ATTACHMENT B

This attachment is hereby made a part of the contract documents to the same extent as though it were originally included therein. This attachment shall take precedence over the original drawings and specifications where its provisions apply.

Descriptions:

Item 2.1 Updated Geotechnical Report
Refer to attached Geotechnical engineering report prepared by Intertek PSI, dated May 30, 2025. Soil data and recommendations listed should be referenced for bid preparation.

Item 2.2 Bidder Questions

Question 1: Is there a Geotechnical Report that can be shared?

R1: Refer to attached 2025 Geotechnical report by Intertek PSI.

Question 2: Please confirm the design intent for interior aluminum-framed openings, including the intended aluminum type (I or II) and the intended finish for interior aluminum framing.

R2: Interior Aluminum-framed openings should have clear anodized finish and be architectural class 1 aluminum.

Question 3: Does the project require Division 27-28 work?

R3: Please reference technology drawings and attached updated Division 27/28 specifications.

Question 4: Please post the pre-bid meeting attendees list.

R4: Refer to CoSA response.

Question 5: There are conflicting details/specifications on the required flag details and overall flagpole height, please confirm the correct dimensions.

R5: The provided American flag should be polyester and measure 5'x8'. The exposed pole height is to be 25'-0".

Question 6a: Backbone Infrastructure: Backbone fiber and copper cabling are not shown on the contract drawings. Please confirm whether backbone infrastructure will be provided by the City of San Antonio (COSA) under a separate contract, or if it is to be included in our scope of work.

R6a: CoSA will be responsible for coordination with the ISP for Phone/Internet service. The D-Mark will be inside the MDF/IT room.

Question 6b: AV specification is missing. Please also provide AV schedule and clarify intended scope.

R6b: Division 27 specifications have been issued as a part of this Addendum 02 and AV schedule has been added to Technology drawings.

Question 6c: The IDF buildout drawings depict cable tray; however, the associated note references ladder rack. Please confirm whether ladder rack is required in the IDF rooms in lieu of cable tray.

R6c: Please follow enlargement keynotes. Updated technology drawings for clarification are attached.

Question 6d: Please confirm whether COSA has an existing or designated security integrator for this project. If so, provide specifications and confirm whether our scope should include cabling only, with device installation and commissioning by others.

R6d: Security system is Contractor furnished, Contractor installed. Please refer to updated security drawings and specifications.

BEATY PALMER ARCHITECTS

KENWOOD COMMUNITY & SENIOR CENTER

ATTACHMENT B

Date of Issuance
03.10.26

Architect Project No.
24-04

Owner
City of San Antonio
100 W. Houston St., 15th floor
San Antonio, TX 78205

From Architect
Beaty Palmer Architects
110 Broadway Suite 600
San Antonio, Texas, 78206

Attachments
Geotechnical Report (Intertek PSI 2025)

Technology: T000, T101, T700, T701, T702, T703

Technology Specifications: 270000, 270500, 270526, 270528, 270537, 271100, 271323, 271500, 271600, 274000, 274100, 276000, 276200, 276400

Issued By

03.10.26

Cory W. Hawkins
Beaty Palmer Architects, Inc.

Question 7: The bid spec does not have an Audio Visual Section (27 41 00) and the drawings reference an equipment schedule that we cannot locate. Can you please clarify if AV is indeed in this spec?

R7: Division 27 specifications have been issued as a part of this Addendum 02 and AV schedule has been added to Technology drawings.

Question 8: Some equipment is either missing, rooms mislabeled, or equipment is not identified. Which locations are just Digital Signage? Please provide FPD-1 detail and Microphone paddle locations on walls. The T700 drawings do not match T100 drawings. Can you give more details please?

R8: Refer to attachments for updated drawings and specifications.

Question 9: S Missing documentation and specifications for Technology and AV. Also, what are the Security specifications? There are speaker schedules referenced but none shown.

R9: Refer to attachments for updated drawings, schedules and specifications.

Question 10: Please confirm whether Simplex would be considered an approved alternate manufacturer for the fire alarm

R10: Simplex will not be considered an approved alternate manufacturer for the fire alarm system. It is CoSA standard to avoid fire alarm systems that utilize proprietary equipment or programming.

Question 11: Is the City reissuing the VOSB tracking form?

R11: Refer to CoSA response.

Question 12: Plase confirm if sales tax should be included in base bid.

R12: Refer to CoSA response.

Question 13: Please clarify responsibility for costs associated with CPS Energy service to the building. CPS Energy does not provide final design or pricing for conductors and related services until after award. Given that this pricing cannot be confirmed at bid time, please confirm if this scope is to be excluded from the Contractor's proposal and handