM E1725, “Standard Test Methods for Fire Tests of Fire-Resistive Barrier Systems for Electrical System Components”.

E. CAN/ULC S115, "Standard Method of Fire Tests of Firestops Systems."

F. UL 1479, “Fire Tests of Through Penetration Firestops”.

G. National Fire Protection Association (NFPA) – NFPA 101: Life Safety Code.

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

I. Underwriters Laboratories Inc. (UL) – Fire Resistance Directory

J. Refer to Section 27 00 00 for additional requirements.

1.05 QUALIFICATIONS

A. Refer to Section 27 00 00 for additional requirements.

1.06 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

1.07 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

1.08 CLOSEOUT SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

Part 2 - PRODUCTS

2.01 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

2.02 GENERAL PERFORMANCE REQUIREMENTS

A. Fire rated cable pathway devices shall be used in fire-rated construction for all low-voltage or optical fiber raceways. Such devices shall:

1. Meet the hourly fire-rating of fire rated wall and or floor penetrated.

2. Be tested for the surrounding construction and cable types involved.

3. Re-enterable firestop pathway shall have UL Systems permitting cable loads from zero to 100% visual fill.

4. Re-enterable firestop pathway shall be maintenance-free as defined by not requiring the removal and or replacement of any material such as, but not limited to, firestop caulk, putty, pillows, bags, foam muffins, foam, foam plugs, foam blocks, or foam closures of any sort.

5. Pathways shall be engineered such that two or more devices may be ganged together for additional cable capacities.

6. Affix adhesive wall label immediately adjacent to devices to communicate to future cable technicians, authorities having jurisdiction and others the manufacturer of the device and the corresponding UL System number installed.

7. Size as shown on the drawings or as required when not specifically identified.

B. Non-rated cable pathway devices shall be used in non-fire-rated construction such as smoke partitions for all low-voltage and fiber optic cabling where frequent cable moves, adds and changes may occur. Such devices shall:

1. Limit the movement of smoke and sound of wall and or floor penetrated.

2. Restore the STC Rating of the penetrated assembly.

3. Provide L Ratings of greater than 1 CFM when empty and greater than 2.5 CFM at all other loading up to 100 percent.

4. Accommodate cable loads from zero to 100% visual fill.

5. Be maintenance-free as defined by not requiring the removal and or replacement of any material such as, but not limited to, firestop caulk, putty, pillows, bags, foam muffins, foam, foam plugs, foam blocks, or foam closures of any sort.

6. Pathways shall be engineered such that two or more devices may be ganged together for larger cable capacities.

7. Pathways shall be engineered to be re-enterable so they can be retrofitted and removed from around existing cables without cutting and re-splicing them.

8. Affix adhesive wall label immediately adjacent to devices to communicate to future cable technicians, authorities having jurisdiction and others the manufacturer of the device and the corresponding UL System number installed.

C. Where non-mechanical pathways must be utilized, such as sealing (caulking) around single or grouped conduits, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction.

D. Cable tray shall terminate at each barrier and resume on the other side such that cables pass independently through devices. Cable tray shall be properly supported on each side of the barrier.

E. Single Source: Obtain firestop systems for each type of penetration and construction condition indicated only from a single manufacturer.

2.03 MATERIALS

A. General: Use only products that have been tested for specific fire resistance rated construction conditions or acoustical and smoke related requirements conforming to construction assembly type, penetrating item type, annular space requirements, and rating involved for each separate instance.

B. Firestop Sealants: Single component latex formulations that upon cure do not re-emulsify during exposure to moisture.

1. Acceptable Manufacturers:

a. Specified Technologies Inc. (STI) SpecSeal Series SSS or LCI Sealant.

b. Hilti

C. Firestop Putty: Intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers or silicone compounds.

1. Acceptable Manufacturers:

a. Specified Technologies Inc. (STI) SpecSeal Series SSP Putty.

b. Hilti

D. Firestop Pillows: Re-enterable, non-curing, mineral fiber core encapsulated on six sides with intumescent coating contained in a flame retardant poly bag.

1. Acceptable Manufacturers:

a. Specified Technologies Inc. (STI) SpecSeal Series SSB Pillows.

b. Hilti

E. Fire-Rated Cable Grommet: Molded, two-piece grommet with an integral fire and smoke sealing foam membrane for sealing individual cable penetrations through framed wall assemblies.

1. Acceptable Manufacturers:

a. Specified Technologies Inc. (STI) EZ-Firestop Grommets.

b. Hilti

F. Fire-Rated Cable Re-Enterable Pathways: Device modules comprised of steel pathway with self-adjusting intumescent foam pads or fabric ring allowing 0 to 100 percent cable fill.

1. Provide with radius control modules (waterfalls) by pathway manufacturer.

2. Acceptable Manufacturers:

a. Specified Technologies Inc. (STI) EZ-PATH Fire Rated Pathway.

b. Hilti Speed Sleeve

G. Smoke and Acoustical Pathways: Device module comprised of a nonmetallic pathway with integral self-adjusting smoke and sound sealing system for cable penetrations through non-fire-resistance rated wall or floor assemblies

1. Acceptable Manufacturers:

a. Specified Technologies Inc. (STI) EZ-PATH Smoke & Acoustical Pathway.

b. Hilti

H. Protective Wrap: Endothermic Wrap incorporating foil scrim for protection of cable pathways, through-penetration and membrane-penetration firestopping, Electrical Metallic Tubing (EMT), Rigid Metallic Conduit (RMC), or Cable Trays.

1. Acceptable Manufacturers:

a. Specified Technologies, Inc. (STI) E-Wrap™ Endothermic Wrap

b. Hilti

Part 3 - EXECUTION

3.01 TESTING

A. Refer to Section 27 00 00 for additional requirements.

3.02 TRAINING

A. Refer to Section 27 00 00 for additional requirements.

3.03 WARRANTY

A. Refer to Section 27 00 00 for additional requirements.

3.04 INSTALLATION

A. Install systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified or required.

B. Comply with manufacturer's instructions for installation of products.

C. Place system stickers on each side of wall penetrations.

D. Place a reproduction (photo copy) of the UL System description in a document protector and mount to the wall next to the wall penetration. Highlight the section of the system description that list the allowed cable types.

E. Do not install products when ambient or substrate temperatures are outside limitations recommended by manufacturer.

F. Do not install products when substrates are wet due to rain, frost, condensation, or other causes.

G. Do not use materials that contain flammable solvents.

H. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to requirements.

I. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

3.05 SCHEDULES

Penetrant Type	Concrete Floor	Concrete Wall	Gypsum Board Wall

Blank Opening	C-AJ-0100, C-AJ-0101, C-AJ-0113, C-AJ-0116	C-AJ-0100, C-AJ-0101, C-AJ-0113, C-AJ-0116	W-L-0020, W-L-0034
Metal Conduits	C-AJ-1080, C-AJ-1240, C-AJ-1353	C-AJ-1080, W-J-1098, W-J-1100	W-L-1049, W-L-1222, W-L-1168
Plastic Conduits and Raceways	C-AJ-2140, C-AJ-2292, F-A-2186, F-A-2210, F-A-2225	C-AJ-2038, C-AJ-2108, C-AJ-2578, C-AJ-2586, W-J-2018, W-J-2076	W-L-2059, W-L-2074, W-L-2093, W-L-2241
Cables	C-AJ-3214, C-AJ-3231, F-A-3015, F-A-3021, F-A-3054	C-AJ-3214, C-AJ-3231, W-J-3098, W-J-3099,W-J-3124, W-J-3150, W-J-3180	W-L-3219, W-L-3248, W-L-3287, W-L-3356, W-L-3377, W-L-3378, W-L-3379, W-L-3390
Cable Trays	C-AJ-3317, C-AJ-8181, C-AJ-4029, F-A-3015, F-A-3037	C-AJ-8181, W-J-4021, W-J-4022, W-J-4033, W-J-3098, W-J-3145, W-J-3158	W-L-3218, W-L-3271, W-L-3286, W-L-3306, W-L-4008, W-L-4029, W-L-4043, W-L-8073

End of Section

SECTION 27 1100
COMMUNICATIONS EQUIPMENT ROOMS

Part 1 - GENERAL

1.01 SCOPE

A. Refer to Section 27 00 00 for additional project scope information.

B. This section describes the products and execution requirements relating to telecommunications cabling, termination components, racks, pathways, telecommunication rooms and related subsystems. Covered systems include the following:

1. Equipment room cable management system and equipment racks
2. Horizontal and backbone cable terminating equipment
3. Telecommunications grounds and related components

1.02 RELATED WORK

A. Section 27 00 00 – General Technology Requirements

B. Section 27 05 00 – Communications General Requirements

C. Section 27 05 26 – Grounding and Bonding for Technology Systems

D. Section 27 05 28 – Pathways for Technology Systems

E. Section 27 05 37 – Firestopping for Technology Systems

F. Section 27 13 00 – Communications Backbone Cabling

G. Section 27 13 23 – Interbuilding OSP Pathways

H. Section 27 15 00 – Communications Horizontal Cabling

I. Section 27 60 00 – Physical Security General Requirements

J. Section 27 62 00 – Electronic Access Control System

K. Section 27 64 00 – Video Surveillance System

1.03 DEFINITIONS

A. Refer to Section 27 00 00 for additional definitions.

1.04 REFERENCE STANDARDS AND CODES

A. Refer to Section 27 00 00 for additional requirements.

1.05 QUALIFICATIONS

A. Refer to Section 27 00 00 for additional requirements.

1.06 PRE-CONSTRUCTION SUBMITTALS

A. Provide a comprehensive Communications submittal package; refer to 27 05 00 Communications General Requirements for detailed requirements. Do not provide a separate submittal for this section on its own.

1.07 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

1.08 CLOSEOUT SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

Part 2 - PRODUCTS

2.01 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

2.02 CATEGORY 6 PATCH PANELS

A. Cables shall be terminated at the telecommunication closets on high-density modular patch panels incorporating Category 6 jacks (non-keyed 8-pin), meeting the specifications for the telecommunications outlet specified.

B. Patch panel configuration shall be 48 ports unless noted otherwise.

C. The patch panel shall exceed ANSI/TIA 568.2-D Category 6 component compliance standard. All pair combinations shall be considered, with the worst-case measurement being the basis for compliance.

D. The patch panels shall be interoperable and backwards compatible to lower performing cabling systems.

E. Panels shall incorporate cable support and/or strain relief mechanisms to secure the horizontal cables at the termination block and to ensure that all manufacturers' minimum bend radius specifications are adhered to.

F. The patch panel shall have color-coded designation strips to identify cable count.

G. Manufacturers:

1. Leviton Quickport
2. Ortronics Clarity
3. Panduit Mini-Com
4. CommScope Uniprise

2.03 CATEGORY 6A PATCH PANELS

A. Cables shall be terminated at the telecommunication closets on high-density modular patch panels incorporating Category 6a jacks (non-keyed 8-pin), meeting the specifications for the telecommunications outlet specified.

B. Patch panel configuration shall be 48 ports unless noted otherwise.

C. Wireless access points shall be installed on their own dedicated patch panel at the top of the rack.

D. The patch panel shall ANSI/TIA/EIA 568.2-D Category 6a compliance standard. All pair combinations shall be considered, with the worst-case measurement being the basis for compliance.

E. The patch panels shall be interoperable and backwards compatible to lower performing cabling systems.

F. Panels shall incorporate cable support and/or strain relief mechanisms to secure the horizontal cables at the termination block and to ensure that all manufacturers' minimum bend radius specifications are adhered to.

G. The patch panel shall have color-coded designation strips to identify cable count.

H. Manufacturers:

1. Leviton Quickport
2. Ortronics Clarity
3. Panduit Mini-Com
4. CommScope Uniprise

2.04 FIBER OPTIC PATCH PANELS

A. The Contractor shall provide a fiber optic patch panel at each location where a fiber optic cable terminates.

B. All terminated fibers shall be mated to duplex LC couplings mounted on enclosed patch panels. Couplers shall be mounted on a panel that, in turn, snaps into the enclosure. The proposed enclosure shall be designed to accommodate a changing variety of connector types, including SC, ST, Fixed Shroud Duplex (e.g., "FDDI Connector"), Biconic, and FC by changing panels on which connector couplings are mounted.

C. The patch panel enclosure shall be sized to accommodate the total fiber count to be installed at each location as defined in the specifications and Drawings, including those not terminated (if applicable), PLUS 50% future growth.

D. The Contractor shall provide all required connector panels and connector couplings (sleeves, bulkheads, etc.) adequate to accommodate the number of fibers to be terminated.

E. Patch panels shall be designed for easy installation, front removal, and expansion of snap-in adapter panels.

F. Patch panels shall be enclosed assemblies affording protection to the cable subassemblies and to the terminated ends. The enclosures shall incorporate a hinged or retractable front cover designed to protect the connector couplings and fiber optic jumpers.

G. The patch panel's enclosure shall provide for strain relief of incoming cables and shall incorporate radius control mechanisms to limit bending of the fiber to the manufacturer's recommended minimums or 1.2", whichever is larger.

H. Access to the inside of the patch panel enclosure during installation shall be from the front and rear. Panels that require any disassembly of the cabinet to gain entry will not be accepted.

I. All patch panels shall provide protection to both the "facilities" and "user" side of the coupling. The patch panel enclosure shall be configured to require front access only when patching. The incoming cables (backbone, riser, etc.) shall not be accessible from the patching area of the panel. The enclosure shall provide a physical barrier to access of such cables.

J. Where singlemode fibers are installed, the fibers contained in these cables may be terminated either by (1) splicing of factory-terminated cable assemblies ("pigtails") or (2) use of a "fan-out" kit. In the latter approach, individual fibers are to be secured in a protective covering (such as an Aramid reinforced tube, for example) with connectors mated to the resulting assembly. In both instances, the proposed termination hardware shall incorporate a mechanism by which cable and subassemblies are secured to prevent damage. Splicing shall be by the "fusion" method. Individual splice loss shall not exceed 0.2 dB.

K. Fiber optic patch panels shall be Corning PCH-02 in TR/IDF and PCH-4U in MDF or Server Rooms or approved equal.

L. Singlemode LC adaptor panels shall be Corning CCH-CP12-A7 or approved equal.

2.05 CABLE MANAGEMENT SYSTEM

A. The cable management system shall be used to provide a neat and efficient means for routing and protecting fiber and copper cables and patch cords on telecommunication racks and enclosures. The system shall be a complete cable management system comprising 4-post and 2-post floor mount racks, wall mount racks, equipment cabinets and vertical and horizontal cable managers to manage cables on both the front and rear of the rack. The system shall protect network investment by maintaining system performance, controlling cable bend radius, and providing cable strain relief.

1. 2-Post Equipment Racks

a. The Contractor shall provide and install 2-post adjustable equipment racks to house cable termination components (e.g., copper data and fiber optic) and network electronics (by others) as shown on the drawings. Prior to installation, the Contractor shall coordinate exact placement with Owner.

b. Rack shall be 84" in height and shall be self-supporting.

c. Channel uprights shall be spaced to accommodate industry standard 19" mounting and have pass-through holes with smooth edges to protect cables.

d. Rack shall be constructed of aluminum.

e. Able to support up to 1,500 pounds.

f. Rack shall be double side drilled and tapped to accept 12-24 screws. Uprights shall also be drilled on back to accept cable brackets, clamps, power strip(s), etc. Hole pattern on rack front shall be per EIA/TIA specifications (5/8"-5/8"-1/2"). Hole pattern on the rear shall be at 3" intervals to accept cable brackets.

g. Rack shall be supplied with at least 24 spare screws.

h. Rack shall be supplied with a vertical ground bar and #6 AWG ground lug.

i. Manufacturers:

i. Chatsworth #55053-703

ii. Commscope

iii. Panduit

iv. nVent Hoffman

v. Or approved equal.

B. Vertical Cable Management

1. At the telecommunication rooms, vertical cable management shall be furnished and installed to adjacent racks to organize cables on front and rear of telecommunication racks.

2. Vertical cable managers shall include components that aid in routing, managing, and organizing cable to and from equipment. Panels shall protect network equipment by controlling cable bend radius and providing cable strain relief. Panels shall be a universal design mounting to EIA 19" or 23" racks.

3. Vertical cable management system shall feature the following:

a. Open cabling section on the rear that provides easy access and routes cable bundles feeding into the back of patch panels and 1 RMU cable guide on the front designed for fanning and managing patch cords.

b. Edge-protected pass-through ports designed for easy routing of cable from front channel to back.

c. Vertical slots along the center separator to allow securing cable bundles neatly with management straps.

d. Door/cover (front only) that is easily opened from the right or left and still easily removed to allow for quick moves, adds, and changes.

e. Movable wire retainers to retain the cables during cover removal.

4. Vertical cable management at the end of rack rows shall be 6”.
5. Vertical cable management between racks shall be 10”
6. Manufacturers:
    a. Chatsworth MCS 30095-703 / 30096-703 or Evolution G2 35521-703 / 35523-703
    b. Commscope VCM-DS-84-6B / VCM-DS-84-10B
    c. Panduit PR2VD06 / PR2VD10
    d. nVent Hoffman CableTek DV6DF7 / DV10DF7
    e. Or approved equal

2.06 POWER DEVICES

A. Refer to Section 27 00 00 for additional requirements.

B. Horizontal PDU, Single Circuit for Network Racks
1. Power strip shall provide 3,840 joules of surge protection.
2. 40-80db of EMI/RFI power conditioning
3. 2 isolated and filtered power banks
4. Contractor shall provide one (1) power strip per rack/cabinet.
5. Power strip shall be rated for 20 amps.
6. Manufacturer:
    a. Tripp-Lite IBAR12-20ULTRA
    b. CyberPower
    c. Or approved equal

C. Vertical PDU, Single Circuit for Network/Server Racks
1. 120 VAC, 30-amp input with L5-30P plug.
2. 2.9KW output with (24) 5-15/20R outlets with two breakered load banks.
3. Current meters on both banks.
4. Furnish and install with all required mounting accessories.
5. Manufacturer:
    a. Tripp-Lite PDUMV30
    b. CyberPower
    c. Or approved equal

2.07 HORIZONTAL CABLE MANAGEMENT

A. Horizontal cable managers shall include components that aid in routing, managing, and organizing cable to and from equipment. Panels shall protect network equipment by controlling cable bend radius and providing cable strain relief. Panels shall be a universal design mounting to EIA 19" racks and constructed of steel bases with PVC duct attached. The duct fingers shall include retaining tabs to retain the cables in place during cover removal. The covers shall be able to hinge from either side yet still be easily removed to allow for quick moves, adds, and changes.

B. The cable managers shall be provided with movable wire retainers to retain the cables during cover removal and #12-24 mounting screws. An integral strain relief bracket shall be provided on either end of the duct to allow for easy cover placement.

C. Double-Sided horizontal cable managers shall be placed above and below each patch panel.

D. The Contractor shall also supply (1) per 48-port patch panel additional managers for network electronics.

E. Manufacturers:

1. Chatsworth #30530-719
2. Commscope
3. Panduit
4. nVentHoffman
5. Or approved equal.

2.08 TELECOMMUNICATION GROUND

A. The Telecommunication Contractor is responsible for providing an appropriate ground for all racks, trays, and telecommunications equipment installed by this Contractor. Refer to the Grounding and Bonding for Technology Systems specification section.

2.09 WIRE BASKET RUNWAY TRAY

A. Within each Telecommunications Room, the Contractor shall provide and install sufficient wire basket tray to support cable bundles from corridor to equipment racks or as shown on the Project Drawings, this Contractor shall provide and install sufficient basket tray to support cable bundles from corridor to equipment racks or cabinets.

B. The Contractor shall provide all necessary labor, supervision, materials, equipment, tests, and services to install complete wire basket runway systems in the telecommunication closet.

C. Wire basket runway systems shall include, but are not limited to, straight sections of continuous wire mesh, field formed horizontal and vertical bends, tees, drop outs, supports, and accessories.

D. Specifications and Drawings are for assistance and guidance, but exact routing, locations, distances, and levels will be governed by actual field conditions.

E. All straight section longitudinal wires shall be straight (with no bends).

F. Wire basket runway 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. All wire ends along runway sides (flanges) shall be rounded during manufacturing for safety of cables and installers.

G. All fittings shall be field formed as needed.

H. All splicing assemblies shall be the bolted type using serrated flange locknuts. Hardware shall be either yellow zinc dichromate in accordance with ASTM B633 SC2 or AISI Type 304 stainless steel. Splicing assemblies shall provide a continuous ground connection.

I. Wire Basket Tray shall be grounded to a Telecommunications Room ground bus bar.

J. Cable Drop Out/Waterfall

    1. Where cables bundles transition from tray and drop to the rack, cabinets or ladder rack, the Contractor shall provide and install a radius control device. This device shall be a waterfall or drop out device and shall be properly sized to accommodate cable bundle plus 20% future growth.

K. T-sections of tray shall be made using T-section fittings.

L. Straight section splices shall be made using splice plates.

M. Wire basket runway supports shall be wall mounted brackets and trapeze hangers when spanning the room.

N. Trapeze hangers shall be supported by 3/8 inch diameter rods.

O. Provide size as indicated on the drawings.

P. Tray shall have flat Black finish.

Q. Accessories (connectors, splice plates…) shall be painted to match tray finish.

R. Manufacturer:

    1. Cooper B-Line
    2. Legrand Cablofil
    3. Pentair Hoffman
    4. Or approved equal

2.10 LADDER RACK

A. Within each Telecommunications Room, the Contractor shall provide and install ladder rack as shown on the Project Drawings.

B. Within each Telecommunications Room with a vertical conduit riser the Contractor shall provide and install vertical ladder rack connecting the ground conduit sleeve penetrations with the ceiling conduit sleeve penetrations.

C. The Contractor shall provide all necessary labor, supervision, materials, equipment, tests, and services to install a complete ladder rack system in the telecommunications room as shown on the Drawings.

D. Specifications and Drawings are for assistance and guidance, but exact routing, locations, distances, and levels will be governed by actual field conditions.

E. All splicing assemblies shall be the bolted type using serrated flange locknuts. Hardware shall be either yellow zinc dichromate in accordance with ASTM B633 SC2 or AISI Type 304 stainless steel.

F. Cable Drop Out/Waterfall

1. Where cables bundles transition from tray and drop into the racks/cabinets, the Contractor shall provide and install a radius control device. This device shall be a waterfall or drop out device and shall be properly sized to accommodate cable bundle plus 20% future growth.

G. Size ladder rack as indicated on the Contract Documents.

H. Accessories (connectors, splice plates…) shall be painted to match tray finish.

I. Manufacturers:

1. Chatsworth
2. Cooper
3. Legrand
4. Pentair Hoffman
5. Or approved equal

2.11 PLYWOOD

A. The Contractor shall provide plywood. Plywood shall be installed on all walls within a telecommunications room and other locations as noted.

B. Provide void-free, interior grade, fire rated A-C grade plywood, 3/4” by 48” by 96”, or as indicated.

C. When plywood is required to be painted, the paint shall be UL 723 rated white or gray fire retardant. The plywood’s rating stamp shall be exposed (not painted over) on each sheet. Plywood shall have fire calk around all edges. Provide label including paint manufacturer, date painted, UL listing and name of Installer

D. Plywood shall be mounted vertically starting at 22” AFF to 118” AFF and anchored to all studs.

Part 3 - EXECUTION

3.01 TESTING

A. Refer to Section 27 00 00 for additional requirements.

3.02 TRAINING

A. Refer to Section 27 00 00 for additional requirements.

3.03 WARRANTY

A. Refer to Section 27 00 00 for additional requirements.

3.04 EQUIPMENT RACK AND CABINETS

A. Prior to permanently securing racks or cabinets, the Contractor shall coordinate a walk through with the Owner to determine exact placement of racks.

B. The Contractor shall bolt the rack to the floor as recommended by the manufacturer. Multiple racks shall be joined and the ground made common on each. Rack shall also be stabilized by extending a brace extending to the wall. Alternately, overhead cable tray over which the cabling accesses the equipment rack(s) shall provide this function.

C. A space between the rack upright and the wall (~6") shall be planned to allow for cabling in that area. The rear of the rack shall be ~40" from the wall to allow for access by maintenance personnel. In all cases, a minimum of 40" workspace in front of the rack is also required. Locations where these guidelines cannot be followed shall be brought to the attention of the Consultant for resolution prior to installation.

D. All hardware and equipment is to be mounted at least 18" above floor level. This is to afford easy access and, in the case of the lower limit, prevent damage to the components. Positioning of hardware shall be reviewed and approved by the Consultant and Site Coordinator(s) prior to installation.

E. Equipment rack shall be equipped with cable management hardware to allow an orderly and secure routing of twisted pair cabling to the data patch panels. At minimum, one such horizontal jumper management panel shall be placed below each fiber optic patch panel installed by the Contractor. Additional jumper management panels may be required pending installation of other cable types on the rack. The rack shall be grounded to the telecommunications grounding backbone (TGB) using a #6 AWG (or larger) insulated stranded copper conductor (GREEN jacket).

3.05 WIRE BASKET TRAY AND LADDER RACK RUNWAY

A. Runway shall be installed in accordance with recognized industry practices, to ensure that the cable tray equipment complies with requirements of NEC, applicable portions of NFPA 70B and NECA's "Standards of Installation" pertaining to general electrical installation practices.

B. Coordinate installation of runway with other electrical work as necessary to properly interface installation of wire basket runway with other work.

C. Provide sufficient space encompassing runways to permit access for installing and maintaining cables.

D. Test runways to ensure electrical continuity of bonding and grounding connections and to demonstrate compliance with specified maximum grounding resistance.

End of Section

SECTION 27 1300
COMMUNICATIONS BACKBONE CABLING

Part 1 - GENERAL

1.01 SCOPE

A. Refer to Section 27 00 00 for additional project scope information.

B. This section describes the products and execution requirements relating to telecommunications voice, data and video backbone cabling and termination components.

C. Backbone Cabling is the cable and hardware interconnecting telecommunication rooms (TRs), building demarcation rooms, equipment rooms and server rooms. The backbone cabling shall consist of the following cable types:

1. Singlemode Fiber Optic Cable

1.02 RELATED WORK

A. Section 27 00 00 – General Technology Requirements

B. Section 27 05 00 – Communications General Requirements

C. Section 27 05 26 – Grounding and Bonding for Technology Systems

D. Section 27 05 28 – Pathways for Technology Systems

E. Section 27 05 37 – Firestopping for Technology Systems

F. Section 27 11 00 – Communications Equipment Rooms

G. Section 27 13 23 – Interbuilding OSP Pathways

H. Section 27 15 00 – Communications Horizontal Cabling

1.03 DEFINITIONS

A. Refer to Section 27 00 00 for additional definitions.

1.04 REFERENCE STANDARDS AND CODES

A. Refer to Section 27 00 00 for additional requirements.

1.05 QUALIFICATIONS

A. Refer to Section 27 00 00 for additional requirements.

1.06 PRE-CONSTRUCTION SUBMITTALS

A. Provide a comprehensive Communications submittal package; refer to 27 05 00 Communications General Requirements for detailed requirements. Do not provide a separate submittal for this section on its own.

1.07 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

1.08 CLOSEOUT SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

1.09 TEST DATA – FIBER OPTIC MEDIA

A. The test result information for each link shall be recorded in the memory of the field tester upon completion of the test.

B. The test result records saved by the tester shall be transferred into a Windows-based database utility that allows for the maintenance, inspection, and archiving of these test records. A guarantee shall be made that these results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test.

C. The database for the completed job shall be stored and delivered on USB flash drive. This USB flash drive shall include the software tools required to view, inspect, and print any selection of test reports.

D. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:

1. The identification of the link in accordance with the naming convention defined in the overall system documentation.
2. The overall Pass/Fail evaluation of the link-under-test including the Attenuation worst-case margin (margin is defined as the difference between the measured value and the test limit value as defined in this document).
3. The date and time the test results were saved in the memory of the tester.

E. The following general information is to be provided in the electronic database containing the test result information for each link:

1. The identification of the customer site as specified by the end user.
2. The overall Pass/Fail evaluation of the link-under-test.
3. The name of the standard selected to execute the stored test results.
4. The cable type and the value of the ‘index of refraction’ used for length calculations.
5. The date and time the test results were saved in the memory of the tester.
6. The brand name, model, and serial number of the tester.
7. The revision of the tester software and the revision of the test standards database in the tester.

F. The detailed test results data to be provided in the electronic database for each tested optical fiber shall contain the following information:

1. The identification of the link/fiber in accordance with the naming convention defined in the overall system documentation.

2. The insertion loss (attenuation) measured at each wavelength, the test limit calculated for the corresponding wavelength, and the margin (difference between the measured attenuation and the test limit value).

G. The link length shall be reported for each optical fiber for which the test limit was calculated.

H. Contractor shall provide accurate as-built Construction Drawings at the site during construction.

I. 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. 2004 and ".dxf") formats on which as-built construction information can be added. These documents will be modified accordingly by the Contractor to denote as-built information as defined above and returned to the Owner.

J. The Contractors shall annotate the base Drawings and return to the Consultant in hard copy (same plot size as originals) and electronic (AutoCAD rel. 2004 and ".dxf") form.

Part 2 - PRODUCTS

2.01 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

2.02 TIGHT-BUFFERED OPTICAL FIBER CABLES FOR INDOOR DISTRIBUTION APPLICATIONS

A. General Considerations

1. The cable shall meet the requirements of the National Electrical Code (NEC) Section 770.

2. For plenum applications, the cable shall meet applicable flame tests: ANSI/UL 910 (NFPA 262-1994).

3. Finished cables shall conform to the applicable performance requirements of Tables 8-6 and 8-7 of the Insulated Cable Consultants Association, Inc. (ICEA) *Standard for Fiber Optic Premises Distribution Cable* (ICEA S-83-596).

B. Cable Construction

1. The coated fiber shall have a layer of Teflon placed between the acrylate coating of the optical fiber and the thermoplastic buffer. The diameter of the thermoplastic buffer coating shall be 900 ±50µm. The fiber coating and buffer

shall be removable with commercially available stripping tools in a single pass for connectorization or splicing.

2. Cables with 2 to 24 fibers layered aramid yarns shall serve as the tensile strength member of the cable.
3. A ripcord shall be applied between the aramid yarns and the outer jacket to facilitate jacket removal.
4. The outer jacket shall be extruded over the aramid yarns for physical and environmental protection. The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness. The jacket shall be smooth, as is consistent with the best commercial practice.
5. The fibers shall be stranded around a dielectric central member.
6. For cables containing 12-24 fibers, the fibers shall be arranged in two layers.
7. The central member shall be over coated with a thermoplastic, when required, to achieve dimensional sizing to accommodate and support the 900 µm buffered fibers.
8. Cables with 24 to 60 fibers shall have unitized riser and plenum constructions.
9. The buffered fibers shall be grouped in six-fiber subunits.
10. The fibers shall be stranded around a dielectric central member in the subunit.
11. Layered aramid yarns shall serve as the tensile strength member of the subunit.
12. A ripcord may be applied between the aramid yarns and the subunit jacket to facilitate jacket removal.
13. The subunit jacket shall be extruded over the aramid yarns for physical and environmental protection. The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness. The jacket shall be smooth, as is consistent with the best commercial practice.
14. The subunits shall be stranded around a dielectric central member. A ripcord shall be inserted beneath the outer jacket to facilitate jacket removal. The outer jacket shall be extruded around the subunits. The strength members shall be of a high modulus aramid yarn. The aramid yarns shall be helically stranded around the buffered fibers. Non-toxic, non-irritant talc shall be applied to the yarns to allow them to be easily separated from the fibers and the subunit jacket.

C. Outer Cable Jacket

1. The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness; jackets extruded under high pressure are not acceptable. The jacket shall be smooth, as is consistent with the best commercial practice. The jacket shall provide the cable with a tough, flexible, protective coating, able to withstand stresses. The nominal thickness of the cable outer jacket shall be sufficient to provide adequate cable protection while meeting the mechanical, flammability, and environmental test requirements of this document over the life of the cable.

2. The indoor distribution cable specified herein shall have an interlocking armor made of steel or aluminum. Provide plenum rated cable as required.

3. The color of the jacket shall match the jacket color of the optical fiber cable located inside of the cable.

D. Fiber Identification

1. The individual fibers shall be color-coded for identification. The optical fiber color-coding shall be in accordance with ANSITIA/EIA-598-B “Optical Fiber Cable Color Coding.” The coloring material shall be stable over the temperature range of the cable, shall not be susceptible to migration, and shall not affect the transmission characteristics of the optical fibers. Color-coded buffered fibers shall not adhere to one another.

2. When buffered fibers are grouped into individual subunits, each subunit jacket shall be numbered for identification, with the exception of filler subunits where used. The number shall be repeated at regular intervals. The subunit jacket color shall be aqua for subunits containing OM3/4 multimode fibers, yellow for subunits containing singlemode fibers, and white for filler subunits.

3. The outer jacket for all dielectric cable shall be marked with the manufacturer name or UL file number, date of manufacture, fiber type, flame rating, listing symbol, and sequential length markings every two feet. The marking shall be in contrasting color to the cable jacket. The cable jacket color shall be Aqua for cables containing OM3/4 multimode fibers and yellow for cables containing singlemode fibers.

4. Cables shall be marked with the manufacturer name, date of manufacture, fiber type, flame rating, listing symbol, and sequential length markings every two feet. The marking shall be in contrasting color to the cable jacket. The cable jacket color shall match the color of the core optical fiber cable.

E. Cable Specifications

1. Temperature Range

a. Non-Plenum Applications: The storage temperature range for the cable on the original shipping reel shall be -40 to +70ºC. The installation/operating temperature range for riser cables shall be -20 to +70 ºC. Testing shall be in accordance with FOTP-3.

b. Plenum Applications: The storage temperature range for the cable on the original shipping reel shall be -40 to +70ºC.The installation/operating temperature range for plenum cables shall be 0 to +70ºC.Testing shall be in accordance with FOTP-3.

2. Compressive Load Resistance

a. When tested in accordance with FOTP-41, Compressive Loading Resistance of Fiber Optic Cables, the cable shall withstand a minimum compressive load of 89 N/cm (50 lbf/in) applied uniformly over the length of the compression plate. While under compressive load, the fiber shall not experience an attenuation change greater than 0.4 dB at 1550 nm (singlemode) or greater than 0.6 dB at 1300 nm (multimode). After the compressive load is removed,

the fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.4 dB at 1300 nm (multimode).

3. Cyclic Flexing

    a. When tested in accordance with FOTP-104, Fiber Optic Cable Cyclic Flexing Test, the cable shall withstand 25 mechanical flexing cycles at a rate of 30 ± 1 cycle per minute. The fiber shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.4 dB at 1300 nm (multimode).

4. High and Low Temperature Bend

    a. When tested in accordance with FOTP-37, Fiber Optic Cable Bend Test, Low and High Temperature, the cable shall withstand four full turns around a mandrel at test temperatures of 0 ºC and +50 ºC. The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.5 dB at 1300 nm (multimode).

5. Impact Resistance

    a. When tested in accordance with FOTP-25, Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies, the cable shall withstand a minimum of 20 impact cycles for riser cables and 10 impact cycles for plenum cables. The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.4 dB at 1300 nm (multimode).

6. Temperature Cycling

    a. When tested in accordance with FOTP-3, Procedure to Measure Temperature Cycling Effects on Optical Fiber, Optical Cable, and Other Passive Fiber Optic Components, the change in attenuation at extreme operational temperatures (0 to +50 ºC) shall not exceed 0.3 dB/km at 1550 nm (singlemode) or 0.6 dB/km at 1300 nm (multimode). The change in attenuation is measured with respect to the baseline values measured at room temperature before temperature cycling.

7. Twist-Bend

    a. When tested in accordance with FOTP-91, Fiber Optic Cable Twist-Bend Test, a length of cable no greater than 2 meters shall withstand 10 cycles of mechanical twisting and bending around a mandrel 20 times the cable outer diameter. The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or 0.4 dB at 1300 nm (multimode).

F. Singlemode OS2

1. The singlemode fiber utilized in the optical fiber cable shall meet EIA/TIA-492CAAA, Detail Specification for Class IVa Dispersion-Unshifted Singlemode Optical Fibers, and ITU recommendation G.652, Characteristics of Singlemode Optical Fiber Cable. The cable shall meet the following specifications:

    a. Core Diameter (Characterized): 8.3 µm

    b. Cladding Diameter: 125. ±1.0µm

    c. Core-to-Cladding Concentricity: ≤ 0.8 µm

d. Cladding Non-Circularity: ≤1.0 %

e. Coating Diameter: 245 ±10µm

2. Attenuation: The maximum attenuation shall be 0.5 dB/km at 1310 nm and 0.4 dB/km at 1550 nm.

3. Attenuation Uniformity: There shall be no point discontinuity greater than 0.10 dB at either 1310 nm or 1550 nm.

4. Attenuation at the Water Peak: The attenuation at 1383 ± 3 nm shall not exceed 2.1dB/km.

5. Cutoff Wavelength: The cabled fiber cutoff wavelength shall be ≤1260 nm.

6. IEEE 802.3z Performance: The fiber shall support laser-based Gigabit Ethernet (1GbE) operation in the 1000BASE-LX (1310 nm) operating window at 10000 m.

7. IEEE 802.3ae Performance: The fiber shall support laser-based Gigabit Ethernet (10GbE) operation in the 10000BASE-LX (1310 nm) operating window at 10000 m.

8. IEEE 802.3ba Performance: The fiber shall support laser-based Gigabit Ethernet (40/100GbE) operation in the 40000/100000BASE-LX (1310 nm) operating window at 10000 m.

9. Mode Field Diameter: The mode field diameter of the fiber shall be 9.30 ±0.50µm at 1310 nm 10.50 ±1.0µm at 1550 nm.

10. 12 Macrobend Attenuation: The attenuation due to 100 turns of fiber around a 75-± 2mm diameter mandrel shall not exceed 0.05 dB at 1310 nm and 0.10 dB at 1550 nm.

11. Zero Dispersion Wavelength (∂o): The zero dispersion wavelength of the fiber shall be 1301.5 nm ≤ ∂o ≤ 1321.5 nm.

12. Zero Dispersion Slope (So): The zero dispersion slope of the fiber shall be ≤0.092 ps/(nm•km).

13. Maximum Dispersion: The maximum dispersion shall be ≤ 3.2 ps/(nm•km) from 1285 nm through 1330 nm and shall be ≤18 ps/(nm•km) at 1550 nm.

G. The cable shall be manufactured by:

1. Belden

2. Berk-Tek

3. Corning

4. General Cable

5. Or approved equal.

2.03 LOOSE TUBE OPTICAL FIBER CABLES FOR OUTSIDE PLANT DISTRIBUTION APPLICATIONS

A. The cable shall be all-dielectric gel-free designed for outdoor and limited indoor use for campus backbones in lashed aerial and duct installations.

B. The cable shall be fully waterblocked using water-swellable materials.

C. The outer sheath shall be marked with the manufacturer's name, words identifying the cable type (e.g. "Optical Cable" or "Fiber Optic Cable"), year of manufacture, and sequential length markings. The actual length of the cable shall be within -0/+1% of the length markings. The marking shall be in a contrasting color to the cable jacket.

D. Temperature Range:

1. Storage: -40 to +70C (no irreversible change in attenuation)
2. Operating: -40 to +70C
3. Humidity Range: 0 to 100%

E. F. Maximum Tensile Strength:

1. During Installation: 2700 Newton (600 lb. force) (no irreversible change in attenuation)
2. Long Term: 890 N (200 lb. force)

F. G. Bending Radius:

1. During Installation: 20 times cable diameter
2. No Load: 10 times cable diameter

G. The maximum pulling tension shall be 2700 N (608 lbf) during installation (short term) and 890 N (200 lbf) long term installed.

H. The cable shall be manufactured by:

1. Belden
2. Corning
3. General Cable
4. Draka
5. Or approved equal

I. Single Mode Optical Fiber Performance

1. The single mode fiber shall be dispersion-unshifted, fiber which meets the ITU-T G.652c requirements.
2. The fiber cable shall be fully capable of handling existing and legacy singlemode applications which traditionally operate in the 1310nm and 1550nm regions.
3. The fiber cable shall be designed to handle applications that utilize the "Extended" E band, 1360-nm to 1460 nm.
4. The fiber cable shall also be designed to provide optimum performance from 1265nm to 1625nm making it suitable for 16-channel Course Wavelength Division Multiplexing applications.
5. The fiber shall meet the following specifications:

a. Fiber Type Single mode; doped silica core surrounded by a concentric glass cladding.

b. Core Diameter: 8-9 µm. All fibers shall be of the same nominal core diameter and profile.

c. Cladding Diameter: 125 + 0.7 micron

d. Core-to-Cladding Offset: < 0.5 micron

e. Cladding Non-Circularity: < 1.0%

f. Coating Diameter: 245 + 10 micron

g. The coating shall be mechanically strippable without damaging the optical fiber.

h. Cutoff Wavelength (cabled fiber; ccf)<1260-nm

i. Mode field diameter: 9.2+0.4 micron at 1300-nm; 10.4+0.5 micron at 1550 -nm

j. Zero Dispersion Wavelength: 1302< < 1322nm

k. Zero Dispersion Slope (S0): <0.092 ps/nm2*km

l. Fiber Attenuation:

   i. 1383-nm 0.4 dB/km

   ii. 1550-nm 0.3 dB/km

   iii. The average change in attenuation at extreme operational temperature (40 C to +70 C) shall not exceed 0.05 dB/km at 1550 nm. The magnitude of the maximum attenuation change of each individual fiber shall not be greater than 0.05 dB/km at 1550 nm.

m. Fiber Dispersion (maximum):

   i. 1285-1330-nm < 3.2-ps/nm*km

   ii. 1625-nm < 22-ps/nm*km

n. 14. No single mode optical fiber shall show a point discontinuity greater than 0.03 dB at the specified wavelengths. Such a discontinuity or any discontinuity showing a reflection at that point shall be cause for rejection of that fiber by the Owner.

2.04 OUTSIDE PLANT (OSP) CABLE AND PENETRATION SEALANT

A. The Contractor shall seal all OSP cable ends with an appropriate sealant.

B. Should not corrode copper and be appropriate for electronics.

C. Should have non-sag properties.

D. Utilize manufacturer recommended product to not void warranties.

E. Manufacturer:

1. Rainbow Technology B-Sealant 79500
2. Or manufacturer approved equivalent

2.05 FIBER OPTIC CONNECTORS

A. The SM optical connector shall be LC UPC type.

B. The OSP SM optical connector shall be LC UPC type.

C. The connector ferrule shall be ceramic or glass-in-ceramic. The optical fiber within the connector ferrule shall be secured with an adhesive.

D. The attenuation per mated pair shall not exceed 0.35 dB (individual) and 0.2 dB (average). Connectors shall sustain a minimum of 200 mating cycles per EIA/TIA-455-21 without violating specifications.

E. The connector shall meet the following performance criteria:

1. Cable Retention (FOTP-6) 0.2 dB
2. Durability (FOTP-21) 0.2 dB
3. Impact (FOTP-2) 0.2 dB
4. Thermal Shock (FOTP-3) 0.2 dB
5. Humidity (FOTP-5) 0.2 dB

F. Connectors shall be field terminated and polished or fusion spliced. Mechanical, quick connect or index-gel based connectors are not allowed.

Part 3 - EXECUTION

3.01 TESTING

A. Refer to Section 27 00 00 for additional requirements.

B. Field Test Requirements for Fiber Optic Cabling System

1. The fibers utilized in the installed cable shall be traceable to the manufacturer. Upon request by the Owner, the Contractor shall provide cable manufacturer's test report for each reel of cable provided. These test reports shall include the manufacturers on reel attenuation test results at 850-nm and 1300-nm for each optical fiber of each reel prior to shipment from the manufacturer.
2. Factory data shall be provided upon request, showing on-the-reel bandwidth performance results as tested at the factory.
3. Every fiber optic backbone link in the installation shall be tested in accordance with the field test specifications defined by the Telecommunications Industry Association (TIA) standard ANSI/TIA/EIA-568-C or by the appropriate network application standard(s), whichever is more demanding.
4. The test shall include the representative connector performance at the connecting hardware associated with the mating of patch cords. The test does

not, however, include the performance of the connector at the interface with the test equipment.

5. 100% of the installed cabling links shall be tested and shall pass the requirements of the standards mentioned above and as further detailed in this document. Any failing link shall be diagnosed and corrected at no additional cost to the Owner. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with RFP.
6. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:
    a. The manufacturer of the fiber optic cable and/or the fiber optic connectors
    b. The manufacturer of the test equipment used for the field certification
    c. Training organizations authorized by BICSI
7. Field test instruments for multimode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-14-A. The light source shall meet the launch requirements of ANSI/EIA/TIA-455-50B, Method A. This launch condition can be achieved either within the field test equipment or by use of an external mandrel wrap (as described in clause 11 of ANSI/TIA/EIA-568-C.1) with a Category 1 light source.
8. Field test instruments for singlemode fiber cabling shall meet the requirements of ANSI/EIA/TIA-526-7.
9. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
10. The fiber optic launch cables and adapters shall be of high quality and the cables shall not show excessive wear resulting from repetitive coiling and storing of the tester interface adapters.
11. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests.
12. Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter.
13. A representative of the Owner shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase five business days before testing begins.
14. A representative of the Owner will select a random sample of 5% of the installed links. The results obtained shall be compared to the data provided by the installation Contractor. If more than 2% of the sample results differ in terms of the Pass/Fail determination, the installation Contractor, under supervision of the Owner representative, shall repeat 100% of the testing. The cost of retesting shall be borne by the installation Contractor.

C. Fiber Performance Test Parameters

1. The link attenuation shall be calculated by the following formulas specified in ANSI/TIA/EIA standard 568-B.

    a. Link Attenuation = Cable_Attn + Connector_Attn + Splice_Attn

    b. Cable_Attn (dB) = Attenuation_Coefficient (dB/km) * Length (Km)

    c. The values for the Attenuation_Coefficient are listed in the table below:

Type of Optical Fiber	Wavelength (nm)	Attenuation_Coefficient (dB/km)
Singlemode (Inside plant)	1310	0.5
	1550	0.4
Singlemode (Outside plant)	1310	0.4
	1550	0.5

    d. Connector_Attn (dB) = number_of_connector_pairs * connector_loss (dB)

    e. Maximum allowable mated connectors_loss = 0.50 dB

    f. Splice_Attn (dB) = number of splices (S) * splice_loss (dB)

    g. Maximum allowable splice_loss = 0.1 dB (when tested bidirectionally)

2. Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices—i.e., it does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.

3. Test equipment that measures the link length and automatically calculates the link loss based on the above formulas is preferred.

4. The above link test limits attenuation are based on the use of the One Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method B and ANSI/TIA/EIA-526-7, Method A.1. The user shall follow the procedures established by these standards or application notes to accurately conduct performance testing.

5. The backbone link (multimode/singlemode) shall be tested in two directions at both operating wavelengths to account for attenuation deltas associated with wavelength.

6. Because backbone length and the potential number of splices vary depending upon site conditions, the link attenuation equation shall be used to determine limit (acceptance) values.

7. Singlemode backbone links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1. All singlemode links shall be certified with test tools using laser light sources at 1310 nm and 1550 nm.

3.02 TRAINING

A. Refer to Section 27 00 00 for additional requirements.

3.03 WARRANTY

A. Refer to Section 27 00 00 for additional requirements.

3.04 CABLE SLACK

A. Cable slack shall be provided in each backbone fiber optic cable. This slack is exclusive of the length of fiber that is required to accommodate termination requirements and is intended to provide for cable repair and/or equipment relocation. The cable slack shall be stored in a fashion as to protect it from damage and be secured in the termination enclosure or a separate enclosure designed for this purpose. Multiple cables may share a common enclosure.

B. A minimum of 15 feet of slack cable (each cable) shall be coiled and secured at each end.

C. A minimum of 50 feet of slack cable (each cable) shall be coiled and secured vertically in handholes/manholes used for installation assistance unless otherwise noted in the drawings.

D. A minimum of 100 feet of slack cable shall be provided whenever fiber splice enclosures are required unless otherwise noted in the drawings. This excess slack shall provide added cable for restorations or reconfigurations without digging up large parts of the cable system.

3.05 INSTALLATION PRACTICES FOR FIBER OPTIC CABLE

A. Fiber optic cable is a high-capacity transmission medium with qualities and characteristics, which can be degraded when it is subjected to excessive pulling tension, sharp bends, and crushing forces.

B. The maximum pulling tension for armored cable is 2,700 Newtons (600 lbs.).

C. Maximum long-term crush forces for armored cable are 100N/cm (57.1 lb./in.).

D. The minimum bend radius for an armored cable during installation and following installation over the life span of the cable must be 20 times (20 x) the cable diameter.

E. The minimum diameter required for pull wheels or rollers should be double the minimum bend radius. The Contractor will be responsible to check manufacturer's specifications for the cable feed-chute, to make sure that the chute's critical dimensions and clearances are compatible with the placing cable. The chute must have a 31-inch minimum radius.

3.06 CABLE TERMINATION FOR FIBER OPTIC CABLE

A. All fibers shall be terminated using the specified connector type. No mechanical splice is allowed.

B. All terminated fibers at the Telecommunications Closets shall be mated to couplings mounted on patch panels. Couplings shall be mounted on a panel that, in turn, snaps into the housing assembly. Any unused panel positions shall be fitted with a blank panel inhibiting access to the fiber optic cable from the front of the housing.

C. All couplings shall be fitted with a dust cap.

D. Fibers from multiple locations may share a common enclosure; however, they must be segregated on the connector panels and clearly identified. Fibers from multiple

destinations may be secured in a common enclosure provided that they are clearly identified as such. Fibers from different locations shall not share a common connector panel (e.g. “insert”).

E. Slack of 15 feet in each fiber cable shall be provided as to allow for future re termination in the event of connector or fiber end-face damage. Adequate slack shall be retained to allow termination at a 30” high workbench positioned adjacent to the termination enclosure(s). A minimum of 1-meter (~39”) of slack shall be retained regardless of panel position relative to the potential work area.

3.07 FIBER OPTIC SYSTEM ACCEPTANCE

A. The fiber optic outside plant system will be accepted by the Owner when:

1. All the work has been completed in accordance with the contract and specifications.
2. The system operates in conformance with manufacturer’s published specifications.
3. The system has completed a successful performance period. The performance period will begin on the day following the cutover and must continue for 30 consecutive days during which time the system will operate at an average effectiveness level of 99 percent or more. If for any reason this level cannot be maintained, a new 30-day performance period will be initiated. It is not necessary that one 30-day period expire before another performance period begins.
4. The Contractor has certified in writing to Consultant when the cable is installed, operational in accordance with these specifications, and ready for use.
5. The final step in accepting buried cable installation will be a thorough inspection of the entire route from start to finish. The “as-built” drawings must be submitted to the Owner one week prior to final inspection. The drawings will be examined by Consultant’s personnel and involved parties for conformance to Consultant’s plans, codes, regulations, and general accuracy.
6. The construction area above ground will be inspected to ensure the following:
7. Restoration has been accomplished.
8. Permanent markers have been installed immediately beside the cables.
9. Road bores, if used, are properly completed and will not collapse a portion of the road.
10. Debris and trash have been removed from the site.
11. Other instructions specific to the installation have been completed to the project manager’s specifications.
12. All test results should be submitted in hard copy and in usable (MS Word) electronic format and meet specifications.
13. At this time, upon Owner’s written acceptance, operations control becomes the responsibility of the Owner.

End of Section

SECTION 27 1323
INTERBUILDING OSP PATHWAYS

Part 1 - GENERAL

1.01 SCOPE

A. Refer to Section 27 00 00 for additional project information.

F. This section describes the products and execution requirements relating to outside plant inter-building backbone cabling, termination and splicing components, pathways, underground enclosures and related subsystems. Covered systems include the following:

1. Equipment room cable management system and equipment racks
2. Horizontal and backbone cable terminating equipment
3. Telecommunications grounds and related components

1.02 RELATED WORK

A. Section 27 00 00 – General Technology Requirements

B. Section 27 05 00 – Communications General Requirements

C. Section 27 05 26 – Grounding and Bonding for Technology Systems

D. Section 27 11 00 – Communications Equipment Rooms

E. Section 27 13 00 – Communications Backbone Cabling

1.03 DEFINITIONS

A. OSP – Outside Plant.

1.04 REFERENCE STANDARDS AND CODES

A. Refer to Section 27 00 00 for additional requirements.

1.05 QUALIFICATIONS

A. Contractor and/or its subcontractors shall be fully authorized/certified to supply, upgrade, install, configure, provide warranty service, and troubleshoot the proposed equipment.

B. Refer to Section 27 00 00 for additional requirements.

1.06 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

1.07 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

1.08 CLOSEOUT SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

1.09 CLOSE OUT CHECKLIST

A. The following checklist shall be confirmed prior to close out approval:

1. All the work has been completed in accordance with the contract and specifications.
2. The system operates in conformance with specifications.
3. The system has completed a successful performance period of 30 days.
4. As-built drawings with GPS coordinates have been submitted.
5. Thorough inspection of the entire route from start to finish has been completed.
6. Restoration has been accomplished.
7. Permanent markers have been installed immediately beside the cables.
8. Debris and trash have been removed from the sites.
9. All test results have been submitted and reviewed.
10. All punch list items have been addressed.

Part 2 - PRODUCTS

2.01 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

2.02 HIGH-DENSITY POLYETHYLENE (HDPE) DUCT

A. All underground segments of cable shall be installed in HDPE duct.

B. The duct shall be High-Density Polyethylene (HDPE) and rated at SDR11. This duct shall be manufactured to ASTM D2447, ASTM D3350 AND NEMA TC7 Specifications. The duct size and quantity shall be as detailed on project drawings.

C. The duct shall be listed per UL 651-B (Continuous length coiled HDPE conduit).

D. The duct shall meet NEC 347 and 710 requirements for installation of nonmetallic conduit direct buried or concrete encased.

E. An AWG #14 trace wire shall be installed in each duct.

F. The Duct walls shall be pre-lubricated with silicone to reduce the frictional forces applied during cable installation.

G. The duct shall contain a measured pull tape. The pull tape shall be a minimum of 1200lbs in tensile strength.

H. The duct shall be supplied with certified test reports.

I. The Duct shall be Arnco, Carlon Dura-Line or other approved products, which meet these specifications.

2.03 DUCT PLUG SYSTEMS

A. Reusable Inflatable Duct Plugs

1. Commscope TDUX
2. Maxcell Wolf Termination Bags
3. TE Connectivity Raychem Rayflate
4. Or approved equal

B. Mechanical Duct Plugs

1. Metraflex MetraSeal
2. Or approved equal

2.04 DUCT SEAL PUTTY

A. The Contractor shall seal all OSP conduits/ducts at all ends to make a water tight seal.

B. The Contractor shall also seal all gaps around the conduits/ducts including wall sleeves.

C. Should not adversely affect other plastic materials or corrode metal.

D. Should contain UV Stabilizers

E. Shall be designed for the specific application.

F. Manufacturer:

1. Rainbow Technology Duct Seal Putty 79511/79526
2. Or approved equivalent

Part 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which the new exterior telecommunication pathways are to be installed.

B. Verify field measurement and pathway routing conditions.

C. Beginning of exterior telecommunication pathway installation indicates Contractor acceptance of existing conditions.

3.02 DIRECTIONAL BORING OPERATIONS

A. All directional boring operations are subject to the following conditions:

1. The machine operator shall follow all current OSHA regulations, including the use of grounding mats and other safety measures.
2. The machine operator shall have control over the direction of the boring tool.
3. The bore crew must have, in their possession, a copy of the permit authorizing the company to perform work, and a copy of the approved drawing and specifications for the bore work location.
4. When possible, the Contractor shall mark the proposed running line and bore head location. Mark the proposed running line every 5’ to 10’, using a longitudinal line; mark the actual location with a white paint spot at the end of each stem push. Only white paint is approved for this use.
5. The bore is not allowed to deviate more than six (6) inches from the proposed marked running line, and the ends of the bore must be at the designated depth.
6. Slurry use shall be kept at a minimum and only used for head lubrication and/or spoils return. The Contractor shall calculate anticipated slurry use and monitor slurry use during the bore operation to determine slurry loss into the surrounding soil.
7. Slurry must be contained during the bore operation and must be removed prior to backfilling, with dry dirt.
8. During pull back, the mandrels shall be not more than two inches larger than the diameter of the duct or casing.
9. Shallow bores or other unsuccessful bores shall be abandoned and filled.
10. The bore operation shall be stopped if any damage occurs to a road surface and it shall remain inactive until corrective measures are taken. The Contractor is liable for any damage done to the right-of-way or structures.
11. Auger heads are not allowed more than six inches ahead of the casing being inserted.
12. Bore stems and cutting heads may have to be left in the ground if they cannot be retrieved through the bore hole. Open excavation to retrieve the parts is not allowed.
13. When boring near creeks and streams, silt fences shall be properly installed to prevent disturbed soil from flowing into the waterways and remain in place after the bore has been completed.
14. Bores shall not be located beneath trees without specific permission in writing from the design team.

3.03 EXCAVATION AND TRENCHING REQUIREMENTS

A. Make trench sides as nearly vertical (max depth is 48") as practical except where sloping of sides is allowed.

B. Remove all rock, boulders, hard material, unstable material, and yielding and unsatisfactory materials within the limits indicated for trench excavation and dispose of off the site. Notify the Owner's Representative immediately in writing if it becomes necessary to remove such materials beyond the trench limits. Where excavations are deeper or wider than the trench limits in order to remove unsuitable materials, they shall be refilled with approved borrowed material.

C. Existing concrete or granite curb encountered in excavation shall be temporarily supported or replaced in kind. Bituminous lip curb shall be disposed and replaced in kind.

D. Excavation operations adjacent to and below existing structures and utilities shall be done manually. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Owner's Representative. Report damage to utility lines or subsurface construction immediately to the Consultant.

E. Use appropriate traffic control as specified in the associated permits that the Contractor is to obtain.

F. Keep excavated materials and construction equipment and materials a safe distance back from the edge of excavations to avoid overloading the sides of the trench and to prevent slides or cave-ins.

G. Grade areas around trench as necessary to prevent surface water from flowing into excavations.

H. Walkway and grassed areas left backfilled at the end of the workday shall be enclosed with snow fence until restored to grade. Roadway trenches shall not be re-opened to traffic unless either a road plate capable of sustaining HS-20 loading is in place or temporary gravel is placed to bring the trench area to finish grade.

I. Keep excavated materials out of the gutter lies and other surface water runoff paths.

J. Sweep tracked sediment or soils off streets daily.

3.04 CUTTING PAVEMENT

A. Where trench excavation occurs in paved areas, saw cut existing pavement to obtain sound, vertical edges one foot wider than the indicated trench width on each side of the trench. When the saw cut is within two feet of an existing joint or curb, remove pavement to the existing joint or curb or as required by the Owner, etc.

B. Existing pavements and base course beyond the indicated lines for trench excavation which have been disturbed, damaged or undermined shall be restored or replaced by the Contractor to match existing pavements and base course or as requested by the Owner, etc.

3.05 BACK FILLING

A. Construct backfill in two operations (initial and final) as indicated and specified in this section. Initial backfill shall be select backfill material placed in 6-inch maximum loose

lifts to one foot above conduit or duct unless otherwise specified. Bring up evenly on each side and along the full length of the conduit or duct structure. Ensure that no damage is done to the conduit or duct structure, or its protective coating or as required by the Owner, etc.

B. Place the remainder of the backfill (final backfill) in 6-inch maximum loose lifts to the bottom of the sub-grade, unless otherwise specified. Compact each loose lift before placing the next lift. Do not backfill where the material in the trench is muddy, except as authorized or as required by the Owner, etc.

C. Provide a minimum cover from final grade of 42 inches for fiber ducts unless otherwise indicated on the Drawings or as required by the Owner, etc.

D. Where settlement occurs in trenches and pits due to improper compaction, excavate to the depth necessary to rectify the problem, then backfill and compact the excavation as specified herein and restore the surface to the required elevation or as required by the Owner, etc.

E. The Contractor shall coordinate back filling with testing of utilities. Testing for the following shall be complete before final back filling: water distribution, sanitary sewer, steam compressed air, fuel oil, and refrigeration systems.

3.06 COMPACTION

A. Use hand-operated, plate-type, vibratory or other suitable hand tampers in areas not accessible to larger rollers or compactors. Avoid damaging pipes and protective pipe coatings. Compact material in accordance with local code unless otherwise specified. If necessary, alter, change, or modify selected equipment or compaction methods to meet compaction requirement and meet requirements of the Owner, etc.

3.07 PROTECTION OF EXISTING UTILITIES, STRUCTURES AND NEW WORK

A. Excavation, backfill and compaction operations shall be done in such a manner to prevent cave-ins of excavations or the undermining, damage or disturbing of existing utilities and structures or of new work. Backfill shall be placed and compacted to prevent future settlement or damage to existing utilities and structures and new work and meet requirements of the Owner, etc.

B. Any damage due to excavation, back filling or settlement of the backfill, or injury to persons or damage to property occurring as a result of such damage shall be the responsibility of the Contractor. All costs to repair such damage, in a manner satisfactory to the Owner’s Representative, shall be borne by the Contractor at no additional expense to the Owner and meet requirements of the Owner, etc.

C. Protect newly back filled areas and adjacent structures, slopes, or grades from traffic, erosion settlement, or any other damage. Repair and re-establish damaged or eroded grades and slopes and restore surface construction prior to acceptance. Protect existing storm drain inlets from water-borne soil and meet requirements of the Owner, etc.

3.08 RESTORATION

A. The Contractor is responsible for repairs to any streets, sidewalks, grass areas, etc., which must be trenched or otherwise disturbed in the process of installation. In areas

owned by the Owner, the cities have final determination whether such repairs are acceptable.

B. In areas owned by Owner, the Owner has final determination whether such repairs are acceptable.

C. All sidewalks, streets, alleyways and landscaping shall be replaced to its original condition or better.

D. All existing conditions shall be videotaped prior to construction activities to provide information of pre-existing conditions.

E. Grassed Areas:

1. After completion and acceptance of all conduit, excavation, and backfilling work in a given area, the Contractor shall seed to cover all disturbed areas. The Contractor may choose to cut and remove turf prior to the area being disturbed. This would be used to place back over the disturbed area and meet requirements of the Owner, etc. The Contractor shall water all restored grass areas for a duration of 30 days as a minimum and return in the spring the following year as required to patch areas.

F. Sidewalks:

1. All sidewalks shall be constructed using the same backfill and compaction procedures used for street opening.

2. Unless unusual conditions exist, sidewalk panels, which are cut into for construction, shall be replaced with full panels. New or prior construction saw cuts are not considered as panel ends. Sidewalk panels end at score lines, curbs, boulevards or property lines. If curb is part of the sidewalk panel, the curb shall also be replaced.

3. The Contractor shall take care in removing sidewalk panels. If adjacent panels are chipped, the Contractor will be required to replace them.

4. Any pedestrian ramp removed shall be replaced to the current Cities, County and ADA standards. Please note that this may involve removal and replacement of additional curb and gutter and/or sidewalk panels that were disturbed by the fiber optic installment. The Contractor shall ensure compliance with current regulations. Newly installed pedestrian ramps that do not meet current ADA standards will need to be removed and replaced at the Contractor’s expense.

G. Road Restoration:

1. The Contractor shall properly replace or cause to be replaced all pavement cut into and disturbed by the Contractor in compliance with local Municipal Codes, and in the manner and following the specifications required by the Cities and County Engineers.

2. The Contractor shall comply with the Cities and County Codes and standards.

3. In the event of the Contractor’s failure to do so, the Cities or County may replace such pavement or employ another contractor to do so, at the expense of the Contractor, such expense to be deducted from the final payment.

4. In addition, the Cities and County may take such civil action as provided by law, including, but not limited to, imposition of penalties or other relief as provided for herein.

3.09 WORK WITHIN BUILDINGS

A. If cable taken into a building is not in a metal conduit, it shall be terminated within fifty feet (50') of the point of entry into the structure. If the termination point (telecommunications room) is located further than 50' from the point of entry into the structure, rigid metallic conduit shall be installed from the building penetration point all the way to a telecommunication room.

B. Any cable that shall be properly sealed and tested at building entrance.

C. At each building entrance, a maintenance loop of fiber 4 feet in diameter and 10 to 15 feet in length must be installed.

3.10 CUTTING AND PATCHING

A. Where it is necessary to do any cutting and patching, no cutting of beading walls, beams, etc. shall be done without the approval of the Owner's Representative. All patching, finishing, etc. shall match the surroundings. All cutting and patching shall be done by workmen skilled in the trades.

B. Holes through concrete and masonry in new and existing structures shall be cut with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills shall not be allowed, except where permitted as required by limited working space.

C. Holes shall be located so as not to affect structural sections such as beams.

D. Holes shall be laid out in advance. The Owner's Representative shall be advised, prior to drilling through structural sections, for determination of proper layout.

E. Floor, exterior wall, and roof seals shall be watertight. Walls and floors that are cored for installation of conduit shall be sleeved with steel tubing, grouted, and the space between the conduit and sleeve filled as specified herein.

F. Conduits shall extend four-inch minimum above finished floor.

3.11 GROUNDING AND BONDING

A. Use a sheath grounding unit to ground the outer shield and armor of the fiber-optic cables at the buildings entrances to a building existing ground infrastructure.

B. All metallic cable elements at splice points and building entrance must be bonded and grounded to the building metal structure.

C. Copper wire AWG #6 should be used as a minimum.

D. Clean each grounding component with 300-grit emery cloth before bonding and apply a mineral-oil-based oxide inhibitor to the bond area.

E. Install sheath grounding units for all fiber-optic cable ground locations in splice handholes/manholes. In the fiber-optic splice handhole/manhole, only one sheath

grounding unit is needed between the splice enclosure and the ground rod. Sheath-grounding unit shall be used on each fiber-optic cable entering/exiting the splice enclosure. Each fiber optic cable sheath shall be connected to a test station. The sheath grounding unit shall:

1. Connect to the cable armor.
2. Be designed for below grade use and have a No. 6 AWG stranded copper lead wires.

F. The Contractor shall apply an oxide inhibitor over bonded connections to ground rods. The oxide inhibitor shall provide an airtight seal around the conductor and ground rod.

G. The Contractor shall bond the ground conductor to the ground rod by one of three methods: compression bond, exothermic welding, or irreversible compression bond.

H. The Contractor shall achieve an irreversible compression bond by:

1. Using a hydraulic press with a connector die.
2. Using a solid copper connector with a run for a 0.625-inch ground rod and a tap for the specified ground conductor.
3. Using connectors that can accommodate a conductor range from No. 6 solid copper through 500 Kcmil.
4. Using connectors that are pre-filled with an antioxidant compound and are strip sealed.

I. All metallic cable elements at splice points and building entrance must be bonded and grounded to the building metal structure.

J. Copper wire AWG #6 should be used as a minimum.

3.12 SUPPORT AND ANCHORS

A. The Contractor shall exercise judgment when supporting equipment. If support methods are questionable or not available, the Contractor shall call it to the attention of the Engineer prior to installation.

B. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors, beam clamps, spring steel clips.

C. Install hangers and supports, sleeves and fasteners in accordance with approved printed manufacturers' installation procedures, and as specified.

D. Coordinate all affected trades and all aspects of the electrical work, including installation of raceways and wiring as necessary to interface installation of supporting devices with other work.

E. Install hangers and supports, and attachments to properly support raceways, equipment and accessories from building structure.

3.13 DUCT INSTALLATION

A. The duct shall be joined at the "tie-in" locations using metal couplers designed to thread the two ends of PVC conduits together. These couplers shall provide a pull-proof connection of the duct.

B. The depth at which buried duct shall be placed will vary with local conditions. PVC duct should be buried a minimum depth of:

	Location	Depth
1.	Minimum cover in soil	42 in.
2.	Minimum cover under draining ditches	42 in.
3.	Minimum cover under railroads	140 in. below top of rail
4.	Minimum cover at roadway crossing	60 in.
5.	Minimum cover in rock	36 in.

C. When crossing unimproved roads, streets and alleys that may later be paved or hard surfaced, the cable should be placed at a depth that retains sufficient cover following permanent grading of the road. The Contractor shall coordinate with Owner the depth of each street crossing.

D. When crossing rail road tracks, PVC conduits shall be placed into 6” steel casing.

E. During construction, the end of the ducts shall be plugged to prevent water washing mud into the duct.

F. The Contractor shall seal watertight ends of all ducts at each handhole/manhole.

G. The Contractor shall seal openings around ducts that pass through handhole/manhole walls with a silicone sealer for a waterproof seal.

H. The Contractor shall proof all conduit sections prior to installation of the fiber cable to ensure conduit integrity. After proofing of the duct, measurements will be taken to verify the length of the installed conduit.

I. The Contractor shall leave a pull tape in the conduit with the cable after installation.

J. The Contractor shall leave a pull rope in all empty conduits after installation.

K. Install a trace wire in all empty conduits consisting of one #12 steel or copper wire.

3.14 INNERDUCT INSTALLATION

A. Contractor shall install according to manufacturer’s installation recommendations.

1. Contractor shall use a ball-bearing swivel to prevent twisting of fabric innerduct.
2. Fabric innerduct for future use shall be neatly folded and secured to a nearby wall.

3.15 BURIED WARNING TAPE

A. When trenching is involved or required by certain conditions (i.e., customer or citizen request, topographical reasons or as directed by the State or City forces), the use of warning tape is required. A bright orange (preferably "ULCC" orange) warning tape with a minimum width of three inches shall be buried approximately one foot below the existing grade. As a minimum, the tape should be marked "WARNING-OPTICAL CABLE." The tape shall be placed directly above the conduit to alert any excavator of the presence of an underground facility.

3.16 INSPECTION AND CLEANING OF EXISTING CONDUITS

A. The following provisions shall apply to Existing Conduit Systems:

1. When installing fiber optic cable in existing conduits through existing manholes, the Contractor shall visually check the cable route to ensure that there is a smooth transition between exit and entrance elevations and that the horizontal and vertical angle is not so sharp as to cause damage to the cable as it is being pulled through the existing conduit. Should the Contractor encounter sharp bends in existing conduit, the Contractor shall bring the situation to the Consultants's attention. Reinstalling existing conduit through a hand hole to provide smooth transitions is a potential solution.

B. Clean the existing conduit of any debris that could impede pulling fiber optic cable through it or that could damage the cable if the debris remained.

C. Inspection and Cleaning Existing Conduit Systems includes but shall not be limited to inspecting the cable route, notifying the Engineer of sharp bends, cleaning, and all materials and labor necessary to Inspect and Clean Existing Conduit Systems. Inspection and cleaning of existing conduit systems shall be considered incidental for which no direct compensation will be made.

3.17 TEST AND ACCEPTANCE CRITERIA

A. Testing

1. The Contractor will be provided with cable manufacturer's test report for each reel of cable provided. These test reports will include (1) manufacturer's on-reel OTDR and attenuation test results for each optical fiber of each reel prior to shipment from the manufacture and (2) on-the-reel bandwidth performance as tested at the factory.

2. The Contractor will perform on-reel OTDR tests for each fiber strands of each provided reel prior to taking the reels from the yard. The OTDR test shall be in one direction at 1550 nm.

3. The Contractor is responsible for supplying all equipment and personnel necessary to conduct the acceptance tests.

4. Upon completion of the fiber optic cable installation, the Contractor shall conduct acceptance testing according to a schedule coordinated with the Consultant. Consultant may be in attendance to witness the test procedures. The Contractor shall offer adequate advance notice to the Consultant as to allow for such participation.

5. The Contractor shall utilize a manufacturer-recommended “OTDR Trace Analysis” and a “Power Meter Report” software program or a single software program that is a combination of “ODTR Trace Analysis” and “Power Meter Report.”. The Contractor shall identify the software to the Owner as part of the Project Documentation Submittal. If the Owner does not already own a copy of the proposed software, the Contractor shall provide the Owner with a licensed copy.

B. Tests After Installation

1. Upon completion of cable installation and termination, the Fiber Optic cabling shall be tested to include:
2. Optical Attenuation (“Insertion Loss” Method)
3. Verification of Link Integrity (OTDR)
4. Optical return loss (ORL)

C. Optical Attenuation Testing

1. Optical Attenuation shall be measured on all terminated optical fibers in both directions of transmission using the “Insertion Loss” method. Measurement shall be inclusive of the optical connectors and couplings installed at the system endpoints. Access jumpers shall be used at both the transmit and receive ends to ensure that an accurate measurement of connector losses is made.
2. Multi-mode fibers shall be tested in accordance with the TIA/EIA 526 14A, Method B at 850□30 nm and 1310□ nm. Single mode fibers shall be tested in accordance with the TIA/EIA 526-7-1998. Method A.1. Testing shall be at 1300□20 nm and 1500□10 nm.
3. Attenuation of optical fibers shall not exceed the values calculated as follows:
4. Attenuation (max.) = 2*C+L*F+S dB
5. Where C is the maximum allowable Mated Connector Loss 0.35 dB, L is the length of the run (in kilometers) and F is the maximum allowable fiber loss (in dB/km). S is the total splice loss □0.1 dB (# of splices * max. attenuation per splice).
6. Documentation of the insertion loss testing for each fiber run shall be provided to the Owner to include a record of:
7. Wavelength
8. Fiber type
9. Fiber and cable number
10. Measurement direction
11. Test equipment model and serial number
12. Operator
13. Test documentation must be stored in a floppy disk and printed as a hard copy with all test results labeled.

14. All testing is to be done through connectors.

15. Any fiber that fails testing must have appropriate corrective action taken to rectify the situation.

D. Optical Time Domain Reflectometer (OTDR) Testing

1. The OTDR shall comply with the latest revision for the Bellcore/Telcordia Document GR-196-CORE “Generic Requirements for OTDR-Type Equipment” and SR-4731 “OTDR Data Format.” In addition, the OTDR performance requirements shall comply with the following:

2. The event dead zone shall be less than or equal to three meters.

3. The attenuation dead zone is less than or equal to 5 meters.

4. Has a dynamic range of 25 dB or greater.

5. Each fiber shall be tested after splices are sealed in the Outdoor Fiber Splice Enclosure. Should any fiber fail ODTR or power meter test, re-splice that fiber and retest all fibers disturbed in the splice enclosure.

6. All links shall be tested bi-directionally with an OTDR that are 330 feet (100 m) or longer. (Contractor shall supply the OTDR meter – see below.) Single mode fibers shall be tested at 1310/1550-nm (nominal).

7. The Contractor shall provide a flowchart for each tested fiber cable. The flowchart shall illustrate location of launch and end of a fiber link, interconnect points, and splice points. The flowchart shall be used to distinguish a splice from a micro/macrobend.

8. Launch cables of adequate length (1000’ minimum) shall be used to allow viewing of the entire length of the cable, including the connectors at the launch and receive end.

9. OTDRs used as part of these testing specifications shall be calibrated to sheath (jacket) length, not optical length by adjusting the unit's index of refraction.

10. All OTDR traces shall maximize both the vertical and horizontal scales to the greatest extent possible and still fit the entire cable link trace on the screen with optimum resolution.

11. All OTDR tests shall be averaged for a minimum of two (2) minutes.

12. Failure of a link at any part of the testing shall result in the contractor having to repair the problem and retest the installation. Cost for any required repairs and re testing shall be borne solely by the Contractor.

13. Reflective and non-reflective events shall be marked by OTDR, and the data for each event must be retrievable.

14. In an event where two non-reflected event anomalies (“gainer” and “exaggerated loss”) are detected by OTDR in any given splice point, the bidirectional average of each splice must be calculated by the Contractor to get the actual value for each splice.

15. OTDR traces revealing a point discontinuity greater 0.1-dB (average, when tested by-directionally) in a single mode fiber at any of the tested wavelengths or

any discontinuity showing a reflection at that point shall be a valid basis for rejection of that fiber by the Owner.

16. Where applicable, test each fusion splice in the forward and backward directions. Each reading (not an average) shall be recorded. All events shall be recorded.
17. OTDR traces revealing a “Ghost” shall also be a valid basis for rejection of that fiber by the Owner.
18. The installation of that cable shall be reviewed in an effort to solve any problems that may be causing the fault. If such efforts do not remove the fault, that cable and the associated terminations shall be replaced at the expense of the Contractor.
19. All fiber shall be tested for attenuation loss using an OTDR set to 2 Point loss measurement parameters. Marker points shall be placed at the beginning and end of each backscatter signature recorded by the OTDR. The manufacturer’s instructional guide can be used to determine proper placement of these markers.
20. Links that contain splice points or interconnect points shall also contain an additional "Events Display Table" to accompany the OTDR trace. This display shall show the distance to the events, distance between multiple events, each events loss in dB, and a description of the event (reflective event, non-reflective event, gains and cable end). All attenuation event loss readings shall be in the LSA (Least Square Average) mode of the OTDR. 2-Point attenuation measurements at events are not acceptable.
21. Proper pulse width selection is required to minimize attenuation dead zone effect.
22. Fiber links that are shorter than 6000 feet require pulse width to set to 10ns. That is equal to MM dead zone=23 feet (7 m), SM dead zone = 33 feet (10 m).
23. The OTDR display shall be recorded on USB Flash Media with identification and numbering, sequences to be pre-approved by the Engineer. Each trace must contain as a minimum:
24. Cable/sheath length (not optical fiber length)
25. 2-point dB loss, attenuation in dB/mile (dB/km)
26. Fiber type
27. Wavelength used
28. Pulse width selection
29. And fiber/cable identification
30. The stored fiber trace shall allow full manipulation of the trace when viewed with the PC emulation software. Both a hard copy printout and soft copy of each trace shall be submitted to the consultant for approval.
31. The Contractor shall provide the Owner with a licensed copy of OTDR trace viewing software one week prior to OTDR tests starts.
32. Documentation of the OTDR signature traces displaying the entire length of the cable run shall be provided to the Owner to include a record of:
33. Wavelength

34. Fiber type
35. Fiber and cable number
36. Measurement direction
37. Test equipment model and serial number
38. Operator

E. ORL Testing

1. All connectors at single mode fiber links shall be tested for optical return loss (ORL) using OTDR. The OTDR shall be capable to measure connector spike with respect to the backscatter signal on the OTDR. This technique shall be accomplished by software embedded in the instrument.
2. The launch cords must be kept clean and periodically repolished to ensure as perfect a surface finish as possible to match polishing on the connectors.
3. The single-mode connector's optical return loss shall be not less than 60 dB for APC connectors.
4. Test documentation must be stored on a USB Flash Media and printed as a hard copy with all test results labeled.
5. The Contractor shall provide the Owner with a licensed copy of OTDR trace viewing software one week prior to fiber test starts.

3.18 DOCUMENTATION

A. As-built drawings

1. The following requirements apply to all record drawings:
2. Location coordinates for each splice point, handhole/manhole and underground cable shall be indicated on the record drawings.
3. The record drawings shall be maintained at the Contractor's expense.
4. All such drawings shall be provided as necessary for clarification.
5. The record drawings shall be in 1"-30' scale.
6. The Contractor shall indicate on the drawings the fiber optic cable location with the reference to the center of the street.
7. The record drawings shall be returned to Consultant on completion of the work and are subject to the approval of the consultant.
8. The record drawings shall be submitted in the following formats:
9. In one blueline set
10. In one reproducible set
11. In one AutoCAD set
12. As-built drawings shall be submitted to the Engineer within 40 working days subsequent to the substantial completion. The Engineer reserves the right to

allow the Contractor greater than 40 working days after contract approval to make submittals.

B. Test Records

1. Test readings shall be recorded along with the annotation that these are post installation readings. Printed copies of these readings shall be provided to the Owner upon completion of the project. Records are to include date of testing, name of technician, and readings of all above-described test results.

2. The objective of fiber optic cable test documentation is to document OTDR and Power Meter test results to verify that these results meet specifications, as well as to document the link loss, fiber optic cable distance between splices and terminations, and the fusion splice losses.

3. The following provisions shall apply to fiber optic test documentation:

4. The Contractor shall provide post installation documentation on USB Flash Media.

5. The Contractor shall record power meter and OTDR test data, fiber count, and fiber routing of the cable and cable run.

6. Measure and record the following values for all fiber optic cables:

7. Fiber optic cable length markings at all splice and termination locations on the fiber optic schematics.

8. Fiber optic cable index of refraction.

9. Attenuation of each fiber optic splice in both directions and average attenuation.

10. Event notes for each trace. These notes shall identify each splice location and shall be consistent with each fiber optic schematic vault location.

11. Attenuation of each fiber optic link, in both directions, as measured with a light source and power meter at 1550 nm wavelength for SM.

12. Manufacturer's reel (spool) test documentation that is shipped with the fiber optic cable spool.

3.19 GPS COMPONENT AND UTILITY LOCATION DATA

A. Collect location coordinates for each splice point, handhole and underground cable, including cable installed in conduits and empty conduits using a GPS receiver capable of sub foot accuracy.

B. Location data must meet the following criteria:

1. The collected coordinates should be accurate to less than one foot.

2. Use a minimum of five (5) satellites by the receiver to collect location data.

3. Data to be collected based on NAD83 (1996) HARN adjustment with G03WGS84 or NAD83 (2007) adjustment with G09WGS84.

C. Measure above-ground components from the street side of the asset collected.

D. Collect underground cable location no more than two (2) weeks after it has been installed. Collect underground cable as line geometry. Capture the vertex points every 100 feet and at every junction or change in cable direction. Depth does not need to be collected unless underground cable is installed outside the depth of 42 inches.

E. If depth change has occurred, capture a vertex point before and after the depth change.

F. If GPS coordinates are required for in-place underground facilities, capturing the coordinates based on recent aboveground utility locate markings would be acceptable.

G. Data that does not meet the above criteria and guidelines may be rejected, and the contractor would be responsible to repeat the data collection.

End of Section

SECTION 27 1500
COMMUNICATIONS HORIZONTAL CABLING

Part 1 - GENERAL

1.01 SCOPE

A. This section describes the products and execution requirements relating to telecommunications voice, data and video horizontal (station) cabling and termination components.

B. Horizontal cabling is the cabling between the work area telecommunications outlet and the telecommunications room (TR). Horizontal cabling is often referred to as “station cabling”.

C. The horizontal cabling system will consist of the following:

1. Unshielded Twisted Pair (UTP) Cable
2. Outlet Termination Modules (jacks)
3. Outlet Termination Plates
4. Horizontal Fiber Optic/Copper Composite Cabling
5. Above Ceiling Cable Support Systems
6. Horizontal Cable Testing Requirements
7. Cable Pathway/Sleeve Requirements

1.02 RELATED WORK

A. Section 27 00 00 – General Technology Requirements

B. Section 27 05 00 – Communications General Requirements

C. Section 27 05 26 – Grounding and Bonding for Technology Systems

D. Section 27 05 28 – Pathways for Technology Systems

E. Section 27 05 37 – Firestopping for Technology Systems

F. Section 27 11 00 – Communications Equipment Rooms

G. Section 27 13 00 – Communications Backbone Cabling

H. Section 27 60 00 – Physical Security General Requirements

I. Section 27 62 00 – Electronic Access Control System

J. Section 27 64 00 – Video Surveillance System

1.03 DEFINITIONS

A. Refer to Section 27 00 00 for additional definitions.

1.04 REFERENCE STANDARDS AND CODES

A. Refer to Section 27 00 00 for additional requirements.

1.05 QUALIFICATIONS

A. Refer to Section 27 00 00 for additional requirements.

1.06 PRE-CONSTRUCTION SUBMITTALS

A. Provide a comprehensive Communications submittal package; refer to 27 05 00 Communications General Requirements for detailed requirements. Do not provide a separate submittal for this section on its own.

1.07 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

1.08 CLOSEOUT SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

Part 2 - PRODUCTS

2.01 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

2.02 CATEGORY 6 HORIZONTAL COPPER CABLES

A. All cables and equipment shall be furnished, tested, installed and wired by the Contractor.

B. All horizontal data cables shall terminate on modular patch panels in the telecommunications closet as specified on the Drawings.

C. This specification defines the requirements for commercially available high performance Category 6 cable.

D. This cable shall be utilized and suitable for installation free-air, in building risers, in conduit, and/or in cable tray and shall carry CMP rating.

E. The cable design described herein shall exceed transmission performance of Category 6 cables.

F. Cables shall be Underwriters Laboratory (UL) listed, comply with Article 800 (Communications Circuits) of the National Electrical Code, and meet the

specifications of NEMA (low loss), UL 444, and ICEA. Conductor shall also conform to the requirements for solid annealed copper wire in accordance with ASTM B 3.

G. All cables, termination components, and support hardware shall be furnished, tested, installed, and wired by the Contractor.

H. IMPORTANT: Cable and termination components (jack, patch panel, wiring blocks) are specified to function as a system. The compatibility of the cable to be installed with the proposed termination components shall be recognized and documented by the termination component manufacturer.

I. Manufacturers:

1. Berk-Tek Lanmark 1000
2. General Cable Genspeed 6000
3. Commscope Uniprise Ultramedia 6
4. Superior Essex DataGain Category 6+

2.03 CATEGORY 6A HORIZONTAL COPPER CABLES

A. All cables and equipment shall be furnished, tested, installed and wired by the Contractor.

B. All horizontal data cables shall terminate on modular patch panels in the telecommunications closet as specified on the Drawings.

C. All wireless access points shall utilize Category 6a cable unless noted otherwise.

D. This cable shall be utilized and suitable for installation free-air, in building risers, in conduit, and/or in cable tray and shall carry CMP rating.

E. The cable design described herein shall exceed transmission performance of Category 6a cables.

F. Category 6a cables shall be bundled separately from lower Category rated cabling.

G. Cables shall be Underwriters Laboratory (UL) listed, comply with Article 800 (Communications Circuits) of the National Electrical Code, and meet the specifications of NEMA (low loss), UL 444, and ICEA. Conductor shall also conform to the requirements for solid annealed copper wire in accordance with ASTM B 3.

H. All cables, termination components, and support hardware shall be furnished, tested, installed, and wired by the Contractor.

I. IMPORTANT: Cable and termination components (jack, patch panel, wiring blocks) are specified to function as a system. The compatibility of the cable to be installed with the proposed termination components shall be recognized and documented by the termination component manufacturer.

J. Manufacturers:

1. Berk-Tek LM-RDT
2. General Cable GenSPEED 10 MTP Gen 5 or later
3. Commscope Uniprise CS44P SD
4. Superior Essex 10Gain XP+

2.04 DATA CABLING COLORS

A. The jacket color for data cables shall be:

1. Standard Data Outlets – BLUE
2. Wireless Access Points – BLUE
3. IP Security Devices (Cameras, Access Control Panels, Intercoms, Intrusion Detection Panels, Vape Detectors, etc.) – BLUE
4. AV Systems - BLUE

2.05 INFORMATION OUTLET

A. General

1. Station cables shall each be terminated at their designated workstation location in the connector types described in the subsections below. Included are modular jacks, faceplates, and surface mount raceway. The combined assembly is referred to as the Standard Information Outlet (SIO). These connector assemblies shall snap into a mounting frame.
2. SIOs shall be mounted in new outlet boxes, where existing boxes are in place, on surface mount raceway typically in surface raceway with barrier, in floor mount interface boxes, or on power poles either currently owned or new.
3. The telecommunications outlet frame shall accommodate or incorporate the following:
    a. A minimum of four (4) modular jacks, when installed on a wall-mounted assembly.
    b. A mechanism for adjusting the surface plate to a plumb position.
4. When multiple jacks are identified in close proximity on the Drawings. The Contractor shall determine the optimum compliant configuration based on the products proposed.
5. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation. Prior to installation, the Contractor shall submit the proposed configuration for each SIO type for review by the Consultant.

B. Modular Jack

1. Data jacks shall be non-keyed 8-pin modular jacks.
2. Termination components shall be designed to maintain the cable’s pair twists as closely as possible to the point of mechanical termination.

3. Jacks shall utilize a four-layer printed circuit board to control NEXT.
4. Jack housings shall fully encase and protect printed circuit boards and IDC fields.
5. Modular jack contacts shall accept 2500 plug insertions.
6. Modular jack contacts shall be formed flat for increased surface contact with mated plugs. These contacts shall be arranged on the PC board in two staggered arrays of four to maximize contact spacing and minimize crosstalk.
7. Modular jack contacts shall be constructed of Beryllium copper for maximum spring force and resilience.
8. Contact Plating shall be a minimum of 50 micro inches of gold in the contact area over 50 micro-inch of nickel, compliant with FCC part 68.5.
9. Jack termination shall be 110 IDC, integral to the jack housing, laid out in two arrays of four contacts.
10. Jacks shall utilize a paired punch down sequence. Cable pairs shall be maintained up to the IDC, terminating all conductors adjacent to its pair mate to better maintain pair characteristics designed by the cable manufacturer.
11. Jacks shall utilize tin lead plated (60% tin/40%lead) phosphor bronze 110 insulation displacement contacts.
12. Jacks shall terminate 22-26 AWG stranded or solid conductors.
13. Jacks shall terminate insulated conductors with outside diameters up to .050”.
14. Jacks shall be compatible with single conductor 110 impact termination tools.
15. Jacks shall be compatible with EIA/TIA 606 color code labeling and accept snap on icons for identification or designation of applications.
16. Jacks shall be marked as either T568A or T568B wiring.
17. Category 6 jacks shall be manufactured by:
    a. Leviton Extreme
    b. Ortronics Clarity TracJack
    c. Panduit NetKey
    d. CommScope Uniprise UKJ600
18. Category 6a jacks shall be manufactured by:
    a. Leviton Atlas-X1
    b. Ortronics Clarity TracJack
    c. Panduit Mini-Com
    d. CommScope Uniprise SL-Series

C. Data Jack Colors

1. The color for data jacks shall be:

    a. Standard Data Outlets – Confirm Prior to Ordering

    b. Wireless Access Points – Confirm Prior to Ordering

    c. IP Security Devices (Cameras, Access Control Panels, Intercoms, Intrusion Detection Panels, Vape Detectors, etc.) – Confirm Prior to Ordering

    d. AV Systems – Confirm Prior to Ordering

D. Outlet Faceplates

1. Faceplates shall match the electrical outlets for material type and color and may vary by location.

2. Faceplates shall incorporate recessed designation strips at the top and bottom of the frame for identifying labels. Designation strips shall be fitted with clear plastic covers.

3. Any unused jack positions shall be fitted with a removable blank inserted into the opening.

4. Modular jacks shall have capability to incorporate a dust cover that fits over and/or into the jack opening. The dust cover shall be designed to remain with the jack assembly when the jack is in use. No damage to the jack pinning shall result from insertion or removal of these covers. Dust covers that result in deformation of the jack pinning shall not be accepted.

5. Wall-mounted “voice only” outlets shall be installed where identified on the floor plan Drawings to accommodate wall-mounted telephone sets. The wall plate shall be of stainless steel construction, accommodate one RJ-45 jack, mount on a standard single gang outlet box or bracket, and include mating lugs for wall phone mounting. Some types of phones may require a horizontal mounting.

6. All standard information outlets and the associated jacks shall be of the same manufacturer throughout each/the building. An allowable exception, however, is the wall-mounted “voice only” outlet described above.

7. Faceplates shall be manufactured by modular jack manufacturer.

E. Surface Mount Interface Box

1. Low profile, surface mount boxes shall incorporate recessed designation strips at the top for identifying labels. Designation strips shall be fitted with clear plastic covers.

2. The box shall feature built-in cable management for both fiber and copper applications.

3. Any unused jack positions shall be fitted with a removable blank inserted into the opening.

4. Modular jacks shall have capability to incorporate spring-loaded shutter door for added protection from dust and other airborne contaminants. The dust cover shall be designed to remain with the jack assembly when the jack is in use.

5. The box shall have the capability to incorporate optional magnets that can be internally mounted.

6. Surface mount box shall be manufactured by modular jack manufacturer.

2.06 COMMUNICATIONS PATCH CORDS

A. The Owner has the right to determine the final length of the patch cords after the contract is awarded.

B. All patch cords shall be round and consist of eight insulated 24 AWG, stranded copper conductors, arranged in four color-coded twisted pairs within a flame retardant jacket and be backwards compatible with lower performing categories. Modular patch cords shall utilize ISO termination method that is designed to reduce and control near-end cross talk (NEXT) and far end cross talk (FEXT) without compromising signal impedance.

C. Both ends of the cord shall be equipped with modular 8-position (RJ45 style) plugs wired straight through with standards compliant wiring. All modular plugs shall exceed FCC CFR 47 part 68 subpart F and IEC 603.7 specifications, and have 50 micro inches of gold plating over nickel contacts. Cable shall be label-verifiable. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Patch cords shall have color-coded insert molded strain relief boot with a latch guard to protect against snagging. Additional color-coding shall be available by the use of snap-in icons.

D. Patch cords shall be wired straight through. Pin numbers shall be identical at each end and shall be paired to match T568B patch panel jack wiring per ANSI/TIA/EIA-568-B. Patch cords shall be unkeyed.

E. The patch cords shall match the Category rating of the jack and cable it will be connecting to.

F. Prior to ordering patch cords the Contractor shall schedule meeting with Owner and Consultant to verify patch cord lengths, colors and quantities.

G. Contractor shall coordinate delivery of patch cords with Owner. Contractor shall have list of delivered cords and shall have Owner sign delivery sheet at time of delivery.

H. The manufacturer of the cords shall be the same as the manufacturer for UTP termination hardware (jacks & patch panels) for a complete system. Cords shall be highest quality patch cords available by connectivity manufacturer and match the performance grade of the utilized horizontal cable solution. Exceptions may be acceptable in special circumstances such as OSP or shielded applications and should be included in the submittals for review.

I. Manufacturers:

1. Leviton/Berk-Tek

2. Panduit/General Cable

3. Commscope

4. Ortronics/Superior Essex

J. Patch Cable Colors

1. The jacket color for patch cables shall be:

a. Standard Data Outlets – WHITE

b. Wireless Access Points – GREEN

c. IP Security Devices (Cameras, Access Control Panels, Intercoms, Intrusion Detection Panels, Vape Detectors, etc.) – YELLOW

d. AV Systems - PURPLE

e. OSP – BLACK for OSP side, match system color above for interior side.

K. Locations and types of patch cords:

1. Patch panel / data rack

a. The Contractor shall provide one patch cord for every terminated jack at the patch panel. These cords shall be turned over to the Owner.

b. The lengths of the cords shall depend on the rack layout to enable patching in the network switches.

i. In racks where the network switch is immediately below the associated patch panel, the Contractor shall provide 12”-18” patch cords.

ii. In racks where the network switches are stacked at the bottom, below a series of patch panels, or in an adjacent rack, the Contractor shall provide a mixture of 5-foot, 7-foot, and 10-foot or greater patch cords based on the specific distances and layout.

c. Patch cords at the rack shall be non-plenum.

2. Installed network devices

a. The Contractor shall provide one patch cord for every permanently installed IP device, such as a surveillance camera, intercom station, or wireless access point. These cords shall be turned over to whoever is installing the associated device, which may be a different subcontractor, an Owner’s vendor, or the Owner’s IT department.

b. Outdoor-mounted devices shall receive a shielded patch cord.

c. Patch cords for installed network devices shall be plenum rated.

d. The lengths of the patch cords shall depend on the installation conditions. For example, if the suspended ceiling is very close to the bottom of structure, and a surface-mount interface box is mounted to the structure to support a wireless access point in the ceiling, a 3-foot or 5-foot cord may be appropriate. If there is a large gap between the suspended ceiling and the bottom of structure, then a 7-foot, 10-foot, or even longer cord may be required. The Contractor shall review the specific installation conditions and use that to inform the patch cord lengths.

3. Standard outlets for workstations, printers, telephones, etc.

    a. The Contractor shall provide one 10-foot patch cord for every standard data outlet jack. These cords shall be turned over to the Owner.

    b. Patch cords for standard data outlets shall be non-plenum.

2.07 FIBER OPTIC PATCH CORDS

A. The Owner has the right to determine the final length of the patch cords after the contract is awarded.

B. All SM fiber optic patch cords shall:

1. Be duplex 2-3mm tight buffer design with Yellow jacket.

2. Have LC-LC connectors with straight thru connectors (A-A Polarity). Adjust as required for the specific device being connected.

3. Have 8-9-micron OS2 core.

C. Locations and types of fiber optic patch cords:

1. Installed network devices

    a. The Contractor shall provide one patch cord for every contractor furnish and installed network device with SFP or fiber optic connections, such as a fiber optic media converter, remote network switches/power supplies such as those on a pole or exterior enclosure, servers such as a video surveillance server, etc. These cords shall be turned over to whoever is installing the associated device, which may be a different subcontractor, an Owner's vendor, or the Owner's IT department.

    b. The lengths of the patch cords shall depend on the installation conditions. The Contractor shall review the specific installation conditions and use that to inform the patch cord lengths.

2. Fiber optic patch panel / Network Switches

    a. The Contractor shall provide one fiber optic patch cord for every network switch or network switch stack. These cords shall be turned over to the Owner.

    b. The lengths of the cords shall depend on the rack layout to enable patching in the network switches.

        i. In racks where the network switches are stacked at the bottom or in an adjacent rack, the Contractor shall provide a mixture of 5-foot, 7-foot, and 10-foot or greater patch cords based on the specific distances and layout.

    c. Patch cords at the rack shall be non-plenum.

Part 3 - EXECUTION

3.01 TESTING

A. Refer to Section 27 00 00 for additional requirements.

3.02 TWISTED PAIR TEST EQUIPMENT

A. Test equipment used under this contract shall be from a manufacturer who has a minimum of five years' experience in producing field test equipment. Manufacturers shall be ISO 9001 certified.

B. All test tools of a given type shall be from the same manufacturer and have compatible electronic results output. Test adapter cable shall be approved by the manufacturer of the test equipment. Baseline accuracy of the test equipment shall exceed TIA Level III, as indicated by independent laboratory testing.

C. Test equipment shall:

1. Be capable of certifying Category 6 and 6A permanent links.
2. Have a dynamic range of at least 100dB to minimized measurement uncertainty.
3. Be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.
4. Include S-band time domain diagnostics for NEXT and return loss.
5. Be capable of running individual NEXT, return loss, etc., measurements in addition to AutoText.
6. Include a library of cable types, stored by major manufacturer.
7. Store at least 1000 Category 6 or 6A autotests in internal memory.

D. The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurements.

E. The approved manufacturer of the test equipment is Fluke and JDSU/Viavi.

3.03 TRAINING

A. Refer to Section 27 00 00 for additional requirements.

3.04 WARRANTY

A. Refer to Section 27 00 00 for additional requirements.

3.05 STATION CABLING

A. Information outlet cables with copper media (voice & data UTP and "TV" coax) shall be located as detailed on the Project Drawings.

B. The Contractor shall utilize these documents in determining materials quantities and routing.

C. Station cables shall be run to the information outlet from the telecommunications room serving each area in conduit, free-air above drop ceiling, in cable tray, and/or in modular furniture.

D. The maximum station cable drop length for UTP cables shall not exceed 295 feet (90 meters) in order to meet data communications performance specifications. This length is measured from the termination panel in the wiring closet to the outlet and shall include any slack required for the installation and termination. The Contractor shall install station cabling in a fashion to avoid unnecessarily long runs.

E. Contractor shall verify cable lengths comply with published standards; prior to installation of any horizontal cabling, this Contractor shall verify cable paths and confirm no horizontal cable will exceed 295 total feet. If it is determined that the cable will exceed 295', this Contractor shall route the cabling to another telecommunications room or determine shorter path so cables are under 295'. If this is not possible, the Contractor shall notify the Consultant prior to installation. Failure to do this step will not result in a change order from the Contractor.

F. All cables shall be installed splice-free unless otherwise specified.

G. During pulling operation, an adequate number of workers shall be present to allow cable observation at all points of duct entry and exit as well as the feed cable and operate pulling machinery.

H. Avoid abrasion and other damage to cables during installation.

I. All cable shall be free of tension at both ends. In cases where the cable shall bear some stress, Kellom grips may be used to spread the strain over a longer length of cable.

J. Where installed free-air, installation shall consider the following:

    1. Cable shall run at right angles and be kept clear of other trades' work.

    2. Cables shall be supported according to code, using "J-hooks" anchored to ceiling concrete, walls, piping supports, or structural steel beams.

    3. Hooks shall be designed to maintain cable bend to larger than the minimum bend radius (typically 4x the cable diameter).

    4. Supports shall be spaced at a maximum 4-foot interval unless limited by building construction. If cable "sag" at mid-span exceeds 6 inches, another support shall be used.

K. Cable shall never be laid directly on the ceiling grid.

L. Cables shall not be attached to existing cabling, plumbing, or steam piping, ductwork, ceiling supports, or electrical or communications conduit.

M. Manufacturers' minimum bend radius specifications shall be observed in all instances. Use of plastic cable ties is not acceptable. Cable bundles shall be neatly dressed with use of Velcro type straps.

N. Cable sheaths shall be protected from damage from sharp edges. Where a cable passes over a sharp edge, a bushing or grommet shall be used to protect the cable.

O. A coil of one foot in each cable shall be placed in the ceiling at the last support (e.g., J-hook) before the cables enter a fishable wall, conduit, surface raceway, or box. At any location where cables are installed into movable partition walls or modular furniture via a service pole, approximately 15 feet of slack shall be left in each station cable under 250 feet in length to allow for change in the office layout without re-cabling. These "service loops" shall be secured at the last cable support before the cable leaves the ceiling and shall be coiled from 100% to 200% of the cable recommended minimum bend radius.

P. To reduce or eliminate EMI, the following minimum separation distances from ≤480V power lines shall be adhered to:

   1. Twelve (12) inches from power lines of <5-kVa
   2. Eighteen (18) inches from high voltage lighting (including fluorescent)
   3. Thirty-nine (39) inches from power lines of 5-kVa or greater
   4. Thirty-nine (39) inches from transformers and motors

Q. All openings shall be sleeved and firestopped per prevailing code requirements upon completion of cable installation.

3.06 INFORMATION OUTLET

A. Information outlets shall be flush mounted on wall-mounted boxes, in floor-mounted boxes, on surface raceway, or on modular furniture.

B. Any outlets to be added where these conditions are not met shall be positioned at a height matching that of existing services or as directed otherwise by the Site Coordinator and the Consultant. Nominal height (from finished floor to center line of outlet) in new installation shall be as follows:

   1. Standard Voice & Data Outlet (SIO) shall match adjacent electrical outlets.
   2. Wall-Mounted Telephone Outlet (Standard Voice only) shall meet ADA requirements for both front and side reach access.

C. The Contractor shall coordinate the style of the telecommunication outlets to be installed in the floor mount boxes and surface mount raceways with the Owner.

3.07 CABLE TERMINATION

A. At the telecommunication closet, all data and voice cables shall be positioned on termination hardware in sequence of the outlet ID, starting with the lowest number.

B. Termination hardware (blocks and patch panels) positioning and layout will be reviewed and approved by the Consultant prior to construction. The review does not exempt the Contractor from meeting any of the requirements stated in this document.

C. Cable Termination – Data/Voice UTP

1. Data/voice patch panels shall be designed and installed in a fashion as to allow future station cabling to be terminated on the panel without disruption to existing connections.

2. Data patch panels shall be sized to accommodate a minimum of 20% growth in the quantity of stations relative to the initial installation.

3. At information outlets and data/voice patch panels, the installer shall ensure that the twists in each cable pair are preserved to within 0.5 inch of the termination for data/voice cables. The cable jacket shall be removed only to the extent required to make the termination.

D. Cable Termination – Fiber Optic

1. All fibers shall be terminated using the specified connector type.

2. All terminated fibers at the telecommunications closets shall be mated to couplings mounted on patch panels. Couplings shall be mounted on a panel that, in turn, snaps into the housing assembly. Any unused panel positions shall be fitted with a blank panel inhibiting access to the fiber optic cable from the front of the housing.

3. All couplings shall be fitted with a dust cap.

4. Fibers from multiple locations may share a common enclosure, but they shall be segregated on the connector panels and clearly identified. Fibers from multiple destinations may be secured in a common enclosure, provided they are clearly identified as such. Fibers from different locations shall not share a common connector panel (e.g., “insert”).

5. Slack in each fiber shall be provided as to allow for future re-termination in the event of connector or fiber end-face damage. Adequate slack shall be retained to allow termination at a 30” high workbench positioned adjacent to the termination enclosure(s). A minimum of one meter (~39”) of slack shall be retained regardless of panel position relative to the potential work area.

6. If the cable is armored the Contractor shall install a plastic twist-on bushing on each end of interlocking armored fiber to protect cable from sharp edges of the armor.

3.08 TEST DATA – COPPER MEDIA

A. The test result records saved by the tester shall be transferred into a Windows-based database utility that allows for the maintenance, inspection, and archiving of these test records. A guarantee shall be made that these results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test. Comma separated value (CSV) format is not acceptable.

B. The database for the completed job – including twisted-pair copper cabling links, if applicable –shall be stored and delivered on USB flash drive. This USB flash drive shall include the software tools required to view, inspect, and print any selection of test reports.

C. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:

1. The identification of the link in accordance with the naming convention defined in the overall system documentation.

2. The overall Pass/Fail evaluation of the copper channel-under-test, including the NEXT worst-case margin (margin is defined as the difference between the measured value and the test limit value).

3. The overall Pass/Fail evaluation of the fiber link-under-test, including the Attenuation worst-case margin (margin is defined as the difference between the measured value and the test limit value).

4. The date and time the test results were saved in the memory of the tester.

3.09 COPPER STATION CABLES

A. Station cabling testing shall be from the jack at the outlet in the work area to the patch panel on which the cables are terminated.

B. Testing shall be of the permanent link. Contractor shall warrant performance, however, based on channel performance and provide patch cords that meet channel performance criteria. All cabling not tested strictly in accordance with these procedures shall be retested at no cost to the Owner.

C. Testing shall be from the jack at the SIO to the patch panel on which the cables are terminated at the wiring hub.

D. Horizontal “station” cables shall be free of shorts within the pairs and shall be verified for continuity, pair validity and polarity, and wire map (conductor position on the modular jack). Any defective, split, or mispositioned pairs shall be identified and corrected.

E. Testing of the cabling systems rated at TIA Category 6/6a and above shall be performed to confirm proper functioning and performance.

F. Testing of the transmission performance of station cables (Category 6/6a) shall include the following:

1. Length

2. Attenuation

3. Pair to Pair NEXT

4. ACR

5. PSNEXT Loss

6. Return Loss
7. Pair to Pair ELFEXT Loss or ACRF
8. PSEFEXT Loss or PS-ACRF
9. Propagation Delay
10. Delay Skew
11. Return Loss

G. The maximum length of station cable shall not exceed 90 meters, which allows 10 meters for equipment and patch cables.

H. Worst case performance at 20°C, based on a horizontal cable length of 90 meters and equipment cord length of 4 meters, shall be as follows:

1. CATEGORY 6 (Permanent LINK)

Frequency (MHz)	Insertion Loss (Maximum dB)	NEXT Loss Pair to Pair (dB)	PS-NEXT Loss (dB; Worst Case)	ELFEXT Loss Pair to Pair (dB)	PSELFEXT loss (dB)
1.0	1.9	65.0	62.0	64.2	61.2
4.0	3.5	64.1	61.8	52.1	49.1
8.0	5.0	59.4	57.0	46.1	43.1
10.0	5.5	57.8	55.5	44.2	41.2
16.0	7.0	54.6	52.2	40.1	37.1
20.0	7.8	53.1	50.7	38.2	35.2
25.0	8.8	51.5	49.1	36.2	33.2
31.25	9.8	50.0	47.5	34.3	31.3
62.5	14.1	45.1	42.7	28.3	25.3
100.0	18.0	41.8	39.3	24.2	21.2
200.0	26.1	36.9	34.3	18.2	15.2
250.0	29.5	35.3	32.7	16.2	13.2

2. CATEGORY 6a (Permanent LINK)

Frequency (MHz)	Insertion Loss (Maximum dB)	NEXT Loss Pair to Pair (dB)	PS-NEXT Loss (dB; Worst Case)	ACRF Pair to Pair (dB)	PS-ACRF (dB)
1.0	1.9	65.0	62.0	64.2	61.2
4.0	3.5	64.1	61.8	52.1	49.1
8.0	5.0	59.4	57.0	46.1	43.1
10.0	5.5	57.8	55.5	44.2	41.2
16.0	7.0	54.6	52.2	40.1	37.1
20.0	7.8	53.1	50.7	38.2	35.2
25.0	8.8	51.5	49.1	36.2	33.2
31.25	9.8	50.0	47.5	34.3	31.3
62.5	14.1	45.1	42.7	28.3	25.3

Frequency (MHz)	Insertion Loss (Maximum dB)	NEXT Loss Pair to Pair (dB)	PS-NEXT Loss (dB; Worst Case)	ACRF Pair to Pair (dB)	PS-ACRF (dB)
100.0	18.0	41.8	39.3	24.2	21.2
200.0	26.1	36.9	34.3	18.2	15.2
250.0	29.5	35.3	32.7	16.2	13.2
300.0	32.7	34.0	31.4	14.6	11.6
400.0	38.5	29.9	27.1	12.1	9.1
500.0	43.8	26.7	23.8	10.2	7.2

I. In the event results of the tests are not satisfactory, the Contractor shall make adjustments, replacements, and changes as necessary and shall then repeat the test or tests that disclosed faulty or defective material, equipment, or installation method. The Contractor shall make additional tests as the Consultant deems necessary at no additional expense to the Owner or Consultant.

J. All data shall indicate the worst-case result, the frequency at which it occurs, the limit at that point, and the margin. These tests shall be performed in a swept frequency manner from 1 MHz to highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements. Information shall be provided for all pairs or pair combination and in both directions when required by the appropriate standards.

K. Cables shall be tested to the maximum frequency defined by the standards covering that performance category. Transmission Performance Testing shall be performed using a test instrument designed for testing to the specified frequencies. Test records shall verify “PASS” on each cable and display the specified parameters—comparing test values with standards-based “templates” integral to the unit.

End of Section

SECTION 27 6000
PHYSICAL SECURITY GENERAL REQUIREMENTS

Part 1 - GENERAL

1.01 SCOPE

A. Refer to Section 27 00 00 for additional project scope information. This section describes the general product and execution requirements related to furnishing and installing Physical Security Systems. Physical Security Systems includes Video Surveillance, Electronic Access Control, Intrusion Detection, and their sub systems.

B. Contractor shall be responsible for providing complete and functional systems as described in this specification and project drawings.

C. Contractor shall provide low voltage power and control lines to and from power supplies, remotely controlled equipment, and other devices, even though not explicitly indicated on drawings or listed in equipment tables.

D. Contractor shall be, or Contractor shall provide, an Electrical Contractor for provision of high voltage power and conduits/raceway, where necessary.

E. Contractor shall be responsible for any and all related programming and end-user training unless noted otherwise.

1.02 RELATED WORK

A. Section 27 00 00 – General Technology Requirements

B. Section 27 05 00 – Communications General Requirements

C. Section 27 05 26 – Grounding and Bonding for Technology Systems

D. Section 27 05 28 – Pathways for Technology Systems

E. Section 27 05 37 – Firestopping for Technology Systems

F. Section 27 11 00 – Communications Equipment Rooms

G. Section 27 15 00 – Communications Horizontal Cabling

H. Section 27 62 00 – Electronic Access Control System

I. Section 27 64 00 – Video Surveillance System

1.03 DEFINITIONS

A. Refer to Section 27 00 00 for additional definitions.

1.04 REFERENCE STANDARDS AND CODES

A. Refer to Section 27 00 00 for additional requirements.

1.05 QUALIFICATIONS

A. Refer to Section 27 00 00 for additional requirements.

B. Training: Programmer shall have received manufacturer-provided and/or manufacturer approved training in the configuration of the physical security system(s) being provided.

C. Certification: Programmer shall hold the highest applicable manufacturer programming certification(s) offered by the manufacturer(s) of the physical security system(s).

D. Submittal: Certification certificate shall be submitted with physical security system(s) submittals.

1.06 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

B. Hardware, Application Software, and Network Requirements: A system description including analysis and calculations used in sizing equipment required by the Physical Security Systems. The description shall show how the equipment will operate as a system to meet the performance requirements of the systems. The following information shall be supplied as a minimum:

1. Server(s) processor(s), disk space and memory size
2. Workstation(s) processor(s), disk space and memory size
3. Operating System(s) Software, where software is provided or upgraded
4. Application Software, with Optional and Custom Software Modules supplied in this project
5. Integration Schemes: Proposed connectivity, software, development requirements, and SDK information, for inter-system communication.
6. Network reliability requirements
7. Number and location of LAN ports required
8. Number of IP addresses required.
9. Other specific network requirements, preferences, and constraints
10. Backup/archive system size and configuration
11. Start-up operations
12. Description of site (field) control equipment (Controllers/Field Panels) and their configuration
13. Access control power calculations.
14. Battery backup requirements

1.07 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

1.08 CLOSEOUT SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

B. Quick-Reference Guides: Contractor shall create a concise quick-reference guide covering normal system operation and basic troubleshooting procedures for each room/system type. Length of each quick-reference guide shall be commensurate with the information needed for successful operation, subject to Owner approval.

1. Upon Owner approval, Contractor shall provide two (2) laminated copies and one (1) digital copy for each room/system type.

C. Serial Numbers: Contractor shall provide a list of serial numbers for all supplied components with serial numbers and with a unit price greater than $99. Organize list by room/system type.

Part 2 - PRODUCTS

2.01 SUBSTITUTIONS

A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

2.02 GROUNDING AND BONDING

A. The Contractor shall bond and ground the primary protectors and the metallic member of cable sheaths to building ground utilizing a minimum of 14-awg and no greater then 6-awg at the closest point of entrance as practical, not exceeding 50 feet, in accordance with the NEC.

2.03 REFER TO INDIVIDUAL SECTIONS FOR ADDITIONAL PRODUCT INFORMATION.

2.04 FIRE STOPPING MATERIALS

A. Refer to Section 27 00 00 for additional requirements.

Part 3 - EXECUTION

3.01 NETWORK TIME PROTOCOL (NTP) SYNCHRONIZATION

A. All security systems as well as additional integrated systems such as intercom/PA, SQL/database servers and data logging servers shall synchronize to a common NTP server.

B. All systems including servers and workstations shall be within 250ms of each other or less depending on specific system requirements. The synchronization frequency shall be no less than every 1 hour.

C. The Contractor shall coordinate with the Owner for a NTP server connection address.

3.02 TESTING

A. Refer to Section 27 00 00 for additional requirements.

3.03 TRAINING

A. Refer to Section 27 00 00 for additional requirements.

B. On-Site Training

1. General: Present, review and describe equipment and materials to the Owner and Owner's operating personnel and fully demonstrate the operation and maintenance of the systems, equipment and devices specified herein.

2. Include with new systems, Contractor to arrange and provide for video recording of each onsite training session.

    a. Provide professional video and audio recording of each software screen option with Owner approval of content.

    b. Provide end user video recording for all training levels.

3. Training shall comprise two separate levels of training;

    a. User Group upon substantial completion of the project.

        i. User group training shall include a site/building walk through indicating locations of equipment and their usage.

        ii. User group training shall include the operation of workstation capability of system monitoring, command override and report generation.

    b. Maintenance Group upon completion of the project prior to close out.

        i. Maintenance group training shall include a site/building walk through indicating locations of equipment and their usage at up to six representative sites.

        ii. Review of a-build documentation at each controller location.

        iii. Troubleshooting techniques in hardware and software.

4. The training shall cover the overall system, each individual system, each subsystem, and each component. The training shall also cover procedures for database management, normal operations, and failure modes with response procedures for each failure. Each procedural item shall be applied to each equipment level.

C. Duration: Refer to the individual sections for the minimum time requirements.

3.04 WARRANTY

A. Refer to Section 27 00 00 for additional requirements.

B. Furnish and guarantee maintenance, repair and inspection service for the system using factory trained authorized representatives of the manufacturer of the equipment for a period of one year after final acceptance of the installation.

C. Third Party Device warranties are transferred from the manufacturer to the Contractor, which may then transfer third party warranties to the Owner. Specific third party warranty details, terms and conditions, remedies and procedures, are either expressly stated on, or packaged with, or accompany such products. The warranty period may vary from product to product. These products include but are not limited to devices that are directly interconnected to the field hardware or computers and are purchased directly from the manufacturer.

D. Purpose

1. The Contractor shall repair any system malfunction or installation deficiency discovered by the Owner or their representatives during the burn in and warranty period.

2. The Contractor shall correct any installation deficiencies found against the contract drawings and specifications discovered by the Owner or their representatives during the warranty period.

3.05 EXAMINATION OF SITE AND DOCUMENTS

A. Bidder shall examine all documents, shall visit the site(s) prior to submitting proposal, record their own investigations, and shall inform themselves of all conditions under which the Work is to be performed at the site(s) of the Work, including the structure of the ground, the obstacles that may be encountered, and all of the conditions of the documents, including superintendence of the Work, requirements of temporary environmental controls, the time of completion, list of Subcontractors, and all other relevant matters that may affect the Work or the proposal process.

B. Verify cable lengths comply with published standards.

C. Notify Owner/Consultant of installation that would exceed maximum lengths prior to installation of cable.

D. Contactor shall consult with Owner/Consultant regarding alternative routing or location of cable.

E. Do not proceed until unsatisfactory conditions have been corrected.

F. Failure to make the examination shall not result in any Change Order requests.

G. The Bidder shall base the proposal on the site(s) examination, materials complying with the plans and specifications and shall list all materials where the proposal form requires.

H. The commencement of work by the Contractor shall indicate acceptance of existing conditions, unless a written notice of exceptions has been provided to the Owner/Consultant prior to commencement.

I. If the Contractor observes, during preliminary examinations or subsequent work, existing violations of fire stopping, electrical wiring, grounding, or other safety- or code-related issues, the Contractor shall report these to the Owner/Consultant in a timely manner.

3.06 INSTALLATION REQUIREMENTS

A. Refer to Section 27 00 00 for additional requirements.

B. Contractor shall furnish and install all cables, connectors, and equipment as shown on Drawings and as specified herein.

C. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified. This includes any modifications required to route and conceal horizontal distribution wiring.

D. Beginning installation means Contractor accepts existing conditions.

E. The Contractor shall be responsible for identifying and reporting to the General Contractor any existing damage to walls, flooring, tiles, and furnishings in the work area prior to start of work. All damage to interior spaces caused by the installation of cable, raceway, or other hardware shall be repaired by the Contractor.

F. Repairs shall match preexisting color and finish of walls, floors, and ceilings. Any Contractor-damaged ceiling tiles, floor, and carpet shall be replaced to match color, size, style, and texture.

G. Where unacceptable conditions are found, the Contractor shall bring this to the attention of the construction supervisor immediately. A written resolution will follow to determine the appropriate action to be taken.

H. All wiring shall be run "free-air," in conduit, in a secured plastic raceway or in modular furniture as designated on the Drawings. All cable shall be free of tension at both ends. PLENUM rated cable shall be used in areas used for air handling.

I. Avoid abrasion and other damage to cables during installation.

J. The cable system will be tested and documented upon completion of the installation as defined in the section below.

K. All manufactured items, materials, and equipment shall be applied, installed, connected, erected, used, and adjusted as recommended by manufacturers or as indicated in their published literature, unless specifically noted herein to the contrary.

3.07 COOPERATION

A. The Contractor shall cooperate with Consultant's and Owner's personnel in locating work in a proper manner.

B. Should it be necessary to raise, lower, or move longitudinally any part of the work to better fit the general installation, such work shall be done at no extra cost to the Owner, provided such decision is reached prior to actual installation. The Contractor shall check location of electrical outlets with respect to other installations before installing.

3.08 COMMISSIONING SUBMITTALS

A. Provide the following to the Owner no later than 30 days prior to system commissioning/programming.

1. Commissioning Test Plan and Check-Off List: Specified elsewhere in this document.

2. Software: One set of fully functional software in manufacturer's original media packaging, temporarily licensed for a 30-day evaluation period.

3. Web-based Training: Access to web-based training modules.

3.09 COMMISSIONING

A. Provide programming and commissioning for each system as described in individual sections below.

B. This Contractor shall develop and submit a plan for coordination of settings and programming issues with the Consultant and Owner no later than 30 days prior to performing programming and commissioning.

C. The security Contractor is required to place entire system into full and proper operation as designed and specified.

D. Verify that all hardware components are properly installed, connected, communicating, and operating correctly.

E. Verify that all system software is installed, configured, and complies with specified functional requirements.

F. Perform final acceptance testing in the presence of Owner's representative, executing a point-by-point inspection against a documented test plan that demonstrates compliance with system requirements as designed and specified.

1. Submit documented test plan to Owner at least 14 days in advance of acceptance test, inspection, and check-off.

2. Conduct final acceptance tests in presence of Owner's representative, verifying that each device point and sequence is operating correctly and properly reporting back to control panel and control center.

3. Acceptance by Owner is contingent on successful completion of check-off; if check-off is not completed due to additional work required, re-schedule and perform complete check-off until complete in one pass, unless portions of system can be verified as not adversely affected by additional work.

4. The system shall not be considered accepted until all acceptance test items have been successfully checked-off. Beneficial use of part or all of the system shall not be considered as acceptance.

3.10 OPERATION AND MAINTENANCE MANUALS

A. Part One: Notwithstanding requirements specified elsewhere, submit the following labeled as the "Operating and Maintenance Manual" within thirty (30) days after Final Acceptance of the Installation:

1. Record Drawings: Submit two (2) copies of revised versions of drawings as submitted in the "Shop and Field" and "Equipment Wiring Diagrams" Submittals showing actual device locations, conduit routing, wiring and relationships as they were constructed. Include nomenclature showing as-built wire designations and

colors. Drawings shall include room numbers coinciding with Owner space planning numbering. Drawings shall be submitted in electronic editable AutoCAD 2010 files, in ".dwg" format, on CD or DVD disks.

2. Manuals: Submit two (2) copies of each of the following materials in bound manuals, or electronic PDF copies, with labeled dividers:

    a. A final Bill of Material for each system

    b. Equipment Instruction Manuals: Complete, project specific comprehensive instructions for the operation of devices and equipment provided as part of this work.

    c. Manufacturers Instruction Manuals: Specification sheets, brochures, Operation Manuals and service sheets published by the manufacturers of the components, devices and equipment provided.

    d. Include information for testing, repair, troubleshooting, assembly, disassembly and recommended maintenance intervals.

    e. Provide a replacement parts list with current prices. Include list of recommended spare parts, tools, and instruments for testing and maintenance purpose.

    f. Performance, Test and Adjustment Data: Comprehensive documentation of performance verification according to parameters specified herein.

    g. Warranties: Provide an executed copy of the Warranty Agreement and copies of all manufacturer's Warranty Registration papers as described herein.

B. Part Two: Within fourteen (14) days of receipt of Consultant reviewed Operating and Maintenance Manual (Phase One), submit three (3) electronic copies in AutoCAD 2010 editable .dwg format of the reviewed Record Drawings and three (3) copies of the reviewed Operating and Maintenance Manuals to the Owner, on CD or DVD disks.

    1. Within each equipment enclosure and/or terminal cabinet, the Contractor shall place a Single Line drawing of the system(s) and the respective Terminal Cabinet Wiring Diagram in a clear plastic sleeve permanently attached to the inside cover of the terminal cabinet.

    2. In each equipment enclosure the Contractor shall place a drawing providing device locations served by the equipment within the enclosure with identification that is identical to the wiring tags and with the software description of each point.

    3. The Contractor shall provide to the Owner one (1) copy of new administration and user software, including required graphical maps, on CD or DVD disks.

C. Sufficient information, (detailed schematics of subsystems, assemblies and subassemblies to component level) clearly presented, shall be included to determine compliance with drawings and specifications.

3.11 CLOSEOUT PROCEDURES

A. Notification: Contractor shall provide written notification to Architect/Consultant and Owner when Contractor is satisfied that the work has been completed and is ready for inspection.

B. Closeout Submittals: Contractor shall provide closeout documentation to the Architect/Consultant. The Architect/Consultant shall receive the closeout submittals no less than 72 hours prior to the scheduled inspection time.

C. Inspection: Contractor shall be present for the inspection by the Architect/Consultant. Contractor shall supply all testing equipment needed to verify compliance with the specifications found in Bid package.

D. Punch List: Work or materials found to be incomplete, of unsatisfactory quality, failing to meet the specifications in the Bid package, and/or unacceptable to the Architect/Consultant shall be documented by the Architect/Consultant and provided to Contractor to rectify.

E. Re-Inspection: If a re-inspection is necessary, the costs of the Architect/Consultant's additional travel, hours, and expenses may be deducted by the Owner from the contract amount due Contractor.

F. Punch List Approval: The punch list shall be considered complete only after having been signed by the Owner and Architect/Consultant.

G. The system has successfully completed a 30-day performance period.

H. Payment Authorization: Final payment will be authorized only after all closeout procedures and requirements have been followed and fulfilled by Contractor and approved in writing by the Owner and Architect/Consultant, including punch list(s) and/or re-inspection(s).

End of Section

SECTION 27 6200
ELECTRONIC ACCESS CONTROL SYSTEM

Part 1 - GENERAL

1.01 SCOPE

A. This specification section covers the furnishing and installation of a new and complete, low-voltage, Electronic Access Control System (EACS).

B. Contractor shall furnish and install access control hardware devices, mounting brackets, power supplies, switches, controls, consoles and other components of the system as required.

C. Contractor shall furnish and install access control related software to allow this system expansion. Software includes required license addition for access control readers and electrified portals, workstations and required physical security system Integration.

D. Furnish and install outlets, junction boxes, conduit, connectors, wiring, and other accessories necessary to complete the system installation. Requirements shall be in accordance with Division 26.

E. Refer to Section 27 00 00 for additional project scope information.

1.02 PRECEDENCE

A. Obtain, read and comply with General Conditions and applicable sub-sections of the contract specifications. Where a discrepancy may exist between any applicable sub-section and directions as contained herein, this section shall govern.

1.03 RELATED WORK

A. Division 08 - Door Hardware

B. Section 27 00 00 – General Technology Requirements

C. Section 27 05 00 – Communications General Requirements

D. Section 27 05 26 – Grounding and Bonding for Technology Systems

E. Section 27 05 28 – Pathways for Technology Systems

F. Section 27 05 37 – Firestopping for Technology Systems

G. Section 27 11 00 – Communications Equipment Rooms

H. Section 27 15 00 – Communications Horizontal Cabling

I. Section 27 60 00 – Physical Security General Requirements

J. Section 27 64 00 – Video Surveillance System

1.04 DEFINITIONS

A. ACS – Access Control System

B. IDS – Intrusion Detection System

C. VMS – Video Management System

D. Refer to Section 27 00 00 for additional definitions.

1.05 REFERENCE STANDARDS AND CODES

A. IEC 60839-11-5:2020 - Open Supervised Device Protocol (OSDP)

B. Refer to Section 27 00 00 for additional requirements.

1.06 QUALIFICATIONS

A. The Contractor shall be a LenelS2 OnGuard certified dealer.

B. Lock installers for fire rated doors are to be trained and certified by the manufacturer via Intertek Qualified Personnel (IQP) Raceway and Hardware Installer Program on the proper installation and adjustment of fire, life safety, and security products in compliance with NFPA 80 including: hanging devices; locking devices; closing devices; and seals.

1. Trained and qualified raceway installers are required to ensure modifications do not affect the integrity of fire doors. Doors must remain compliant with NFPA 80.

C. Refer to Section 27 00 00 for additional requirements.

1.07 REQUIRED SUB-CONTRACTOR

A. The contractor shall sub-contract the following contractor for all security work:

All State Communications

1.08 PRE-CONSTRUCTION SUBMITTALS

A. The following items shall be provided in a single, combined, comprehensive submittal package. Partial submittals will only be considered in special circumstances, such as getting early approval of long-lead-time items or products requiring additional coordination with other trades.

B. Equipment Schedules

1. Provide a complete schedule of significant materials for the project, with columns for the following items: Manufacturer, Part Number, Description, Quantity, and Unit Pricing.

C. Product Cut Sheets

1. Provide basic product data sheets (1-2 pages per product) for all products listed in the equipment schedule. Do not include longer documents such as installation manuals.

2. Identify (highlight, arrow, etc.) the actual version and part number of the product that will be utilized on the project. This applies to mounting hardware, cabling, connectors, software, and power distribution equipment in addition to major system components.

D. Shop Drawings

1. Pre-construction submittals are intended to document the details of installation. Exact copies of the Consultant's drawings and specifications are not acceptable as pre-construction shop drawings. The Consultant's drawings are intended to outline the functional requirements, but do not provide install-level detail.

2. Exact requirements will vary depending on the project scope. Provide the following elements where applicable:

a. Floor Plans: Include device/equipment locations, cable routes, maximum cable distance calculations, installation notes, and electrical coordination notes (specific conduit routing, etc.).

b. System Drawings: Include functional diagrams for each system detailing system flow including all equipment, routing, inputs/outputs, wiring signal type, cable identification labels, connectors, adapters, intra/inter-rack power distribution, installation notes, and any other information required to convey the complete turnkey system design for an installer to complete the work.

c. Wall Equipment Elevations: Include placement of all wall-mounted equipment, drawn to scale.

d. Hardware Layouts: Include individual panel layouts, showing the number of controllers, sub-panels, and other associated devices per location.

e. Power Calculations: Include the anticipated power loads, number and type of power supplies including all power supply boards, number of 120VAC circuits required, battery backup including the quantities of batteries to meet requirements, PoE loads, fire alarm connection requirements, etc.

1.09 PRE-INSTALLATION PROCEDURES

A. The Contractor shall cable all controlled or monitored doors, intercoms, etc. and terminate this cable in the access control panels no less than 3 weeks prior to substantial completion regardless of the status of the field devices such as door hardware, card readers, intercoms, etc.

B. The Contractor shall program the access control system no less than 2 weeks prior to substantial completion so when field devices are installed and terminated, associated door hardware and full system functionality can be tested. Programming shall include all doors, associated inputs, outputs, and interoperability regardless of final field device status.

C. The Contractor shall perform final connections and testing onsite when field devices such as electrified door hardware has been installed.

D. Refer to section 27 00 00 and 28 00 00 for additional requirements.

1.10 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 27 00 00 requirements.

1.11 CLOSEOUT SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

Part 2 - PRODUCTS

2.01 ACS SYSTEM SOFTWARE

A. The Contractor shall extend the existing LenelS2 OnGuard system for this project.

B. The Contractor shall furnish all required licensing and software maintenance to expand the system.

2.02 ELECTRONIC ACCESS CONTROL HARDWARE

A. The Access Control Panel (ACP) is used as the subcomponent to the security management system for the purpose of initiating all decision-making criteria as it relates to the cardholders, readers, and associated hardware connected. Decisions are made by the ACP and uploaded to the host computer as historical events.

B. The ACP shall be listed for Underwriters Laboratory (UL):

1. UL294 (Access Control System)

C. Provide an access control system based off of HID Mercury Security open platform hardware and interface modules. The panels shall:

1. Operate without the need for the host to be on-line. No decisions shall be dependent on the host.
2. Support on-board 10/100 Ethernet communications to the host as primary communication.
3. Include a request-to-exit and door status contact input for each reader without the need for additional modules for future use.
4. Detect “forced entry” and “door left open.” A separate action is required for each.
5. Allow mapping of readers to any output address within the same controller.
6. Support at least 50 user-selected holidays.
7. Allow all unused door logic, such as door strike relays, request-to-exit inputs, and door status inputs to be assigned as general-purpose points.
8. Support optional modules for additional customization of inputs and outputs.
9. Wireless intelligent lock support.
10. Wired intelligent lock support.
11. Elevator support.

12. Maintain historical information for a minimum of three (3) months without AC power.
13. Automatically adjust for daylight savings time and leap year.
14. Support a variety of reader technologies.
15. Support for OSDP V2 and OSDP V2 SC (Secure Channel).
16. Support the following card/reader technologies as a minimum:
    a. Magnetic Stripe
    b. 125KHz Proximity cards
    c. 13.56Mhz Smart Cards and technologies
    d. Biometrics
    e. Vehicle Identification
    f. Support multiple technologies simultaneously.
    g. Support for HID 37-bit card formats.
    h. Support for HID iClass SE and Seos technologies.
    i. Support for NXP and HID MiFare DESFire EV1, EV2 and EV3
17. Maintain the expiration date for each cardholder. Once the date is reached, the card will automatically be disabled. No access shall be authorized.
18. Maintain three (3) access times for each door location: Standard, Long, and Egress.
19. Have the ability to maintain an automatic door unlock during specific hours and days.
20. Support a minimum of (2) “levels” of Anti-Passback: Global and Area.
21. All controllers and expansion modules shall have the latest ACS recommended firmware installed and shall have matching firmware versions. The Contractor shall provide all necessary firmware upgrades to keep the Owner on the latest version throughout the duration of the project. At the completion of the project the Owner shall have the option to receive a final firmware update the latest version before the project is paid in full.

D. Panels shall use HID Mercury Security MP controllers with Series-3 MR interface panels. Legacy LP/EP controllers and Series-2 interface panels are not allowed.
    1. The Contractor shall provide adequate number of access control panels, controllers, door interface panels and I/O panels for a complete turnkey system to support all components as indicated on project drawings, specifications and as required.
    2. Basis of design is MP1502 controllers, MR52-S3 interface panels and MR16IN-S3/OUT-S3 I/O panels as required.

3. MP1501 Single door controllers shall only be used when specifically specified or approved by the Consultant.
4. MR50 single door expansion modules shall only be used when specifically specified or approved by the Consultant.
5. For RS-485 based intelligent lock installations, expansion module star topologies, or complex installations requiring significant RS-485 connection the Contractor shall utilize Mercury Security MUX8 RS-485 multiplexers.
6. Mercury Security Series-3 MP1502 Controller:
    a. Power Input
        i. Direct current (12-24VDC) ±10% 500 mA maximum.
    b. Power Output: 12 Volts DC at 650mA including reader and AUX output.
    c. Reader Interface: 12-24VDC ±10%. PTC limited to 300mA maximum per reader.
    d. Inputs: Eight general purpose programmable circuit type and dedicated tamper.
    e. Outputs: Four relays – Form-C, 2 Amp, 30 volts direct current
    f. Onboard Reader Ports: Supports 4 readers on up to 2 openings.
    g. RS-485 Bus: (1) RS-485 bus.
    h. OSDP Secure Channel support.
    i. LED: TTL, two wire or one wire bi-color support
    j. Buzzer: One-wire LED mode
    k. Supports up to 128 OSDP readers on up to 64 openings with downstream modules.
    l. Supports up to 520 inputs and 516 outputs with downstream modules.
    m. 240,000 card holder capacity.
    n. 2gb to 8gb MicroSD card support.
    o. Dimensions: 8”W x 6”H x 1”D.
    p. Provide with Mercury Security Series-3 MR52 or other SIO modules as necessary for the application when Mercury controllers are utilized.
    q. Provide with an appropriate, lockable enclosure to house the controller as well as the terminations and any expansion modules.
7. Mercury Security Series-3 MR53-S3 Reader Expansion Module:
    a. Power Input
        i. Direct current (12-24VDC) ±10% 500 mA maximum.

b. Reader Interface: 12-24VDC ±10%. PTC limited to 300mA maximum per reader.

c. Inputs: Eight general purpose programmable circuit type and dedicated tamper.

d. Outputs: Six relays – Form-C, 2 Amp, 30 volts direct current

e. Onboard Reader Ports: Supports 4 readers on up to 2 openings.

f. Host Communication: RS-485

g. OSDP Secure Channel support.

h. LED: TTL, two wire or one wire bi-color support

i. Buzzer: One-wire LED mode

j. Dimensions: 6”W x 8”H x 1”D.

8. Mercury Security Series-3 MR16IN-S3 Input Expansion Module:

a. Power Input

i. Direct current (12-24VDC) ±10% 350 mA maximum.

b. Reader Interface: 12-24VDC ±10%. PTC limited to 300mA maximum per reader.

c. Inputs: Sixteen general purpose programmable circuit type and dedicated tamper.

d. Outputs: Two relays – Form-C, 2 Amp, 30 volts direct current

e. Onboard Reader Ports: None.

f. Host Communication: RS-485

g. Dimensions: 6”W x 8”H x 1”D.

9. Mercury Security Series-3 MR16OUT-S3 Output Expansion Module:

a. Power Input

i. Direct current (12-24VDC) ±10% 1100 mA maximum.

b. Reader Interface: 12-24VDC ±10%. PTC limited to 300mA maximum per reader.

c. Inputs: Two general purpose programmable circuit type and dedicated tamper.

d. Outputs: Sixteen relays – Form-C, 2 Amp, 30 volts direct current

e. Onboard Reader Ports: None.

f. Host Communication: RS-485

g. Dimensions: 6”W x 8”H x 1”D.

2.03 ELECTRONIC ACCESS CONTROL SERVER

A. The Contractor shall utilize the existing server.

2.04 CONTACTLESS 13.56 MHZ SMART CARD AND 125 KHZ LEGACY CARD MULTICLASS READERS

A. 13.56 MHz Supported Credentials:

1. HID Seos, iClass SE, iClass SR and iClass with Secure Identity Object (SIO)
2. Mifare DESFire EV1/EV2/EV3, Classic
3. Able to read 37-bit card format support with no facility code.
4. NFC based credentials
5. 2.4 GHz based Bluetooth credentials
6. Apple Enhanced Contactless Polling (ECP) capable

B. 125 KHz Supported Credentials:

1. HID Proximity
2. Indala Proximity, obtain Owner's specific Indala credential prior to ordering.
3. AWID Proximity
4. EM Proximity

C. Provide with integrated keypad where shown or required.

D. Operating voltage: 12 VDC

E. Current draw: 65mA average and 250mA peak @ 12VDC.

F. Color: Black with Silver Bezel

G. UL294 Outdoor and Indoor rated and IP65 rated.

H. With attached pigtail

I. Typical read range of 1.6" to 4".

J. Provide adapter plate to mount on a single-gang mud ring as required.

K. Firmware upgradable via OSDP, HID reader manager or pre-programmed cards.

L. Provide the ability to transmit an alarm signal via OSDP or an integrated dry contact optical tamper switch if an attempt is made to remove the reader.

M. An audio beeper and RGB light bar shall provide various tone and light sequences to signify: access granted, access denied, power up, and diagnostics.

N. Manufacturer:

1. Card readers shall be HID Signo Model 40 for standard applications and Model 20 for mullion/jamb applications.

2. Card readers with integrated keypad shall be HID Signo Model 40K for standard applications and Model 20K for mullion/jamb applications.

2.05 POWER SUPPLIES AND ACCESS CONTROL ENCLOSURES

A. Provide a power supply/chargers and sub-assemblies to power various access controller boards, locking hardware and other access control or security system components. The Contractor shall select the appropriate enclosure, power supply and sub-assemblies for each application. The Contractor shall include network monitoring modules for all power supplies.

B. All power supplies and their supporting infrastructure shall be mounted to fire rated with rating exposed, ¾" plywood secured to the wall. The Security Contractor shall furnish and install this plywood behind all enclosures.

C. All power supplies shall be hardwired by a licensed electrician with 120VAC power on a dedicated circuit.

D. All enclosures shall be bonded to building ground.

E. Enclosures

1. Shall be capable of accommodating power supplies, sub-assemblies and other manufactures access control controller boards when required.

2. Internal components pre-wired at manufacturer including connectors for Mercury panels.

3. Wall mountable.

4. Include a cam-lock and tamper switch. Connect tamper switch to tamper input on access control panel and label as panel door.

5. The following architecture shall be utilized:

   a. Select 16 or 24 door/reader enclosure size capacity based on hardwired reader count, never less than 16 door capacity for the main access control panel and never less than 8 door capacity for the remote access control sub-panels.

   b. The Secondary enclosure is an expansion enclosure located next to the primary enclosure that connects to the primary power supplies network monitoring module.

   c. The remote enclosure is an enclosure that has a network controller located in a different telecommunications closet then the primary.

   d. Select multiple primary plus secondary enclosures when hardwired reader count exceeds 16 in a single closet.

6. Include with Panduit finger duct wire management and Velcro straps for pre-installed cable.

7. Pre-wired for Mercury panels. Select proper pre-wire version based on enclosure configuration.

8. Manufacturer:

    a. LifeSafety Power ProWire MClass Panduit

F. Power Supplies

1. 120 VAC hardwired input

2. Foor all configurations, furnish FPO250 power supplies.

G. Sub-Assemblies

1. The Contractor shall provide all necessary sub-assemblies to meet the project requirements.

2. Provide with M8, fused intelligent relay distribution modules, quantity as required. PTC self-resetting fuses are not allowed.

3. Provide with D8P, intelligent power limited auxiliary fused output modules, quantity as required including (1) dedicated for Mercury panel power.

4. Provide power switches to shut down power for service.

H. Batteries

1. The Contractor shall provide a minimum of (2) 12V, 7ah, sealed Absorbent Glass Mat (AGM) style batteries with F style terminals per power supply.

2. Provide adequate battery backup as required by Authority Having Jurisdiction (AHJ) or a minimum of 4-hours.

3. Manufacturer:

    a. Interstate Power Patrol FAS1075

    b. Power Sonic PS-1270

    c. Or approved equal

2.06 CABLING

A. Provide cabling per manufacturer's recommendations and code requirements for riser rated, plenum, and non-plenum cable types.

B. UTP data cabling required will be provided, installed, terminated and tested by the Division 27 structured cabling Contractor.

C. UTP patch cables will be provided and installed by the Contractor in the IDF and provided and installed by Contractor at the control panels or at the door when required.

D. Wiegand cables for electronic access-controlled doors shall be a composite bundled cable and include the following cables and conductor counts:

1. Card reader, Wiegand – 6 conductor, 22 awg shielded.

2. Lock power – 4 conductor, 18 awg unshielded.
3. Door contact – 2 conductor, 22 awg unshielded. Furnish and install a second 22 awg, 2-conductor cable when the door contact connects to both the access control system and intrusion detection system.
4. Request to exit and/or latch detection/spare – 4 conductor, 22 awg unshielded
5. Manufacturer (Wiegand):
    a. Belden (Wiegand) #658AFJ
    b. General Cable (Wiegand) #4EPL1S
    c. Superior Essex (Wiegand) #AC-A1x-68
    d. West Penn #AC251822B
    e. Or approved equal

E. Cables for RS-485/OSDP in panel or in-panel controller shall be: 2 conductor stranded, twisted, 24 awg, 100% foil shield with 90% tinned copper braid shield with drain, 120 ohm nominal impedance.
1. Manufacturer:
    a. Belden #82841
    b. Or approved equal

F. RS-485/OSDP cables for electronic access-card reader only doors not requiring composite cabling such as secondary/daisy-chained OSDP card readers, remote controllers or RS-485 based intelligent locks, hubs or gateways shall be:
1. Card reader, OSDP – 2 conductor stranded, twisted, 24 awg, 100% foil shield with 90% tinned copper braid shield with drain, 120 ohm nominal impedance, designed for RS-485.
2. Card reader/Device power - 2 conductor, 18 awg unshielded
3. Manufacturer (OSDP):
    a. Belden 6381MD
    b. Sterling Wire & Cable # S182241PRS-10
    c. West Penn # 1PR2418P
    d. Or approved equal

B. Cables for controlled doors shall be 16-guage, 2-conductor, unshielded, stranded cable per controlled door. The cable shall be white in color and plenum rated.

G. Cables for intercom trigger wires, door release buttons, and panic/lockdown buttons shall be 18-gauge, four-conductor, unshielded, stranded cable. The cable shall be white in color and plenum rated.

H. Cables for intercom trigger wires or door contacts shall be 18-gauge, four-conductor, unshielded, stranded cable. The cable shall be white in color and plenum rated.

2.07 DOOR CONTACTS/DOOR POSITION SWITCHES (DC)

A. All doors with card readers and all doors shown for monitored only shall have a door position switch. When the door position switches are not shown in the Division 08 specifications, the security contractor shall furnish and install them. The Security Contractor shall be responsible for the connection of all door position devices to the access control system and other systems if sharing the same door position switch. Door position devices shall be integral to the door hardware whenever possible. The Contractor shall refer to the door hardware schedule and coordinate with the door hardware Contractor on locations and requirements.

B. Sealed and potted magnetic reed switch in contact housing.

C. Provide DPDT

D. Door contacts shall be appropriately sized for any established holes within door frames.

E. Parts provided are basis of design. Determination of final part number is the responsibility of Contractor.

F. Provide color that matches door as close as possible.

G. Provide recessed switch whenever possible.

H. Provide armored whip for surface mount contacts.

I. Provide with a 1k/2k end of line (EoL) pre-built resistor pack. GRI (George Risk Industries, Inc.) 6644 series or approved equal.

J. Provide GRI (George Risk Industries, Inc.) 180 Series for recessed applications.

1. Magnasphere
2. Nascom
3. Or approved equal.

K. Provide GRI (George Risk Industries, Inc.) 4400 series for surface mount applications.

1. Magnasphere
2. Nascom
3. Or approved equal.

L. Provide GRI (George Risk Industries, Inc.) MC-180 Series for hollow top channel applications.

1. Magnasphere
2. Nascom

3. Or approved equal.

M. Provide GRI (George Risk Industries, Inc.) 4532 Series for overhead door applications.

1. Magnasphere
2. Nascom
3. Or approved equal.

2.08 REQUEST TO EXIT (REX) DEVICES

A. All doors with card readers shall have a request to exit with the exception of doors with a card reader in and a card reader out. When integrated request to exit devices are not shown in the Division 08 specifications, the security contractor shall furnish and install motion-based request to exit devices. The Security Contractor shall be responsible for the connection of all requests to exit devices integral to the door, motion based or other to the access control system. Request to Exit devices shall be integral to the door hardware whenever possible. The Contractor shall refer to the door hardware schedule and coordinate with the door hardware Contractor on locations and requirements. Motion based Request to Exit devices shall only be used when not available in the door hardware.

B. Provide with a 1k/2k end of line (EoL) pre-built resistor pack when utilized to release doors with magnetic locks or other high security applications. GRI (George Risk Industries, Inc.) 6644 series or approved equal.

C. Independent adjustable beam pattern.

D. Provide with mounting plate or wall mounting plate to mount over a single-gang backbox when required.

E. Provide white or black color that matches door as close as possible.

F. (2) Form C relay contacts each rated 1 A at 30 VAC or VDC for resistive loads.

G. DC Power draw: 39mA max @ 12 VDC.

H. Dimensions: 1.8”H x 6.75”W x 1.75”D.

I. Utilize contact closure REX hardware built into the handle or crashbar whenever possible.

J. Provide Bosch DS160/161

1. Provide with TP160/161 mounting plate when mounted over a backbox.
2. Or approved equals.

2.09 ELECTRIFIED HARDWARE (EH)

A. The Security Contractor shall be responsible for the connection of all electrified hardware to the access control system. This shall include providing centralized power supplies located next to or integral to the access control panels. The Contractor shall

coordinate with the door hardware specifications and schedules for additional information.

2.10 ADA POWER ASSIST DOOR OPERATOR INTEGRATION RELAYS

A. The Contractor shall provide all necessary relays to interface to the ADA operators at access-controlled doors with ADA door operators. The ADA operator interface shall be managed by the access control system. Local “smart relays” that require compiled code are not allowed.

B. Hardwired paddles

1. Provide with a DPDT relay. Replace existing relay in paddle as necessary.

2. Manufacturer:

a. Altronix RB1224

b. Or approved equal

C. Wireless paddles

1. Provide with DPDT wireless relay transmitter and receiver. Replace existing relay in paddle as necessary.

2. Manufacturer:

a. Larco Atek 234475 transmitter and Larco Atek 233804 receiver

b. Or approved equal

2.11 DOOR RELEASE BUTTON, UNDER COUNTER

A. SPDT, momentary push button

B. Guard ring around button to prevent accidental activation

C. Mount with button facing back of desk

D. Coordinate exact mounting location after deck or counter is fully complete and the sitting position has been decided.

E. Manufacturer:

1. Alarm Controls TS-18

2. Or approved equal

2.12 LOCKDOWN BUTTONS

A. Exact device type and style to be coordinated with Owner prior to approval or purchase. A selection of button options shall be presented to the Owner for review.

B. Button shall be hardwired.

C. Provide with a 1k/2k end of line (EoL) pre-built resistor pack. GRI (George Risk Industries, Inc.) 6644 series or approved equal.

D. Buttons within a single space may be wired in parallel and be programmed as a single zone.

E. Manufacturer:

1. Under desk – Honeywell Resideo 269R

2. Wall push type – STI-USA Stopper Station #SS2432LD-EN

a. Blue, flush cover, latching with key to unlock, Text = LOCKDOWN. Coordinate exact text to use with Owner prior to purchase. Provide with appropriate power supply connection for illumination.

3. Or approved equals

2.13 DISCONNECTING DOOR CORD

A. The Contractor shall furnish and install disconnecting door cords for all removable mullions.

B. Polarized quick disconnecting plug

C. Integrated stress relief chain

D. Surface mountable

E. Manufacturer:

1. Honeywell Resideo 69 Disconnecting Door Cord

Part 3 - EXECUTION

3.01 SYSTEM PROGRAMMING

A. The Contractor shall provide all programming necessary for a turnkey system.

B. Programming shall include but not limited to setting all required IP addressing, setting passwords, firmware upgrades, adding the devices into the software, partitioning, area/zone creation, device naming, mapping, cross system integration, schedules, basic card holder groups, access levels, etc.

C. The Contractor shall be responsible for temporary schedules, card holder groups, access levels, etc required to make a building functional for certificate of occupancy requirements or basic facility use.

3.02 SYSTEM MAPPING

A. The Contractor shall provide a satellite level screen shot map showing exterior devices. These maps shall include drill down links to access the building floor plans where all interior and exterior devices are shown. The overview satellite map shall show alarms signifying there is an alarm in the building to draw attention quickly to the correct building then floor plan.

B. The maps shall have links to the other levels/sections as well as the global map.

C. Integrated cameras shall show their approximate field of view.

D. The floor plans shall include all access-controlled doors, controlled overhead doors and integrated devices.

E. Alarm icons for lockdown, panic and other alarms.

F. Contractor shall create non-card reader doors for non-card reader door unlock and status monitoring.

G. Contractor shall create map entities for intercoms.

3.03 SYSTEM PARTITIONING, ZONING AND NAMING

A. The Contractor shall program each facility to be in its own partition. Some facilities may require sub-partitions to control user access to certain areas. Each manufacturer may use different names for partitions, zones, areas, etc. Adapt as required.

B. All devices, inputs, outputs and other applicable software/hardware entities shall be named by the Contractor which includes naming at the administration/interface level in additional to the user facing interface.

C. As a basis to start, the following partition, zoning and naming shall be followed:

1. Partition: Building name
    a. Zone 1: Building name and zone name such as exterior, 1st floor, etc.
        i. Device 1: Building name and floor/zone name - Door # or device name
        ii. Device 2: Building name and floor/zone name - Door # or device name
        iii. Repeat as required
    b. Zone 2: Building name and zone name such as 2nd floor, etc.
        i. Device 1: Building name and floor/zone name - Door # or device name
        ii. Device 2: Building name and floor/zone name - Door # or device name
        iii. Repeat as required
    c. Repeat zones as required.
2. Repeat Partitions as required.

D. The Owner shall have the final say. The Contractor shall schedule a coordination meeting with the Owner and Consultant to coordinate actual project structure and naming prior to starting any programming.

3.04 INSTALLATION PROCEDURES

A. The Contractor shall cable all controlled or monitored doors, intercoms, etc. and terminate this cable in the access control panels no less than 3 weeks prior to substantial completion regardless of the status of the field devices such as door hardware, card readers, intercoms, etc.

B. The Contractor shall program the access control system no less than 2 weeks prior to substantial completion so when field devices are installed and terminated, associated door hardware and full system functionality can be tested. Programming shall include all doors, associated inputs, outputs, and interoperability regardless of final field device status.

C. The Contractor shall perform final connections and testing onsite when field devices such as electrified door hardware has been installed.

3.05 ADA POWER ASSIST DOOR OPERATOR INTERFACE

A. Certain electric locking mechanisms with card access shall be connected (hardwired) to the ADA Power Assist Door Operator pushbutton. In this scenario, card reader shall be interfaced to the ADA Door Operator pushbutton to approve activation of door motor based on card authorization or pre-programmed security schedule.

B. Door motor/operator shall not be energized until authorized by the security system to prevent operation and eventual burn-out of the motor from hitting the button with the security system activated.

C. The door shall allow free egress via push paddle regardless if the door is in a locked or unlocked state.

D. The paddles and operators shall be tied through the access control system, so the actions appear in the device trees, are mappable, logged and can be scheduled or overridden.

1. Connect the exit paddle to an input on the access contro panel to trigger a door unlock when activated.

2. Connect an output from the access control system to the exit paddle input on the door operator to trigger the door operator to activate. Program a 1-second delay to prevent binding.

3. Connect the entry paddle to a relay that follow the lock status. When the lock is energized, the relay shall close allowing the entry paddle to activate the operator.

4. Connect the latch bolt monitor, if present, to the access control system to signal the door is manually dogged and to allow the entry paddle to operate.

E. Contractor shall provide all necessary cable, hardware, relays, I/O modules, interfaces, and system programming to support all necessary functionality.

F. All logic and programming shall be controlled through the access control system. Local logic boards, smart relays, etc. shall not be utilized.

3.06 DOOR RELEASE BUTTONS

A. Door release buttons shall be tied through the inputs of the access control system.

B. The button release shall be interfaced in a way that the actions appear in the device trees, are mappable, logged and can be scheduled or overridden.

C. Contractor shall provide all necessary cable, hardware, relays, I/O modules, interfaces, and system programming to support all necessary functionality.

3.07 INTERCOMS AND REMOTE INTERCOM RELEASE

A. The Contractor shall configure the intercoms and intercom master stations for point to point/multi-point communication with call rolling.

B. Remote intercom release relays shall be tied through the inputs of the access control system.

C. The intercom release shall be interfaced in a way that the actions appear in the device trees, are mappable, logged and can be scheduled or overridden.

D. Contractor shall provide all necessary cable, hardware, relays, I/O modules, interfaces, and system programming to support all necessary functionality.

3.08 PANIC/DURESS BUTTONS

A. Panic/Duress buttons shall be tied through dedicated inputs of the access control system.

B. The buttons shall be interfaced in a way that the actions appear in the device trees, are mappable and logged.

C. When a panic/duress button is activated an event to action shall occur notifying client workstations. These alarms shall be activated on a map with a clear red flashing icon. Any associated or integrated cameras shall pop-up.

D. Additional actions may be required and shall be coordinated with the Owner and Consultant.

E. Contractor shall provide all necessary cable, hardware, relays, I/O modules, interfaces, and system programming to support all necessary functionality.

3.09 FIRE ALARM INTERFACE

A. Certain electric locking mechanisms shall be connected (hardwired) to the building fire alarm system for fail safe release upon any fire alarm. A single low voltage/low current normally closed dry contact from the fire alarm system shall be provided by others in each room with Security Control Panels. This contact shall open on any fire alarm condition.

B. The access control system shall provide an output to the fire alarm system to release mag hold opens on alarm.

C. The fire alarm system shall provide an output to the access control system to trigger various rules and actions in the access control system.

D. All doors equipped with mag locks shall be connected to a fire alarm relay to release on fire alarm.

E. All doors secured with a card reader in and out shall be connected to a fire alarm relay to release on fire alarm.

F. The Contractor shall provide all additional UL listed failsafe relays and power supplies as necessary to interface to this contact and unlock all of these doors.

G. The Contractor shall verify fail safe and fail secure locking requirements with the Architect, door hardware contractor/provider and the AHJ.

3.10 END OF LINE SUPERVISION

A. The Contractor shall furnish and install end-of-line resistors to provide end-of-line supervision on all access control input devices. This shall include but is not limited to door position switches, request to exit devices, door release buttons, and duress/panic buttons.

B. The Contractor shall furnish and install resistors as near to the field device as possible. Supervision resistance values shall be natively compatible with the associated control panel.

1. Mercury Security based installations shall utilize 1K resistors to provide a 1K / 2K ohm resistance values from associated inputs.

3.11 RS-485 AND OSDP BASED COMMUNICATION

A. RS-485 based communication busses utilized by the access control system shall be compliant with the RS-485 communication standard, including RS-485 start-of-line and end-of-line termination requirements.

B. RS-485 communication busses include control panel and module communication, OSDP based reader communication, and RS-485 based intelligent lock gateways.

C. The Contractor shall furnish and install 120-ohm end of line termination at control panels, modules, readers, and other peripherals where applicable.

D. Termination shall be integral to the hardware where available. The Contractor shall furnish and install a 120-ohm resistor to terminate equipment not featuring on-board RS-485 termination.

E. The Contractor shall furnish and install 1K-ohm pull down/line bias resistors between the DAT/TR- and GND lines on interface modules and controllers. The pull down/line bias resistor shall be installed at the panel for each reader.

F. The Contractor shall configure OSDP devices to communicate at a minimum of 38,400 baud rate. The default 9,600 baud rate is not acceptable.

3.12 PASSWORDS

A. The Contractor shall coordinate a secure project password with the Owner and Consultant. This password shall be documented by the Contractor and used for all devices.

3.13 TESTING

A. Refer to Section 27 00 00 for additional requirements.

B. Prior to energizing or testing the system, ensure the following:

1. All products are installed in a proper and safe manner per the manufacturer’s instructions.

2. Dust, debris, solder, splatter, etc., is removed.

3. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.

4. All products are neat, clean, and unmarred, and parts are securely attached.

C. Contractor shall ensure that each device in the security system is functioning normally and in such a manner as to meet the functional and performance requirements in this specification.

3.14 TRAINING

A. Refer to Section 27 00 00 for additional requirements.

B. Provide system operations, administration, and maintenance training by factory-trained personnel qualified to instruct.

1. Contractor shall provide up to 4 hours of scheduled and dedicated training time.

2. Provide printed training materials for each trainee, including product manuals, course outline, workbook or student guides, and written examinations for certification.

3. Provide hands-on training with operational equipment.

4. Training shall be oriented to the specific system being installed under this contract as designed and specified.

5. Contractor shall provide all necessary documentation of system operating parameters prior to scheduled training sessions.

3.15 WARRANTY

A. Refer to Section 27 00 00 for additional requirements.

3.16 INSTALLATION PRACTICES

A. All services provided shall be professional and conform to the highest standards for industry practices. The Owner reserves the right to halt any installation due to poor workmanship. All work shall be defect free, and the installer shall replace, at their expense, any work found to be defective.

B. The Owner reserves the right to halt any installation due to failure of Contractor to observe installation-free periods due to instructional or administrative requirements. To the maximum extent possible, the Owner will provide advance notice of such periods.

C. Contractor is responsible for providing a complete and system.

D. All manufactured items, materials, and equipment shall be applied, installed, connected, erected, used, and adjusted as recommended by the manufacturers, or as indicated in their published literature, unless specifically noted herein to the contrary.

E. Contractor shall follow these standards and approved submittals for locations of power supplies. The Owner intends to limit the number and location of power

supplies to facilitate more effective long-term support and maintenance of the system.

F. Installation of locks on fire rated doors which require any modification or drilling of the door shall be done in accordance with the NFPA by a properly qualified and certified installer. The doors field WH-ETL labelling shall be properly updated.

3.17 COORDINATION

A. Contractor shall provide up to 8 hours (up to four, 2-hour sessions) of scheduled and dedicated coordination time to assist Owner with sequence of operation, rule creation and coordination as requested by Owner or Consultant.

3.18 AESTHETICS

A. All cables and equipment terminating at panels frames shall be vertically straight, with no cables crossing each other, from twelve inches inside the ceiling area to the termination block.

B. All cable bundles shall be combed and bundled to accommodate individual termination block rows and panels.

C. For any given telecom room, a horizontal and vertical alignment for all mounting hardware will be maintained to provide a symmetrical and uniform appearance to the distribution frame.

D. All surface-mounted devices shall be firmly secured level and plumb

E. All rack mount equipment shall be securely installed.

3.19 HARDWARE LAYOUT

A. Hardware positioning and layout shall be reviewed and approved by the Owner prior to construction. The review does not exempt Contractor from meeting any of the requirements stated in this document.

3.20 SERVER INSTALLATION PRACTICES

A. Verify that the manufacturer approved server hardware, OS meets the Owner’s IT standards prior to ordering.

B. Coordinate server power, cooling, and mounting requirements with Owner prior to installation.

C. Coordinate virus scan/security software requirements with Owner and manufacturer prior to installation.

3.21 DEVICE CABLING/WIRING INSTALLATION PRACTICES

A. All external wire and cables shall be supported at least every five feet from the structure or as required to maintain not more than 12" cable sag between supports and without over tensioning the cables. Provide j-hooks as needed where cable tray or raceway is not available.

B. This Contractor shall coordinate installation with Division 27 cabling Contractor to ensure there is at least 2-inches of physical separation between security cabling and voice/data cabling throughout cable path. Voice/data cabling Contractor has first claim to cable tray.

C. All cables, regardless of length, shall be labeled within 18" of both ends with an identifier that is keyed to the door, room, or corridor number as identified.

D. All cables shall have 6-foot service loops neatly coiled in the equipment room. During initial cable rough-in, this Contractor shall have sufficient slack to route anywhere within the equipment room.

E. Cabling shall be adequately supported with Velcro wire wraps and horizontal support cable managers fastened to rack frame. Cables shall be dressed in a neat and orderly fashion. Any cabling or equipment installation that is deemed unacceptable by the Owner or Consultant shall be replaced or corrected by the Contractor at no additional cost. Plastic zip ties are not allowed.

F. All cables are to run at right angles to the structure, placed above the ceiling in halls or corridors.

G. Cables shall not run above red iron joist.

H. Contractor shall make every effort to conceal wiring and other apparatus into walls, floors, and ceilings, assuming code and good engineering practice allows and suggests.

I. Ties and straps shall be installed snugly without deforming cable insulation. Ties shall be spaced at uneven intervals not to exceed four feet. No sharp burrs shall remain where excess length of the cable tie has been cut.

J. Contractor shall notify Owner immediately if obstruction or hazard is discovered in a pathway provided by others.

K. Cable shall be stored and handled to assure that it is not stretched, kinked, crushed, or abraded in any way. Bend radiuses shall meet manufacturer specifications and/or recommendations. Cable shall not be installed in ambient temperatures or moisture conditions above or below the manufacturer’s rating.

L. No splices shall be installed in any cable.

3.22 CABLE TERMINATION

A. Termination hardware (blocks and patch panels) positioning and layout shall be reviewed and approved by the Owner prior to construction. The review does not exempt Contractor from meeting any of the requirements stated in this document.

3.23 FIRE STOPPING

A. Fire stopping of openings between floors, fire-rated walls, and smoke-rated walls, created by others for This Contractor to pass cable through, shall be the responsibility of the This Contractor. Sealing material and application of this material shall be accomplished in such a manner that is acceptable to the local fire and building authorities having jurisdiction over this work.

B. Any openings created by or for This Contractor and left unused shall be sealed up by This Contractor.

C. This Contractor shall be responsible for creating a waterproof seal in and around any openings that This Contractor creates from the structure to the outside environment.

3.24 SYSTEM INSPECTION

A. Contractor shall coordinate with project representative for inspection after Contractor has completed testing of entire system.

B. Contractor shall have trained Contractor representative and testing equipment on site during inspection to assist with spot verification of tests.

3.25 LABELING

A. Contractor shall neatly label all security devices and cabling at both ends. All labels shall be on Project as-built drawings.

3.26 DOCUMENTATION

A. Upon completion of the installation, Contractor shall provide full documentation sets to the Consultant for approval as described in section 27 60 00. All documentation shall become the property of the Owner.

B. Documentation shall include the additional specific items detailed in the subsections below:

1. Contractor shall provide hard copy and electronic forms of the final test results.
2. Contractor shall provide a document including the following:
    a. Door label/identifier
    b. Location of each drop by orientation/permanent landmark in the room
    c. Contractor shall provide accurate as-built Construction Drawings. The drawings are to include cable routes and device locations.

3.27 PRE-CHECK OUT

A. The Contractor shall demonstrate the following to Owner during system demonstration.

1. The card readers are fully installed and functional.

3.28 FINAL ACCEPTANCE

A. In addition to closeout requirements in section 27 60 00, This Contractor shall demonstrate the following before final approval.

1. Owner training is complete.
2. Punch list items are complete.
3. As-built documentation is complete and submitted to Owner/Consultant.

3.29 FINAL PROCEDURES

A. Perform final procedures in accordance with section 27 60 00.

End of Section

SECTION 27 6400
VIDEO SURVEILLANCE SYSTEM

Part 1 - GENERAL

1.01 SCOPE

A. This specification section covers the furnishing and installation of a new and complete, low-voltage, Video Management System (VMS).

B. Contractor shall furnish and install video surveillance hardware devices, mounting brackets, and other components of the system as required.

C. Contractor shall furnish and install all video management system related software to allow this system expansion. Software includes required licensing cameras, devices, workstations and required physical security system Integration.

D. Furnish and install outlets, junction boxes, conduit, connectors, wiring, and other accessories necessary to complete the system installation. Requirements shall be in accordance with Division 26.

E. Refer to Section 27 00 00 for additional project scope information.

1.02 PRECEDENCE

A. Obtain, read and comply with General Conditions and applicable sub-sections of the contract specifications. Where a discrepancy may exist between any applicable sub-section and directions as contained herein, this section shall govern.

1.03 RELATED WORK

A. Section 27 00 00 – General Technology Requirements

B. Section 27 05 00 – Communications General Requirements

C. Section 27 05 26 – Grounding and Bonding for Technology Systems

D. Section 27 05 28 – Pathways for Technology Systems

E. Section 27 05 37 – Firestopping for Technology Systems

F. Section 27 11 00 – Communications Equipment Rooms

G. Section 27 15 00 – Communications Horizontal Cabling

H. Section 27 60 00 – Physical Security General Requirements

I. Section 27 62 00 – Electronic Access Control System

1.04 DEFINITIONS

A. Refer to Section 27 00 00 for additional definitions.

1.05 REFERENCE STANDARDS AND CODES

A. Refer to Section 27 00 00 for additional requirements.

1.06 QUALIFICATIONS

A. The Contractor shall be a Milestone certified dealer.

B. Refer to Section 27 00 00 for additional requirements.

1.07 REQUIRED SUB-CONTRACTOR

A. The contractor shall sub-contract the following contractor for all security work:

All State Communications

1.08 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

B. The following items shall be provided in a single, combined, comprehensive submittal package. Partial submittals will only be considered in special circumstances, such as getting early approval of long-lead-time items or products requiring additional coordination with other trades.

C. Equipment Schedules

1. Provide a complete schedule of significant materials for the project, with columns for the following items: Manufacturer, Part Number, Description, Quantity, and Unit Pricing.

D. Product Cut Sheets

1. Provide basic product data sheets (1-2 pages per product) for all products listed in the equipment schedule. Do not include longer documents such as installation manuals.

2. Identify (highlight, arrow, etc.) the actual version and part number of the product that will be utilized on the project. This applies to mounting hardware, cabling, connectors, software, and power distribution equipment in addition to major system components.

E. Shop Drawings

1. Pre-construction submittals are intended to document the details of installation. Exact copies of the Consultant's drawings and specifications are not acceptable as pre-construction shop drawings. The Consultant's drawings are intended to outline the functional requirements, but do not provide install-level detail.

2. Exact requirements will vary depending on the project scope. Provide the following elements where applicable:

a. Floor Plans: Include device/equipment locations, installation notes, and electrical coordination notes (specific conduit routing, etc.).

b. System Drawings: Include functional diagrams for each system detailing system flow including all equipment, routing, inputs/outputs, wiring signal type, cable identification labels, connectors, adapters, intra/inter-rack power distribution, installation notes, and any other information required to convey the complete turnkey system design for an installer to complete the work.

c. Wall Equipment Elevations: Include placement of all wall-mounted equipment, drawn to scale.

d. Server Storage Calculations: Include each camera type, quantity, resolution, storage parameters, and storage duration, with the calculations showing the resulting server size or space requirements on an existing server.

1.09 PRE-INSTALLATION PROCEDURES

A. For in-use, existing facilities or retrofit projects, the Contractor shall assign all applicable electronics IP addresses and secure passwords prior to being delivered to the project or installed. Confirm password with Owner and Consultant prior to setting them.

1.10 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

1.11 CLOSEOUT SUBMITTALS

A. Refer to Section 27 00 00 for additional requirements.

1.12 GENERAL SUMMARY

A. System shall include IP cameras and a server based NVR with client stations and storage as described in this section and on the drawings.

B. The Category 6 cabling to each camera shall be provided by the structured cabling Contractor.

C. Patch cords for the IP cameras to the network switches shall be furnished by this Contractor and installed by the Contractor with participation by the Owner. Patch cords from the IP Camera to the data jack shall be furnished by this Contractor and installed by this Contractor.

D. System installation shall include, but not be limited to, installation, programming, and configuration of system components as well as all associated software upgrades, patches, and maintenance for the first year.

E. Contractor is responsible for meeting with Owner’s representative at time of camera installation to verify exact placement and view of each camera to ensure coverage area is as intended.

1.13 MOUNTING AND INSTALLATION

A. Contractor shall provide the appropriate mounting hardware for all ceiling types and wall types where cameras shall be located. Plastic anchors are not allowed.

B. Wall mounted 180/360 degree or multi-sensor cameras shall be mounted horizontally on a wall arm, gooseneck, parapet, pendant or other similar method.

C. Exterior cameras shall be mounted on a wall arm/gooseneck.

D. Cameras mounted in droptile shall have a tile support bridge with a steel support cable connected to structure to prevent tile sagging, theft and vandalism. Utilizing toggle bolts or other screw in anchors is not allowed.

1.14 CODE AND STANDARD REQUIREMENTS

A. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association and any other codes as required by the AHJ.

B. All materials shall be listed by UL and shall bear the UL label. 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.

Part 2 - PRODUCTS

2.01 VMS GENERAL REQUIREMENTS

A. The Contractor shall extend the existing Milestone Xprotect Professional Plus software for this project.

B. The Contractor shall furnish all required licensing

C. The Contractor shall match the current software maintenance duration for new licensing.

2.02 MAPPING SOFTWARE

A. The VMS software shall be provided with native integrated mapping software.

B. The Contractor shall provide a satellite level screen shot map showing exterior devices. These maps shall include drill down links to access the building floor plans where all interior and exterior devices are shown. The overview satellite map shall show alarms signifying there is an alarm in the building to draw attention quickly to the correct building then floor plan.

C. The maps shall have links to the other levels/sections as well as the global map.

D. All cameras shall show their approximate field of view.

E. The cameras shall change state when motion is detected.

F. The floor plans shall include all access controlled door and integrated devices.

G. The Contractor shall be responsible to provide all the labor to setup these maps and place all the devices.

H. The Contractor shall get sign-off from the Owner and Consultant on the finished maps.

I. The Contractor shall obtain the building plans from the Consultant for their use.

2.03 VMS SERVERS

A. The Contractor shall utilize the existing servers.

2.04 CAMERAS AND DEVICES

A. General:

1. All cameras and devices shall be time synced to the Owner's NTP server. Coordinate with the Owner to acquire the appropriate NTP address to use.
2. The contractor shall coordinate with the owner for IP addressing, network configuration, QoS and multicast network configuration.
3. The Contractor shall enable QoS on all cameras and intercoms for the video stream, audio stream, event/alarm data, management and metadata at the Owners request.
4. The Contractor shall select the appropriate mounting hardware for the situation.
5. All cameras shall be equipped with remote autofocus or autoback focus with the exception of fixed lens 180/360 degree cameras and encoded analog cameras.
6. Multi-sensor 180 and 360 cameras shall have each sensor optimally calibrated independently to the conditions.
7. All cameras shall be vandal proof and appropriate for the environment it is being installed in.
8. All cameras and devices shall have the latest VMS recommended firmware installed and all cameras of the same model shall have matching firmware versions. The Contractor shall provide all necessary firmware upgrades to keep the Owner on the latest version throughout the duration of the project. At the completion of the project the Owner shall have the option to receive a final firmware update the latest version before the project is paid in full.
9. The contractor shall coordinate with the owner for IP addressing, network configuration and multicast network configuration.
10. All cameras regardless of manufacturer/model shall have a consistent user name and non-standard password set. This shall be documented and provided to the owner and consultant prior to inspections.
11. Cameras and devices shall not be manufactured by or contain components manufactured by a federal, state or local government proposed blacklisted or sanctioned manufacturer or a subsidiary of those manufacturers.
12. Cameras and devices shall not be an OEM or "white label" product. The camera or device shall be manufactured by the named manufacturer.
13. The cameras and devices firmware shall be developed and manufactured by the stated manufacturer and shall not be developed, written or OEM by a 3rd party.
14. The camera requirements below represent general performance criteria. Approved equals will have slight differences in specifications. The Owner and

Consultant have complete discretion to reject approved equals that stray too far from the minimum requirements.

B. Camera Type 1 shall:

1. Be designed to provide at least four video streams in all resolutions at a selectable range up to 30 frames per second (60Hz mode) using H.265, H.264 and MJPEG.
2. Native resolution of 1920x1080 pixels.
3. Support the following video resolutions: 1920x1080, 1280x720, 640x360, 320x180, 160x90
4. Provide both 4:3 and 16:9 aspect ratios.
5. 3.4-8.9 mm lens @ F-stop 1.8.
    a. Minimum horizontal view angle 100°-36°
6. Be equipped with a high-quality varifocal lens, provide automated iris functionality with provide remote focus functionality.
7. Mechanical day/night IR cut filter.
8. Provide pictures down to 0.16 lux while in day mode (with IR-filter in use) and down to 0.03 lux while in night mode (with IR-filter removed).
9. Be equipped with true multi-frame wide dynamic range (WDR) of at least 120dB at maximum native resolution.
10. Minimum IP66 and IK10 ratings (Exterior model) and Minimum IP52 and IK08 ratings (Interior model).
11. Camera shall provide modern bit rate reduction technology. Such as Axis Zipstream technology.
12. Contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.
13. Be equipped with an integrated event functionality, which can be triggered by: video motion detection, schedule, camera tampering, embedded third party applications, external input, audio detection, edge storage disruption detection. The camera shall provide memory for pre & post alarm recordings. Event functions shall be configurable via the web interface.
14. Provide the ability to adjust the camera modules angle with at least 180° pan, 80° tilt and 95° rotation while maintaining an image that is not interfered with by the camera housing.
15. IEEE 802.1X (Authentication) compliant.
16. Manufacturer and model:
    a. Interior Location - Axis P3275-LV
    b. Exterior Location – Axis P3275-LVE

C. Camera Type 2 shall:

1. Be designed to provide at least four video streams in all resolutions at a selectable range up to 30 frames per second (60Hz mode) using H.265, H.264 and MJPEG.
2. Native resolution of 3840x2160 pixels (8mp).
3. Support the following video resolutions: 3840x2160, 1920x1080, 1280x720, 640x360, 320x180, 160x90
4. Provide both 4:3 and 16:9 aspect ratios.
5. 6.3-13 mm lens @ F-stop 1.5-2.9.
    a. Minimum horizontal view angle 104°-50°
6. Be equipped with a high-quality varifocal lens, provide automated iris functionality with provide remote focus functionality.
7. Mechanical day/night IR cut filter.
8. Provide pictures down to 0.04 lux while in day mode (with IR-filter in use).
9. Be equipped with true multi-frame wide dynamic range (WDR) of at least 120dB at maximum native resolution.
10. Minimum IP66 and IK10 ratings (Exterior model) and Minimum IP52 and IK08 ratings (Interior model).
11. Camera shall provide modern bit rate reduction technology. Such as Axis Zipstream technology.
12. Contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.
13. Be equipped with an integrated event functionality, which can be triggered by: video motion detection, schedule, camera tampering, embedded third party applications, external input, audio detection, edge storage disruption detection. The camera shall provide memory for pre & post alarm recordings. Event functions shall be configurable via the web interface.
14. Provide the ability to adjust the camera modules angle with at least 180° pan, -40° - +75° tilt and 95° rotation while maintaining an image that is not interfered with by the camera housing.
15. IEEE 802.1X (Authentication) compliant.
16. Manufacturer and model:
    a. Interior Location – Axis Q3548-LV
    b. Exterior Location - Axis Q3548-LVE

D. Camera Type 3 shall:

1. Wide Angle 180-degree single sensor camera with Stereographic fisheye lens.

2. Be designed to provide at least four video streams of each sensor in all resolutions at a selectable range up to 15 frames per second (60Hz mode) using H.265, H.264 or MJPEG.
3. Native sensor resolution of 2880x2880 pixels.
4. 1.3 mm lens @ F-stop 2.4.
    a. 183-degree horizontal view, 360-degree total panoramic view
5. Contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.
6. Be equipped with a high-quality varifocal lens, provide automated iris functionality with provide remote focus functionality.
7. Provide pictures down to 0.19 lux while in day mode (with IR-filter in use) and down to 0.04 lux while in night mode (with IR-filter removed).
8. Mechanical day/night IR cut filter.
9. Power efficient, long life invisible 850 (nm) IR LED. Adjustable intensity, range of up to 49'.
10. Be equipped with an integrated event functionality, which can be triggered by: video motion detection, schedule, camera tampering, embedded third party applications, external input, audio detection, edge storage disruption detection. The camera shall provide memory for pre & post alarm recordings. Event functions shall be configurable via the web interface.
11. IEEE 802.1X (Authentication) compliant
12. IK10, NEMA 4X and IP66 rated camera.
13. Manufacturer and model:
    a. Exterior Location - Axis M4318-PLE

E. Camera Type 4 Shall:

1. Semi-panoramic (2) two sensor camera.
2. Be designed to provide at least four video streams of each sensor in all resolutions at a selectable range up to 30 frames per second (60Hz mode) using H.264 or MJPEG.
3. Native resolution of each sensor of 1920x1080 pixels.
4. Support the following video resolutions per sensor: 1920x1080 to 640x360.
5. Motorized 3.3 – 8.1 mm lens @ F-stop 1.9-3.2.
    a. 107 to 39 degree horizontal field of view.
6. Remote zoom and focus.
7. Integrated 850nm IR with up to a 50' range.

8. Contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.
9. Be equipped with a high-quality varifocal lens, provide automated iris functionality and remote focus functionality.
10. Provide pictures down to 0.15 lux while in day mode (with IR-filter in use) and down to 0.04 lux while in night mode (with IR-filter removed).
11. Be equipped with an integrated event functionality, which can be triggered by: video motion detection, schedule, camera tampering, embedded third party applications, external input, audio detection, edge storage disruption detection. The camera shall provide memory for pre & post alarm recordings. Event functions shall be configurable via the web interface.
12. IEEE 802.1X (Authentication) compliant
13. IK09, NEMA 4X and IP66 rated camera.
14. Manufacturer and model:
    a. Interior/Exterior Location - Axis P4705-PLVE

F. Camera Type 5 Shall:

1. Semi-panoramic (2) two sensor camera.
2. Be designed to provide at least four video streams of each sensor in all resolutions at a selectable range up to 30 frames per second (60Hz mode) using H.264 or MJPEG.
3. Native resolution of each sensor of 3840x2160 pixels.
4. Support the following video resolutions per sensor: 3840x2160 to 360x240.
5. Motorized 3.2 – 8.1 mm lens @ F-stop 1.9-3.2.
    a. 108 to 40 degree horizontal field of view.
6. Remote zoom and focus.
7. Integrated 850nm IR with up to a 50’ range.
8. Contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.
9. Be equipped with a high-quality varifocal lens, provide automated iris functionality and remote focus functionality.
10. Provide pictures down to 0.19 lux while in day mode (with IR-filter in use) and down to 0.05 lux while in night mode (with IR-filter removed).
11. Be equipped with an integrated event functionality, which can be triggered by: video motion detection, schedule, camera tampering, embedded third party applications, external input, audio detection, edge storage disruption detection. The camera shall provide memory for pre & post alarm recordings. Event functions shall be configurable via the web interface.

12. IEEE 802.1X (Authentication) compliant
13. IK09, NEMA 4X and IP66 rated camera.
14. Manufacturer and model:
    a. Interior/Exterior Location - Axis P4708-PLVE

G. Camera Type 6 shall:

1. Panoramic (4) four sensor 360-degree camera
2. Be designed to provide at least four video streams of each sensor in all resolutions at a selectable range up to 30 frames per second (60Hz mode) using H.264 or MJPEG.
3. Native resolution of each sensor of 1920x1080 pixels.
4. Support the following video resolutions per sensor: 1920x1080 to 160x90.
5. Motorized 3.0 – 6.0 mm lens @ F-stop 1.8-2.6.
    a. 96 to 49 degree horizontal field of view.
6. Remote zoom and focus.
7. Integrated 850nm IR with up to a 49’ range.
8. Contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.
9. Be equipped with a high-quality varifocal lens, provide automated iris functionality and remote focus functionality.
10. Provide pictures down to 0.17 lux while in day mode (with IR-filter in use) and down to 0.04 lux while in night mode (with IR-filter removed).
11. Be equipped with an integrated event functionality, which can be triggered by: video motion detection, schedule, camera tampering, embedded third party applications, external input, audio detection, edge storage disruption detection. The camera shall provide memory for pre & post alarm recordings. Event functions shall be configurable via the web interface.
12. IEEE 802.1X (Authentication) compliant
13. IK09, NEMA 4X and IP66 rated camera.
14. Manufacturer and model:
    a. Interior/Exterior Location - Axis P3735-PLE

H. Camera Type 7 Shall:

1. Panoramic (4) four sensor 360-degree camera
2. Be designed to provide at least four video streams of each sensor in all resolutions at a selectable range up to 30 frames per second (60Hz mode) using H.264, H.265 or MJPEG.

3. Native resolution of each sensor of 3840x2160 (4k/8MP) pixels.
4. Motorized 3.0 – 6.0 mm lens @ F-stop 1.9-3.2.
    a. 108 to 40 degree horizontal field of view.
5. Remote zoom and focus.
6. Integrated 850nm IR with up to a 50’ range.
7. Contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.
8. Be equipped with a high-quality varifocal lens, provide automated iris functionality and remote focus functionality.
9. Provide pictures down to 0.2 lux while in day mode (with IR-filter in use) and down to 0.04 lux while in night mode (with IR-filter removed).
10. Be equipped with an integrated event functionality, which can be triggered by: video motion detection, schedule, camera tampering, embedded third party applications, external input, audio detection, edge storage disruption detection. The camera shall provide memory for pre & post alarm recordings. Event functions shall be configurable via the web interface.
11. IEEE 802.1X (Authentication) compliant
12. IK09, NEMA 4X and IP66 rated camera.
13. Manufacturer and model:
    a. Interior/Exterior Location - Axis P3738-PLE

2.05 FURNISH AND INSTALL WITH APPROPRIATE AXIS MID-SPAN POE INJECTORCAMERA MANAGEMENT TOOLS

A. The Contractor shall setup on an appropriate server the manufacturer’s camera management tools utilized to manage the settings, firmware and status of all installed cameras. The Contractor shall train the Owner on the use of this software.

2.06 CAMERA ANALYTICS PLUG-IN

A. The Contractor shall install and configure any analytic plug-ins required on the servers and client workstations as required.

B. The Contractor shall furnish and install all licensing required to utilize the analytics and plug-ins.

2.07 ETHERNET WITH POWER OVER ETHERNET (POE) UTP EXTENDER

A. The Contractor shall provide Ethernet with PoE UTP extenders for out-of-distance cameras or Ethernet devices.

B. Shall support IEEE 802.3af (PoE) and IEEE 802.3at (PoE+) on input and output.

C. Extends UTP up to 350 meters or greater.

D. 10Base-T or 100Base-TX, full-duplex with auto-negotiation.

E. Multicast support.

F. Mid-span extenders are forbidden.

G. Manufacturer:

1. Veracity Longspan with PoE

a. Provide specific models as required

b. Provide with dedicated power supply as or when required.

2. Or approved equal

2.08 ETHERNET WITH POWER OVER ETHERNET (POE) UTP SURGE SUPPRESSOR

A. The Contractor shall provide and install a surge protector for all exterior mounted cameras. Cameras that are not attached to the building or reach above the building roof line shall have a surge protector at the camera side and interior termination side.

B. There shall be a minimum of a 36” shielded patch cable from the surge protector to the device to allow for adequate clamping time.

C. When protector is mounted in interior, dry or weather sealed enclosure:

1. Shielded RJ-45 jacks and ground stud

a. Bond to building steel or ground point with a minimum of a 14 AWG green solid copper cable keeping the distance as short as practical. Ground connection shall not exceed 5 ohms.

b. Do not use shielded cable on the output.

2. Maximum supported data rate: 10,000Mb/s (10 Gigabit)

3. Supports IEEE 802.3af (PoE)

4. Max current rating of 30A per pair.

5. UL 497B listed

6. 110 punch down in and 110 punch down out.

a. 110 punch down in and RJ-45 out may be used when output is connected directly to a switch or device port only when approved in specific situations.

7. Manufacturer:

a. 110 to 110 - Ditek DTK-110C6APOE

b. 110 to RJ-45 – Ditek DTK-110RJC6APOE

c. Or approved equal

D. When protector is exposed to weather or moisture:

1. Shielded RJ-45 jacks and ground connection.
    a. Connected ground connection directly to ground.
    b. Do not use shielded cable on the output.
2. Outdoor-rated NEMA 4X enclosure
3. Maximum supported data rate: 1,000Mb/s (1 Gigabit)
4. Supports IEEE 802.3af, 802.3at (PoE) and PoE+ up to 144 watts per port.
5. Max current rating of 20,000A per pair.
6. UL 497B listed
7. RG-45 in and RJ-45 out.
8. Provide with appropriate mounting kit.
9. Manufacturer:
    a. Ditek DTK-MRJPOEX
    b. Or approved equal

2.09 CABLING

A. Provide cabling per manufacturer's recommendations and code requirements for riser rated, plenum, and non-plenum cable types.

B. UTP data cabling required will be provided, installed, terminated and tested by the Division 27 structured cabling Contractor.

C. UTP patch cables will be provided and installed by the Contractor in the IDF and provided by Contractor and installed by Contractor at the device.

Part 3 - EXECUTION

3.01 SYSTEM PROGRAMMING

A. The Contractor shall provide all programming necessary for a turnkey system.

B. Programming shall include setting all required IP addressing, setting passwords, firmware upgrades, adding the devices into the software, setting video streams, motion detection areas, recording settings, device naming, mapping, cross system integration, etc.

3.02 SYSTEM MAPPING

A. The Contractor shall provide a satellite level screen shot map showing exterior devices. These maps shall include drill down links to access the building floor plans where all interior and exterior devices are shown. The overview satellite map shall show alarms signifying there is an alarm in the building to draw attention quickly to the correct building then floor plan.

B. The maps shall have links to the other levels/sections as well as the global map.

C. Cameras shall show their approximate field of view.

D. The floor plans shall include all integrated access-controlled doors, controlled overhead doors and integrated devices.

E. Contractor shall create map entities for intercom cameras for any intercom being recorded.

3.03 SYSTEM PARTITIONING, ZONING AND NAMING

A. The Contractor shall program each facility to be in its own partition. Some facilities may require sub-partitions to control user access to certain areas. Each manufacturer may use different names for partitions, zones, areas, etc. Adapt as required.

B. All devices, inputs, outputs and other applicable software/hardware entities shall be named by the Contractor.

C. As a basis to start, the following partition, zoning and naming shall be followed:

1. Partition: Building name

    a. Zone 1: Building name and zone name such as exterior, 1st floor, etc.

        i. Device 1: Building name and floor number– Camera or other device name

        ii. Device 2: Building name and floor - Camera or other device name

        iii. Repeat as required

    b. Zone 2: Building name and zone name such as 2nd floor, etc.

        i. Device 1: Building name and floor - Camera or other device name

        ii. Device 2: Building name and floor - Camera or other device name

        iii. Repeat as required

    c. Repeat zones as required.

2. Repeat Partitions as required.

D. Camera Naming

1. All cameras shall be named based on Owner direction.

2. Multi-sensor cameras shall be named similar, and each sensor shall end with an identifier such as A, B, C and D so the images can be easily aligned in the client software by an end user.

E. The Owner shall have the final say. The Contractor shall schedule a coordination meeting with the Owner and Consultant to coordinate actual project structure and naming prior to starting any programming.

3.04 VMS VIDEO STREAMING

A. The contractors shall match the existing streaming settings and receive sign-off from the Owner.

3.05 CAMERA POSITIONING PROCEDURES

A. The Contractor shall set an initial aim, zoom, field of view adjustment, rotation and focus immediately after the camera is installed following the design intent on the drawings, camera schedule and industry best practices.

B. The Contractor shall then take screen shots from the camera's web interface, label them based on the drawings device number and present them to the Owner and Consultant for an initial review and comment. The Contractor shall furnish a battery powered PoE injector to power up the camera to provide the initial aim/focus and screen shots and shall not rely on the Owner's network or PoE switches to be online or available.

C. The Contractor shall then fine tune the cameras aim and field of view based on the Owner's and Consultant's feedback then update the screen shots and present them back to the Owner and Consultant.

D. After the cameras aim, zoom, field of view adjustment and focus are finalized by the Consultant, the Contractor shall submit the screen shots to the Owner to obtain their final sign-off or additional comments. If any comments are received, the Contractor shall make the adjustments necessary and take updated screen shots and submit for re-approval.

E. The above will not happen at the same time and the Contractor shall plan on multiple trips to the project to make the adjustments.

F. The Contractor shall include the final screen shots as part of the as-builts.

3.06 COORDINATION

A. Contractor shall provide up to 8 hours (up to four, 2-hour sessions) of scheduled and dedicated coordination time to assist Owner with camera positioning/repositioning and coordination as requested by Owner or Consultant including post final signoff.

3.07 PASSWORDS

A. The Contractor shall coordinate a secure project password with the Owner and Consultant. This password shall be documented by the Contractor and used for all devices.

B. This secure password shall be set in the archiver default password field and each device in the video unit tab shall be set to use that set default.

3.08 TESTING

A. Refer to Section 27 00 00 for additional requirements.

B. Prior to energizing or testing the system, ensure the following:

1. All products are installed in a proper and safe manner per the manufacturer's instructions.

2. Dust, debris, solder, splatter, etc., is removed.

3. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.

4. All products are neat, clean, and unmarred, and parts are securely attached.

C. Contractor shall ensure that each device in the security system is functioning normally and in such a manner as to meet the functional and performance requirements in this specification.

3.09 TRAINING

A. Refer to Section 27 00 00 for additional requirements.

B. Provide system operations, administration, and maintenance training by factory-trained personnel qualified to instruct.

1. Contractor shall provide up to 4 hours of scheduled and dedicated training time.

2. Contractor shall provide up to 2 hours of scheduled and dedicated training time for maintenance including lens and dome cleaning, focusing and positioning.

3. Provide printed training materials for each trainee, including product manuals, course outline, workbook or student guides, and written examinations for certification.

4. Provide hands-on training with operational equipment.

5. Training shall be oriented to the specific system being installed under this contract as designed and specified.

6. Contractor shall provide all necessary documentation of system operating parameters prior to scheduled training sessions.

3.10 WARRANTY

A. Refer to Section 27 00 00 for additional requirements.

3.11 INSTALLATION PRACTICES

A. All services provided shall be professional and conform to the highest standards for industry practices. The Owner reserves the right to halt any installation due to poor workmanship. All work shall be defect free, and the installer shall replace, at their expense, any work found to be defective.

B. The Owner reserves the right to halt any installation due to failure of Contractor to observe installation-free periods due to instructional or administrative requirements. To the maximum extent possible, the Owner will provide advance notice of such periods.

C. Contractor is responsible for providing a complete and functional video surveillance system.

D. All manufactured items, materials, and equipment shall be applied, installed, connected, erected, used, and adjusted as recommended by the manufacturers, or as indicated in their published literature, unless specifically noted herein to the contrary.

E. Contractor shall follow these standards and approved submittals for locations of power supplies. The Owner intends to limit the number and location of power supplies to facilitate more effective long-term support and maintenance of the system.

3.12 AESTHETICS

A. All cables and equipment terminating at panels frames shall be vertically straight, with no cables crossing each other, from twelve inches inside the ceiling area to the termination block.

B. All cable bundles shall be combed and bundled to accommodate individual termination block rows and panels.

C. For any given telecom room, a horizontal and vertical alignment for all mounting hardware will be maintained to provide a symmetrical and uniform appearance to the distribution frame.

D. All surface-mounted devices shall be firmly secured level and plumb

E. All rack mount equipment shall be securely installed.

3.13 HARDWARE LAYOUT

A. Hardware positioning and layout shall be reviewed and approved by the Owner prior to construction. The review does not exempt Contractor from meeting any of the requirements stated in this document.

3.14 VMS INSTALLATION PRACTICES

A. Verify that the manufacturer approved server hardware, OS meets the Owner's IT standards prior to ordering.

B. Coordinate server power, cooling, and mounting requirements with Owner prior to installation.

C. Coordinate virus scan/security software requirements with Owner and manufacturer prior to installation.

3.15 DEVICE CABLING/WIRING INSTALLATION PRACTICES

A. All external wire and cables shall be supported at least every five feet from the structure or as required to maintain not more than 12" cable sag between supports and without over tensioning the cables. Provide j-hooks as needed where cable tray or raceway is not available.

B. This Contractor shall coordinate installation with Division 27 05 00 cabling Contractor to ensure there is at least 2-inches of physical separation between security cabling and voice/data cabling throughout cable path. Voice/data cabling Contractor has first claim to cable tray.

C. All cables, regardless of length, shall be labeled within 18" of both ends with an identifier that is keyed to the door, room, or corridor number as identified.

D. All cables shall have 6-foot service loops neatly coiled in the equipment room. During initial cable rough-in, this Contractor shall have sufficient slack to route anywhere within the equipment room.

E. Cabling shall be adequately supported with Velcro wire wraps and horizontal support cable managers fastened to rack frame. Cables shall be dressed in a neat and orderly fashion. Any cabling or equipment installation that is deemed unacceptable by the Owner or Consultant shall be replaced or corrected by the Contractor at no additional cost. Plastic zip ties are not allowed.

F. All cables are to run at right angles to the structure, placed above the ceiling in halls or corridors.

G. Cables shall not run above red iron joist.

H. Contractor shall make every effort to conceal wiring and other apparatus into walls, floors, and ceilings, assuming code and good engineering practice allows and suggests.

I. Ties and straps shall be installed snugly without deforming cable insulation. Ties shall be spaced at uneven intervals not to exceed four feet. No sharp burrs shall remain where excess length of the cable tie has been cut.

J. Contractor shall notify Owner immediately if obstruction or hazard is discovered in a pathway provided by others.

K. Cable shall be stored and handled to assure that it is not stretched, kinked, crushed, or abraded in any way. Bend radiuses shall meet manufacturer specifications and/or recommendations. Cable shall not be installed in ambient temperatures or moisture conditions above or below the manufacturer's rating.

L. No splices shall be installed in any cable.

3.16 CABLE TERMINATION

A. Termination hardware (patch panels) positioning and layout shall be reviewed and approved by the Owner prior to construction. The review does not exempt Contractor from meeting any of the requirements stated in this document.

3.17 FIRE STOPPING

A. Fire stopping of openings between floors, fire-rated walls, and smoke-rated walls, created by others for This Contractor to pass cable through, shall be the responsibility of the This Contractor. Sealing material and application of this material shall be accomplished in such a manner that is acceptable to the local fire and building authorities having jurisdiction over this work.

B. Any openings created by or for This Contractor and left unused shall be sealed up by This Contractor.

C. This Contractor shall be responsible for creating a waterproof seal in and around any openings that This Contractor creates from the structure to the outside environment.

3.18 SYSTEM INSPECTION

A. Contractor shall coordinate with project representative for inspection after Contractor has completed testing of entire system.

B. Contractor shall have trained Contractor representative and testing equipment on site during inspection to assist with spot verification of tests.

C. Contactor shall verify with Project Representative the precise positioning of camera aim and shall make fine adjustments as requested.

3.19 LABELING

A. Contractor shall neatly label all security devices and cabling at both ends. All labels shall be on Project as-built drawings.

3.20 CAMERA INSTALLATION

A. Contractor shall field verify all camera locations and positioning with Owner prior to installation.

3.21 DOCUMENTATION

A. Upon completion of the installation, Contractor shall provide full documentation sets to the Consultant for approval as described in section 27 60 00. All documentation shall become the property of the Owner.

B. Documentation shall include the additional specific items detailed in the subsections below:

1. Contractor shall provide hard copy and electronic forms of the final test results.
2. Contractor shall provide a document including the following:
    a. Camera label/identifier
    b. Location of each drop by orientation/permanent landmark in the room
    c. Contractor shall provide accurate as-built Construction Drawings. The drawings are to include cable routes and device locations.

3.22 PRE-CHECKOUT

A. The Contractor shall demonstrate the following to Owner during system demonstration.

1. The cameras are fully installed and functional.
2. Camera adjustments are complete to the Owner’s satisfaction including.
    a. Aim/Zoom
    b. Focus/Back Focus
    c. Masking Zones
    d. Motion Detection Zones

e. Pre-Sets/Tours

3.23 FINAL ACCEPTANCE

A. In addition to closeout requirements in section 27 60 00, This Contractor shall demonstrate the following before final approval.

1. Owner training is complete.
2. Punch list items are complete.
3. As-built documentation is complete and submitted to Owner/Consultant.

3.24 FINAL PROCEDURES

A. Perform final procedures in accordance with section 27 60 00.

End of Section

INDEX TO ELECTRONIC SAFETY AND SECURITY SYSTEMS

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

SECTION NUMBER	SECTION NAME
28 0100	COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY
28 0005	SUBMITTALS, CLOSEOUT DOCUMENTS, TRAINING AND SPARE PARTS
28 0150	TESTING AND FIRE ALARM SYSTEMS
28 3100	FIRE ALARM AND NETWORKED, INTELLIGENT VOICE EVACUATION SYSTEMS

END OF INDEX

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SECTION 28 0100

COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 GENERAL

1.1 GENERAL PROVISIONS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 1 Specifications apply to the work of this section.

1.2 SUMMARY

A. Section Includes:

1. Work consists of furnishing labor, materials, equipment and services required for the complete installation of work shown in the Contract Documents and specified in Division 28.
2. Include all parts and labor which are incidental and necessary for a complete and operable installation even though not specifically mentioned in the Contract Documents. Such items include nuts, bolts, anchors, brackets, sleeves, offsets in conduit, fittings, relays, etc.
3. Some equipment and materials provided under Division 26 may require composite work crews because of trade jurisdiction. Where this occurs, include in the bid this portion of the composite crew labor costs. It is the Contractor's responsibility to review Division 26 and 27 Contract Documents to determine where these composite crews are required.
4. Obtain all temporary and permanent permits and licenses required in connection with this Division's work. Pay all fees and expenses required for such permits and licenses.
5. Request inspections as required by regulating agencies and/or regulations. Pay all charges for inspections by regulating agencies of installations of plans specifications.
6. Include State and Local sales taxes in the bid. Keep accurate records of these taxes and furnish such records to the Owner upon request.
7. Provide the Owner with a certificate of final inspection and approval by enforcement authorities.

B. Related Sections:

1. Divisions 0 and 1 apply to all work of Division 28 and are an integral part of this Section. Where the conditions specified are at variance with other Divisions, Section 28 01 00 takes precedence. Section 28 01 00 specifies conditions, procedures, equipment and material particular to the electrical work and applies to all electrical work of the Contract Documents.
2. Division 0 and 1 and Section 28 01 00 and all Addenda form a part of and apply to all contracts or sub-contracts relating to Division 28 work. Copy these documents to all Sub-contractors receiving other Sections of Division 28.
3. Where a Specification Section refers to other Sections under the Article on Related Sections, this is done for Contractor's convenience only. It shall in no way relieve the Contractor of responsibilities stated in other Sections of the Specifications, even though these Sections are not specifically referenced. The Contractor is responsible for all information contained in this Division's Specifications as well as for information contained in all other Divisions.

1.3 REFERENCES

A. Meet or exceed all current applicable codes, ordinances and regulations for all installations. Promptly notify the Engineer, in writing, if the contract documents appear to conflict with governing codes and regulations. Contractor assumes all responsibility and costs for correcting non-complying work installed without notifying the Engineer.

B. Higher quality of workmanship and materials indicated in the Contract Documents takes precedence over that allowed in referenced codes and standards.

C. Perform all work in compliance with the currently adopted version of the following codes and standards for this project:

National Electric Code
State and Local Electrical Codes
International Building Code
International Fire Code
International Mechanical Code
State and Local Building Codes and Ordinances
State Industrial Commission Regulations
State and Local Fire Codes and Regulations
State and Local Mechanical Codes
State Elevator Code
Occupational Safety and Health Administration Regulations
Americans with Disabilities Act
Uniform Federal Accessibility Standards
State Board of Health
NFPA 101 Life Safety Code
State Energy Code

D. Use the Standard where referenced in the specifications by the following abbreviations:

AIA: American Insurance Association
AIA: American Institute of Architects
ANSI: American National Standards Institute
ASTM: American Society of Testing and Materials
EPA: Environmental Protection Agency
FM: Factory Mutual Insurance Association
IEEE: Institute of Electrical and Electronic Engineers
IES: Illuminating Engineering Society of North America
ICEA: International Cable Engineers Association
NBS: National Bureau of Standards
NEMA: National Electrical Manufacturers Association
NFPA: National Fire Protection Association
NSC: National Safety Council
UL: Underwriter's Laboratories

1.4 DEFINITIONS

A. The terms defined below apply to all work included in Division 26.

1. The work – as defined in the 2007 AIA Document A201: “The term ‘Work’ means the construction and services required by the Contract Documents whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor’s obligations. The Work may constitute the whole or a part of the Project.”
2. Furnish – to obtain in new condition ready for installation into the work.
3. Install – to store, set in place, connect and place into operation into the work.
4. Provide – to furnish and install.
5. Connect – to bring service to the equipment and make final attachment including necessary switches, outlets, boxes, terminations, etc.
6. Conduit – includes in addition to conduit, all fittings, pull boxes, hangers and other supports and accessories related to such conduit.

7. Concealed – hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction, in crawl spaces or buried.
8. Exposed: not installed underground nor concealed as defined above.
9. Building structure or building structural members - consists of steel columns, steel beams, steel joists (top chord and at panel points), concrete walls and concrete block walls. Metal decking, joist bridging and bottom chords of bar joists shall not be construed as building structure nor as a building structural member for the purpose of support.

B. The drawing and specifications constitute the Contract Documents. Any item noted in the specification or shown on the drawings is included in the Contract Documents.

C. All electrical details and drawings are diagrammatic, unless specifically noted. Field-verify all dimensions and notify the Engineer of any conflicts of discrepancies, in writing, prior to installation.

1.5 BIDDING REQUIREMENTS

A. Alternates:

1. Refer to Bid Form and Instruction to Bidders.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Initiate, maintain and supervise all safety precautions required with this work in accordance with the regulations of the Occupational Safety and Health Administration (OSHA) and other governing agencies.

B. Environmental Requirements:

1. Do not remove or disturb any asbestos containing materials from the project. Immediately stop work and notify the Owner if asbestos containing materials are suspected.
2. Do not dispose of any PCB containing materials. Disposal of all PCB containing materials will be the responsibility of the Owner.

C. Provide new, first quality material for all products specified. Do not reuse materials unless indicated or approved by the Engineer.

D. Comply with the NEC as applicable to the construction and installation of equipment specified in this section.

E. Provide equipment specified in this section that has been listed and labeled by a nationally recognized testing laboratory.

F. Comply with ANSI as applicable to equipment specified in this section.

G. Comply with NEMA as applicable to equipment specified in this section.

1.7 PROJECT/SITE CONDITIONS

A. Site Inspections:

1. Before submitting a proposal on the work contemplated, examine the site of the proposed work and become thoroughly familiar with existing conditions and limitations. No extra compensation will be allowed because of misunderstanding as to the amount of work involved nor bidders lack of knowledge of existing conditions which could have been discovered or reasonably anticipated prior to bidding.
2. Conduits, pipes, ducts, lights, devices, speakers, etc., shown on the drawings as existing have been based on existing plans and may not be installed as originally shown. It is the Contractor's responsibility to visit the site and make exact determination of the existence, location and condition of such facilities prior to submitting a bid.

B. Correlation of Work:

1. Consult the drawings and specifications of all other Divisions for correlating information and lay out work so that it will coordinate with other trades. Verify dimensions and conditions (i.e., finished ceiling heights, footing and foundation elevations, beam depths, etc.) with the Architectural and Structural drawings. Notify the Architect/Engineer of any conflicts that cannot be resolved, in the field, by affected trades. Replacement of work due to lack of coordination and failure to verify existing conditions will be completed at no cost to the Owner.
2. Install all conduit, cable tray, equipment, etc. allowing proper code and maintenance clearances and to avoid blocking passageways and access panels.
3. Where work must be replaced due to the failure of the Contractor to verify the conditions existing on the job, such replacement must be accomplished at no cost to the Owner. This applies to shop fabricated work as well as to work fabricated in place.
4. Throughout the course of the work, minor changes and adjustments to the installation may be requested by the Engineer. The Contractor shall make adjustments without additional cost to the Owner, where such adjustments are necessary to the proper installation and operation within the intent of the Contract Documents. This does not include work already completed.
5. Equipment outlines shown on detail plans of 1/4"=1'-0" scale or larger and/or dimensions indicated on the plans are limiting dimensions. Do not install any equipment that exceeds the equipment outlines shown or reduces indicated clearances.
6. Obtain exact location of connection to equipment, furnished by others, from the person furnishing the equipment.
7. Drawings and specifications are complementary and what is called for in either on is as binding as if called for in both.
8. Include the better quality, greater quantity or higher cost for an item or arrangement where a disagreement exists in the drawings and specifications.

1.8 SEQUENCING AND SCHEDULING

A. Refer to General Conditions and Requirements.

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 PREPARATION

A. Continuity of existing systems:

1. No Division 28 systems are to remain inactive at the end of the workday. Assure that the systems are all operational at the end of each workday. Coordinate temporary outages with the Owner.
2. Coordinate/schedule all work with the Owner to minimize any disruptions. Confine all interruptions to the smallest possible area. Provide temporary connections if required to provide continuity of service.
3. Inspect all areas affected by the interruptions and return all automatically controlled equipment, electrically operated equipment to the same operating condition prior to the interruption.

B. Use of Facility:

1. Do not disturb normal use of the facility, except within the immediate construction area. Keep walks, driveways, entrances, etc. free and clear of equipment, material and debris.

2. Store all equipment and material in a place and manner that minimizes congestion and is approved by the Owner.

3.2 INSTALLATION

A. Material and Workmanship

1. Provide new material and equipment, unless noted otherwise. Protect equipment and material from damage, dirt and the weather.
2. Provide the highest quality workmanship and perform all work only by skilled mechanics. Install material and equipment in accordance with manufacturers' recommendations, instructions and current NECA standards.
3. The Engineer reserves the right to reject material or workmanship not in accordance with the specifications, before or after installation.

B. Excavation and Backfilling:

1. Provide all excavation and backfilling required to complete the installation of the fire alarm system. Conform with the provisions of Division 31 Earthwork of these specifications for all work.
2. Bed all conduit and structures on a 6" thick compacted layer of granular material. Should unsatisfactory soil conditions be discovered, the Engineer/Architect will inspect the excavation and determine the necessary additional support required.
3. Backfill around conduit and structures by hand using coarse sand, pit run gravel or the native material if it is similar to the above. Remove all large stones, frozen lumps, perishable rubbish and excessive amounts of clay. Carefully compact this material in 6" layers to a depth of 8" above the conduit, cable or duct. . Compact to not less than 90% outside the building and 95% within the building limits of maximum density given by ASTM D698-70T (Standard Proctor Density). Architect/Engineer reserves the right to require soil compaction tests in any areas which do not appear to be compacted properly with the cost of the test paid by the Contractor.
4. Replace all existing surface improvements (i.e.,-street pavement, curbs, sidewalks, finish sodding, etc.) removed or damaged in the course of the work unless such improvements are to be reconstructed under the general contract. Make all necessary arrangements to perform such repairs, pay all costs in connection therewith and include them in the bid.

C. Cutting and Patching:

1. Perform all cutting and patching necessary to work, unless specifically delegated to be performed by a different Division.
2. Obtain special permission from the Engineer before cutting structural members or finished material.
3. Perform all patching in a manner as to leave no visible trace and return the area affected to the condition of undisturbed work. Perform all patching by workers experienced, skilled, and licensed for the particular type of work involved. Inferior work will not be accepted.
4. Patch all holes left as a result of demolition of electrical equipment and devices.
5. Drill all holes in masonry with rotary drill. Impact tools are not allowed. Core drill all holes in masonry and concrete for electrical raceway. Provide and dispose of all water required for core drilling. Coordinate with other trades to prevent damage from water.
6. Prevent the spread of dust, debris, and other material into adjacent areas.
7. Replace all ceiling tiles damaged during installation of work, with new tile.

D. Painting:

1. Refinish all fire alarm equipment damaged during shipping and/or installation to its original condition. Remove all rust; prime, and paint per manufacturer's recommendations for finish equal to original.
2. Paint all new raceway systems in exposed finished areas to match existing finish.

E. Precast Construction

1. Provide recessed boxes, cabinets and conduits within precast construction. Install boxes and conduit in the precast panel forms.
2. Submit a coordinated set of shop drawings with the precast manufacturer, that indicates electrical box locations, cabinet locations and conduit routing locations.
3. Provide written confimation to the precast manufacturer that all boxes and conduit have been installed, and installed in the correct locations prior to the fabrication of the precast panels.

3.3 FIELD QUALITY CONTROL

A. Final Inspection:

1. A final inspection of the electrical systems will be required before the Contract can be closed out. Request a final inspection by the Engineer after all systems are fully completed and operational. The Engineer will schedule an inspection and generate a list of items to be corrected or completed before Contract Closeout. If the Engineer is requested to make a final inspection by the Contractor, and the Engineer finds the work is not complete enough to perform that inspection, the Contractor will compensate the Engineer for his time. The Contractor will then perform the necessary work to complete the project and again request a Final Inspection.

3.4 CLEAN UP

A. Keep the premises free from accumulation of waste material or rubbish, caused by his employees or work, at all times. Remove rubbish, tools, scaffolding, and surplus materials from and about the building, and leave work areas "broom clean" or its equivalent upon completion of the work. Clean electrical equipment and remove temporary identification. In case of dispute the Owner will remove the rubbish and charge the cost to the Contractor.

B. After tests have been made and accepted clean light fixtures, panels and other equipment installed by the Contractor, leaving the entire work area in a clean and complete working order.

3.5 PROTECTION

A. Cover openings and equipment, where set, to prevent obstruction to conduits, breakage, misuse, or disfigurement of equipment. Cover openings in equipment immediately upon uncrating or receipt at the job site and keep covered until permanent connection is made.

B. Contractor is responsible for any damage to electrical equipment or materials until final acceptance of the entire project by the Owner. Keep all equipment clean materials until final acceptance of the entire project by the Owner.

C. If a portion of the project is to be occupied by the Owner prior to Substantial Completion of the entire project make arrangements with the Owner to transfer responsibilities for protection and housekeeping.

END OF SECTION

SECTION 28 0105

SUBMITTALS, CLOSEOUT DOCUMENTS, TRAINING AND SPARE PARTS

PART 1 GENERAL

1.1 GENERAL PROVISIONS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 1 Specifications apply to the work of this section.

1.2 PRIOR APPROVALS

A. Submit written requests to use unspecified items, to the Engineer, no later than ten (10) calendar days prior to the bid opening. Submit detailed information for proposed material or equipment.

B. Accepted substitutions will be incorporated in an Addendum to the Contract Documents.

C. Contractor is responsible for dimensional differences, electrical requirements and any other resulting changes, when using accepted substitutions. Contractor is responsible for any additional costs incurred as a result of substitutions, including other contractors and Architect/Engineer fees.

D. Material and equipment not specified or accepted in an Addendum will be removed and replaced at no cost or inconvenience to the Owner.

1.3 PAY REQUEST COST BREAKDOWN

A. Provide Schedule of Values for the utilization of submitting a “Pay Request”. Allocate appropriate share of overhead and profit to each item. Separate each item into labor and material.

B. Submit cost breakdown on AIA document G703. Provide minimum breakdown as indicated below. Provide additional breakdown as required for clarity or requested by the Engineer.

1. General Conditions
2. Conduit, fittings and boxes (rough-in materials)
3. Fire Alarm System

1.4 SHOP DRAWINGS AND SAMPLES

A. Submit in accordance with the Division 0 and Division 1. Submit drawings to the Engineer for review within 30 calendar days after award of Contract.

B. Include project name, name of Architect, name of Engineer, contractor, sub-contractor, manufacture, supplier and sales representative, include name, address, and phone number for the sales representative. Clearly identify section number and description of equipment submitted. Shop drawings not including all of this information will be returned without review.

C. Examine all shop drawings noting capacity, arrangement and physical dimensions. Clearly mark all relevant items on catalog data and cross-out unrelated information. Review and stamp shop drawing prior to submitting to the Engineer.

D. Submit a minimum of six (6) sets of shop drawings. The Engineer will distribute as follows:

1. Engineer - One (1) copy.
2. Architect - One (1) copy.
3. General Contractor - Remaining copies (two copies to be incorporated into the O&M Manuals.

E. All shop drawings must be reviewed and accepted by the Engineer prior to fabrication and installation.

F. Shop Drawings will be reviewed by the Engineer, with one of the following actions checked on the submittal stamp:

1. NO EXCEPTIONS TAKEN—Indicates the Submittal appears to conform to the design concept of the Work and that the Contractor at his discretion, may proceed with fabrication and/or procurement and installation.
2. MAKE CORRECTIONS NOTED—Indicates that the Submittals, after noted corrections are made, would appear to conform to the design concept of the Work and that the Contractor, at his discretion, may proceed with fabrication and/or procurement and installation, if the corrections are accepted by the Contractor without an increase in Contract Sum or Time.
3. REJECTED—Indicates that the Submittal does not appear to conform to the specifications, and that a complete resubmittal is required. The Contractor shall not proceed with fabrication or procurement.
4. NO ENGINEER ACTION REQUIRED—Indicates the Contractor may proceed without review of the Submittal based on provisions of the Contract Documents.

G. Allow a minimum of fourteen (14) calendar days for the Engineer to review the shop drawings. Time is from the receipt of drawings in the Engineers office until they are shipped out of the office.

H. If the Engineer rejects (Make corrections noted/Submit corrected copy, Rejected/Submit specified item) two (2) times for the same section the Engineer will be compensated for the additional reviews. Compensation will be incorporated by Change Order and deducted from the Contractor's application for payment. Contractor is responsible for delays caused by the resubmittal process.

I. Refer to the end of this section for list of Shop Drawings required for this project.

1.5 CAD DRAWING FILES:

A. The electrical CAD drawing files prepared by Hallberg Engineering, Inc. for this project are Instruments of Service of Hallberg Engineering, Inc. for use solely with respect to this project and will not be made available to the Contractor.

B. Request CAD drawing files of Architectural floor plans, elevations, sections, etc directly from the Architect.

1.6 DEMONSTRATION / TRAINING

A. Fully energize, initiate, boot up, etc. all equipment, per manufacture's recommendation, prior to start-up.

B. Operate equipment and systems in all their operating modes, to verify proper operation, prior to final inspection and Owner instructions. Notify the Engineer, in writing, that all systems have been tested and are functioning and operating properly.

C. Fully instruct the Owner's designated operating in the operation of each system at the time it is put into service. Provide instruction using competent instructors and factory-trained personnel.

D. Include documentation of instructions in the Operation and Maintenance Manuals.

E. Obtain a written statement from the Owner that his designated personnel have been instructed.

F. Refer to the end of this section for training requirements for each system

1.7 OPERATING AND MAINTENANCE MANUALS:

A. Submit to the Engineer two (2) Operating and Maintenance manuals. Submit in portfolio form neatly edited with similar equipment grouped, tabbed and indexed. Provide printed or typewritten materials. Provide the following in each manual:

1. Shop drawings, approved manufacturer's bulletins, and other appropriate data from specific manufacturer of each piece of equipment furnished and/or installed. Shop drawings, manufacturer's bulletin, and other data shall be appropriate marked to reflect the "as-built" condition. Cross out or delete all information shown on shop drawings or literature not applying to this specific project.

2. Copies of manufacturer's warranties
3. Operating instruction for equipment.
4. Wiring and installation instructions for equipment.
5. Recommended maintenance schedules and procedures for equipment.
6. Recommended trouble shooting procedures for equipment.
7. Equipment parts list.
8. Settings/adjustments/calibrations For systems as required.
9. Local equipment suppliers/reps names, addresses, and telephone numbers.
10. Equipment manufacturers names, addresses, and telephone numbers.
11. Sub-contractors names, addresses, and telephone numbers.
12. Refer to individual Sections in Division 28 for additional requirements.
13. Test reports.

1.8 RECORD DRAWINGS

A. Provide record drawings in accordance with the requirements of the Division 0, Division 1 and this section.

B. As work progresses, in a neat and legible manner, record the following information on the record set of plans:

1. Update the contract documents to show all modifications including but not limited to Addendums, Change Orders, approved Proposal Requests and Architect's Supplemental Instructions. Cut and paste original documents to the as-built set.
2. Provide exact routing of outside underground conduits and services, showing dimensions from structural foundation walls or columns. Indicate depth and type of conduits.
3. Record exact location and elevation of underground conduits dedicated to technology systems including backbone fiber conduits, telephone conduits and cable TV conduits. Where spare underground conduits are terminated underground (i.e. property line), indicate exact dimensions from two different points of the foundation wall corner or structural columns.
4. Record routing of all cabling, above ground and underground.

C. The Engineer will recommend withholding payment if as-built drawings are not being maintained on-site.

D. Submit record drawings to the Engineer for review at completion of the Work. Submit final record drawings as part of the Operation and Maintenance Manual package after the completion of the project.

1.9 DOCUMENT TURNOVER

A. Construction Documents CD's, Owner and Operation Manuals (O&M's), As-Builts, Specifications and other documents turned over at the completion of the projects shall be furnished to the Owner in both paper hard copy and digital Adobe PDF.

1. Construction Documents
    a. PDF Creation: Each roll of drawings shall be scanned or converted to PDF to one single PDF document.
        1) Scanning:
            i) 200DPI Grayscale
            ii) Cropped to original size

iii) Color corrected and despeckled

b. Bookmarking: Each page of the PDF shall be bookmarked with the number and name of the sheet.

c. Naming: The PDF shall be labeled: “Building Name_Year_Title_Spec_Type”

1) Name = Building Name

2) Year = Date of Documents

3) Title = “Addition” “Remodel,” etc…

4) CD = Construction Document

5) Type = Arch, Mech, Electrical Communications or a combination of the above

2. Specifications

a. PDF Creation: Each book of specifications shall be scanned or converted to PDF to one single PDF document.

1) Scanning:

i) 200 DPI Grayscale

b. Bookmarking: Not required.

c. Naming: The PDF shall be labeled: “Building Name_Year_Title_Spec_Type”

1) Name = Building Name

2) Year = Date of Documents

3) Title = “Addition” “Remodel,” etc…

4) CD = Construction Document

5) Type = Arch, Mech, Electrical Communications or a combination of the above

3. Owners and Operation Manuals

a. O & M’s shall be turned over by the Contractor.

b. PDF Creation: Each book of specifications shall be scanned or converted to PDF to one single PDF document.

1) Scanning:

i) 200 DPI Grayscale

c. Bookmarking: Bookmarking of O & M Manuals shall be extensive.

1.10 WARRANTY

A. Guarantee and maintain the stability of work and materials and keep same in perfect repair and condition for the period of one (1) year after the final completion of the work as evidenced by issuance of the final certificate by the Architect.

B. Defects of any kind due to faulty work or materials appearing during the above mentioned period must be immediately made good by the Contractor at his own expense to the entire satisfaction of the Owner and Architect and Engineer. Include damage to the finish or the building resulting from the original defect or repairs.

C. Guarantee does not apply to injuries occurring after final acceptance and due to wind, fire, violence, abuse or carelessness or other Contractors or their employees or the agents of the Owner.

D. Guarantee does not apply where other guarantees for different lengths of time are specifically called for.

E. Refer to the end of this section for a list of specific warranty items for each system.

1.11 FORMS

Section	Equipment	Shop Dwgs Req'd?	Warranty	Owner Training	AHJ Cert. Req'd?	System Testing and report required?	Spare Parts
28 31 00	Fire Alarm System	Yes	1 Yr parts &labor	8 Hrs	Yes	Yes	-(5) Smoke detectors w/bases -(1) Duct smoke detector housing & sampling tubes -(1) manual pull stations -(5) keys for fire alarm cabinets

END OF SECTION

SECTION 28 0150

TESTING AND FIRE ALARM SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Testing of Fire Alarm Systems.

PART 2 PRODUCTS

2.1 MATERIALS

A. Miscellaneous testing equipment as detailed.

PART 3 EXECUTION

3.1 FIRE ALARM SYSTEM TESTING

A. Make an inspection of the fire alarm system with the manufacturer's representative of the fire alarm equipment, including those components necessary to the direct operation of the system such as manual stations, thermal detectors, smoke detectors, flow switches and controls, whether or not manufactured by the manufacturer. The inspection to comprise examination and certification of such equipment for the following:

1. The system functions properly;
2. The type of equipment installed is that designated by the Engineer's specifications;
3. The wiring connections to all equipment components have been installed in accordance with UL requirements;
4. Equipment of the manufacturer has been installed in accordance with the manufacturer's recommendation and that all signaling devices of whatever manufacturer have been operated or tested to verify their operation: The supervisory wiring of those items of equipment connected to a supervised circuit is operating and that the regulations, if any, concerning such supervisory wiring, have been met to the satisfaction of inspecting officials.

B. Inspection Certification: Upon completion of the inspection and when all of the above conditions have been complied with, the manufacturer is to issue to the Engineer:

1. A copy of the inspecting technician's report showing location of each device and certifying the test results of each device.
2. A certificate of verification confirming that the inspection has been completed and accepted by the authority having jurisdiction and showing the conditions upon which such inspection and certification have been rendered.

C. Owners Instruction: The manufacturer to provide the services of a competent alarm system technician for the period of two working days, at a time convenient to the Owner, to instruct the staff in the operation and maintenance of the system.

D. Provide a letter to the Owner and Fire Marshal certifying that the installed system is UL certified.

END OF SECTION

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SECTION 28 3100

FIRE ALARM AND NETWORKED, INTELLIGENT VOICE EVACUATION SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 SUMMARY

A. Fire Alarm System

B. Interface to HVAC Systems

C. Interface to Fire Protection System

D. Interface to Owner Telephone and/or Telecommunications system

E. Interface to Access Control System

F. Interface to Public Address System

G. Interface to CCTV System

1.3 REFERENCES

A. Section 26 0100: General Provisions – Electrical.

B. Section 26 0529: Supporting Devices.

C. Section 27 5114: Public Address System.

D. Section 28 0100: Common Work Results for Electronic Safety and Security

E. Section 28 0105: Submittals, Closeout Documents, Training and Spare Parts

F. Section 28 0150: Testing and Fire Alarm Systems

G. Section 28: Access Control System

H. Section 28: CCTV System

I. This section is subject to all of the applicable provisions of the above indicated sections.

1.4 SYSTEM DESCRIPTION

A. Provide a complete and operational intelligent addressable voice evacuation fire alarm system including the following components: Main control panel complete with central processing unit, communications cards, initiating loop cards, indicating zone cards, power supplies and backup batteries; NAC power supplies; Voice Evacuation system to include digital voice control with microphone, digital amplifier, zone paging and all-call capabilities, remote annunciators with alarm silence and reset capability; remote intelligent detectors; interfaces to HVAC fans, combination smoke/fire dampers and sprinkler systems; audible and visual indicating devices; monitor and control modules; communication devices; raceway system, boxes, wiring, grounding and the associated labor, programming, setup and testing.

B. Provide an intelligent, fully addressable system whereby all system components communicate with the main control panel for alarm, trouble, supervisory, monitoring and control functions over supervised twisted pair wiring.

1.5 SUBMITTALS

A. For general requirements see Section 26 0100 and 28 0100.

B. Submit qualifications of the system installer as specified in this section.

C. Submit a complete shop drawing package of the proposed system.

D. Provide clearly legible shop drawings.

E. All shop drawings shall be provided electronically in the latest edition of CADD or by USB flash drive. Indicate on the front cover the date submitted, project name, specification section number, electrical contractor's name, address, telephone number and the submitting equipment supplier's address and telephone number. Allow enough clear area on the title sheet for shop drawing review stamps.

F. Submit 1/8" scale reproducible floor plans showing all rooms, stairways, corridors, horizontal exits, controlled HVAC units, sprinkler flow and control valves, and all fire alarm system components. The drawings shall include exact wire counts and types, and point address information for each device. Single line for walls may be used.

G. Submit the following riser/wiring/connection diagrams:

1. Single line riser drawing indicating all system components and the vertical wiring necessary to connect the components. Indicate conduit sizes and wire counts and a legend indicating the type of wiring.
2. Functional block diagram showing initiating device wiring, loop communications wiring, annunciator wiring, power supply wiring, indicating device wiring, power supply wiring, battery wiring, communications/modem wiring, etc. It is not necessary to show every initiating and indicating device on the riser diagram, but illustrate the wiring and connection of each type of device on each addressable loop. Indicate on the diagram the quantity of devices on each loop and the maximum allowable quantity of devices on each loop (to determine the number of spare addresses for future expansion).
3. Wiring diagrams showing wiring and terminations between HVAC fan units and the fire alarm system.
4. Wiring diagrams showing wiring and terminations between combination fire/smoke dampers and the fire alarm system.
5. Wiring diagrams showing wiring and terminations between self closing and automatically closing devices and the fire alarm system.
6. Wiring diagrams showing wiring and terminations between sprinkler system flow switches, valve position switches, dry pipe low pressure monitoring switches, etc., and the fire alarm system.
7. Branch circuit wiring to the main control panel, sub-panels, and other devices in the system requiring 120 volt power.

H. Submit original drawings produced by the supplier/manufacturer. Submitting reproductions of the Contract Documents is not acceptable.

I. Submit a material list showing quantity, manufacturer, type and description of each item being furnished. Indicate in a separate list, the quantity and description of all spare parts to be turned over to the Owner at the end of the project.

J. Submit original prints of the manufacturer product sheets with complete technical data for each item being provided. Circle, arrow or provide other permanent marking on each data sheet to clearly indicate the specific product included in the submittal. Remove or crosshatch out any product on the data sheets not applicable to the project or not being submitted for review.

K. Submit physical and schematic drawings of special and custom components or hardware.

L. Submit power supply sizing and battery sizing calculations showing total fire alarm system power draw in the supervisory and alarm conditions.

M. Submit complete description of system operating sequence.

N. Submit voltage drop calculations for indicating devices.

O. Submit complete mounting details and instructions for all equipment to be installed.

P. Submit complete description of system operating sequence.

Q. Shop drawings not containing all the information listed above will be rejected without review.

1.6 QUALITY ASSURANCE

A. Only manufacturers that provide complete engineering, technical and support services to properly complete the project as designed are allowed.

B. Provide the following, prepared by the manufacturer and supplier:

1. Certification of project and drawings.
2. Project management as required by Engineer and Owner.
3. Complete project testing and training to Engineers and Owners satisfaction.
4. Underwriters Laboratories (U.L.) Certification.
5. Service personnel to be NICET Level II Certified.
6. Maintained inventory levels to provide service parts as required by the specification.

C. Provide fire alarm and detection systems conforming to the requirements of the latest edition of the following National Fire Protection Association (NFPA) publications including all amendments to these publications:

1. 13: Standard for the Installation of Sprinkler Systems.
2. 70: National Electrical Code, including Article 760.
3. 71: Protective Signaling Systems.
4. 72: National Fire Alarm Code.
5. 101: Life Safety Code.

D. Construct and install all fire alarm and fire detection equipment in accordance with the following publications:

1. Underwriters Laboratories Inc. (UL):
   a. 38 Manually Activated Signaling Boxes for Use with Fire Protection Signaling Systems.
   b. 268 and 268A Smoke Detectors for Fire Protective Signaling Systems.
   c. 346 Waterflow Indicators for Fire Protective Signaling Systems.
   d. 464 Audible Signal Appliances.
   e. 864 Control Units for Fire Protective Signaling Systems.
   f. 1481 Power Supplies for Fire Protective Signaling Systems.
   g. 1971 Visual Signaling Appliances for the Hearing Impaired.
2. Americans with Disabilities Act.
3. International Fire Code (IFC).
4. International Mechanical Code (UMC).
5. International Building Code (IBC).
6. State Building Code
7. State Amendments to the IBC, IMC and IFC.

8. Local (City) Codes

E. Provide components that are listed and cross listed as a product of a single fire alarm system manufacturer by Underwriter's Laboratory, Inc. (U.L.) and bear the "U.L." label. Provide control equipment listed under U.L. category UOJZ as a single control unit.

F. Qualifications of the Installer:

1. Before commencing work, submit data showing that the contractor/subcontractor has successfully installed fire alarm systems of the same type and design as specified. Include the names, locations, and the contact name and telephone number of at least six (6) such installations completed by the installer. Specify type and design for each system and furnish documentation that the system has performed satisfactorily for the preceding eighteen (18) months.

2. Provide evidence of completion of the required manufacturers' training and experience by the contractor or have NICET Level II (or higher), Certified Fire Alarm or Special Hazard Associate Engineering Technician(s), as applicable, in their employ.

3. Installed system to be certified by Underwriter's Laboratories for a period of five (5) years. The system must be covered by a maintenance contract, during this five (5) year term, by a U.L. certified service company. Installing contractor/subcontractor to furnish proof of qualification and listing to perform this service.

4. Experience of Installer: Accomplish installation by a Contractor with a minimum of five years of experience in the installation of the specified fire alarm system. Any proposed installer who cannot show evidence of such qualifications will be rejected.

G. Manufacturer's Representative

1. Provide the services of a representative or technician licensed in the State of Minnesota from the manufacturer of the system, or technician trained by the manufacturer of the system, experienced in the installation and operation of the type of system provided. Supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system. Provide the required instruction to the Owner's personnel in the system operation, maintenance and programming.

1.7 ZONING

A. Initiating zones

1. Provide one initiating zone for each initiating device.

2. Provide a fire alarm control panel that supports at least 1000 automatic intelligent detectors. Provide loading of each loop card adhering to the following specifications:

a. Load each loop card with the equal quantity of initiating points (e.g. if three loop cards are required for the system, load each loop card with 33% of the total number of system points, and homerun back to the main panel with the loop wiring).

b. Load each loop card to a maximum of 80% of the total number of initiating points possible for the loop card.

B. Indicating zones

1. Provide one indicating zones for the interior indicating devices of the building as required by the building design with a minimums of one (1) zone per floor. In addition provide one (1) indicating zone for the exterior sprinkler waterflow indicating device.

2. Provide 25% spare capacity on each interior indicating circuit for future indicating devices.

1.8 WARRANTY

A. Provide a complete parts and labor warranty for the system, commencing on the date of final acceptance and continuing for a period of one (1) year. Provide all materials and labor required to correct any system malfunction or failure (determined not to be the result of negligence, abuse or misuse) at no charge to the Owner during this time period.

B. Off-Site Monitoring: As part of the one-year warranty period, the Installing Contractor shall provide to the Owner, one year of off-site monitoring included as part of this project. Prior to the end of the first year, the Installing Contractor shall provide to the owner a monitoring agreement with terms and conditions that will be agreed upon by both parties.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Equipment supplied by manufacturers as listed herein are considered approved for bidding on this project. Where specific models are referred to, the intent is to establish a minimum level of features and performance.

B. Systems manufactured by the following are approved for bidding purposes on this project. Approval for installation is subject to review and approval of shop drawings.

1. Notifier Inspire N16X Series
2. Siemens Cerberus Pro Series
3. GE / Edwards System Technology EST-3 series
4. Gamewell/FCI 53 Series
5. Pre-approved equal

2.2 MAIN CONTROL PANEL

A. Provide a microprocessor-based main control panel with the following features and modules:

1. Communications module for controlling and monitoring all input, output, and accessory modules; power supplies, batteries, supervision of wiring, etc.
2. 10” high definition color touch screen display with customizable buttons. Plain English description of the location of each device.
3. Password protection for programming and system settings.
4. Provide the required quantity of input and output cards within the main control panel enclosure required for the system zoning plus spare capacity as described elsewhere in this specification.
5. Communication between main control panel and remote devices via RS-485 data lines.
6. Provide adequately sized power supply to power all system devices.
7. Provide alarm, trouble and supervisory silence, reset and drill functions.
8. Lamp test switch.
9. Monitors each remote initiating device and compensate for long term drift. Initiates a unique alarm when a detector requires maintenance due to excessive dirt/dust buildup.
10. Adjustable programmable day/night and weekend sensitivity setting ability.
11. One person-walk through system test on a zoned basis.
12. Password protection for administration and maintenance purposes.
13. Provide a durable, baked enamel finish for the main control panel enclosure.

14. UL listed (864).

B. The fire alarm system shall allow for loading and editing special instructions and operating sequences as required. The system shall be capable of on-site, and off-site via dial-up service modem, programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control panel. Loss of primary and secondary power shall not erase the instructions stored in memory. Full flexibility for selective input/output control functions based on ANDing, ORing, NOTing, timing, and special coded operations shall also be incorporated in the resident software programming of the system.

C. Resident software shall allow for full configuration of initiating circuits so that additional hardware shall not be necessary to accommodate changes in, for instance, sensing of normally open contact devices to sensing of normally closed contact devices, or from sensing of normally open contact devices to sensing a combination of current limited and non-current limited devices on the same circuit and being able to differentiate between the two, or changing from a non-verification circuit to a verification circuit or vice-versa.

D. Resident software shall also allow for configuration of indicating appliance and control circuits so that additional hardware shall not be necessary to accommodate changes in, for instance changing a non-coded indicating appliance circuit to a coded circuit, or from a slow march time (20 BPM) to a fast march time (120 BPM).

E. Provide a system that records system events (in chronological order) including the following:

1. Supervisory alarms
2. Trouble alarms
3. Fire alarms.

F. Provide a digital alarm communication transmitter to allow alarms to be transmitted to a constantly attended off-site alarm monitoring company. Verify with the Owner the location, phone number and required protocol to provide communications between the panel and the off-site monitoring station. Provide individual point-by-point monitoring to the monitoring company for each point in the fire alarm system. DACT system shall include provisions for IP based monitoring cell phone and standard phone monitoring as required in NFPA 72 26.6.4.1.4.

G. Provide power and control wiring to automatic closing and self closing devices (door holders, fire shutters, smoke dampers, etc.), relays, HVAC unit starters, and any other interfaces to equipment required to be interfaced to the fire alarm system.

H. Provide the required communications port in the main control panel to allow a future printer to be plugged into the system for printing hard copies of all system events and history logs.

I. The Digital Voice Command Center located with the FACP, shall contain all equipment required for all audio control, signaling and supervisory functions. This shall include speaker zone indication and control, digital voice and units and microphone. Provide a factory recorded library of voice messages and tones in standard WAV file format. Digital voice messages shall be coordinated with the Building Owner. Audible Speaker Circuits shall be designed utilizing a 2 Watt speaker setting. For speakers associated with auditoriums, gymnasiums and mechanical spaces a 4 watt speaker setting shall be used.

2.3 REMOTE ANNUNCIATOR PANELS

A. Provide remote annunciator panels with the following specifications:

1. Five Inch High Definition Touchscreen Display.
   a. Provides system status, point information and event counters.
   b. Shows two events simultaneously.
   c. Pages through up to 50 of the highest priority events in the system.

2. Configurable control buttons that are operational only when key switch is unlocked.
    a. Acknowledge
    b. Silence
    c. Reset
    d. Drill
3. Six programmable buttons, each with a descriptor/label, status indoor and configurable action (on/off, disable, enable)
4. Supervision of remote power supply.
5. Field programmable using Verifire Tools and interactive touchscreen
6. USB C Connection
7. Ability to filter events displayed on the RLD by zone
8. Powered from the main control panel.
9. Network Options – AIO power-limited, two wire serial communication with N16 or NCD control panels.
10. Remote Annunciator shall include a paging microphone for all call emergency use.
11. Remote annunciator and paging microphone shall be installed in a single common lockable equipment cabinet, keyed the same as the main control panel cabinet.

B. Locate remote annunciator(s) as indicated on the drawings.

2.4 STANDBY BATTERIES

A. Provide standby batteries in accordance with the requirements of NFPA 72 that are appropriately sized to operate the fire alarm system for a minimum of twenty-four (24) hours and then operating all indicating units for at least fifteen (15) minutes after the 24 hours, **plus an additional 10% spare capacity.**

B. Provide battery charger sized to fully charge all standby batteries within eight (8) hours after a full discharge cycle.

C. Provide maintenance-free, sealed gel cell or sealed lead-acid batteries. Batteries which vent gases are not acceptable.

D. Mount batteries inside the main control panel enclosure on the bottom. Separate battery enclosures are not acceptable.

E. Provide monitoring of batteries, charger and associated wiring from the main control panel.

F. Provide a voltmeter and ammeter to indicate battery voltage and charging current through the front LCD display on the fire alarm control panel.

2.5 MANUAL STATIONS

A. Provide manual pull stations with the following specifications:

1. Single action type (non-break glass type).
2. Die cast aluminum construction with baked red enamel finish.
3. Semi flush mounted to recessed backbox.
4. Pull lever locks in the protruding position when actuated.
5. Key lock switch for resetting handle and for testing purposes.
6. Fully enclosed silver plated contacts configured as normally open or normally closed.

7. UL listed.

B. Provide vandal proof shield over each manual pull station, to sound a local alarm when the shield is raised. Refer to “Vandal Equipment” specified elsewhere in this section.

C. Provide manual station with addressable communications module or provide addressable communications module immediately adjacent to manual station.

D. Provide unique address assignment for each detector, either through rotary dial located in the communication module or assigned by the main control panel.

2.6 VANDAL EQUIPMENT

A. Manual pull station vandal shields

1. Provide a UL listed clear polycarbonate hinged shield with integral peizo alarm to sound a local alarm when the shield is raised. Provide batteries for each.

a. Safety Technology International #1100/#6600 Series or pre-approved equal.

B. Clear Plastic Guard

1. Provide clear plastic cover guard where indicated on the drawing or specified herein.

C. Vandal proof enclosures

1. Where vandal proof equipment enclosures are noted in this specification and on the plans, provide enclosures with the following specifications:

a. Heavy duty sheet metal with piano hinge

b. Minimum ¼” thick clear lexan faceplate.

c. BEST/SCHLAGE lock, keyed to the Owner’s master.

d. Secured to the wall with approved anchoring hardware.

e. Verify color with Owner.

2.7 INTELLIGENT AUTOMATIC PHOTOELECTRONIC SMOKE DETECTORS

A. Provide automatic photoelectronic smoke sensors with the following specifications:

1. Utilizes light scattering principle from an internal infrared LED light source and reports the percent obscuration to the main control panel.

2. Factory set threshold at a nominal 1.5% light obscuration per foot (set via the main control panel)

3. Operates +14 to +120 degree F temperature, 10% to 93% humidity range.

4. Operates on single twisted pair cable.

5. Self-compensating drift compensation for maximum stability (set via the main control panel).

6. Integral red LED visible to the eye from below the detector to indicate an alarm condition and to indicate the polling pulse from the main control panel.

7. Mounts to base by twist locking motion.

8. U.L. 268 listed.

B. Provide detector base with addressable communications module.

C. Provide unique address assignment for each detector, either through rotary dial located in the communication module or assigned by the main control panel.

2.8 INTELLIGENT AUTOMATIC HEAT DETECTORS

A. Provide automatic heat detectors with the following specifications:

1. Utilizes a combination of fixed temperature and rate of rise compensation (temperature exceeds 15 degree per minute rise, set via the main control panel).
2. Operates at +14 to +122 degree F temperature, with relative humidity less than 93%.
3. Integral red LED visible to the eye from below the detector to indicate an alarm condition and to indicate the polling pulse from the main control panel.
4. Mounts to base by twist locking motion.
5. U.L. 521 listed.

B. Provide detector base with addressable communications module.

C. Provide ordinary rated (135 degree F) detectors in normal spaces. Provide intermediate rated (175 degree F) in unconditioned spaces such as boiler rooms or other areas with a high ambient temperature.

D. Provide unique address assignment for each detector, either through rotary dial located in the communication module or assigned by the main control panel.

2.9 INTELLIGENT PHOTOELECTRONIC DUCT SMOKE DETECTORS

A. Provide automatic photoelectronic duct smoke sensors with the following specifications:

1. Utilizes light scattering principle from an internal infrared LED light source and reports the percent obscuration to the main control panel.
2. Factory set threshold at a nominal 1.5% light obscuration per foot (set via main control panel)
3. Self-compensating drift compensation for maximum stability (set via main control panel).
4. Operates at air velocities from 300-4000 ft/min, +32 to +120 degree F operating temperature, 10%-93% humidity range.
5. Operates on single twisted pair cable.
6. Smoke chamber blocks particles larger than 200 microns.
7. Integral red LED visible to the eye from outside the detector housing to indicate an alarm condition and to indicate the polling pulse from the main control panel.
8. Mounts to housing/base by twist locking motion.
9. U.L. 268 listed.

B. Provide detector base with addressable communications module.

C. Provide unique address assignment for each detector, either through rotary dial located in the communication module or assigned by the main control panel.

D. Provide HVAC duct-mounted housing and sampling tubes of the proper length to sample the entire width of the HVAC duct. Provide additional duct smoke detectors as required for ducts wider than the longest sampling tube recommended by the fire alarm manufacturer.

E. Provide addressable control module and associated relay rated at 10 amps for connection to HVAC unit starter circuit for fan motor shutdown. Provide unique address assignment for each control module, either through DIP switches located in the control module or assigned by the main control panel.

F. Provide addressable control module and associated relay for connection to combination smoke/fire dampers. Provide unique address assignment for each control module, either through DIP switches located in the control module or assigned by the main control panel.

G. Provide remote test station for each duct detector in a readily accessible location near the unit. Provide engraved label on remote test station denoting the location, HVAC unit number, “RETURN”, damper location, etc. as required to identify the detector’s location and function.

2.10 INTELLIGENT ADDRESSABLE CARBON MONOXIDE DETECTORS

A. Provide intelligent addressable carbon monoxide detectors with the following specifications:

1. Incorporates carbon monoxide (CO) detection principals meeting the UL 2075 standards for system-connected life safety carbon monoxide detection.
2. CO detector to have an intelligent sounder base that generates a temp 4 pattern for CO alarm indication.
3. Operates +32 to +122 degree F temperature, 15% to 90% humidity range.
4. Self-compensating drift compensation for maximum stability (set via the main control panel).
5. Alarm thresholds: 70 PPM plus or minus 5 PPM -60 - 240 minutes. 150 PPM plus or minus 5 PPM – 10 – 50 minutes. 400 PPM plus or minus 10 PPM -4 – 15 minutes.
6. Mounts to base by twist locking motion.
7. U.L. 2075 listed.

B. Provide unique address assignment for each detector, either through rotary dial located in the communication module or assigned by the main control panel.

C. Interface/program fire alarm system such that the Carbon Monoxide detector alarm puts the fire alarm panel into supervisory condition and activates the local sounder bases.

2.11 AUTOMATIC SPRINKLER WATERFLOW SWITCHES

A. Provided by Mechanical Contractor.

B. Provide addressable communications module for each waterflow switch to communicate alarm and trouble signals to the main control panel.

C. Provide unique address assignment for each waterflow switch, either through rotary dial located in the communication module or assigned by the main control panel.

2.12 AUTOMATIC SPRINKLER VALVE POSITION (TAMPER) SWITCHES

A. Provided by Mechanical Contactor

B. Provide addressable communications module for each valve position switch to communicate trouble and supervisory signals to the main control panel.

C. Provide unique address assignment for each valve position switch, either through rotary dial located in the communication module or assigned by the main control panel.

2.13 DOMESTIC WATER SHUTOFF SOLENOIDS

A. Solenoids provided by Mechanical Contractor. Provide 120 volt power wiring to the solenoid.

B. Provide addressable control module to allow the fire alarm system to control the state of the solenoid. Provide control wiring between the solenoid and the control module.

C. Provide unique address assignment for the control module, either through DIP switches located in the control module or assigned by the main control panel.

D. Provide system programming to shut the solenoids (remove power to the solenoid) if water flow is detected by any sprinkler flowswitch.

2.14 ALARM INDICATING STROBES

A. Provide alarm indicating strobes with the following specifications:

1. Semi-flush mounting to 4-inch square electrical box
2. 24 VDC operation powered from the main control panel.
3. In rooms larger than 1600 square feet

a. Minimum 120 candela when measured on axis

b. Rated for wall mount applications per UL 1971 at a minimum of 110 candela effective intensity.

4. Non-assembly rooms and corridors

a. Minimum 75 candela when measured on axis

b. Rated for wall mount applications per UL 1971 at a minimum of 15 candela effective intensity.

5. One to three flashes per second with a one (1) hertz synchronous flash pattern in accordance with ADA.

6. White with Red “Alert” lettering. Vandal-proof polycarbonate lens.

7. Supervised wiring

8. U.L. 1971 listed, ADA compliant

2.15 SPEAKER NOTIFICATION APPLIANCES

A. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.

B. Communication transducers multi-tapped 1/4W to 2 W, with moisture-resistant, sealed compression driver.

C. Sensitivity: 87 – 96 dBA on-axis at 10’ or higher if required for vendor-supplied layout drawings.

D. Frequency response: 400-4000 Hz for tonal signaling and 125- 12,000 Hz for general signaling.

E. Matching Transformers: Tap range matched to acoustical environment of speaker location.

F. Mounting Faceplate: Factory finished, white.

G. Speaker circuits are to be designed utilizing 2 watt speaker setting. For speakers associated with auditoriums, gymnasiums and mechanical spaces a 4 watt up to 8 watt speaker setting shall be used.

2.16 ALARM INDICATING SPEAKER/STROBE UNIT

A. Provide speaker/strobe units with the following specifications:

1. Temporal sounding pattern of ½ to 1 sec ON, followed by ½ to 1 second OFF for three cycles, followed by a 1½ to 2 second OFF period for no less than 180 seconds.

2. Semi-flush mounting to 4-inch square electrical box

3. 24 VDC operation powered from the main control panel.

4. A minimum 90 dB output at 10 feet on axis.

5. Strobe light with the specifications of the strobe unit specified elsewhere in this section.

6. White with Red “Alert” lettering. Vandal-proof polycarbonate lens.

7. Supervised wiring

8. U.L. 1971 listed, ADA compliant

9. Speaker circuits shall be designed using 2 watt speaker setting. For speakers associated with auditorium, gymnasiums and mechanical spaces a 4 watt up to 8 watt speaker setting shall be used.

2.17 ADDRESSABLE MONITOR MODULE

A. Provide addressable monitor modules to serve as interfaces between the fire alarm system and ancillary systems where indicated on the drawings.

B. Provide with ability to monitor devices with normally-open (NO) contacts.

C. Match style and configuration of existing wiring. Provide with integral EOL resistor if required.

D. Provide enclosures for modules where not part of factory equipment.

2.18 ADDRESSABLE CONTROL MODULE

A. Provide addressable control modules to serve as interfaces between the fire alarm system and ancillary systems where indicated on the drawings.

B. Provide with ability to provide a contact closure, fully current rated for control of indicated devices. Provide with both normally-open (NO) and normally-closed contacts. Contacts on control module shall be rated for the proper voltage and current of the control circuits to which they are interfaced. Additional interfaces (interposing higher current relays, transformers, etc), if required to meet amperage or voltage requirements of the control system, are the responsibility of the contractor.

C. Match style and configuration of existing wiring. Provide with integral EOL resistor if required.

2.19 SYSTEM WIRE AND CABLE

A. Provide all conductors and cables in conformance with the National Electrical Code Section 760-30.

B. Size all initiating and indicating circuit wiring as recommended by the system manufacturer. Provide minimum 14 AWG size for indicating and control circuits, and 18 AWG for initiating circuits.

C. Provide shielded cable to minimize RFI if recommended by the manufacturer.

D. Provide maximum individual circuit voltage drop of 15% at the most distant device; or less if necessary to meet the manufacturer's operating voltage range for all devices.

PART 3 EXECUTION

3.1 SYSTEM SEQUENCE OF OPERATIONS

A. Remote station monitoring

1. The following system conditions shall initiate the communicator to transmit the point-specific information to the remote monitoring location:
   a. Sprinkler waterflow alarm.
   b. Any fire alarm condition initiated by a manual pull station.
   c. Any verified automatic detector alarm.
2. The following system conditions shall **not** initiate the communicator to transmit the alarm information to the remote monitoring location:
   a. Smoke duct detectors required for HVAC unit shutdown.
   b. Detectors required for the automatic release of fire doors.
   c. Detectors required for the automatic release of combination fire/smoke dampers.
   d. Detectors used for kitchen equipment power shutoff.
3. Automatic detectors at the following locations shall initiate a supervisory signal, not a general alarm:
   a. Smoke duct detectors required for HVAC unit shutdown.
   b. Detectors required for the automatic closure of fire doors and fire shutters.
   c. Detectors required for the automatic closure of fire/smoke dampers.

B. Walk test mode

1. The actuation of the "enable walk test" program at the control panel shall activate the "Walk Test" mode of the system which shall cause the following to occur:

   a. The city circuit connection shall be bypassed.

   b. Control relay functions shall be bypassed.

   c. The control panel shall show trouble condition.

   d. The alarm activation of any initiation device shall cause the audible signals to code a number of pulses to match the zone number.

   e. The panel shall automatically reset itself after signaling is complete.

   f. Any momentary opening of an initiating or indicating appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating a trouble condition.

   g. The system shall have the capacity of 8 distinctive walk test groups, such that only a portion of the system need be disabled during testing.

C. The control panel shall have the capability to display the number of times (tally) a zone, or addressable point, has gone into a verification mode. Should this smoke verification tally reach a pre-programmed number, a trouble condition shall occur.

D. Alarm verification zones shall be able to be divided into eight separate groups whereby only verification zones from the same group will confirm the first activation and cause the alarm sequence to occur.

E. Provide the following sequence of events after the main control panel has determined that an alarm condition exists within the building, and the alarm has been verified:

1. Sound the alarm notification signal at the main control panel and all remote annunciators.

2. Display in plain English the description of the location of the device in alarm at the main control panel and each remote annunciator.

3. Activate all audible and visual indicating devices in the associated indicating zone within the building. Activate all audible alarm indicating devices in a synchronous temporal pattern and all visual indicating devices in a one (1) hertz synchronous flash pattern until silenced by the alarm silence switch at the control panel or remote annunciator.

4. Close the domestic water shutoff solenoids at the sprinkler service(s) if water flow is detected by any sprinkler flow switch.

5. Release all self-closing and automatically closing devices powered by the fire alarm system within the building.

6. Shut off any monitored HVAC system if smoke is detected by the associated HVAC unit duct detector.

7. Initiate the communication/modem device to transmit the point-specific information to the off-site monitoring station.

8. Recall the elevator cab if any elevator lobby, elevator equipment room, or top of hoistway smoke detector goes into alarm according to the following sequence:

   a. If the alarmed detector is in the elevator equipment room, top of hoistway, or in the elevator lobby on any floor other than the main level of egress, the elevator cab shall be recalled to the main level of egress.

   b. If the alarmed detector is in the elevator lobby on the main egress level, the elevator cab shall be recalled to the predetermined alternate recall level as determined by the local authority having jurisdiction.

9. Store the event in the history log.

F. Provide the following sequence of events after the main control panel has determined that a trouble condition exists within the building:

1. Sound the trouble notification signal in the main control panel and all remote annunciators.
2. Display in plain English the description of the location of the device in trouble at the main control panel and each remote annunciator.
3. Store the event in the history log.

G. Provide the following sequence of events after the main control panel determined that a supervisory condition exists within the building:

1. Sound the trouble notification signal in the main control panel and all remote annunciators.
2. Display in plain English the description of the location of the supervisory signal at the main control panel and each remote annunciator.
3. Store the event in the history log.

H. Provide an interface to the building sprinkler system siamese connection indicating device on a separate indicating circuit. Provide alarm indication at the indicating circuit whenever water flow is detected. Provide a separate key switch at the main control panel to silence the indicating device.

I. If sprinkler water flow is detected by the kitchen hood water flow switch, the system shall shutoff electric power to the following:

1. Electric appliances located under the hood.
2. The exhaust fans serving the hood.
3. The electric gas solenoid valve. A general building alarm shall not initiate equipment shutoff.

J. The following system conditions shall initiate the communicator to transmit the point-specific information to the remote monitoring location:

1. Sprinkler water flow alarm.
2. Sprinkler valve position switch supervisory alarm.
3. Any fire alarm condition initiated by a manual pull station.
4. Any verified automatic detector alarm.

K. The following system conditions shall **not** initiate the communicator to transmit the alarm information to the remote monitoring location:

1. Smoke duct detectors required for HVAC unit shutdown.

L. Automatic detectors at the following locations shall initiate a trouble signal, not a general alarm:

1. Smoke duct detectors required for HVAC unit shutdown.

M. Provide green LED and the word NORMAL on the LCD display if the system is in its normal operating mode, and no alarms or faults exist in the system.

N. A manual evacuation (drill) switch shall be provided to operate the alarm indicating appliances without causing other control circuits to be activated. However, should a true alarm occur, alarm functions would occur as described previously.

O. The control panel shall maintain a moving average of the sensor's smoke chamber value to automatically compensate (move the threshold) for dust and dirty conditions that could affect detection operations. The system shall automatically maintain a constant smoke obscuration sensitivity for each sensor (via the floating threshold) by compensating for environmental factors. Photoelectric smoke detector smoke obscuration sensitivity shall be adjustable to within 0.2% of either limit of the UL window (0.2% to 4.0%) to compensate for any environment.

P. The system shall automatically indicate when an individual sensor needs cleaning. When a sensor's average value reaches a predetermined level, a "DIRTY SENSOR" trouble condition shall be audibly and visibly 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. 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. To prevent false alarms, these "DIRTY" conditions shall in no way decrease the amount of smoke obscuration necessary for system activation. For scheduling of maintenance, the control panel shall be able to generate an "ALMOST DIRTY" indication for any sensor approaching a "DIRTY" trouble condition. This report shall generate a list of sensor approaching a "DIRTY" trouble condition. This report shall generate a list of sensors requiring cleaning in advance of any trouble indication.

Q. The control panel shall continuously perform an automatic self-test routine on each sensor which will functionally check sensor electronics and ensure the accuracy of the values being transmitted to the control panel. Any sensor that fails this test shall indicate a "SELF TEST ABNORMAL" trouble condition with the sensor location at the control panel.

R. An operator at the control panel, having a proper access level, shall have the capability to manually access the following information for each sensor:

1. Primary status
2. Device type
3. Present average value
4. Present sensitivity selected
5. Peak detection values
6. Sensor range (normal, dirty, etc.)

S. An operator at the control panel, having a proper access level, shall have the capability to manually control the following for each sensor:

1. Clear peak detection values
2. Enable or disable the point
3. Clear verification tally
4. Establish alarm sensitivity
5. Control a sensor's relay driver output

T. It shall be possible to program the control panel to automatically change the sensitivity settings of each sensor based on time-of-day and day-of-week. There shall be five (5) sensitivity settings available for each sensor.

U. The control panel shall have the capability of being programmed for a pre-alarm or two-stage function. This function allows an indication to occur when, for example, a 3% sensor reaches a threshold of 1.5% smoke obscuration.

V. Adjust the sensitivity of the elevator lobby smoke detectors to maximum sensitivity.

3.2 INSTALLATION

A. Provide a complete and fully operational fire alarm and detection system as described herein and as shown on the drawings.

B. Provide a two wire Class B, low voltage, power limited, ADA compliant, addressable, closed circuit, electrically supervised, non-coded, temporal sounding type system as described in NFPA 72.

C. Provide individual alarm and trouble indication for each initiating device.

D. Provide supervisory signal indication for the sprinkler valve position switches (provided by others). Provide separate and unique monitoring of each valve position switch.

E. Provide supervision of the following circuits and devices:

1. Each individual initiating device and associated wiring
2. Each individual indicating device and associated wiring
3. Fire pump and fire pump wiring status.
4. Standby battery voltage.
5. Battery wiring.
6. Power supply voltage
7. CPU operation
8. Communications/Modem
9. Error Memory
10. Software Configuration
11. Hardware Configuration
12. Remote sub-panels, power supplies and associated wiring between the sub-panel and the main control panel.

F. Provide a clear distinction (at the main control panel and remote annunciators) between the alarm notification signal and the trouble notification signal.

G. Provide automatic HVAC system shut down for air handling units that move an air volume in excess of 2000 cfm. Provide duct detectors in the return ducts, and addressable control modules at each motor starter.

H. Provide automatic HVAC shutdown for air handling units that move an air volume in excess of 12,000 cfm. Provide duct detection in the supply and return ducts and addressable control modules at each motor starter.

I. Install and wire all equipment in accordance with this specification, project drawings and shop drawings.

J. Provide all wiring, conduit, junction boxes and outlet boxes required for the system, including terminations to initiating, indicating and control devices furnished by others.

K. Install all wiring in concealed conduit in new construction. Provide surface raceway and boxes in finished areas of existing construction. Reuse existing conduit and boxes wherever possible.

L. Paint all junction boxes red and label “Fire Alarm”.

M. Provide plain English description of the location of each initiating device (zone). Coordinate wording of each device with the Owner.

N. Provide a laminated floor plan showing all device locations, addresses and plain-English description of the location. Mount the plan adjacent to the annunciator panel in the building Engineer's office.

O. Provide color coded wiring throughout. Test all wiring for opens, shorts and grounds before system startup.

P. Terminate all fire alarm wiring at terminal strips at the main control panel and all annunciator panels. Identify each cable with a number corresponding to a wiring diagram to be submitted in the O&M manuals. Neatly arrange of cabling around the sides of the cabinets to facilitate servicing of equipment and modules.

Q. Provide the required system programming. Coordinate with the Owner all plain English address points, alarm verification presets, passwords, communication dialer protocol information, etc.

R. Coordinate the installation of the fire alarm system with mechanical contractor. Verify locations of sprinkler waterflow switches and valve position switch locations with mechanical contractor. Provide wiring and make terminations to sprinkler waterflow devices and valve position switches being installed by mechanical contractor.

S. Coordinate the installation of the fire alarm system with mechanical contractor. Verify locations of smoke damper and end switch locations with mechanical contractor. Provide wiring and make terminations to end switches being installed by mechanical contractor.

T. Provide interface between carbon monoxide detection and the fire alarm system. Program such that carbon monoxide detector puts the fire alarm panel into supervisory condition and activates local sounder bases.

U. Provide and install power to magnetic door holders, including wiring and connections through the associated smoke detector. Wire existing magnetic door holder wiring through the associated smoke detector base for automatic closure if the smoke detector senses smoke.

V. Mount end-of-line resistors in separate junction box located near the last device in the circuit or in last device. Clearly and permanently label "EOL RESISTOR" at each junction box cover plates and/or devices containing EOL resistors.

W. Provide 3/4 inch conduits and UTP cables from main fire alarm control panel to the telephone terminal board and telecommunications network for tie-in to remote monitoring company. Verify tie-in location with Owner. Provide a turn-key installation as required by NFPA 72, 26.6.1.

X. Provide and connect wiring from the duct smoke detector control modules to associated motor controllers.

Y. Install smoke detectors after the site is free from abnormal dust and dirt conditions, or provide manufacturer-approved protective cover over the device until the site is clean.

Z. Provide permanent labels for controls and indicators.

AA. Provide Form C relays where required to control line voltage equipment.

BB. Mount fire alarm devices to electrical boxes.

CC. Locate automatic detectors a minimum of 36 inches away from supply air diffusers.

3.3 PLENUM CABLE INSTALLATION

A. Plenum rated conductors are to be installed above accessible, suspended ceilings. Provide conduit for all exposed areas. Where provided utilize cable trays. Do not utilize cable trays provided for voice/data cabling.

B. Provide bushings on all conduit drops to outlet boxes for devices installed in walls.

C. Route all cables to avoid access panels on equipment and in ceiling.

D. Support all cable at 5’ intervals using “J” hooks. Fasten “J” hooks to building structure. Adhere to the manufacturer’s maximum fill for the cable support hardware. Bundle cables to eliminate sagging between “J” hooks. Install “J” hooks to eliminate sagging on ceilings, ducts, pipes, etc.

E. Install cables without violating the minimum bend radius recommended by the cable manufacturer.

F. Maintain at least a 12” spacing from fluorescent light fixtures and other EMI/RFI noise sources.

G. No splices are allowed in individual runs of cables. If splices are required due to the construction schedule then splices are to be made within junction boxes. Notify engineer for inspection of junction boxes prior to installation of ceiling tiles.

H. Maintain conductor shields at each connection point and tie to ground. Conductor shields are to be continuous throughout the entire run of cable.

I. Provide test results indicating continuity of conductor shields. Replace all cables where shields have become nicked or cut.

J. Terminate all conductors in flush outlet boxes behind devices. Provide stress relief. Provide grommets where cables enter HVAC equipment.

K. Provide red plenum cable for fire alarm systems.

3.4 TESTS AND ADJUSTMENTS

A. Upon completion of the installation phase, test and adjust the system to insure proper operation.

B. Test all operational features of the system at this time.

C. Where required, make appropriate correction(s) and adjustments.

D. Make an inspection of the fire alarm system with the manufacturer's representative of the fire alarm equipment, including those components necessary to the direct operation of the system such as manual stations, thermal detectors, smoke detectors, flow switches and controls, whether or not manufactured by the manufacturer. The inspection to comprise examination and certification of such equipment for the following:

1. The system functions properly;
2. The type of equipment installed is that designated by the Engineer's specifications;
3. The wiring connections to all equipment components have been installed in accordance with UL requirements;
4. Equipment of the manufacturer has been installed in accordance with the manufacturer's recommendation and that all signaling devices of whatever manufacturer have been operated or tested to verify their operation: The supervisory wiring of those items of equipment connected to a supervised circuit is operating and that the regulations, if any, concerning such supervisory wiring, have been met to the satisfaction of inspecting officials.

E. Inspection Certification: Upon completion of the inspection and when all of the above conditions have been complied with, the manufacturer is to issue to the Engineer:

1. A copy of the inspecting technician's report showing location of each device and certifying the test results of each device.
2. A certificate of verification confirming that the inspection has been completed and accepted by the authority having jurisdiction and showing the conditions upon which such inspection and certification have been rendered.

F. Owners Instruction: The manufacturer to provide the services of a competent alarm system technician for the period of two working days, at a time convenient to the Owner, to instruct the staff in the operation and maintenance of the system.

G. Provide a letter to the Owner and Fire Marshal certifying that the installed system is UL certified.

3.5 TRAINING

A. Provide a minimum of eight (8) hours of on-site instruction and training to the person or persons so designated by the Owner.

3.6 AS-BUILT DOCUMENTATION

A. Provide to the Engineer two (2) complete as-built manuals assembled in loose-leaf binders containing the following:

1. As-built system functional block diagrams.
2. Corrected copies of approved shop drawings
3. As-built system wiring diagram to be provided in CADD Format. Field as-builts will not be accepted..
4. List indicating each device, location, address, label, etc.
5. Final operating sequence (step by step) for the system as tested and accepted by the Fire Marshal.
6. **Hard copy printout of the complete fire alarm operating program, and a USB flash drive with programming software as written and customized for this project.**
7. System operation manuals.
8. System maintenance manuals.
9. Name, address and phone number of the responsible service organization.

3.7 FINAL CHECKOUT AND ACCEPTANCE

A. Demonstrate the operation and use of the system to the Architect/Engineer, to the Owner's representative(s) and the Fire Marshal.

B. Verify the following before scheduling the system demonstration:

1. System installation is complete.
2. System is fully operational.

C. Verify the following before requesting final approval:

1. Owner training is complete.
2. As-built documentation is complete and turned over to the Engineer.

D. Provide a letter to the Owner certifying that the installation is complete, fully operational and successfully tested.

E. Final acceptance of the system will be given upon completion of all of the above requirements.

3.8 MAINTENANCE

A. Maintain a local service organization which is available to perform testing, inspection, repair and maintenance service on the system.

B. Make available to the Owner a maintenance contract proposal, from the system supplier to provide a minimum of two (2) inspections and test per year in compliance with NFPA-72 guidelines.

3.9 SPARE PARTS

A. Provide the following spare parts for the system:

1. Five intelligent smoke detectors with bases.
2. One duct smoke detector with housing and sampling tubes, control/relay module and remote test station

3. One manual pull stations.
4. Two addressable control modules.
5. Two addressable monitor module.
6. Five keys for fire alarm cabinets.

B. Turn spare parts over to Owner at the completion of the project. Provide written documentation signed by the Owner that the spare parts were turned over at the completion of the project.

END OF SECTION

SECTION 31 1000
SITE CLEARING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Clearing and protection of vegetation.

B. Removal of existing debris.

1.02 SUSTAINABILITY REQUIREMENTS

A. See Section 01 81 13 B3 Sustainability Design Requirements.

PART 2 PRODUCTS

2.01 MATERIALS

A. Fill Material: As specified in Section 31 2323 - Fill

PART 3 EXECUTION

3.01 SITE CLEARING

A. Comply with other requirements specified in Section 01 7000.

B. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

3.02 EXISTING UTILITIES AND BUILT ELEMENTS

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Contractor shall call Gopher State One Call in Minnesota [1-800-252-1166] for locating and marking of all utilities within the work area prior to any excavation on the project site.

C. Protect existing utilities to remain from damage.

D. Do not disrupt public utilities without permit from authority having jurisdiction.

E. Protect existing structures and other elements that are not to be removed.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary

3.03 VEGETATION

A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, paving, playing fields, lawns, and planting beds. Contractor shall remove all vegetation within the construction limits necessary to perform the work. All necessary vegetation removal is incidental to the work.

B. Minnesota B3 Requirement: Removal of trees shall not occur between June 1 and August 15 to minimize impacts to endangered bat habitats.

C. Do not remove or damage vegetation beyond the limits indicated on drawings. Provide protective fencing around trees to be preserved where indicated on the plans. Fencing shall be 4-high brightly colored plastic material or approved equal. Fencing shall be placed around the entire drip line of the tree. The drip line is defined by the outer tips of the branches.

D. Vegetation Removed: Do not burn, bury, landfill, or leave on site. All other vegetation cleared shall be removed from the site.

E. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated. All other vegetation cleared shall be removed from the site.

F. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

3.04 EXISTING BUILT ELEMENTS

A. Scope:
   1. Neat line sawcut and remove paving and curbs as required to accomplish new work.
   2. Remove items as indicated on Drawings.
   3. Coordinate with the owner any items to be salvaged.
   4. Fill excavations, open pits and holes in ground areas generated as a result of removals, using General Fill; compact fill as required so that required rough grade elevations do not subside within one year after completion.

B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Provide, erect and maintain temporary barriers and security devices.
   3. Conduct operations to minimize effects on, and interference with, adjacent structures and occupants.
   4. Do not close or obstruct public roadways or sidewalks without permit.
   5. Conduct operations to minimize obstruction of public andd private entrances and exits; to no obstruct required exits at any time; protect persons using entrances and exits from removal operations.

C. Do not begin removal until receipt of notification to proceed from Owner.

D. Protect existing structures and other elements that are not to be removed.
   1. Prevent movement or settlement of adjacent structures.

E. Perform demolition in a manner that maximizes salvage and recycling of materials.

F. Partial Removal of Paving and Curbs: Neatly sawcut at right angle to surface. Begin and end removal of concrete walks and curbs at existing expansion joint locations.

G. Dispose of demolished bituminous, concrete and other materials off site in compliance with MPCA and local regulations for waste disposal.

3.05 DEBRIS

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 31 2113
RADON MITIGATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Coordinate sleeving of foundations to connect all slab areas under living spaces to radon vent.

B. Coordinate installation of underslab gas-permeable aggregate.

C. Coordinate installation of underslab perforated collection pipe.

D. Coordinate installation of underslab gas-retarder membrane, including sealing at seams, edges and penetrations.

E. Coordinate installation of vertical vent pipe from slab penetration into aggregate and up through roof.

F. Coordinate installation of electrical junction boxes for vent fan(s), alarm and light.

G. Label radon vent pipe.

1.02 REFERENCES

A. ANSI CC-1000 Soil Gas Control Systems in New Construction of Buildings, 2018.

B. National Radon Proficiency Program: Certification radon tester qualifications.

C. National Radon Safety Board: Certification radon tester qualifications.

1.03 DESIGN REQUIREMENTS

A. A passive sub-slab depressurization system complying with the Minnesota State Building Code and:

1. One 4 inch diameter vertical vent pipe in lieu of 3 inch diameter pipe for every 3,000 square feet of building foot print.
2. An electric outlet installed at the top and/or in the attic for possible installation of future fan that is wired to a common (house) panel.
3. All ground-connected building spaces shall be tested when project is complete and prior to occupancy by certified tester following the test procedures ANSI-AARST Standard: Protocol for Conducting Radon and Radon Decay Product Measurements in Multifamily Buildings, (ANS/AARST MAMF 2012). If testing indicates Radon levels 4 pC/l or greater, then for each area that tests at or above aforemention Radon levels the installed, the Passive Radon mitigation system shall be converted to an Active Radon mitigation system by:
    a. Installing a fan certified by the manufacture for Radon use that shall run continuously and is connected common (house panel) power source.
4. Exterior Radon mitigation systems are not allowed.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide for fan, alarm devices, vapor barrier, pipe and aggregate.

PART 2 PRODUCTS

2.01 MATERIALS

A. Underslab gas-permeable aggregate as specified in Section 31 2323 - Fill .

B. Underslab perforated collection pipe to be 4 inch perforated HDPE drain pipe or perforated PVC drain and sewer pipe as specified in Section 33 4100 - Subdrainage. Polypropylene sock required.

C. Gas retarder membrane as specified in Section 03 3000 - Cast-in-Place Concrete. Use tape and sealant materials as specified therein.

D. Vertical vent pipe to be schedule 40 PVC waste and vent pipe specified in Division 22 - Plumbing.

E. Power, wiring, conduit and other electrical components as specified in Divsion 26.

F. Sampling Device: Stainless steel, cast-in-place sampling device with stainless steel secured cover.
   1. Products: Vapor Pin; www.vaporpin.com.

PART 3 EXECUTION

3.01 EXECUTION

A. Coordinate underslab pipe locations with installation of footings and foundations and provide sleeves where necessary to connect all underfloor areas.

B. Locate systems where indicated on drawings.

C. A 6 inch thick layer of gas permeable aggregate shall be placed on subgrade of the entire floor area directly under the concrete floor slab.

D. A 4 inch perforated under the slab collection pipe shall be installed within the gas permeable aggregate to connect all underslab areas within the building to the point of the vertical vent pipe (or pipes). Install tee connection where pipes join. Install the connection at point where vertical vent pipe connects through the concrete slab to the underslab collection pipe. Friction connections are acceptable below the gas-retarder membrane but all connections made above the gas retarder membrane must be solvent welded air tight joints. Extend underslab collection pipe through interior foundation to interconnect subslab areas when more than one vertical vent pipe is indicated on the drawings. Do not interconnect the areas vented by each vertical vent. Provide at least one 4" diameter vertical vent pipe per 3,000 square feet of building foot print.

E. The gas retarder membrane shall be installed on the top of the gas permeable aggregate and directly under the concrete slab. All seams shall be taped. All edges shall be sealed to the foundation wall or other material that forms the edge. All penetrations (pipe, conduit, other) shall be sealed airtight to the membrane.

F. Install the vertical vent pipe from the underslab collection pipe up through the roof. All joints shall be solvent welded airtight. Flash at roof as for typical plumbing vent stack. do not interconnect to plumbing vents. In attic or roof area, mark pipe "radon vent" with permanent marker in a location above roof insulation and visible from attic access location.

G. Coordinate installation of 110v duplex outlet to location in attic or roof space within 4 feet of vertical vent pipe. (outlet will not be used at this time, but must be available for future fan installation.

END OF SECTION

SECTION 31 2200
GRADING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Removal and storage of topsoil.

B. Rough grading and preparing the site for site structures.

C. Finish grading.

1.02 SUSTAINABILITY REQUIREMENTS

A. See Section 01 81 13 B3 Sustainability Design Requirements.

PART 2 PRODUCTS

2.01 MATERIALS

A. Topsoil: See Section 31 2323.

B. Other Fill Materials: See Section 31 2323.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench mark and intended elevations for the Work are as indicated.

B. Verify the absence of standing or ponding water.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Stake and flag locations of known utilities.

C. Locate, identify, and protect from damage above- and below-grade utilities to remain.
   1. Contractor shall utilize the Minnesota Gopher State One Call [1-800-252-1166] for locating and marking of all utilities within the work area prior to any excavation on the project site.

D. Notify utility company to remove and relocate utilities.

E. Provide temporary means and methods to remove all standing or ponding water from areas prior to grading.

F. Protect site features to remain, including but not limited to bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs, from damage by grading equipment and vehicular traffic.

G. rotect trees to remain by providing substantial fencing around entire tree at the outer tips of its branches; no grading is to be performed inside this line. See Section 31 1000 for vegetation protection procedures.

3.03 ROUGH GRADING

A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.

B. Do not remove topsoil when wet.

C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.

D. Do not remove wet subsoil , unless it is subsequently processed to obtain optimum moisture content.

E. When excavating through roots, perform work by hand and cut roots with sharp axe.

F. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

G. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack surface water control.

3.04 SOIL REMOVAL

A. Stockpile topsoil to be re-used on site; remove remainder from site.

B. Minnesota B3 Requirements:
   1. Topsoil from project site shall not be sold or exported until all landscaped areas (tree, shrub, perennial, annual, or lawn plantings) have received an average 12-inch deep respread using soil from the project soil.
   2. Existing site topsoil shall be stockpiled and protected for an average respread depth of 12 inches in all proposed planting and seeding areas.
   3. No topsoil should be screened with less than a 3-inch screen.

3.05 FINISH GRADING

A. Before Finish Grading:
   1. Verify building and trench backfilling have been inspected.
   2. Verify subgrade has been contoured and compacted.

B. Remove debris, roots, branches, stones, in excess of 1/2 inch in size. Remove soil contaminated with petroleum products.

C. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches.

D. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.

E. Maintain stability of topsoil during inclement weather. Replace topsoil in areas where surface water has eroded thickness below specifications.

3.06 TOLERANCES

A. Top Surface of Subgrade: Plus or minus 0.10 foot (1-3/16 inches) from required elevation.

B. Top Surface of Finish Grade: Plus or minus 0.04 foot (1/2 inch).

3.07 REPAIR AND RESTORATION

A. Existing Facilities, Utilities, and Site Features to Remain: If damaged due to this work, repair or replace to original condition.

B. Trees to Remain: If damaged due to this work, notify the Landscape Architect and trim broken branches and repair bark wounds per the Inspection and Contract Administration Manual for MNDOT Landscape Projects (ICAMMLP); if root damage has occurred, notify Landscape Architect immediately to obtain instructions as to remedy.

C. Other Existing Vegetation to Remain: If damaged due to this work, replace with vegetation of equivalent species and size with approval of Landscape Architect. See Section 32 9300 for submittal requirements.

3.08 FIELD QUALITY CONTROL

A. See Section 31 2323 for compaction density testing.

3.09 CLEANING

A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water.

B. Leave site clean and raked, ready to receive landscaping.

END OF SECTION

SECTION 31 2316
EXCAVATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Excavating for building volume below grade, footings, slabs-on-grade, paving, site structures, and utilities within the building.

B. Trenching for utilities outside the building to utility main connections.

C. Utility Property and Service - Identifying and working around existing utilities.

D. Protection of existing built elements and adjacent areas (Shoring and Bracing).

E. General construction site dewatering.

1.02 SUSTAINABILITY REQUIREMENTS

A. See Section 01 81 13 B3 Sustainability Design Requirements.

1.03 PRICE AND PAYMENT PROCEDURES

A. Unit Price No. 1 : Removal of Unsuitable Soils.
   1. Measurement Method: By the cubic yard, in place volume.
   2. Includes: Excavating Unsuitable Soils to required elevations, loading and removing from site, and dewatering if required.
   3. Does Not Include Over-Excavation: Payment will not be made for over-excavated work nor for replacement materials.

B. See Section 01 2200 - Unit Prices, for general requirements applicable to unit prices for excavation.

1.04 UTILITY PROPERTY AND SERVICE

A. Construction operations in proximity of utility properties shall be performed in accordance with the provisions of MnDOT 1507, except as modified below:
   1. Interference of Underground Structures
      a. When any underground structure interferes with planned placement of the pipeline or appurtenances, to such an extent that alterations in the work are necessary to eliminate conflict or avoid endangering effects on either existing or proposed facilities, Contractor shall immediately notify Engineer of the affected structure. When any existing facilities are endangered by Contractor's operations, Contractor shall cease work associated with the interference and take such precautions as may be necessary to protect in-place structures until a decision is made as to how the conflict will be resolved.
      b. Without specific authorization from Engineer, no essential utility service shall be disrupted, nor shall any change be made in either the existing structures or the planned installations to overcome the interference. Alterations in existing facilities will be allowed only to the extent that service will not be curtailed unavoidably, and then only when the encroachment or relocation will satisfy all applicable regulations and conditions.
      c. Whenever alterations are required as a result of unforeseen underground interferences, not due to any fault or negligence of Contractor, Engineer will issue a written order covering any additional or extra work involved and specifying the revised basis of payment, if any. Any alterations made strictly for the convenience of Contractor shall be subject to prior approval and shall be at Contractor's expense.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Dewatering Plan; submit for review 2 weeks prior to excavation and dewatering activities.

1. When permits are required for dewatering, provide copies of all permits.
2. Provide copies of the layout of all dewatering system components, with collection and disposal areas.

C. Field Quality Control Submittals: Document visual inspection of load-bearing excavated surfaces.

PART 2 PRODUCTS - (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench mark and intended elevations for the Work are as indicated.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. See Section 31 2200 for additional requirements.

C. Locate, identify, and protect utilities that remain and protect from damage.

D. Notify utility company to remove and relocate utilities as needed.

E. Grade top perimeter of excavation to prevent surface water from draining into excavation. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by Architect.

3.03 EXCAVATING

A. Excavate to elevations and dimensions required by the drawings and as necessary to complete the work.

B. Excavate to accommodate new structures and construction operations.
1. Excavate to the specified elevations.
2. Excavate to the length and width required to safely install, adjust, and remove any forms, bracing, or supports necessary for the installation of the work.
3. Cut utility trenches wide enough to allow inspection of installed utilities.
4. See Section 31 2316.26 for required excavation clearances for pipes in utility trenches.
5. Hand trim excavations. Remove loose matter.

C. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

D. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.

E. Do not interfere with 45 degree bearing splay of foundations.

F. Cut utility trenches wide enough to allow inspection of installed utilities.

G. Hand trim excavations. Remove loose matter.

H. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 31 2323.

I. Provide temporary means and methods, as required, to remove all water from excavations until directed by Architect. Remove and replace soils deemed suitable by classification and which are excessively moist due to lack of dewatering or surface water control.

J. Remove excavated material that is unsuitable for re-use from site.

K. Stockpile excavated material to be re-used in area designated on site. Stockpile in designated areas on site. Protect stockpile from erosion.

L. Remove excess excavated material from site.

3.04 COMMON EXCAVATION

A. Material to be excavated that can be removed by hand shoveling, power shovel, bulldozer or other normal heavy equipment but not requiring the use of drills, and blasting shall be defined as common excavation. The contractor is responsible for all common excavation necessary to complete the work.

3.05 UNSUITABLE SOIL REMOVAL

A. In all areas of fill or foundations remove all unsuitable soil (topsoil, soil with trace organics, soft or otherwise disturbed soils) prior to the placement of subsequent fill soils or foundations. Refer to the Geotechnical Report for the extent and depth of unsuitable soils which is to be included in the Base Bid.
   1. The contractor is responsible for all unsuitable soil removal necessary to complete the work.
   2. Oversize soil correction excavations as indicated in the Geotechnical Report..
   3. After all unsuitable soils are removed the Owner's Geotechnical Engineer shall observe the excavated surface to determine if all unsuitable soils have been removed and it is ready for subsequent fill soils or foundations. The Contractor shall coordinate with the Owner's Geotechnical Engineer for these observations.
   4. Unauthorized over excavations by the Contractor shall be backfilled in accordance with Section 31 2323, by the Contractor at no additional cost to the Owner.

3.06 EXCAVATED SOIL STOCKPILING, DISPOSAL AND REMOVAL

A. See Section 31 2200 for topsoil stockpiling and removal.

B. Stockpile excavated subsoil to be re-used on site; the remainder shall be removed from the site.

C. Stockpiles: Use areas designated on site; pile depth not to exceed 8 feet; protect from erosion.

3.07 PROTECTION OF EXISTING BUILT ELEMENTS AND ADJACENT AREAS (SHORING AND BRACING)

A. The Contractor is responsible for the protection of existing buildings, utilities, streets, etc. during construction and for design and installation of all necessary temporary bracing, shoring an underpinning to ensure such protection.

B. Stability of Excavations: Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions, stability of material excavated or need to protect undermining of existing walks, streets and/ or utilities. Maintain sides and slopes of excavations in safe condition.

C. Shoring and Bracing: Provide materials for shoring and bracing, such as soldier piles, sheet piling, uprights, stringers and cross-braces, in good serviceable condition. Establish requirements for shoring, trench shoring and bracing to comply with local codes and authorities having jurisdiction. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses. Remove temporary work when no longer required for overall project construction including building construction. Maintain existing roadway widths and surfaces at all locations unless indicated otherwise.

D. Where sheeting/shoring or other means is used, it shall comply with all OSHA regulations.

3.08 DEWATERING

A. Contractor is responsible for dewatering of site including all bailing and pumping necessary to keep all depressions, pits, trenches and other parts of the site and excavated areas free of water during the entire progress of the work. All dewatering operations shall pass through a sediment containment device prior to discharge from the site.

B. Contractor shall comply with local, state, and federal regulations for dewatering.

C. Coordinate installation of dewatering system with other contractors. Locate dewatering system components in locations that do not interfere with site operations or other construction activities.

D. Provide personnel, equipment, and power necessary to maintain and operate the dewatering system as required to complete construction at the site.

E. Clean receiving storm sewer system, ground surface and surface waters of any sediment or debris deposits resulting from dewatering system operation.

F. Remove all dewatering system components immediately following use.

3.09 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.

B. Provide for visual inspection of load-bearing excavated surfaces before placement of foundations.

C. Provide proof-rolling of excavated subgrade in pavement areas with a loaded tandem axle dump truck prior to placement of fill and/or pavement sub-base materials. Subgrade shall be approved by the geotechnical engineer prior to placement of fill and/or sub-base materials.

3.10 PROTECTION

A. Divert surface flow from rains or water discharges from the excavation.

B. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.

C. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition.

D. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

E. Keep excavations free of standing water and completely free of water during concrete placement.

F. Keep excavations free of water. Provide dewatering by approved means. Water pumped or otherwise discharged from the site during construction shall be directed towards sediment containing devices prior to discharge.

3.11 SUBGRADE APPROVAL/PROOF ROLLING

A. Following excavation to the design subgrade elevations in all buildings and pavement areas and prior to placement of any Base Course or other fill materials, the Contractor shall contact the Owner’s designated Construction Representative to schedule inspection of the subgrade and observe proof rolling operations. Provide minimum of 24 hrs confirmed notice. All proof rolling shall be completed by the Contractor in the presence of the Owner’s designated Construction Representative.

B. To complete proof rolling, exposed subgrade areas shall be provided with a relatively smooth surface, suitable for observing soil reaction during proof rolling.

C. Contractor shall schedule and provide a fully loaded tri-axle dump truck for proof rolling. Loaded truck shall have a minimum gross operating weight of 30 tons. Test shall be conducted with “tag” or “pusher” axles retracted from the ground.

D. Test rolling shall be accomplished in a series of traverses parallel to the centerline of the street, parking area or building area. The truck shall traverse the length of the street or parking / building areas once for each 12 feet of width. Additional passes along the traverse shall be completed as directed by the Owner’s Construction Representative, to further define unsatisfactory subgrade.

E. Soft areas, yielding areas, cracked areas or areas where rolling or wave action is observed shall be considered indicative of an unsatisfactory subgrade. Such areas shall be undercut as outlined in subsequent subsections of this specification.

F. Once the subgrade has been proof rolled and approved, protect the soils from becoming saturated, frozen, or adversely altered.

END OF SECTION

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SECTION 31 2316.13
TRENCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Backfilling and compacting for utilities outside the building to utility main connections.

1.02 SUSTAINABILITY REQUIREMENTS

A. See Section 01 81 13 B3 Sustainability Design Requirements.

1.03 REFERENCE STANDARDS

A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18 in.) Drop; 2017.

B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012, with Editorial Revision (2015).

C. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2015.

D. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2017.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Samples: 10 pound sample of each type of fill; submit in air-tight containers to testing laboratory.

C. Materials Sources: Submit name of imported materials source.

D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

E. Compaction Density Test Reports.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. See Section 31 2323 - Fill.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench marks and intended elevations for the work are as indicated.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Locate, identify, and protect utilities that remain and protect from damage.

C. Notify utility company to remove and relocate utilities.

D. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Protect plants, lawns, rock outcroppings, and other features to remain.

F. Grade top perimeter of trenching area to prevent surface water from draining into trench. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by the Architect.

3.03 TRENCHING

A. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

B. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.

C. Do not interfere with 45 degree bearing splay of foundations.

D. Cut trenches wide enough to allow inspection of installed utilities.

E. Hand trim excavations. Remove loose matter.

F. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.

G. Remove excavated material that is unsuitable for re-use from site.

H. Stockpile excavated material to be re-used in area designated on site in accordance with Section 31 2200.

I. Remove or dispose of excess excavated material in accordance with Section 31 2316.

J. Remove excess excavated material from site.

K. Provide temporary means and methods, as required, to remove all water from trenching until directed by the Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

L. Determine the prevailing groundwater level prior to trenching. If the proposed trench extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Architect.

3.04 PREPARATION FOR UTILITY PLACEMENT

A. See Section 31 2200 for additional requirements for dewatering.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with General Fill.

C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

D. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

3.05 BACKFILLING

A. Conform to the detail on the plans.

B. Backfill to contours and elevations indicated using unfrozen materials.

C. Fill up to subgrade elevations unless otherwise indicated.

D. Employ a placement method that does not disturb or damage other work.

E. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

F. Maintain optimum moisture content of fill materials to attain required compaction density.

G. Granular Fill: Place and compact materials in equal continuous layers not exceeding 12 inches compacted depth.

H. General Fill: Place and compact material in equal continuous layers not exceeding 12 inches compacted depth.

I. Slope grade away from building minimum 6 inches in 10 ft, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.

J. Correct areas that are over-excavated.
   1. Thrust bearing surfaces: Fill with concrete.
   2. Other areas: Use General Fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density.

K. Compaction Density Unless Otherwise Specified or Indicated:
   1. Under paving, slabs-on-grade, and similar construction: 100 percent of maximum dry density within the upper 3ft and 95 percent of maximum dry density below 3ft.
   2. At other locations: 90 percent of maximum dry density.

L. Reshape and re-compact fills subjected to vehicular traffic.

3.06 BEDDING AND FILL AT SPECIFIC LOCATIONS

A. Utility Piping, Conduits, and Duct Bank:
   1. Conform to the detail on the drawings.
   2. Bedding: Use Fill Type Pipe Bedding.
   3. Cover with Fill Type Engineered Fill.

3.07 TOLERANCES

A. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.

3.08 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.

B. Perform compaction density testing on compacted fill in accordance with ASTM D6938.

C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("standard Proctor").

D. If tests indicate work does not meet specified requirements, remove work, replace and retest.

E. Frequency of Tests: 1 test for every 300 linear feet of trench per 3 ft of depth.

3.09 PROTECTION

A. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.

B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

C. Keep excavations free of water. Provide dewatering by approved means. Water pumped or otherwise discharged from the site during construction shall be directed towards sediment containing devices prior to discharge.

3.10 CLEANING

A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

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SECTION 31 2323
FILL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Filling, backfilling, and compacting for building volume below grade, footings, slabs-on-grade, paving, site structures, and utilities within the building.

B. Soil types and descriptions.

C. Backfilling and compacting for utilities outside the building to utility main connections.

D. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

1.02 SUSTAINABILITY REQUIREMENTS

A. See Section 01 81 13 B3 Sustainability Design Requirements.

1.03 PRICE AND PAYMENT PROCEDURES

A. See Section 01 2200 - Unit Prices, for general requirements applicable to unit prices for earthwork.

B. Unit Price No. 01: Excavation of Unsuitable Soils: See Section 31 2316.

C. Unit Price No. 02: Engineered Fill (off-site source):
   1. Method of Measurement: By the cubic yard, in place volume.
   2. Includes: Supplying Engineered Fill, stockpiling, scarifying substrate surface, placing where required, compacting materials, and compaction testing.
   3. Does Not Include Over-Excavation: Payment will not be made for over-excavation work nor for replacement materials.

1.04 REFERENCE STANDARDS

A. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012, with Editorial Revision (2015).

B. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method; 2015, with Editorial Revision (2016).

C. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2017.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Samples: 10 pounds sample of each type of fill; submit in air-tight containers to testing laboratory.

C. Materials Sources: Submit name of imported materials source.

D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used, including manufactured fill.

E. Compaction Density Test Reports.

F. Stormwater Management Infiltration Test Reports.

G. Testing Agency Qualification Statement.

1.06 DELIVERY, STORAGE, AND HANDLING

A. When necessary, store materials on site in advance of need.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. General Fill - Fill Type ____: Non-organic select compactible salvaged Subsoil excavated on-site and/or imported MNDOT 2106.2B Common Embankment. When on-site soils are exhausted the Contractor shall provide imported MNDOT Common Borrow as necessary to complete the work. General Fill excavated from on-site shall meet the following requirements.
   1. Graded.
   2. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
   3. General Fill salvaged from on-site shall be selected, separated and protected to manage the soils moisture content. The Contractor shall dry or moisture condition the soil as necessary in order to achieve the required compaction densities. If drying the soils is not feasible due to weather or the season, the Contractor shall provide Common Borrow to balance the site at no additional cost to the Owner.
   4. If salvaged subsoil from on-site is not compactible due to moisture content, or for other reasons, the Contractor shall remove the uncompactable soils and replace with MNDOT 2106.2B Common Embankment.

B. Engineered Fill: Imported borrow conforming to MnDOT 3149.2B Select Granular Material.

C. Drainage Fill: Conforming to MnDOT 3149.2H Coarse Filter Aggregate, non-carbonate aggregate.

D. Pipe Bedding: Conforming to MnDOT 3149.2F Granular Bedding.

E. Underslab Gas-Permeable Aggregate shall be crushed rock or natural gravel material, 1/2-inch to 3/4-inch clean (no fines).

F. Biofiltration Soil: Conforming to MnDOT 3877.2F Filter Topsoil Borrow (80% sand, 20% compost).

G. Topsoil: Topsoil shall conform to MNDOT 3877.2A Common Topsoil Borrow.
   1. Topsoil source: Imported or salvaged on-site. Reuse surface soil stockpiled on-site when possible. Verify suitability of stockpiled surface soil through testing. Refer to submittals. Amend stockpiled soil to meet MNDOT Spec. 3877.2A, Common Topsoil Borrow.
   2. Clean surface soil of roots, plants, sod, stones greater than 3/4-inch, clay clumps, and other extraneous materials harmful to plant growth.
   3. Maximum particle size of 3/4-inch.
   4. Minnesota B3 Requirements:
      a. Cation Exchange Capacity (CEC) of at least 15.
      b. Base saturation percentage of at least 30% should be achieved.
      c. Mycorrhyzae count of at least two Glomus species per ounce of soil should be achieved.

H. Planting Soil:
   1. Trees and Boulevard Restoration: Imported or salvaged on-site. Reuse surface soil stockpiled on-site when possible. Verify suitability of stockpiled surface soil and amend stockpiled soil to meet MNDOT Spec. 3877.2B, Loam Topsoil Borrow.
   2. Perennial and Shrub Beds: Reuse surface soil stockpiled on-site when possible. Disc in a minimum of 6 inches of compost that shall conform to MNDOT Type 2 Compost. Verify suitability of amended soil to meet MNDOT Spec. 3877.2B, Loam Topsoil Borrow.
   3. Clean surface soil or roots, plants, sod, stones greater than 3/4-inch, clay clumps, and other extraneous materials harmful to plant growth. Salvaged topsoil stockpiled for reuse as planting soil in perennial beds shall be free from noxious weeds, rhizomes, and seeds deleterious to plant growth.
   4. Maximum particle size of 3/4-inch.
   5. Minnesota B3 Requirements:
      a. Cation Exchange Capacity (CEC) of at least 15.

b. Base saturation percentage of at least 30% should be achieved.
c. Mycorrhyzae count of at least two Glomus species per ounce of soil should be achieved.

2.02 ACCESSORIES

A. High Density Rigid Insulation for concrete pavement/walk section with snowmelt system: Insulation board shall be “DOW Styrofoam HI 60” or “Certifoam 60" or approved equal.

B. Geotextile for Drainage: Non-biodegradable, nonwoven; conforming to MnDOT 3733 Type 1 Geotextile.

2.03 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for testing and analysis of soil material.

B. Where fill materials are specified by reference to a specific standard, testing of samples for compliance will be provided before delivery to site.

C. If tests indicate materials do not meet specified requirements, change material and retest.

D. Provide materials of each type from same source throughout the Work. If source must change then retest at no cost to the Owner.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench marks and intended elevations for the Work are as indicated.

B. Identify required lines, levels, contours, and datum locations.

C. See Section 31 2200 for additional requirements.

D. Verify subdrainage, foundation insulation, dampproofing, and/or waterproofing installation has been inspected.

E. Verify structural ability of unsupported walls to support imposed loads by the fill, see structural drawings.

F. Verify subgrade has been approved by the geotechnical engineer. See Section 31 2316.

G. Verify underground tanks are anchored to their own foundations to avoid flotation after backfilling.

H. Verify areas to be filled are not compromised with surface or ground water.

3.02 PREPARATION

A. Scarify and proof roll subgrade surface to a depth of 6 inches to identify soft spots.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Granular Fill.

C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

E. Minnesota B3 Requirements: The bulk density of all unpaved pervious surfaces intended for seeding and planting shall have the following maximum bulk densities. Soils in these areas that exceed the stated bulk densities shall be decompacted to 24 inches prior to planting or seeding by air spading, ripping, adding organic matter (see S.3 F), or other decompaction method.
   1. Organics: Less than1.0g/cm3
   2. Clay and Silt: less than 1.25 g/cm3.
   3. Loam: Less than 1.4 g/cm3
   4. Sand: Less than 1.6 g/cm3

3.03 FILLING

A. Fill to contours and elevations indicated using unfrozen materials.

B. Employ a placement method that does not disturb or damage other work.

C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

D. Bench fill into the native soils on all sloped surface 5 horizontal to 1 vertical or steeper. Place fills in uniform thickness horizontal lifts.

E. Maintain optimum moisture content of fill materials to attain required compaction density.

F. Slope grade away from building minimum 6 inches in 10 ft, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.

G. Correct areas that are over-excavated.
   1. Under building area: Use Engineered Fill, flush to required elevation, compacted to 95 percent maximum dry density.
   2. Under, paving slabs-on-grade and similar construction: Use General Fill, flush to required elevation, compacted to 100 percent of maximum dry density.
   3. Other areas: Use General Fill, flush to required elevation, compacted to minimum 90 percent of maximum dry density.

H. Compaction Density Unless Otherwise Specified or Indicated:
   1. Under paving, slabs-on-grade, and similar construction: 100 percent of maximum dry density.
   2. At all other locations: 90 percent of maximum dry density.

I. Reshape and re-compact fills subjected to vehicular traffic.

J. Maintain temporary means and methods, as required, to remove all water while fill is being placed as required, or until directed by the Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

3.04 FILL AT SPECIFIC LOCATIONS

A. Use General Fill unless otherwise specified or indicated.

B. Under All Footings:
   1. Use Engineered Fill.
   2. Fill to bottom of footing elevation.
   3. Maximum depth per lift: 12 inches, compacted.
   4. Compact to 95 percent of maximum dry density.

C. Under Interior Slabs-On-Grade:
   1. Use Engineered Fill.
   2. Compact to 95 percent of maximum dry density.
   3. Cover with Fill Type Underslab Gas-permeable Aggregate.
      a. Depth: 6 inches.
   4. Compact to 95 percent of maximum dry density.

D. Against Foundation Walls and Footings:
   1. Use Engineered Fill.
   2. Fill up to subgrade elevation.
   3. Compact each lift to 95 percent of maximum dry density.
   4. Do not backfill against unsupported foundation walls.
   5. Cover with 8 inches minimum of General Fill, compacted to 90 percent of maximum dry density.
   6. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.

E. Under Exterior Paving or similar construction:
   1. Use General Fill.

2. Fill up to subgrade elevation. Refer to the finish surface sections on the drawings for subsequent fill layers.
3. Fill layers within the upper 3 feet of exterior pavement or similar construction shall be compacted to 100 percent of maximum dry density, to 95 percent of maximum dry density for more than 3 feet below pavement subgrade elevation, or as specified for the specific fill type..

F. Over Buried Utility Piping and Conduits in Trenches and ____: See Section 31 2316.13.

G. At Infiltration Basins:
1. Use Biofiltration Soil.
2. Do not compact.
3. Install as indicated on drawings.

H. At Vegetated Areas:
1. Use General Fill.
2. Compact to 90 percent of maximum dry density.
3. See Section 31 2200 for topsoil placement.

3.05 TOLERANCES

A. Top Surface of General Filling: Plus or minus 1 inch from required elevations.

B. Top Surface of Filling Under Paved Areas: Plus or minus 1 inch from required elevations.

3.06 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.

B. Perform gradation testing on fill materials in accordance with ASTM C 136.
1. If tests indicate material does not meet specified requirements, remove, replace and retest.
2. Frequency of Tests: Provide the minimum number of tests as follows, one test minimum.
a. Granular Borrow: One test at/of fill source and one test for every 1000 cu. yds. of fill placed on site.
b. Granular Fill, Sand, Drainage Fill, Aggregate Bedding: One test at/of fill source and one test for every 500 cu. yds. of fill placed on site.

C. Perform compaction density testing on compacted fill in accordance with ASTM D6938.
1. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("standard Proctor").
2. If tests indicate work does not meet specified requirements, remove work, replace and retest.
3. Frequency of Tests: Provide the minimum number of tests as follows one test minimum.
a. Slabs-On-Grade: One test for every 1000 sq. ft. per 1ft of depth of material placed or fraction thereof.
b. Foundation Walls and Footings: One test for every 25 lin. ft. of wall/footing length and one test under each column footing.
c. Exterior Paving and Similar Construction: One test for every 2500 sq. ft. per 1ft of depth of material placed or fraction thereof.
d. Over Buried Utility Piping, and Conduits in Trenches: See Section 31 2316.13.
e. Vegetated Areas: One test for every 10,000 sq. ft. per 1ft of depth of material placed or fraction thereof.

D. Biofiltration Soil: Provide gradation, chemical, and pH testing analysis of the compost materials and gradation analysis for the sand.

E. Stormwater Management Infiltration Testing:
1. During Construction:
a. Perform infiltration testing prior to completion of the infiltration practice.

b. Testing to be performed by qualified professional.
c. Infiltration testing to be performed at the bottom of excavation for the proposed infiltration stormwater practice.
d. Complete double-ring infiltrometer or modified Philip-Dunne infiltrometer test per ASTM D3385 or other approved direct infiltration test method included in the Minnesota Stormwater Manual.
e. Provide a minimum of two infiltrometer tests per infiltration stormwater practice.
f. Infiltration rate to meet or exceed two times the design infiltration rate of 0.8 inches per hour.
g. Provide Engineer with test results prior to proceeding with completion of the infiltration practices.

2. Post Construction:
a. Perform a post construction test of the completed infiltration practice to verify the assumed infiltration rate of the Biofiltration Soil is provided.
b. Testing to be performed by a qualified professional.
c. Fill the basin to a minimum depth of 6 inches of water and monitor the time necessary to drain the basin. The Biofiltration Fill shall have an infiltration rate of at least 4 inches per hour as indicated in MnDOT 3877.2F Filter Topsoil Borrow.
d. Provide Engineer with test results prior to vegetation establishment.

F. Topsoil and Planting Soil Testing:
1. Furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; soluble salts; deleterious material; pH; and mineral and plant-nutrient content of the soil.

G. Proof roll compacted fill at surfaces that will be under slabs-on-grade and paving.

3.07 CLEANING

A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

SECTION 32 1123
AGGREGATE BASE COURSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aggregate base course.

1.02 SUSTAINABILITY REQUIREMENTS

A. See Section 01 81 13 B3 Sustainability Design Requirements.

1.03 REFERENCE STANDARDS

A. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2019.

B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012, with Editorial Revision (2015).

C. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method; 2015, with Editorial Revision (2016).

D. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2015.

E. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2017.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Samples: 10 lb sample of each type of aggregate; submit in air-tight containers to testing laboratory.

C. Materials Sources: Submit name of imported materials source.

D. Aggregate Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

E. Compaction Density Test Reports.

PART 2 PRODUCTS

2.01 MATERIALS

A. Aggregate Base: conforming to MNDOT 3138 Aggregate Base, Class 5.

2.02 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for testing and analysis of aggregate materials.

B. If tests indicate materials do not meet specified requirements, change material and retest.

C. Provide materials of each type from same source throughout the Work. If source must change then retest at no cost to the Owner.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench marks and intended elevations for the work are as indicated.

B. Verify substrate has been inspected, is dry, and gradients and elevations are correct.

3.02 PREPARATION

A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.

B. Do not place aggregate on soft, muddy, or frozen surfaces.

3.03 INSTALLATION

A. Under Bituminous Concrete Paving:
   1. Place Aggregate Base to a total compacted thickness indicated on the plans.
   2. Compact to 100 percent of maximum dry density.

B. Under Portland Cement Concrete Paving:
   1. Place Aggregate Base to a total compacted thickness indicated on the plans.
   2. Compact to 100 percent of maximum dry density.

C. Place aggregate in maximum 8 inch lifts and compact to specified density.

D. Level and contour surfaces to elevations and gradients indicated.

E. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.

F. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.

G. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.04 TOLERANCES

A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.

B. Scheduled Compacted Thickness: Within 1/4 inch.

C. Variation From Design Elevation: Within 1/2 inch.

3.05 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.

B. Perform gradation testing on fill materials in accordance with ASTM C136/C136M.
   1. If tests indicate material does not meet specified requirements, remove, replace and retest.
   2. Frequency of Tests: Provide the minimum number of tests as follows, one test minimum.
      a. Aggregate Base: One test at/of fill source and one test for every 1000 cu. yds. of fill placed on site.

C. Compaction density testing will be performed on compacted aggregate base course in accordance with ASTM D1556, ASTM D2167, or ASTM D6938.
   1. Results will be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("standard Proctor").
   2. If tests indicate work does not meet specified requirements, remove work, replace and retest.
   3. Frequency of Tests: Provide the minimum number of tests as follows one test minimum.
      a. Exterior Paving and Similar Construction: One test for every 2500 sq. ft. per 1ft of depth of material placed or fraction thereof.

D. Proof roll compacted aggregate at surfaces that will be under paving. Contractor shall obtain the approval of the geotechnical engineer regarding the suitability of the compacted aggregate surfacing layer prior to the placement of bituminous or concrete surfacing.

3.06 CLEANING

A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

SECTION 32 1216
ASPHALT PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Double course bituminous concrete paving.

1.02 SUSTAINABILITY REQUIREMENTS

A. See Section 01 8113 B3 Sustainability Design Requirements.

B. See Section 01 6116 Volatile Organic Compound (VOC) Content Restrictions.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures

B. Provide bituminous mix design data.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with MnDOT 2360 except as modified below.

1.05 FIELD CONDITIONS

A. Do not place asphalt when ambient air or base surface temperature is less than 32 degrees F or surface is wet or frozen.

PART 2 PRODUCTS

2.01 MATERIALS

A. Tack Coat: Bituminous Tack Coat, in accordance with MnDOT 2357..

2.02 ASPHALT PAVING MIXES AND MIX DESIGN

A. Asphalt Base Course: Conforming to MnDOT Section 2360, mixture type Wearing Course SPWEB340C.

B. Asphalt Wearing Course: Conforming to MnDOT 2360, mixture type Wearing Course SPWEA340C.

2.03 SOURCE QUALITY CONTROL

A. Test mix design and samples in accordance with MnDOT 2360. All testing shall be performed by Contractor.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that compacted Aggregate Base is dry and ready to support paving and imposed loads.

B. Verify gradients and elevations of base are correct.

3.02 PREPARATION - TACK COAT

A. Apply tack coat in accordance with manufacturer's instructions and MnDOT 2357.

B. Apply tack coat on asphalt or concrete surfaces over subgrade surface at uniform rate of 1/3 gal/sq yd.

C. Apply tack coat to contact surfaces of curbs, gutters and existing pavement match points.

D. Coat surfaces of manhole frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

3.03 PLACING ASPHALT PAVEMENT - DOUBLE COURSE

A. Install Work in accordance with MnDOT 2360.

B. Place asphalt base course to thickness indicated on the drawings.

C. Place asphalt wearing course to thickness indicated on the drawings.

D. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

E. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.04 TOLERANCES

A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.

B. Compacted Thickness: Within 1/4 inch of specified or indicated thickness.

C. Variation from True Elevation: Within 1/2 inch.

3.05 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for quality control.

B. Provide field inspection and testing. Take samples and perform tests in accordance with MnDOT 2360. All testing shall be performed by Contractor.

3.06 PROTECTION

A. Immediately after placement, protect pavement from mechanical injury for one (1) day or until surface temperature is less than 140 degrees F.

END OF SECTION

SECTION 32 1313
CONCRETE PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete sidewalks and gutters.

1.02 SUSTAINABILITY REQUIREMENTS

A. See Section 01 81 13 B3 Sustainability Design Requirements.

1.03 REFERENCE STANDARDS

A. AASHTO M 31M/M 31 - Standard Specification for Deformed and Plain Carbon and Low-Alloy Steel Bars for Concrete Reinforcement; 2017.

B. ACI 301 - Specifications for Concrete Construction; 2020.

C. ACI 305R - Guide to Hot Weather Concreting; 2020.

D. ACI 306R - Guide to Cold Weather Concreting; 2016.

E. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2024.

F. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2024.

G. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2025.

H. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types); 2023.

I. ASTM D1752 - Standard Specification for Preformed Sponge Rubber, Cork, and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2018 (Reapproved 2023).

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on joint filler, admixtures, and curing compound.

1.05 QUALITY ASSURANCE

A. Concrete Pavement shall conform to MnDOT 2301.

B. Concrete Sidewalks shall conform to MnDOT 2521.

C. Concrete Curb and Gutter shall conform to MnDOT 2531.

PART 2 PRODUCTS

2.01 FORM MATERIALS

A. Form Materials: As specified in Section 03 1000, comply with ACI 301.

B. Joint Filler: Preformed; non-extruding bituminous type (ASTM D1751) or sponge rubber or cork (ASTM D1752).
   1. Thickness: 1/2 inch.

2.02 REINFORCEMENT

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) yield strength; deformed billet steel bars; unfinished.

B. Epoxy Coated Reinforcement Bars: Conform to:
   1. AASHTO M 31M/M 31
   2. MnDOT 3301

C. Dowels: Conform to MnDOT 3302.

2.03 CONCRETE MATERIALS

A. Concrete Materials: Conform to MnDOT 2461.

2.04 ACCESSORIES

A. Curing Compound: MnDOT 3754 Poly-Alpha Methylstyrene (AMS) Membrane Curing Compound.

2.05 CONCRETE MIX DESIGN

A. Concrete Paving: Conforming to MnDOT 2461, Mix No. 3A41.

B. Concrete Sidewalks: Conforming to MnDOT 2461, Mix No. 3F52.

C. Concrete Curb & Gutter: Conforming to MnDOT 2461, Mix No. 3F52 for manual placement and Mix No. 3F32 for slip-form placement.

2.06 MIXING

A. Transit Mixers: Comply with ASTM C94/C94M.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.

B. Verify gradients and elevations of base are correct.

3.02 SUBBASE

A. See Section 32 1123 for construction of base course for work of this Section.

3.03 PREPARATION

A. Moisten base to minimize absorption of water from fresh concrete.

B. Coat surfaces of manhole frames with oil to prevent bond with concrete pavement.

3.04 FORMING

A. Place and secure forms to correct location, dimension, profile, and gradient.

B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.05 REINFORCEMENT

A. Place reinforcement as indicated in Drawings.

3.06 COLD AND HOT WEATHER CONCRETING

A. Follow recommendations of ACI 305R when concreting during hot weather.

B. Follow recommendations of ACI 306R when concreting during cold weather.

C. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

3.07 PLACING CONCRETE

A. Place concrete paving in accordance with MnDOT 2301.

B. Place concrete sidewalks in accordance with MnDOT 2521,C2.

C. Place concrete curb and gutter in accordance with MnDOT 2531,E, F & G.

D. Do not place concrete when base surface is wet.

E. Ensure reinforcement, inserts, embedded parts, formed joints are not disturbed during concrete placement.

3.08 JOINTS

A. Concrete paving joints and joint sealant shall conform to MnDOT 2301.

B. Joint concrete sidewalks in accordance with MnDOT 2521,C2.

C. Joint concrete curb & gutter in accordance with MnDOT 2531,C.

D. Align curb, gutter, and sidewalk joints.

E. Place 3/8 inch wide expansion joints at 50 foot intervals and to separate paving from vertical surfaces and other components and in pattern indicated.
   1. Form joints with joint filler extending from bottom of pavement to within 1/2 inch of finished surface.
   2. Secure to resist movement by wet concrete.

F. Saw cut contraction joints 1/8 inch wide at an optimum time after finishing. Cut 1/4 into depth of slab.

3.09 FINISHING

A. Finish concrete pavement in accordance with MnDOT 2301 (metal-tine texturing is not required).

B. Finish concrete sidewalks in accordance with MnDOT 2521,C1.

C. Finish concrete curb & gutter in accordance with MnDOT 2531.

D. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

3.10 TOLERANCES

A. Maximum Variation From True Position: 1/4 inch.

3.11 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
   1. Provide free access to concrete operations at project site and cooperate with appointed firm.

B. Compressive Strength Tests: ASTM C39/C39M; for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cu yd or less of each class of concrete placed.
   1. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
   2. Perform one slump test for each set of test cylinders taken.

3.12 PROTECTION

A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.

END OF SECTION

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SECTION 32 1543
STABILIZED AGGREGATE SURFACING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Material and labor requirements for construction with decomposed granite or crushed 3/8” minus aggregate surfacing with binder additive. To be placed within picnic patio area, refer to plans.

1.02 REFERENCE STANDARDS

A. ASTM C 136/C136 M - Method for Sieve Analysis for Fine and Course Aggregates.

B. ASTM D2419 - 14, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregates.

C. ASTM F1951 - 14, Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Submit a 1 quart sample and sieve analysis for grading of stabilized decomposed granite or crushed 3/8” minus aggregate.

C. Manufacturer Product Data Sheets for aggregates, binder, and edging restraint.

D. Base course gradation indicating that the product meets specification.

E. Manufacturer's Material Safety Data Sheet.

1.04 SITE CONDITIONS

A. Ensure that the subgrade and base are properly graded and compacted to required specifications.

B. Do not install the stabilized aggregate during rain. Rain within 3-5 days after installation will increase curing time.

C. Protect all nearby surfaces, plants, and structures from possible contamination from materials or damage by equipment.

D. Do not install stabilized aggregate below 40 degrees Fahrenheit and falling.

E. Field Measurements: Each bidder is required to visit the site of the Work to verify the existing conditions.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Installer to provide evidence to indicate successful experience in providing Stabilized Aggregate surface or ability to follow installation instructions.

B. Test Plot: Install 6 ft. wide x 6 ft. long mock-up of stabilized aggregate at location specified by owner’s representative.

C. Architect or Landscape Architect will view the test plot before installer prodees with rest of installation.

D. Compaction testing to be provided by contractor, one test per 2,000 square feet of base course.

E. Manufacturer’s technical representative shall visit the site at the start of an installation to ensure the installer understands the correct installation methods to use.

1.06 DELIVERY, HANDLING, AND STORAGE

A. Please contact the manufacturer for more information.

B. Delivery of pre-blended stabilizer with aggregate is available from select dealers. Contact your closest dealer or the manufacturer for more information.

1. Handling:
    a. Wear appropriate respirator when ventilation is inadequate. Avoid contact with skin and eyes.
2. Storage:
    a. Protect stabilized crushed aggregate mix from contamination. Store under cover.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Organic-Lock for Organic-Lock stabilized pathway aggregate provided by:
    1. Kafka Granite, LLC. 550 E HWY 153, Mosinee, WI 54455. 800-852-7415. kafka@kafkagranite.com <mailto:kafka@kafkagranite.com> www.kafkagranite.com

B. Stabilizer® for Stabilized Aggregate surfaces provided by :
    1. Stabilizer Solutions, Inc. 33 South 28th St., Phoenix, AZ 85034; phone (602) 225-5900, (800) 336-2468; fax (602) 225-5902; website stabilizersolutions.com; email info@stabilizersolutions.com.

C. Plaisted Companies, Inc,. is a local distributor of stablized aggregate surfacing and binders. 11555 205th Avenue NW Elk River, MN 55330; Phone (763) 441-1100.

D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Crushed Aggregate Materials:
    1. Crushed aggregate material shall consist of sound, angular, durable particles.
    2. Gradation, in accordance with ASTM C136:

B. Binder
    1. Patented, non-toxic, organic binder that is a colorless and odorless concentrated powder that binds decomposed granite or crushed 3/8” or 1/4" minus aggregate.

C. Edging Restraint:
    1. Edger to provide structural support and a restraint edging for the stablized aggregate patio. See landscape plan and details for location.
    2. Basis of Design: Permaloc StucturEdge
    3. Size: 1/8" thickness x 1-5/8" height, L-shape
    4. Material: Aluminum alloy, corrosion resistant.
    5. Finish: Black

D. Excess Materials
    1. Provide owner’s authorized rep. with the following excess materials for use in future stabilized pathway aggregate repair: 40 to 50 lb. Bags of the stabilized aggregate.

PART 3 EXECUTION

3.01 PREPARATION

A. Prepare the subgrade:
    1. Excavate the area to the depth required so that finish grade can be established as noted on plans.
    2. Pre-soak base material with water and compact to 95% determined by Test Method ASTM D 1557 prior to installing stabilized aggregate. Compaction testing to be provided by Contractor, one test per 2,000 square feet of base.

B. Install edging restraint:
    1. Install base of edging resting on compacted level base and facing [away from] [towards and under] stabilized aggregate patio area, drive 3/8" x 10" (9.5 mm x 242 mm) bright spiral steel spikes through edging holes in section base of paver restraint edging every 12 to 24 inches on center.
    2. Securely connect sections together in accordance with manufacturer’s instructions.

3.02 PLACEMENT

A. Place stabilized aggregate directly on prepared sub-grade. Level to desired grade and cross section. Depth of pathways shall be 3” for heavy foot traffic and light vehicles. DO NOT place on filter fabric.

3.03 COMPACTION

A. Compaction will vary with different aggregates due to particle shape and size. Compact to 95% Modified Proctor Density. a 2 to 5-ton double drum roller making 3 to 4 passes.

B. Make 4-6 passes using a 1 ton double or single static drum roller or other method approved by engineer to meet specified compaction requirements. A Foot-Traffic Pathway will typically require one lift, compacted to 3 inches.

C. Do not begin compaction for 6 hours after placement and up to 72 hours. DO NOT use a vibratory plate compactor or vibration feature on roller, as vibration separates large aggregate particles. If pumping or pancaking of surface occurs, surface is still too wet to roll.

D. Take care in compacting surface when adjacent to planting and irrigation systems, use 8” or 10” hand tamp. Installation of stabilized pathway aggregate more than 3” thick shall be installed in lifts. If 4” thick compacted (2) 2” lifts. If 5” thick compacted (2) 2.5” lifts. If Stabilized Aggregate is pre-moistened before installation entire 4” or 5” lift may be installed.

E. Lightly spray surface area following compaction. Do not disturb aggregate surface with spray action.

3.04 INSPECTION

A. Finished surface shall be smooth, uniform and solid with no evidence of chipping or cracking. Cured and compacted pathway shall be firm throughout profile with no spongy areas. Loose material shall not be present on surface after installation, but may appear after use and according to environmental conditions. Pathway shall remain stable underneath loose granite on top with a “natural” look. Any significant irregularities in path surface shall be repaired to the uniformity of entire installation.

3.05 PROTECTION

A. Contractor shall furnish and install construction fence around new surface to prevent public access. Fencing shall be maintained in place for a minimum of 12 - 72 hours after completion of installation, or as directed by the Owner’ Representative. Drying period may take longer due to weather conditions.

B. Do not allow any traffic on the newly installed pathway until fully cured.

C. Allow the newly installed aggregate to cure, but not completely dry out.

3.06 MAINTENANCE

A. Remove debris, such as paper, grass clippings, or organic material by mechanically blowing or hand raking. When plowing snow, use rubber baffle on plow blade or wheels on plow to lift blade 1/4" off the surface.

B. During first year, minor amounts of loose aggregate may appear on surface (1/16 to 1/4"). If material exceeds a ¼”, redistribute over entire surface. Water to 1” depth and compact with power roller of no less than 1000-lbs. If cracking occurs, sweep fines into cracks, water thoroughly and hand tamp with an 8” - 10” hand tamp.

END OF SECTION

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SECTION 32 1723
PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Painted pavement markings.

1.02 SUSTAINABILITY REQUIREMENTS

A. See Section 01 81 13 B3 Sustainability Design Requirements.

1.03 REFERENCE STANDARDS

A. AASHTO MP 24 - Standard Specification for Waterborne White and Yellow Traffic Paints; 2015 (Reapproved 2020).

B. FHWA MUTCD - Manual on Uniform Traffic Control Devices; 2023.

C. FS TT-P-1952 - Paint, Traffic and Airfield Marking, Waterborne; 2015f (Validated 2020).

D. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.

1.04 SUSTAINABILITY REQUIREMENTS

A. See Section 01 8113 B3 Sustainability Design Requirements.

B. See Section 01 6116 Volatile Organic Compound (VOC) Content Restrictions.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver paint in containers of at least 5 gallons accompanied by batch certificate.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.08 SEQUENCING

A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of markings.

PART 2 PRODUCTS

2.01 PAINTED PAVEMENT MARKINGS

A. Painted Pavement Markings: As indicated on drawings.
   1. Line and Zone Marking Paint: In accordance with MPI (APL) No. 97 Latex Traffic Marking Paint; color(s) as indicated on Drawings.
   2. Obliterating Paint: in accordance with FS TT-P-1952.
      a. Bituminous Pavement: Black.
      b. Concrete Pavement: Gray.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Verification of Conditions: Verify that pavement is dry and ready for installation.

C. Notify Architect of unsatisfactory conditions before proceeding.

3.02 PREPARATION

A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.

B. Prepare surfaces using methods recommended by manufacturer for achieving best result for the substrate under the project conditions.

C. Obliteration of existing markings using paint is acceptable in lieu of removal.

D. Establish survey control points for locating and dimensioning of markings.

E. Clean surfaces prior to installation.
   1. Remove dust, dirt, and other surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combiniation of these methhods.
   2. Where oil or grease are present, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each applicaiton; after cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint.

F. Apply paint stencils by type and color at necessary intervals.

3.03 INSTALLATION

A. General:
   1. Begin pavement marking as soon as practicable after surface has been cleaned and dried.
   2. Do not apply paint if temperature of surface to be painted or the atmosphere is less than 50 degrees F or more than 95 degrees F.
   3. Apply markings in locations determined by measurement from survey control points.
   4. Position pavement markings as indicated on drawings.
   5. Field location adjustments require approval of Architect.

B. Painted Pavement Markings:
   1. Apply in accordance with manufacturer's instructions using an experienced technician that is thoroughly familiar with equipment, materials, and marking layouts.
   2. Apply in accordance with FHWA MUTCD standards.
   3. Obliterating Paint: Apply as necessary to cover existing markings completely.
   4. Marking Paint: Apply uniformly, with sharp edges, in lengths and widths as indicated on the drawings.
      a. Applications: One coat.
      b. Wet Film Thickness: 0.015 inch, minimum.
      c. Stencils: Lay flat against pavement, align with striping, remove after application.
      d. Width Tolerance: Plus or minus 1/8 inch.
   5. Parking Lots: Apply parking space lines, entrance and exit arrows, painted curbs, and other markings indicated on drawings.
      a. Hand application by pneumatic spray is acceptable.
   6. Symbols: Use suitable template that will provide a pavement marking with true, sharp edges, of the design and size indicated.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Perform field inspection for deviations from true alignment or material irregularities.

C. If inspections indicate work does not meet specified requirements, rework and reinspect at no cost to Owner.

D. Allow the pavement marking to set at least the minimum time recommended by manufacturer.

3.05 PROTECTION

A. Provide barricades, warning signs, and flags as necessary to prevent approaching traffic from crossing newly applied pavement markings.

B. Remove and replace markings that are applied at less than minimum material rates; deviate from true alignment; exceed length and width tolerances; or show light spots, smears, or other deficiencies or irregularities.

C. Remove markings in a manner to avoid damage to the surface to which the marking was applied, using carefully controlled sand blasting, approved grinding equipment, or other approved method.

D. Replace damaged or removed markings at no additional cost to Owner.

E. Preserve survey control points until pavement marking acceptance.

END OF SECTION

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SECTION 32 1731
STEEL GUARDRAIL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Steel guardrail and steel posts.

1.02 SUSTAINABILITY REQUIREMENTS

A. See Section 01 81 13 B3 Sustainability Design Requirements.

1.03 REFERENCE STANDARDS

A. AASHTO M 180 - Standard Specification for Steel Components for Highway Guardrail; 2025.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

D. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, anchorage, and schedule of components.

C. Product Data: Provide data on rail, posts, accessories, hardware and structural capabilities of rail section.

PART 2 PRODUCTS

2.01 MATERIALS

A. Guardrail Beam: ASTM A36/A36M d steel sections, "W" profile, 3 1/4 inch thick, 12 1/4 inch high die punched bolt holes for site assembly and attachment to posts, formed steel curved and flared termination sections.

B. Steel Posts:
   1. 6" x 9 lbs. Wide Flange Beam (W6x9)
   2. Overall height 6' post or 3' post with 5/8"x10x10 base plate

2.02 FINISHES

A. Components: Galvanized in accordance with ASTM A123/A123M.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install rails and posts and accessories in accordance with manufacturer's instructions.

B. Attach rails securely to posts with anchoring hardware.

END OF SECTION

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SECTION 32 3300
SITE FURNISHINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Picnic Tables

B. Cafe Tables

C. Waste receptacles

1.02 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturer's specifications and descriptive literature, installation instructions, warranty, and maintenance information..

C. Samples: Submit two set of manufacturer's available colors for all furnishings.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.

B. Deliver furnishings to project site in original packaging.

C. Store furnishings securely, under cover and elevated above grade.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide minimum 2 year manufacturer warranty for all furnishings. Complete forms in Owner's name and register with manufacturer.

C. Finish Warranty: Provide 10-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

D. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 PRODUCT TYPES

A. Picnic Tables
   1. Approved Manufacturers:
      a. Vestre, Berg Table, https://vestre.com/us/products/picnic-tables/berg-picnic-table
      b. Victor Stanley, PT 2-2, https://www.victorstanley.com/product/pt-2-2/
      c. Maglin, 210 Cluster Seating, https://www.maglin.com/product/210-cluster-seating/
   2. Type: ADA Picnic Table
      a. Dimensions: 6FT length
      b. Frame Material: Powdercoated steel
      c. Slat Material: Nordic Pine, Kebony, or HDP Woodgrain Texture

d. Colors to be selected by Owner and Landscape Architect based on provided samples.

3. Mounting: None.

B. Cafe Table

1. Approved manufacturers:
   a. Vestre, April Table and Chairs, https://vestre.com/us/products/tables/april-round-table
   b. Victor Stanley, A364, https://www.victorstanley.com/product/a364/
   c. Maglin 1100 Cluster Seating, https://www.maglin.com/product/1100-cluster-seating
2. Type: Round Table with Chairs
   a. Size: 4 chair capacity, chairs and tables to be a fixed unit or to be embedded mount
   b. Frame Material: Powdercoated Steel
   c. Slat Material: Nordic Pine, Kebony, HDP Woodgrain Texture, or Steel.
   d. Colors to be selected by Owner and Landscape Architect based on provided samples.
   e. Mounting: None or Embedded Mount

C. Litter and Recycling Receptacles

1. Approved Manufacturers:
   a. Forms + Surfaces; Tonyo Litter and Recycling Receptacle
   b. Victor Stanley; Sage Dual SGE-236SA Litter and Recycling Receptacle
   c. Vestre, Acceptor 160 Litter and Recycling Receptacle
2. Type:
   a. 1 split-stream securable receptacle for each location as noted on the plans.
   b. Material: Galvanized steel
   c. Finish: Powdercoat finish
   d. Color: To be determined by Owner based on samples and submittals.
   e. Body Pattern: Patterns, if available, to be determined by Owner.
   f. Style: Side-openings, covered top, labelled for trash and recycling.
   g. Accessories:
      1) Rain Cover, to be included or be integral to the design. Materials and finish to match body of receptacle.Colors may vary and will be chosen by Owner and Architect based on submittals.
      2) Graphics for litter and recycling to be included.
3. Mounting: Surface mount per manufacturer's recommendation.

D. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify proper installation of mounting surfaces, preinstalled anchor bolts, and other mounting devices are ready to receive site furnishing items.

B. If substrate preparation is the responsibility of another installer, notify Landscape Architect of unsatisfactory preparation before proceeding.

C. Do not begin installation until unacceptable conditions are corrected.

3.02 INSTALLATION

A. Install site furnishings in accordance with approved shop drawings and manufacturer's installation instructions.

B. Install all furnishings plumb and level unless otherwise noted. If shimming is required and shims are not included with furnishings, verify shimming methods with Landscape Architect before proceeding.

3.03 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Clean furnishings.

3.04 PROTECTION

A. Protect installed furnishings from subsequent construction operations.

B. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION

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SECTION 32 3313
SITE BICYCLE RACKS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior bicycle racks.

1.02 REFERENCE STANDARDS

A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2025.

B. ASTM A312/A312M - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes; 2025.

C. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Handle racks with sufficient care to prevent scratches and other damage to the finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Exterior Bicycle Racks:
   1. MADRAX, a brand of Graber Manufacturing, Inc; _____: www.madrax.com/#sle.
   2. SiteScapes, Inc; _____: www.sitescapesonline.com/#sle.
   3. Dero, a Playcore Company. https://www.dero.com/ or approved equal.

2.02 BICYCLE RACKS

A. Exterior Bicycle Racks: Device allows user-provided lock to simultaneously secure one wheel and part of the frame on each bicycle parked or racked.
   1. Style: Inverted horseshoe rack formed by one u-shaped bend of round pipe.
   2. Capacity: 4 bicycles (7 hoops) total per plan.
   3. Mounting: Surface flange.
   4. Mounting, Wall: Post-installed anchor.
   5. Finish: Powder coat, maintenance-free and weather-resistant.
   6. Color: As selected by Architect from manufacturer's standard range.

B. Materials:
   1. Pipe: Stainless steel, ASTM A312/A312M, Type 304, Schedule 40S.
   2. Tube: Stainless steel, ASTM A269/A269M, Grade TP304, seamless.
   3. Bar Round and Flat, Stainless Steel: ASTM A666/A666M, Type 304.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive bicycle racks.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory conditions before proceeding.

C. Do not begin installation until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install level, plumb, square, and correctly located as indicated on drawings.

C. Surface Flange Installation: Anchor bicycle racks securely in place with 1/2 inch by 4 inch anchor bolts through flange holes.

3.03 CLEANING

A. Clean installed work to like-new condition. Do not use cleaning materials or methods that could damage finish.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 32 8000
DESIGN-BUILD IRRIGATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Design, furnish, install and service a complete, automatic underground irrigation system starting at the designated supply stubs, outside the buildings and downstream of the backflow preventers (installed by others). Provide 100 percent watering coverage of all sodded, seeded, or planted areas unless otherwise noted. The system design shall be capable of watering the entire area designated within an 8-hour period. Instruct the Owner, in person and in written form, as to the proper operation and maintenance of the total system. Winterize the system the first fall and start the system the following spring.

1.02 REFERENCE STANDARDS

A. Factory Mutual Research Corporation - FM P7825 Approval Guide; current edition.

B. NEMA MG 00001 - Motors and Generators; 2024.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Following acceptance of proposal, provide the following information for review and approval:
   1. Product Data: Manufacturer's product data..
   2. Shop Drawings: Submit complete design drawings and shop drawings showing 100 percent head to head coverage of the designated area with pipe layout and sizes, sprinkler head locations and effective watering radii, controller location and quick coupler valves..
   3. Design Data: [Design calculations showing source size in GPM, PSI and pressure losses to the farthest zone. All calculations and design shall be based on a maximum flow rate of 4 inches per second.].

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

C. Installers: Use adequate numbers of skilled workers who are thoroughly trained and experienced in the work of this section.

1.05 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.

1.06 WARRANTY

A. This system shall be fully guaranteed for a period of one year after acceptance by the Owner. This installer shall promptly repair or replace any part of this system, including all materials and/or workmanship, which fails to perform and function correctly.

B. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Toro.

B. Rainbird.

C. Nelson.

D. Hunter

E. Buckner

F. Other established irrigation equipment manufacturers may be used.

2.02 COMPONENTS

A. Piping:
   1. The pressurized irrigation water supply main shall be 160 PSI, SDR 26 PVC piping with a minimum diameter of 1.5 inches.
   2. Lateral zone irrigation piping shall be 100 PSI, NSF rated polyethylene piping, assembled with barbed nylon fittings and two stainless steel clamps per side spaced.

B. Valves:
   1. Zone valves shall be properly sized, 24 volt, and electrically operated with a manual operation feature.
   2. Zone valves shall be housed in Ametek valve boxes with the zone number marked on the cover.
   3. Brass quick coupler valves shall each have a coupler key, located as shown on the drawings each in a valve box with lockable cover.

C. Sleeves:
   1. Piping under pavement shall be installed in 3 inch Schedule 40 PVC sleeves.
   2. Sleeves required for control wire to enter the building will be installed by others.

D. Wiring:
   1. Control wire shall be sheathed, 13 #14 wire minimum, meeting Underwriters Laboratory approval for direct burial with waterproof connections.

E. Devices:
   1. Sprinkler heads shall be high-efficiency pop-up, gear driven, full or part circle rotary heads or pop-up spray heads.
   2. Six extra heads of each type shall be provided to the Owner.Shrub beds shall be watered with Netafim.

F. Controllers:
   1. System controller shall be placed in building at a location to be determined by Owner.
   2. The controller shall be a dual program controller.
   3. The controller shall be a high-efficiency controller with weather sensor.

2.03 MATERIALS

A. All materials shall be new, of first class quality and designed for the intended use.

PART 3 EXECUTION

3.01 SYSTEM DESIGN

A. Design system and prepare drawing and specifications for review and installation. Drawings shall show locations and types of all sprinkler heads and equipment along with information as to watering area of each component, pipe locations and sizing, precipitation rates and flow rates. Specifications shall indicate detailed information for all products and maintenance procedures. Submit system design for review and approval. A copy of the approved drawing shall be on-site during any work.

B. System shall use both times and moisture-sensing and/or weather-sensing controls to limit times of operation and to prevent operation when soil moisture is adequate.

C. System design to meet B3 water usage requirements. System to not be utilized once plants are established unless there are extreme drought conditions. Coordinate with Owner on zoning and controls.

3.02 WORKMANSHIP

A. All materials shall be installed in a workman-like manner in accordance with the approved drawings and specifications. Piping shall be securely capped at all times prior to final assembly of fittings and equipment.

3.03 INSTALLATION

A. All existing utlities and equipment shall be located flagged prior to any work. Gopher State One Call (GSOC) shall have been notified 48 hours prior to work and the resulting ticket number shall be on-site and available to all workers during all work.

B. Locations of equipment and/or any changes shall be approved by the Landscape Architect prior to work.

C. The reduced pressure, double check-valve type backflow preventer in the building and downstream piping to 5 feet outside the building will be installed under another contract.

D. Control wire shall be installed with the pressure main with loops at each valve location. PVC pressure main piping shall be assembled and allowed to cure in dry conditions when the air temperature is above 40 degrees F, in strict accordance with the manufacturer's recommendations prior to testing. Install the pressure main in an open trench, 18 inches deep, free of rock, stones or rubble. Air test PVC main piping according to manufacturer's recommendations. If leaks are detected, they shall be repaired and the line re-tested until satisfactory.

E. The Owner or Landscape Architect must verify a successful air test. Following a successful air-test, backfill the main pipe trench in 6 inch lifts with suitable clean fill and compact to the point of no subsidence. Pulling PVC pipe will not be permitted. Install the proper size zone piping to a minimum depth 10 inch according to the drawing.

F. Pulling pipe will be permitted. Install valves and valve boxes. Prior to installing sprinkler heads, flush lateral lines with a full head of water. Install the sprinkler heads and equipment securely mount the controller in the building where indicated. Others will provide the controller an electrical outlet for operation. Allow sufficient space on the wall for location of the as-built drawing.

G. After installation, adjust system to not spray water on buildings, structures, slabs, walks, curbs or paving. Adjust to eliminate all "shadow" areas behind trees or other obstacles. Adjust to eliminate overspray behind limit of irrigation lines.

H. Install in accordance with manufacturer's written instructions.

3.04 SYSTEM OPERATION AND CLOSEOUT

A. Demonstrate to the Landscape Architect and the Owner that the system meets coverage requirements and that the automatic controls function properly.

B. Furnish an as-built drawing by PDF with the name, address and phone number of the installer which shows identifies and locates all piping and equipment. A plastic covered, mounted copy of the as-built drawing shall be installed in the building near the controller.

C. Instruct the Owner as to the proper operation and maintenance of the system.

D. Prior to the first winter after acceptance and no later than October 15th, this installer shall winterize the system using compressed air. This installer shall put this system back into operation the following spring.

3.05 PROTECTION AND CLEANING

A. Clean all surfaces of soil, mulch, or other debris resulting from this work.

B. Ensure that plants, seed, and turf are not damaged by this work. Restore or replace if damaged.

C. Protect installed irrigation system from subsequent construction operations.

3.06 MAINTENANCE

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

END OF SECTION

SECTION 32 9219
SEEDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preparation of subsoil.

B. Placing topsoil.

C. Fertilizing.

D. Seeding and hydroseeding.

E. Mulch.

F. Watering.

G. Establishment and replacement.

H. Maintenance and mowing.

1.02 REFERENCE STANDARDS

A. ASTM D7322/D7322M - Standard Test Method for Determination of Erosion Control Product (ECP) Ability to Encourage Seed Germination and Plant Growth Under Bench-Scale Conditions; 2017.

B. Mn/DOT Standard Specifications for Construction - Mn/DOT Standard Specifications for Construction; latest edition.

C. O-F-241 - Federal Specification - Fertilizer, Mixed, Commercial; 1975.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Seed Mixes: Submit seed mixes for approval prior to final ordering.

C. Seed tags of delivered seed.

D. Installation schedule: installation schedule shall be submitted a minimum of 30 days before beginning installation. Schedule shall specify planting season (spring or fall), dates, locations, and materials to be installed. Once accepted, revise only as approved in writing, after documentation of reasons for delays.

E. Topsoil sample test results. See Section 31 2323 Fill for requirements.

F. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer ; and recommended procedures to be established by Owner for maintenance/management of native grass and forb planting during entire year.

1.04 QUALITY ASSURANCE

A. Seed Producer: Company specializing in seed production and harvesting with minimum five years experience, and certified by the State of Minnesota.

B. Installer Qualifications: Company specializing in seeding with three years documented experience. Work shall be performed by personnel familiar with seeding procedures, and work shall be carried out under the supervision of a qualified foreman.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable. Deliver seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

C. Store seed in a cool, dry location. Wet or moldy seed will not be accepted.

PART 2 PRODUCTS

2.01 SEED MIXTURE

A. Approved Seed Vendors:
   1. Shooting Star Natives; https://www.shootingstarnativeseed.com/
   2. Minnesota Native Landscapes
   3. Twin City Seed
   4. Ramy Turf

B. No-Mow/EcolawnTurf Seed Mix
   1. No Mow Fine Fescue Mix to meet MnDOT Southern Boulevard (SB) mix.
      a. Composition (% of mix by weight):
         1) Buffalo Grass: 3.3%.
         2) Sheep Fescue: 11.88%.
         3) Chewings Fescue: 10%.
         4) Slender Creeping Red Fescue: 15.63%.
         5) Strong Creeping Red Fescue: 15.63%.
         6) Hard Fescue: 16.25%.
         7) Perennial Ryegrass: 1.88%
         8) Kentucky Bluegrass: 5%
         9) Weeping Alkaligrass: 3.75%
         10) Tall Fescue: 15.63%
         11) White Clover: 1.25%
      b. Follow recommended rates based on MnDOT Seeding Manual 2024 edition for Southern Boulevard Mix.
      c. Notes:
         1) Kentucky Bluegrass- Two different cultivars required.
         2) Alkalai Grass- newer cultivars only.
         3) Tall Fescue- Turf-type cultivards only.
         4) White Clover- Must be turf-compatible cultivars, not large or intermediate forage type cultivars
         5) Buffalo grass: Turf-type cultivars or wild type only.

C. Detention Bottom Seed Mix
   1. Mix Type: SSNS Detention Basin Mix or approved equal.
   2. Seed at a rate of [35] lb/acre.
   3. Cover Crop: Use winter wheat or oats for spring plant.

D. Short Prairie Native Seed Mix
   1. Seed Mix Type: SSNS Dry Short Prairie Mix with forbs enhancement or approved equal.
   2. SSNS Dry Short Prairie Mix seed at a rate of 10 lb/acre.
   3. Add SSNS Dry Forbs Enhancement seed mix at a rate of 1 lb/acre.
   4. Cover Crop: Use winter wheat or oats for spring plant.

E. Shortgrass Prairie 24" Max. Custom Seed Mix
   1. Custom Seed Mix Type: To contain dry, shortgrass prairie species at a maximum height of 24". Submit mix for approval prior to final ordering. Species to include:
      a. Grasses
         1) Blue grama
         2) Plains Oval Sedge
         3) Junegrass
         4) Sideoats Grama
      b. Forbs

1) White Prairie Clover
2) Purple Prairie Clover
3) Prairie Onion
4) Dwarf Blazingstar
5) Prairie Violet

2. Seed at a rate based on manufacturer's recommendations.
3. Cover crop based on manufacturer's recommendations.

F. Mesic Prairie Seed Mix
1. Seed Mix Type: SSNS Mesic Short Prairie Mix with forbs enhancement or approved equal.
2. Seed at a rate of 10 lb/acre.
3. Cover crop based on manufacturer's recommendations.

2.02 SOIL MATERIALS

A. Topsoil: Type as specified in Section 31 2323.

B. Contractor shall rake out and remove all objectionable matter in the topsoil and level soil prior to installing seed.

2.03 WATER

A. Water for the execution of this work and maintenance shall be clean, fresh, and free of deleterious substances.

B. Contractor shall furnish their own source of water.

C. It is the responsibility of the Contractor to verify source of water and its availability prior to its use.

2.04 ACCESSORIES

A. Turf Seed Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable. MnDOT CAT 20 blanket or hydromulch with tackifer will also be accepted. Refer to Erosion Control drawings and specifications.

B. Native Seed Mulching Material: MnDOT CAT 20 blanket or hydromulch with tackifer will also be accepted. Refer to Erosion Control drawings and specifications.

C. Steep Slope Mulching Material: On slopes greater than 4:1 or as indicated on drawings, biodegradable, netless erosion control fabric, in natural color to meet MnDOT CAT 20 or greater. Refer to Erosion Control drawings and specifications.

D. Erosion Fabric: Refer to Section 01 5713 - Temporary Erosion and Sediment Control. See plans.

E. Stakes: Softwood lumber, chisel pointed.

F. Edging:1/8" thick, black steel, with stakes in 10' segments.

2.05 SOURCE QUALITY CONTROL

A. Provide analysis of topsoil under provisions of Sections 01 4000 and 32 9119.13 Topsoil Placement and Grading.

PART 3 EXECUTION

3.01 EXAMINATION

A. Prior to placement of seed, Contractor is responsible for the examination and acceptance of all conditions affecting the proper installation of his work and will not proceed until all unsatisfactory conditions have been corrected.

B. Verify that prepared soil base is ready to receive the work of this Section.

3.02 PREPARATION

A. Prepare subgrade in accordance with Section 32 2323.

B. Prepare topsoil requirements in accordance with Section 31 2323.

C. Prior to seeding, verify finish grades and holddowns have been met. Scarify/loosen top 12 inches of soil and remove any weeds. All debris and weeds must be disposed of off-site.

D. Follow native seed mix supplier recommendations for additional site preparation.

3.03 SEEDING

A. Apply seed mixtures and cover crop at the rates recommended by seed producer.

B. All native seed is to be drop or broadcast seeded mechanically or by hand to ensure good seed to soil contact. Hydroseeding will not be allowed.

C. Seeding Methods to comply with MnDOT Seeding Manual 2024 edition unless otherwise noted.

D. Do not seed areas in excess of that which can be mulched on same day.

E. Planting Season:
   1. No-mow Turf Seeding: April 1-June 1 or July 1 - September 20.
   2. Native Seeding: per seed producer's recommended planting season for each specific seed mix. If no dates are given, seeding season will be April - June, or October through freeze-up.
   3. Winter Seeding: After Landscape Architecture approval, winter or dormant seeding may occur after the fall seeding date and when soil temperatures 1 inch below the surface are no greater than 40 degrees F, if acceptable for specific seed mixture.
      a. Perform snow seeding over the top of snow allowing the seed to melt through the snow to the soil and germinate upon warm-up in the spring.
      b. Additional erosion control may be needed depending on circumstances. To be determined prior to winter seeding approval in conjuction with Engineeer.

F. Do not sow immediately following rain, when ground is too dry, or during windy periods.

G. Roll seeded area with roller not exceeding 112 lbs.

H. Immediately following seeding and compacting, apply mulch to an even thickness of 1 to 3 inches. Install at a rate of 2 tons per acre by disc anchoring. Maintain clear of shrubs and trees. For steep areas, refer to accessories, erosion control specifications and drawings.

I. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

J. Following germination, immediately re-seed areas without germinated seeds that are larger than 4 by 4 inches.

3.04 PROTECTION

A. Place perimeter signage identifying seeded areas as newly seeded native restoration areas. For high-traffic areas near the building or walkways, identify seeded areas with stakes and string around area periphery. Set string height to 36 inches. Space stakes at 48 inches.

B. Cover seeded slopes where grade is 3 inches per foot or greater or as indicated on the plans with erosion fabric. Roll fabric onto slopes without stretching or pulling.

C. Lay fabric smoothly on surface, bury top end of each section in 6 inch deep excavated topsoil trench. Provide 12 inch overlap of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil.

D. Secure outside edges and overlaps at 36 inch intervals with stakes.

E. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

F. Contractor shall protect all that is to remain and shall conduct all seeding operations in a manner that will not damage or jeopardize the surrounding plant life designated on the Drawings as proposed or to remain.

G. Monuments: Carefully maintain benchmarks, monuments and other reference points, if disturbed or destroyed, have replaced or relocated by a registered surveyor at Contractor's expense.

3.05 COORDINATION

A. Coordinate timing of topsoil installation with seed.

3.06 LIMITS OF WORK

A. Seed all areas identified on drawings. Seed areas between the site and public road that are disturbed during construction. Any seed that is placed on site by the excavator for erosion control and subsequently disturbed shall be removed and/or replaced by the landscape contractor.

B. Restore all lawn and surface areas, whether within the contract limits or not, disturbed as a result of earthwork operations of this project. Restoration shall be by seed unless otherwise noted on the plans.

3.07 ESTABLISHMENT AND REPLACEMENT

A. Any seed which fails to germinate within three weeks shall be re-seeded as soon as weather and seasons permit. Spots larger than one foot in diameter which are bare or thinly germinated shall be re-seeded. Acceptance of seeded areas by the Landscape Architect will not be made until it is evident that the seed has germinated and 75% or more perennial cover is established.

B. The Contractor shall ensure establishment and maintain seeded areas by watering, weeding and mowing for a period of three months from Date of Substantial Completion.

3.08 WATERING AND MAINTENANCE

A. Turf Seed Areas:
   1. Provide watering and maintenance of seeded areas from installation through three months from Date of Substantial Completion.
      a. If seeding occurs in the fall and there is insufficient time for the seed to germinate before freeze-up, the Contractor will need to continue to maintain the seeded areas in the spring until the grass is well established and exhibits a vigorous growing condition.
   2. If necessary, mow grass at regular intervals to maintain at a maximum height of 3 inches. Do not cut more than 1/3 of grass blade at any one mowing.
   3. Immediately remove clippings after mowing and trimming.
   4. Water to prevent grass and soil from drying out.
   5. Roll surface to remove minor depressions or irregularities.
   6. Immediately reseed areas that show bare spots.
   7. Protect seeded areas with warning signs during maintenance period.

B. Native Seed Areas:
   1. Provide watering and maintenance of native seeded areas from installation through one full growing season from Date of Substantial Completion.
   2. During first growing season, the native areas shall be mowed a minimum of two (2) times as needed to control annual weed development. Cuttings take place each time regrowth reaches 18 to 30 inches. Cutting height at 4 to 6 inches. A flail or rotary mower or hand held weed whip will be used. Contractor to keep native grass and forb plantings free of all noxious weeds and other invasive vegetation. Reseed as required to meet intended results of a healthy native grass and forb planting.

3. Maintenance Instructions: Contractor to submit typewritten instructions recommending procedures to be established by Owner for maintenance/management of native grass and forb planting during entire year. Submit prior to expiration of required maintenance periods.
4. Provide Owner with optional contract for extended management services to be contracted separately from the installation contract after termination of warranty and management services included in installation.
    a. In years following the first growing season, management services could include controlled burning, spot spraying, spot cutting, hand weeding, and volunteer tree sapling removal.

3.09 INSPECTION

A. Inspection of this work will be made by the Landscape Architect at the conclusion of the planting period upon written notice by the Contractor at least five days prior to anticipated date. Condition of plants will be noted and recorded for reference at end of warranty period.

B. After inspection, the Contractor will be notified in writing by the Landscape Architect if there are any deficiencies of the requirements for Owner acceptance of the Work.

3.10 CLEAN-UP

A. All material brought into paved areas by seeding work operations shall be removed promptly, keeping these areas clean at all times. Upon completion of seeding, excess soils, rock and debris not previously cleaned up shall be disposed of off-site.

B. All ground area disturbed as a result of seeding shall be restored to their original condition or to the desired new appearance.

END OF SECTION

SECTION 32 9223
SODDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preparation of subsoil.

B. Placing topsoil.

C. Fertilizing.

D. Sod installation.

E. Watering.

F. Establishment and replacement.

G. Maintenance and mowing.

1.02 REFERENCE STANDARDS

A. Mn/DOT Standard Specifications for Construction - Mn/DOT Standard Specifications for Construction; latest edition.

B. O-F-241 - Federal Specification - Fertilizer, Mixed, Commercial; 1975.

C. TPI (SPEC) - Guideline Specifications to Turfgrass Sodding; 2006.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Certificate: Certify grass species and location of sod source.

C. Installation schedule: installation schedule shall be submitted a minimum of 30 days before beginning installation. Schedule shall specify planting season (spring or fall), dates, locations, and materials to be installed. Once accepted, revise only as approved in writing, after documentation of reasons for delays.

D. Topsoil test results. See Section 31 2323 Fill for requirements.

E. The Contractor will obtain test samples for determination of soil organic matter content of mineral sod from the soil exposed in the bottom side of the sod rolls. The Contractor will test for organic matter content meeting the requirements of ASTM D2974, Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.

F. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; Include recommended procedures to be established by Owner for maintenance/management of sod during entire year. Submit prior to expiration of required maintenance periods.

1.04 QUALITY ASSURANCE

A. Sod Producer: Company specializing in sod production and harvesting with minimum five years experience, and certified by the State of Minnesota.

B. Installer Qualifications: Company specializing in sodding with three years documented experience. Work shall be performed by personnel familiar with sodding procedures, and work shall be carried out under the supervision of a qualified sodding foreman.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver sod on pallets. Protect exposed roots from dehydration.

B. Do not deliver more sod than can be laid within 24 hours.

PART 2 PRODUCTS

2.01 SOD

A. Salt Tolerant Sod
   1. Provide salt-tolerant sod for use along boulevards or in a potential salt environment meeting the following requirements and characteristics:
      a. Low maintenance type
      b. Fine leafed
      c. Uniform texture
      d. Free of noxious, broad-leafed, and grassy weeds
      e. Contains less than 3 percent coarse grasses
      f. Originated from the blend of grass seed of seed components listed by the Minnesota Crop Improvement Association, Minnesota Turf Association, and the Office of Environmental Services

2.02 SOIL MATERIALS

A. Topsoil: Type as specified in Section 31 2323.

B. Contractor shall loosen soils, rake out and remove all objectionable matter in the topsoil and level soil prior to installing.

2.03 WATER

A. Water for the execution of this work and maintenance shall be clean, fresh, and free of deleterious substances.

B. Contractor shall furnish a hose and hose connection from hydrants and/or outlets where the water will be furnished.

C. It is the responsibility of the Contractor to verify source of water and its availability prior to its use.

2.04 ACCESSORIES

A. Fertilizer: Natural base; recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, to the following proportions:
   1. Nitrogen: 10 percent.
   2. Phosphoric Acid: 10 percent.
   3. Soluble Potash: 10 percent.
   4. Apply at the rate of 30 pounds per 1,000 square feet.

B. Wood Pegs: Softwood, sufficient size and length to ensure anchorage of sod on slope.

C. Edging:1/8" thick, black steel, with stakes in 10' segments.
   1. Rolled safety top.

2.05 SOURCE QUALITY CONTROL

A. Provide analysis of topsoil fill under provisions of Section 31 2323 - Fill .

B. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.

PART 3 EXECUTION

3.01 EXAMINATION

A. Sodding season:
   1. Lawn sod: April 15-June 10 or August 10-November 1
   2. Salt Tolerant sod: April 15-June 10

B. Prior to placement of sod, the Contractor shall be responsible for the examination and acceptance of all conditions affecting the proper installation of his work and shall not proceed until all unsatisfactory conditions have been corrected.

C. Verify that prepared soil base is ready to receive the work of this section.

3.02 PREPARATION

A. Prepare subgrade in accordance with Section 31 2200.

B. Place topsoil in accordance with Section 31 2200.

C. The grading of all areas to within 6 inches of final grade and the placing of 4 inches topsoil for final grading is specified in Section 31 2323 - Fill. Fine grade and smooth out areas as needed in preparation for the sod installation.

D. Immediately prior to sodding, Contractor shall loosen the topsoil placed by the earthwork contractor to a depth of 3 inches on all areas except slopes steeper than 3 horizontally to 1 vertically, using discs, harrows and tiller rakes to produce fine grade. On slopes steeper than 3 to 1, use cultivating equipment in general direction at right angles to the direction of surface drainage wherever practical. The landscape contractor shall top-off the soil with an average of 2 inches of top soil to raise grades to the final elevations.

3.03 FERTILIZING

A. Fertilizer shall be applied to a properly prepared soil bed prior to sodding with a mechanical spreader and thoroughly mixed in top 3 inches by means of a meeker harrow, by weighted chain link fence, or other approved method. Fertilizer must be dry and free flowing when applied.

B. Apply fertilizer no more than 48 hours before laying sod.

C. Lightly water to aid the dissipation of fertilizer.

3.04 LAYING SOD

A. Do not install plant life when ambient temperatures may drop below 35 degrees F or rise above 90 degrees F.

B. Precautions shall be taken to prevent sod from drying out and from heating. Sod that shows visible signs of heating shall not be incorporated in the project.

C. Lay sod smooth and tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces. Lay smooth and align with adjoining grass areas.

D. On slopes, the sodding shall begin at the bottom and progress upward with strips laid transverse to the flow of water. If necessary to protect sod already laid, the Contractor shall furnish ladders or treaded planks.

E. At the top of the slopes, sod will be laid so water from adjacent areas will have free flow into sodded areas.

F. On slopes 6 inches per foot and steeper, or in drainage swales, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet. Pegs shall be spaced not more than 18 inches apart at an angle against the flow of the water. Pegs shall project one inch above the sod.

G. Sod shall be watered and compressed into the underlying soil by rolling, or tamped into place. The initial watering and rolling shall provide firm contact and bond between the sod and the underlying soil. The rolling shall result in a smooth, even surface free of humps and depressions but shall not cause excessive compaction. Water sodded areas immediately after installation. Saturate sod to 4 inches of soil.

3.05 PROTECTION

A. Contractor shall protect all that is to remain and shall conduct all sodding operations in a manner that will not damage or jeopardize the surrounding plant life designated on the Drawings as proposed or to remain.

B. Identify sodded areas with stakes and string around area periphery. Set string height to 36 inches. Space stakes at 48 inches.

C. Monuments: Carefully maintain benchmarks, monuments and other reference points, if disturbed or destroyed, have replaced or relocated by a registered surveyor at Contractor's expense.

3.06 COORDINATION

A. Coordinate timing of topsoil installation with sod.

3.07 LIMITS OF WORK

A. Sod all areas identified on drawings. Sod areas between the site and public road that are disturbed during construction. Any sod that is placed on site by the excavator for erosion control and subsequently disturbed shall be removed and/or replaced by the landscape contractor.

B. Restore all lawn and surface areas, whether within the contract limits or not, disturbed as a result of earthwork operations of this job. Restoration shall be by sod if adjacent areas are sodded and shall otherwise be restored with seed unless otherwise noted on the plans.

3.08 ESTABLISHMENT AND REPLACEMENT

A. Any sod which fails to become established during the first 30 days after Date of Substantial Completion shall be replaced immediately by the Contractor at the direction of the Landscape Architect.

B. The Contractor shall ensure establishment and maintain sodded areas by watering, weeding and mowing for a period of three months from Date of Substantial Completion.

3.09 WATERING AND MAINTENANCE

A. Watering of all turf areas shall be performed by the Contractor as necessary to assure that sodded areas are uniformly moistened and maintained in a moist condition for a period of three months from Date of Substantial Completion.

B. Keep sod continuously moist and well watered for 14 days after laying. Thereafter, water sod until soil is soaked at least once every four days unless natural rainfall has provided equivalent water.

C. Provide maintenance at no extra cost to Owner; Owner will pay for water.

D. Provide maintenance of sodded areas for three months from Date of Substantial Completion.
   1. If sodding occurs in the fall and there is insufficient time for the sod to root back to the soil profile before freeze-up, the Contractor will need to continue to maintain the seeded areas in the spring until the grass is well established and exhibits a vigorous growing condition.

E. Sod must be maintained until rooted back into the soil profile.

F. Mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing.

G. Neatly trim edges and hand clip where necessary.

H. Immediately remove clippings after mowing and trimming.

I. Water to prevent grass and soil from drying out.

J. Roll surface to remove minor depressions and irregularities.

K. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.

L. Immediately replace sod to areas that show deterioration or bare spots.

M. Protect sodded areas with warning signs during maintenance period.

3.10 INSPECTION

A. Inspection of this work will be made by the Landscape Architect at the conclusion of the planting period upon written notice by the Contractor at least five days prior to anticipated date. Condition of plants will be noted and recorded for reference at end of warranty period.

B. After inspection, the Contractor will be notified in writing by the Landscape Architect if there are any deficiencies of the requirements for Owner acceptance of the Work.

3.11 CLEAN-UP

A. All soil manure, or similar material brought into paved areas by work operations shall be removed promptly, keeping these areas clean at all times. Upon completion of sodding, excess soil, stones, and debris not previously cleaned up shall be disposed of off-site.

B. All ground areas disturbed as a result of sodding shall be restored to their original condition or to the desired new appearance.

END OF SECTION

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SECTION 32 9300
PLANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preparation of subsoil and excavation below grade for plants.

B. Placing planting soil and topsoil.

C. Fertilizing.

D. Planting new trees, plants, and ground cover.

E. Relocated trees, plants, and ground cover.

F. Mulch.

G. Watering.

H. Establishment and replacement.

I. Maintenance.

J. Tree Pruning.

1.02 REFERENCE STANDARDS

A. ANSI/AHIA Z60.2 - American Standard for Nursery Stock; 2025.

B. Mn/DOT Standard Specifications for Construction - Mn/DOT Standard Specifications for Construction; latest edition.

C. O-F-241 - Federal Specification - Fertilizer, Mixed, Commercial; 1975.

D. ANSI A300 Part 1 - American National Standard for Tree Care Operations - Tree, Shrub, and Other Woody Plant Management - Standard Practices (Pruning); 2017.

E. ANSI Z60.1 - NURSERY STOCK; 1996.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Installation schedule: installation schedule shall be submitted a minimum of 30 days before beginning installation. Schedule shall specify planting season (spring or fall), dates, locations, and materials to be installed. Once accepted, revise only as approved in writing, after documentation of reasons for delays.

1. A pre-intallation meeting with the Landscape Architect is required. Submit installation schedule and coordinate meeting date a minimum of 30 days before beginning planting.

C. Topsoil and planting soil test results. See Section 31 2323 Fill for requirements.

D. Maintenance Data: Include cutting and trimming method .

1.04 QUALITY ASSURANCE

A. Substitutions will not be permitted. If proof is submitted that any plant specified is not obtainable, a written proposal will be considered for use of the nearest equivalent size or variety with an equitable adjustment of contract price.

B. Codes: Plant materials shall comply with local, state and federal laws relating to inspection for diseases and insect infestation.

C. Grading Standards: Plant stock shall conform to the code of standards set forth in the current edition of American Standards for Nursery Stock (ANSI).

D. Plant Names and Labels: The nomenclature used in the Drawings and Specifications conforms, with few exceptions, to that of the current edition of Standardized Plant Names as adopted by the American Joint Committee on Horticultural Nomenclature.

E. Installer Qualifications: Company specializing in installing and planting the plants with three years documented experience. Work shall be performed by personnel familiar with planting procedures, and work shall be carried out under the supervision of a qualified planting foreman.

F. Labeling: Label at least one tree and one shrub per shrub bed of each variety with a securely attached waterproof tag bearing legible designation of botanical and common name.

G. Maintenance Services: Performed by installer.

H. Inspection: The Landscape Architect may inspect trees and shrubs (at place of growth or at site before planting) for compliance with requirements for genus, species, variety, size and quality. Landscape Architect retains right to further inspect trees and shrubs for size and condition of balls and root systems, insects, injuries and latent defects, and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from project site.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Notify Landscape Architect at least three days in advance of delivery of trees, shrubs and other plant material and manner of shipment. Furnish itemized list of actual quantity and sizes.

B. When shipment of plant material is made by truck, pack to provide adequate protection against climate and breakage during transit and tie to prevent whipping. Cover tops to prevent damage.

C. Deliver all packaged material in original, undamaged containers. Packaging to clearly identify manufacturer, brand, name, analysis of contents and net weight.

D. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

E. Protect and maintain plant life until planted.

F. Deliver plant life materials immediately prior to placement. Keep plants moist.

G. Deliver plant material direct from nursery. Heel-in immediately upon delivery if not to be planted within four hours, covering with moist soil, mulch or other approved medium to protect from drying. Store plants in shade and protect from weather.

H. Do not drop plant materials or pick up balled plants by stems or trunks.

I. Handle packaged materials in such a manner as to prevent contamination or spillage.

J. No plant shall be bound with wire or rope so as to damage the bark or spread of the branches.

K. If required by Landscape Architect, apply anti-desiccant using power spray to provide an adequate film over trunks, branches, stems, twigs and foliage. If deciduous trees or shrubs are moved in full-leaf, spray with anti-desiccant at nursery before moving and again two weeks after planting. Spray coniferous plants that are planted in the fall.

L. All materials used for balled and burlapped plants shall be natural (non-synthetic) and biodegradable. Wire baskets shall not be galvanized.

M. All plant materials shall be assembled in one location on the job site to permit inspection and approval by the Landscape Architect. Stock with broken root balls or loose containers, and stock which shows evidence of being root bound, overgrown or recently canned, or damaged, shall be removed from the site immediately and replaced at the Contractor's expense with another plant meeting the original Specifications

N. Dig balled and burlapped (B&B) plants with firm natural balls of earth of sufficient diameter and depth to include all fibrous and feeding roots. No plants moved with a ball will be accepted if the ball is cracked or broken before or during planting operations.

O. Roots or balls of plants shall be adequately protected at all times from sun and drying winds.

P. All balled and burlapped plants which cannot be planted immediately upon delivery shall be set on the ground and shall be well protected with soil, wet moss, or other acceptable material. Bare rooted plants which cannot be planted immediately shall be protected with soil, wet moss or heeled in trenches immediately upon delivery.

1.06 FIELD CONDITIONS

A. Proceed with the complete landscape work as rapidly as portions of site become available, working within seasonal limitations.

B. Planting shall be conducted under favorable weather conditionsduring either the Spring or Fall planting season for the applicable zone as described in the following table:

Planting Dates by Zone				
			3	**4**
Spring	Deciduous	Bare Root	April 21 to June 1	April 7 to June 1
		Container B&B	April 21 to June 30	April 7 to June 30
		Coniferous	April 21 to June 1	April 7 to May 17
		Perennials	May 1 to June 30	May 1 to June 30
		Seedlings	April 21 to June 1	April 7 to June 1
Fall	Deciduous	Bare Root	October 1 to November 1	October 10 to November 15
		Container B&B	August 25 to October 15	August 25 to November 1
		Coniferous	August 25 to September 15	August 25 to September 15
		Perennials	August 25 to September 15	August 25 to September 15

C. Utilities: Call Gopher State One Call and locate all other underground utilities. Perform work in a manner which will avoid possible damage. Notify Landscape Architect if conflict exists before excavating planting pits. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by both parties concerned.

D. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Landscape Architect before planting.

E. Coordinate planting with specified maintenance periods to provide maintenance up to date of Owner's acceptance.

F. Do not install plant life when ambient temperatures may drop below 35 degrees F or rise above 90 degrees F.

G. Do not install plant life when wind velocity exceeds 30 mph.

H. Coordination with Lawns: Plant trees and shrubs after final grades are established and prior to planting of lawns, unless otherwise acceptable to Landscape Architect. If planting of trees and shrubs occurs after lawn work, protect lawn areas and promptly repair damage to lawns resulting from planting operations.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide one year warranty on all plant material from Date of Substantial Completion or Owner Acceptance of plantings, whichever is later. Plants shall be alive and in satisfactory condition at the end of warranty period. Such warranty excludes vandalism.

C. At the end of the warranty period, inspection will be made by the Landscape Architect upon written notice by the Contractor at least three days before the anticipated date. Any plant required under this Contract that is dead or not in satisfactory condition, as determined by the Landscape Architect, shall be removed from the site, and shall be replaced as soon as conditions permit during the normal planting season.

D. Replacements: Plants of same size and species as specified, planted in the next growing season, with a new warranty commencing on date of replacement, for one complete growing season after replacement (no less than one year). Replacement costs shall be the responsibility of the Contractor.

PART 2 PRODUCTS

2.01 PLANTS

A. Plants: Species and size identified in plant schedule, grown in climatic conditions similar to those in locality of the work.

B. Deciduous Trees: Provide balled and burlapped (B & B) deciduous trees of height and caliper listed scheduled or shown and with branching configuration recommended by ANSI Z60.1 for type and species required. Provide single stem trees except where special forms are shown or listed. Use boxing procedure in drawings for all containerized plants.

C. Deciduous Shrubs and Perennials/Vines: Provide potted shrubs and perennials of the height shown or listed on the plant schedule and with not less than minimum number of canes required by ANSI Z60.1 for type and height of shrub required. Use boxing procedure in drawings for all containerized plants.

D. Plugs: Provide 2"-4" potted plants, species as shown in drawings and to supplement approved seed mixtures. Refer to Section 32 9219 - Seeding for seed mixtures. Plugs shall be thoroughly rooted through the container. No species shall be substituted without approval of the Landscape Architect. Refer to areas on planting schedules and provide quantity to cover area with planting plugs at 18" O.C..

E. Coniferous and Broad-Leafed Evergreens: Provide balled and burlapped evergreens of sizes shown or listed. Dimensions indicate minimum spread for spreading and semi-spreading type evergreens and height for other types, such as globe, dwarf, cone, pyramidal, broad up-right, and columnar. Provide normal quality evergreens with well-balanced form complying with requirements for other size relationships to the primary dimension shown. Use boxing procedure in drawings for all containerized plants.

2.02 SOIL MATERIALS

A. Topsoil as specified in Section 31 2323.

B. Planting soil as specified in Section 31 2323.

C. Landscape contractor shall loosen soils to 24" and rake out and remove all objectionable matter in the topsoil or planting soil and level soil prior to installing plant material.

2.03 WATER

A. Water for the execution of this work and maintenance shall be clean, fresh, and free of deleterious substances.

B. Contractor shall furnish a hose and hose connection from hydrants and/or outlets where the water will be furnished.

C. It is the responsibility of the Contractor to verify source of water and its availability prior to its use.

2.04 ACCESSORIES

A. Double Shredded Hardwood Mulch: Organic mulch free from deleterious materials and suitable for top dressing of trees, shrubs, or plants and consisting of double shredded hardwood in all plant beds unless noted otherwise.

B. Rock Mulch: 1/4" granite chip as specified to the area and depth on the plans.

C. Fertilizer: Natural base, recommended for turf grasses and perennials, with 50 percent of the elements derived from organic sources; of proportion necessary to eliminate deficiencies of topsoil, to the following proportions:
   1. Nitrogen: 18 percent.
   2. Phosphoric Acid: 1 percent.
   3. Soluble Potash: 8 percent.

D. Stakes and Braces: Wood stakes and braces shall be common lumber of the sizes in the following table::

Tree Size	Brace Stakes	Guy Stakes
1"	3-1/2"2" X 2" X 9'-0"	2" X 2" X 2'-0"
4" & over	Not applicable	2" X 2" X 3'-0"
Conifers	Not applicable	2" X 2" X 3'-0"

E. Guy Wires: Guy wires shall be a good commercial quality of galvanized wire. Wire used to guy trees up to four inches shall be No. 12 gauge; wire used to guy trees four inches and over shall be No. 9 gauge.

F. Webbing: Shall be 3" wide nylon with grommets or 16" long polypropylene or polyethylene 40 mil. 3" wide straps. Requests for standard hose and wire guying systems will not be approved. See detail.

G. Edging:1/8" thick, black steel, with stakes in 10' segments.

H. Anti-desiccant: Wilt Pruf; https://wiltpruf.com/

I. Pelleted weed preventer: pre-emergent granular weed prevent containing corn gluten as the active ingredient.

2.05 SOURCE QUALITY CONTROL

A. Provide analysis of topsoil and planting soil under provisions of Sections 01 4000 and 31 2323.

B. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt and organic matter; pH value and _____.

PART 3 EXECUTION

3.01 EXAMINATION

A. Prior to placement of plants, the Contractor shall be responsible for the examination and acceptance of all conditions affecting the proper installation of his work and shall not proceed until all unsatisfactory conditions have been corrected.

B. Verify that prepared subsoil are ready to receive work.

C. Saturate soil with water to test drainage.

D. Verify that required underground utilities are available, in proper location, and ready for use.

E. Obstructions Below Ground

1. In the event that rock or underground construction work or obstructions are encountered in any plant pit excavation work to be done under this Contract, alternate locations may be selected by the Landscape Architect. Where locations cannot be changed, the obstructions shall be removed to a depth of not less than three (3) feet below grade and no less than six (6) inches below bottom of ball or roots when plant is properly set at the required grade The Contractor shall be responsible for the removal of such rock or underground obstructions encountered.

3.02 PREPARATION OF SOIL

A. Prepare subsoil to eliminate uneven areas. Maintain profiles and contours. Make changes in grade gradual. Blend slopes into level areas.

B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated subsoil.

C. Scarify subsoil to a depth of 12 inches where plants are to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.

D. Planting Soil Preparation: Prior to delivery to the Project, the compost for soil amending shall be tested and the test results shall be approved by the Landscape Architect in accord with the guidance provided in Section 31 2323 - Fill for planting soil:

1. The Contractor shall furnish a certification from the supplier that the materials have been produced by accepted aerobic composting techniques employing turning or aeration, pathogen reduction and curing.
2. Prospective sources should be indicated to the Landscape Architect allowing at least six weeks prior to delivery for testing and approval. The Contractor shall bear all testing costs.

3.03 FERTILIZING

A. Apply fertilizer in accordance with manufacturer's instructions.

B. Apply after initial raking of topsoil.

C. Mix thoroughly into upper 3 inches of topsoil.

D. Lightly water to aid the dissipation of fertilizer.

3.04 SHRUB & PERENNIAL PLANTING

A. Layout: All shrub bed locations shall conform to the Drawings.

B. Planting Holes: Conform to the minimum dimensions indicated in the Drawing Details.

C. Spaded Edges, where applicable: Neatline planting bed edges with straight edge spade.

D. Planting: Scarify bottom of plant holes or beds. Set plants at correct spacing, remove containers, and fill with planting soil. Set plants plumb.

E. Weed Control: Apply pelleted weed preventer on soil around plants at manufacturer's rates over entire area to receive mulch, taking care to not damage plantings.

F. Mulch: Spread mulch evenly at 4" depth around plants, taking care not to smother small plants.

3.05 TREE PLANTING

A. Layout: All tree locations will be staked by the Contractor in the field to conform to the Drawings. Locations shall be approved by the Landscape Architect prior to digging and placement. No material shall be planted without approval of the Landscape Architect. Where overhead obstructions are encountered, tree relocation shall be designated by the Landscape Architect.

B. Planting Holes: Shall be essentially circular with a diameter two feet greater than the diameter of the ball of the tree. The depth of the pit shall be enough to set the flare of the tree to its original grade. The flare of the tree shall not be set below grade. If the native soil at the site is heavy or wet, consult with the Landscape Architect to determine correct setting height of the tree.

C. The side walls of the planting pits shall be scarified with a mattock, pick ax, spade or other appropriate tool.

D. Setting of Trees:
1. Dig planting hole to size specified in Planting Hole Dimensions Schedule and/or Planting Details on Drawings.
2. Scarify sides and bottom of hole.
3. Set tree on undisturbed native soil or thoroughly compacted backfill soil at the same depth it was grown in the nursery. In no case shall the flare of the tree root be set below grade.
4. Lifting from the bottom of the root ball, the tree shall be placed in planting hole with burlap and wire basket, if used, intact. Once in place the plant shall be backfilled to within 12" of the top of the rootball and watered. Burlap and rope shall be removed from the top of balls and adjusted to prevent air pockets. No burlap shall be pulled from under the balls.
5. Plumb and backfill with planting soil specified in31 2323 - Fill and L500 Drawings.
6. Apply water to settle plants and fill voids.
7. Water thoroughly within two hours.

8. Place 4" of shredded hardwood mulch within 48 hours of the second watering unless soil moisture is excessive. Use the diameter of planting hole width as the mulch area around every tree. Pull all mulch away from the trunk.
9. If the native or in-place soils are of clay origin, set the plant 1-2" above grade or as directed by the Landscape Architect.
10. If the Contractor encounters poorly drained soils, do not complete planting and contact the Landscape Architect. If the Contractor is authorized to proceed with planting on wet, poorly drained soils (indicated by mottled soils) do not construct watering basin; instead leave a two-inch high pedestal on the bottom of the planting pit.

E. Pruning: Remove dead or damaged branches only. Do not cover any cuts. No leaders shall be cut. All pruning shall be done with clean, sharp tools.

F. Tree Collar: Gently set plastic perforated corrugated pipe collar into top of root ball and surround with mulch. There shall be no mulch between collar and trunk of tree. The Contractor shall be responsible for maintaining this condition for the duration of the warranty.

G. Staking: The Contractor shall stake all evergreen trees planted after October 1st. The stakes and guy wires shall be removed the following spring. The Contractor is responsible for maintaining all other trees in a upright position for the maintenance period. If the trees begin to lean during that period, the Contractor shall stake the trees using the methods described in the Drawings and use the materials described in the definitions above. The Contractor shall remove all staking in the spring following the planting.

H. Tree Watering Bags: Contractor may decide to utilitze tree watering bags during growing season. Tree watering bags must be removed prior to winter season. Watering bags are not a substitute for watering requirements per the plant warranty. Watering bags are considered incidential to the cost of plantings.

3.06 PLANT RELOCATION AND RE-PLANTING

A. Relocate plants as indicated by Landscape Architect.

B. Replant plants in pits or beds, partly filled with prepared topsoil mixture, at a minimum depth as indicated on drawings under each plant. Remove burlap, ropes, and wires, from the root ball.

C. Place bare root plant materials so roots lie in a natural position. Backfill soil mixture in 6 inch layers. Maintain plant materials in vertical position.

D. Saturate soil with water when the pit or bed is half full of topsoil and again when full.

3.07 TREE PRUNING

A. Prune trees as recommended in ANSI A300 Part 1.

B. Prune newly planted trees as required to remove dead, broken, and split branches.

3.08 WATERING AND MAINTENANCE

A. Provide maintenance of new plant materials until Owner acceptance.

B. The Contractor shall be required to make periodic checks on the total project to make certain that the materials are properly cultivated and pruned and that all guys and stakes are in proper adjustment, and that the sum of all conditions are contributing to the satisfactory progress of the materials.

C. The Contractor shall monitor the planting material to assure that, if the site is irrigated, overwatering does not occur. Contractor shall be responsible for providing the Owner a watering schedule for all plants.

D. Planting beds shall be maintained weed-free until Owner acceptance.

E. Replace mulch when deteriorated until one-year warranty review.

F. Maintain wrappings, guys, and stakes. Repair or replace accessories when required until warranty review.

3.09 INSPECTION

A. Inspection of this work will be made by the Landscape Architect at the conclusion of the planting period upon written notice by the Contractor at least five days prior to anticipated date. Condition of plants will be noted and recorded for reference at end of warranty period.

B. After inspection, the Contractor will be notified in writing by the Landscape Architect if there are any deficiencies of the requirements for Owner acceptance of the Work.

3.10 CLEAN UP

A. Any soil, manure, peat or similar material which has been brought onto paved areas by hauling operations or otherwise shall be removed promptly, keeping the area clean at all times. Upon completion of the planting, all excess soil, stones, and debris which have not previously been cleaned up shall be removed from site or disposed of.

B. All ground area disturbed as a result of planting operations shall be restored to their original condition or to the desired new appearance.

END OF SECTION

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SECTION 33 0561
CONCRETE MANHOLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Precast concrete manholes.

B. Prefabricated catch basin structures.

C. Pretreatment Structure.

D. Grade adjustments.

E. Frames, grates, and covers.

1.02 SUSTAINABILITY REQUIREMENTS

A. See Section 01 81 13 B3 Sustainability Design Requirements.

1.03 REFERENCE STANDARDS

A. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2025a.

B. ASTM A5306 - Standard Test Method for Linear Flame Propagation Rate of Lubricating Oils and Hydraulic Fluids; 1992 (Reapproved 2013).

C. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens); 2024.

D. ASTM C478/C478M - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections; 2020.

E. ASTM C490/C490M - Standard Practice for Use of Apparatus for the Determination of Length Change of Hardened Cement Paste, Mortar, and Concrete; 2017.

F. ASTM C807 - Standard Test Method for Time of Setting of Hydraulic Cement Mortar by Modified Vicat Needle; 2013.

G. ASTM C923/C923M - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals; 2020.

H. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.

I. ASTM D1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable; 2016.

J. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2015.

K. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2024.

L. ASTM F594 - Standard Specification for Stainless Steel Nuts; 2024.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manhole covers, component construction, features, configuration, and dimensions.

C. Shop Drawings: Indicate manhole locations, elevations, piping sizes and elevations of penetrations.

D. Manufacturer's qualification statement.

1.05 QUALITY ASSURANCE

A. Manhole and catch basin construction and reconstruction, both storm and sanitary, shall be in conformance with MnDOT 2506.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 CONCRETE MANHOLES

A. Manhole Sections:
   1. All storm sewer manholes shall meet the requirements of MnDOT 3622 and MnDOT Standard Plate 4005M, Design F, and/or MnDOT Standard Plate 4020J. "O" ring gaskets shall be used in the joints in the barrel sections. The cone sections shall be concentric (Type A).
   2. All sanitary sewer, air release, and cleanout manholes shall meet the requirements of MnDOT 3622 and the "Precast Mechanical Joint Sewer Manhole" MnDOT Standard Plate 4007C. Contractor shall be responsible for providing openings in the manhole section at the proper locations according to the drawings. No steps will be allowed in the manholes. All manholes must have an integral concrete base.
   3. Manhole castings shall be No. 700-7, conforming to MnDOT Standard Plate 4101D with cover casting No. 716, conforming to MnDOT Standard Plate 4110F.
   4. Sanitary sewer manhole covers shall be watertight.

B. Manhole Sections: Reinforced precast concrete in accordance with ASTM C478/C478M, with resilient connectors complying with ASTM C923/C923M.

C. Catch Basins:
   1. Catch basins shall conform to Design G on Standard Plate 4006L.
   2. Grate and Frame Casting in Curb Line: Catch basin frame castings shall be No. 802A on Standard Plate 4129G or No. 805 on Standard Plate 4132F. Catch basin grate castings shall be No. 816 on Standard Plate 4154B.
   3. Grate and Frame Casting in Vegetated Area: Catch basin frame castings shall be No. 700-7 on Standard Plate 4101D. Catch basin grate castings shall be No. 720 on Standard Plate 4140D.

D. Prefabricated Catch Basins/Area Drains:
   1. Polyvinyl chloride (PVC) pipe, ASTM D3034 prefabricated drainage structures with manufacturer supplied ASTM A5306 ductile iron grates. ADS Nyloplast Prefabricated Drainage Structures or approved equal.

E. Pretreatment Structure - Rain Guardian:
   1. Provide Rain Guardian pretreatment structure or approved equal.

F. Non-Shrink Grout or Cement-Based Polymer Modified Patching Mortar:
   1. Non-shrink grout shall be a non-metallic type grout which is durable in wetting and drying, freezing and thawing conditions and shall conform to the requirements set forth in ASTM C1107/C1107M. Cement-based polymer modified patching mortar shall conform to the requirements set forth in ASTM C109/C109M, ASTM C490/C490M, and ASTM C807.

G. Adjusting Rings: High density polyethylene (HDPE) recyled adjusting rings as defined in ASTM D1248.

2.02 COMPONENTS

A. Water Tight Seal: Water tight seal at pipe penetration including an internal expanding locking band creating a positive mechanical seal, flexible sleeve and a stainless steel exterior clamp. Seal shall be installed according to manufacturer's instructions and shall conform to the requirements of the Minnesota Plumbing Code, current edition.

B. External Manhole Frame Seal: Seal shall have a minimum thickness of 3/16 inches and shall be made of high quality rubber compound conforming to ASTM C923/C923M, with a minimum 1500 psi tensile strength. Seal shall be attached using 15 gauge stainless steel bands conforming to ASTM A240/A240M, Type 304, with no welded attachments. Any screws, bolts or nuts used shall be stainless steel conforming to ASTM F593 and ASTM F594, Type 304, as manufactured by Cretex Specialty Products or approved equal.

2.03 CONFIGURATION

A. Shaft Construction: Concentric with concentric cone top section; lipped male/female dry joints; sleeved to receive pipe sections.

B. Shape: Cylindrical.

C. Clear Inside Dimensions: As indicated on the drawings; 48 inch diameter minimim.

D. Design Depth: As indicated.

E. Clear Lid Opening: 27 inches diameter

F. Pipe Entry: Provide openings as indicated.

G. Steps: As required by code.

2.04 ACCESSORIES

A. Steps: Formed galvanized steel rungs; 3/4 inch diameter. Formed integral with manhole sections.

B. Adjustment Riser:
   1. EJ; INFRA-RISER Adjusment Riser: www.ejco.com/@sle.
   2. or approved equal.
   3. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify items provided by other sections of work are properly sized and located.

B. Verify that built-in items are in proper location, and ready for roughing into Work.

C. Verify excavation for manholes is correct.

3.02 PREPARATION

A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.

3.03 INSTALLATION

A. Manholes
   1. Manholes shall be bedded on 6 inches minimum of Aggregate Bedding.
   2. Place manhole sections plumb and level, trim to correct elevations, anchor to base pad.
   3. Form and place manhole cylinder plumb and level, to correct dimensions and elevations. As work progresses, build in fabricated metal items.
   4. Cut and fit for pipe.
   5. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour as required.
   6. Set cover frames and covers level without tipping, to correct elevations.
   7. Coordinate with other sections of work to provide correct size, shape, and location.
   8. When using plastic pipe, manhole water stops supplied by the manufacturer shall be installed.
   9. All annular wall space surrounding the in-place pipes shall be completely filled with mortar or concrete and the inside bottom of each manhole shall be shaped with fresh concrete to form free flow-through troughs as directed. The troughs shall be as deep as a half-pipe and the shelves shall slope up 3 inches from the trough to the wall.

10. When a sewer connects with an existing manhole or catch basin, Contractor shall make a suitable connection through the wall of the manhole or catch basin and shall reshape the invert to assure a smooth and unobstructed flow line through.
11. Non-shrink grout or cement-based polymer modified patching mortar shall be used to patch lifting holes in manholes and catch basins.
12. Precast concrete adjusting rings shall be set in a bed of non-shrink grout or cement-based polymer modified patching mortar.
13. Manhole and catch basin castings shall be set in a bed of non-shrink grout or cement-based polymer modified patching mortar.
14. Adjusting rings shall be sealed to the manhole structure, casting, and one another by means of an approved butyl sealant. Utilize a combination of flat and sloping rings to adjust the casting to the slope and grade of the adjacent surface. The top of casting shall be installed uniformly 3/8 inch lower than the adjacent grade.
15. A 4 inch thick concrete encasement shall be placed around the outside of the manhole or catch basin as detailed on the drawings. This encasement shall be placed at the time of final casting placement.
16. Steps shall be provided in all manholes or catch basins exceeding 5.5 feet in depth as measured from the top of casting to the structure invert. The first step shall be located at a maximum of 14 inches up from the bottom of the structure.

B. Prefabricated Catch Basins/Area Drains:
   1. Install per manufacturer's instructions.

C. Pretreatment Structure:
   1. Install per manufacturer's instructions.

D. Frames and Covers:
   1. Place frame plumb and level.
   2. Place grate in frame securely.

3.04 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Section 01 4000 - Quality Requirements.

B. Provide testing of drainage structures per the Minnesota Plumbing Code.

C. If inspections indicate work does not meet specified requirements, adjust work and reinspect at no cost to Owner.

D. Infiltration Test: Test in accordance with Minnesota Plumbing Code, current edition.

END OF SECTION

SECTION 33 1416
SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water pipe for site conveyance lines.

B. Pipe and fittings for site water lines including domestic water lines and fire water lines.

C. Valves.

1.02 SUSTAINABILITY REQUIREMENTS

A. See Section 01 81 13 B3 Sustainability Design Requirements.

1.03 REFERENCE STANDARDS

A. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2023.

B. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80; 2020.

C. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals; 2019.

D. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2023.

E. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2009.

F. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances; 2023.

G. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. through 60 In. (100 mm through 1500 mm); 2022.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.05 QUALITY ASSURANCE

A. Perform Work and Testing in accordance with municipality requirements.

B. All water utility distribution piping, fittings, installation and testing shall be as indicated on the drawings and conform to the City of Alexandria Standard Specifications for Construction, Current Edition.

PART 2 PRODUCTS

2.01 WATER PIPE

A. Pipe: Shall be size and type as specified on the drawings.
   1. Joints and Fittings shall be of the same material an size as the pipe.

B. Ductile Iron Pipe: AWWA C151 and ANSI A-21.51.
   1. Fittings: Ductile iron, standard thickness. Conform to ANSI A-21.10 or ANSI A-21.53. "Megalug" by Ebba Iron, Inc., Uni-Flange Series 1400 "Block Buster" or approved equal type Mechanical Joint Restraint fittings may be substituted for standard fittings, rodding and blocking at thrust points. Megalug or Block Buster type fittings shall be used on Ductile Iron Pipe only, not on the existing Cast Iron pipe.

2. Joints: AWWA C111/A21.11, Styrene butadiene rubber (SBR) or vulcanized SBR gasket with rods.
3. Pipe shall be provided with provisions to maintain electrical continuity for thawing purposes.

C. PVC Pipe: AWWA C900 Class 165 minimum:
1. Fittings: AWWA C111/A21.11, Schedule 40 per ASTM D2466 or schedule 80 per ASTM D2467.
2. Joints: ASTM D3139 compression gasket ring.

D. Trace Wire: Magnetic detectable conductor, clear plastic covering, imprinted with "Water Service" in large letters.

2.02 VALVES

A. Gate Valves 3 Inches and Over:
1. AWWA C509, iron body, bronze trim, non-rising stem with square nut, single wedge, resilient seat, flanged ends, control rod, post indicator, valve key, and extension box.

2.03 BEDDING AND COVER MATERIALS

A. Bedding: As specified in Section 31 2316.13.

B. Cover: As specified in Section 31 2316.13.

2.04 ACCESSORIES

A. Concrete for Thrust Restraints: Concrete type specified in Section 03 3000.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building service connection and municipal utility water main size, location, and invert are as indicated.

3.02 PREPARATION

A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare pipe connections to equipment with flanges or unions.

3.03 TRENCHING

A. See Section 31 2316.13 for additional requirements.

B. Backfill around sides and to top of pipe with Granular Fill, tamp in place and compact, then complete backfilling.

3.04 INSTALLATION - PIPE

A. Maintain separation of water main from sewer piping in accordance with Minnesota Plumbing code.

B. Establish elevations of buried piping to ensure not less than 8 ft of cover.

C. Install pipe to indicated elevation to within tolerance of 1/2 inches.

D. Install ductile iron piping and fittings to AWWA C600.

E. Route pipe in straight line.

F. Install pipe to allow for expansion and contraction without stressing pipe or joints.

G. All plugs, caps, tees, bends and other thrust points shall be provided with thrust blocking according to the details on the plans. "Megalug" by Ebba Iron, Inc., Uni-Flange Series 1400 "Block Buster" or approved equal type Mechanical Joint Restraint fittings may be substituted for standard fittings, rodding and blocking. Megalug or Block Buster type fittings shall be used on Ductile Iron Pipe only, not on the existing Cast Iron pipe.

H. Slope water pipe and position drains at low points.

I. Install trace wire 6 inches above top of pipe; coordinate with Section 31 2316.13.

3.05 INSTALLATION - VALVES

A. Set valves on solid bearing.

B. Center and plumb valve box over valve. Set box cover flush with finished grade.

3.06 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Section 01 4000.

B. All construction quality testing shall conform to the Minnesota Plumbing Code.

C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

END OF SECTION

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SECTION 33 3113
SITE SANITARY SEWERAGE GRAVITY PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sanitary sewerage drainage piping, fittings, and accessories.

B. Connection of building sanitary drainage system to municipal sewers.

C. Cleanout access.

1.02 SUSTAINABILITY REQUIREMENTS

A. See Section 01 81 13 B3 Sustainability Design Requirements.

B. See Section 01 6116 Volatile Organic Compound (VOC) Content Restrictions.

1.03 REFERENCE STANDARDS

A. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015.

B. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2020.

C. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2015.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating pipe and pipe accessories.

C. Field Quality Control Submittals: Document results of field quality control testing.

D. Project Record Documents:
   1. Record location of pipe runs, connections, manholes, cleanouts, and invert elevations.
   2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

PART 2 PRODUCTS

2.01 SEWER PIPE MATERIALS

A. Provide products that comply with Minnesota Plumbing Code.

B. Plastic Pipe: ASTM D3034, SDR 26, Type PSM, Poly(Vinyl Chloride) (PVC) material; inside nominal diameter as indicated on the drawings, bell and spigot style push-on with elastomeric gasketed joints which are bonded to the inner wall of the gasket recess of the bell socket.

C. Plastic Pipe: ASTM D1785, Schedule 40, Poly(Vinyl Chloride) (PVC) material; inside nominal diameter of ____ inches, bell and spigot style solvent sealed joint end.

D. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

2.02 PIPE ACCESSORIES

A. Trace Wire: #12 solid copper with "HMWPE" 30 mil insulation. Insulation for sanitary sewer applications shall be green.

2.03 BEDDING AND COVER MATERIALS

A. Pipe Bedding Material: As specified in Section 31 2323.

B. Pipe Cover Material: As specified in Section 31 2323.

PART 3 EXECUTION

3.01 GENERAL

A. Perform work in accordance with applicable code(s).

3.02 TRENCHING

A. See Section 31 2316.13 for additional requirements.

B. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.03 INSTALLATION - PIPE

A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.

B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
   1. Plastic Pipe: Also comply with ASTM D2321.

C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.

D. Connect to building sanitary sewer outlet and municipal sewer system , through installed sleeves.

E. Install trace wire 6 inches above top of pipe; coordinate with Section 31 2316.13.

3.04 INSTALLATION - CLEANOUTS

A. Form bottom of excavation clean and smooth to correct elevation.

B. Form and place cast-in-place concrete base pad, with provision for sanitary sewer pipe end sections.

C. Establish elevations and pipe inverts for inlets and outlets as indicated.

D. Mount lid and frame level in grout, secured to top cone section to elevation indicated.

3.05 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Section 01 4000 and the Minnesota Plumbing Code, current edition.

B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

C. Air Test: Test in accordance with City requirements.

3.06 PROTECTION

A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 33 4100
SUBDRAINAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stormwater Basin Drainage System.

1.02 SUSTAINABILITY REQUIREMENTS

A. See Section 01 81 13 B3 Sustainability Design Requirements.

1.03 REFERENCE STANDARDS

A. ASTM F758 - Standard Specification for Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage; 2014.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on pipe drainage products, pipe accessories, and _____.

PART 2 PRODUCTS

2.01 PIPE MATERIALS

A. Polyvinyl Chloride Pipe: ASTM F758 PS 46; plain end; with required fittings. Pipe size as specified on plans.

B. Use perforated pipe at subdrainage system; unperforated through sleeved walls and to discharge points.

2.02 AGGREGATE AND BEDDING

A. Drainage Aggregate Material: Drainage Fill Typeas specified in Section 31 2323.

2.03 ACCESSORIES

A. Pipe Couplings: Solid plastic.

B. Geotextile Fabric: Type I geotextile conforming to MnDOT 3733.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout Drawings.

3.02 PREPARATION

A. Hand trim excavations to required elevations. Correct over-excavation with Granular Fill.

B. Remove large stones or other hard matter that could damage drainage piping or impede consistent backfilling or compaction.

3.03 INSTALLATION

A. Install and join pipe and pipe fittings in accordance with pipe manufacturer's instructions.

B. Place drainage pipe on clean cut subsoil.

C. Lay pipe to slope gradients noted on Drawings; with maximum variation from true slope of 1/8 inch in 10 feet.

D. Place pipe with perforations facing down. Mechanically join pipe ends.

E. Install filter aggregate at sides, over joint covers and top of pipe or as indicated on Drawings. Provide top cover compacted thickness of 12 inches.

F. Place filter fabric over levelled top surface of aggregate cover or as indicated on Drawings prior to subsequent backfilling operations.

G. Place aggregate in maximum 4 inch lifts, consolidating each lift.

H. Refer to Section 31 2323 for compaction requirements. Do not displace or damage pipe when compacting.

3.04 PROTECTION

A. Protect pipe and aggregate cover from damage or displacement until backfilling operation begins.

END OF SECTION

SECTION 33 4211
STORMWATER GRAVITY PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Storm drainage piping, fittings, and accessories.

B. Stormwater pipe accessories.

1.02 SUSTAINABILITY REQUIREMENTS

A. See Section 01 81 13 B3 Sustainability Design Requirements.

1.03 REFERENCE STANDARDS

A. AASHTO M 252 - Standard Specification for Corrugated Polyethylene Drainage Pipe; 2023.

B. AASHTO M 294 - Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter; 2021.

C. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe; 2022a.

D. ASTM C76M - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric); 2022a.

E. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets; 2021.

F. ASTM C443M - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric); 2021.

G. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015.

H. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2020.

I. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2015.

J. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials; 2021.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating pipe, pipe accessories.

C. Project Record Documents:

PART 2 PRODUCTS

2.01 SEWER PIPE MATERIALS

A. All materials shall conform to the Minneosta Plumbing Code.

B. Pipe size and type shall be as specified on plans.

C. Concrete Pipe: Reinforced, ASTM C76 (ASTM C76M), Class II with Wall type A; mesh reinforcement; bell and spigot end joints.

D. Reinforced Concrete Pipe Joint Device: ASTM C443 (ASTM C443M) rubber compression gasket joint.

E. Plastic Pipe: ASTM D3034, Type PSM, Poly(Vinyl Chloride) (PVC) material; inside nominal diameter as indicated on the plans, bell and spigot style push-on with elastomeric gasketed joints which are bonded to the inner wall of the gasket recess of the bell socket.

F. Plastic Pipe: ASTM D1785, Schedule 40, Poly Vinyl Chloride (PVC) material; inside nominal diameter as indicated on the plans, bell and spigot style solvent sealed joint end.

G. Corrugated High Density Polyethylene Pipe (HDPE) Sewer (Solid or Perforated)
   1. Provide dual-wall corrugated polyethylene pipe and fittings in accordance with the Plans, MnDOT 2503, AASHTO M 294 or AASHTO M 252, Design Section 18 of the AASHTO Standard Specifications for Highway Bridges, ASTM F714, and the following:
      a. Corrugated polyethylene pipe and fittings shall be manufactured from high density polyethylene (HDPE) virgin compounds.
      b. Clean re-worked HDPE material from the manufacturer's own production may be used by the manufacturer of HDPE pipe, provided that the pipe and fittings produced meet all requirements of these Special Provisions and in AASHTO M 294 or AASHTO M 252 and Design Section 18 of the AASHTO Standard Specifications for Highway Bridges.
      c. The polyethylene compounds shall conform to the requirements of ASTM D3350 Cell Class 335420C.
      d. Wall thickness shall be the thickness of the inner liner measured between corrugation valleys of the outer rib wall. The wall thickness shall equal or exceed the minimum wall thickness values in Table 1.
      e. The pipe stiffness shall be determined in accordance with AASHTO M 294 at 5 percent deflection. The average pipe stiffness shall equal or exceed the minimum pipe stiffness value for each size of pipe listed in Table 1.
      f. All perforated corrugated polyethylene pipe shall conform to AASHTO Class II Perforation. Provide ADS N-12, slotted perforations with CD configuration, or approved equivalent.
      g. Table 1 - Dual Wall Corrugated High Density Polyethylene Pipe (HDPE) - Nominal Diameter (Inches):
         1) 12":
            (a) Min. I.D.: 11.8
            (b) Max. O.D.: 14.7
            (c) Min. Wall Area (in../sq. ft.): 1.50
            (d) Min. C (in.): 0.35
            (e) Min. I (in. cu. in.): 024
            (f) Min. Pipe Stiffness (psi): 46
            (g) Min. Wall Thickness (in.): .035
         2) 15":
            (a) Min. I.D.: 14.8
            (b) Max. O.D.: 18.0
            (c) Min. Wall Area (in../sq. ft.): 1.91
            (d) Min. C (in.): 0.45
            (e) Min. I (in. cu. in.): .053
            (f) Min. Pipe Stiffness (psi): 42
            (g) Min. Wall Thickness (in.): .035
         3) 18":
            (a) Min. I.D.: 17.7
            (b) Max. O.D.: 21.5
            (c) Min. Wall Area (in./sq. ft.): 2.34
            (d) Min. C (in.): 0.50
            (e) Min. I (in. cu. in.): .062
            (f) Min. Pipe Stiffness (psi): 40
            (g) Min. Wall Thickness (in.): .050
   2. Couplings

a. Connections may be made with bell and spigot joints or clamp-on bands. If bell and spigot joints are utilized, a gasket shall be incorporated to make the joint water-tight. If clamp-on bands are utilized, a closed cell expanded rubber or neoprene gasket shall be provided on one corrugation on each side of the joint. The band shall be securely lapped and fastened to prevent pipe movement and provide a water-tight joint. Only ties provided by the pipe manufacturer may be used.
b. All joints shall be water tight type joints, not soil tight.

H. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

2.02 PIPE ACCESSORIES

A. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

B. Trace Wire: Magnetic detectable conductor, clear plastic covering, imprinted with "Stormwater Service" in large letters.

2.03 BEDDING AND COVER MATERIALS

A. Bedding: As specified in Section 31 2316.13.

B. Cover: As specified in Section 31 2316.13.

PART 3 EXECUTION

3.01 TRENCHING

A. See Section 31 2316.13 - Trenching for additional requirements.

B. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.02 INSTALLATION - PIPE

A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.

B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
1. Plastic Pipe: Also comply with ASTM D2321.

C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.

D. Connect to utility/municipal sewer system.

E. Install continuous trace wire 6 inches above top of pipe; coordinate with Section 31 2316.13.

3.03 FIELD QUALITY CONTROL

A. Perform field inspection in accordance with Section 01 4000 - Quality Requirements.

B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

C. Storm sewers within 10 feet of the building or water main shall be tested per Section 712 and 1107 of the Minnesota Plumbing Code, current edition.

D. Deflection Testing (shall apply to HDPE sewer only)

1. Deflection testing shall be performed by the Contractor using a nine point mandrel approved by the Engineer. The diameter of the mandrel shall be as indicated in Table 1 for the minimum inside diameter of the pipe size specified. Mandrel testing shall be done no less than thirty (30) days after installation or upon completion of construction of the roadway to the grading grade, whichever occurs first. The mandrel must be pulled through the pipe by non mechanical means. Pipe through which the mandrel does not pass will be considered unacceptable. New pipe or deformed pipe which is not damaged shall be relaid. The relaid pipe shall be tested for deflection after no less than five (5) calendar days.

3.04 PROTECTION

A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION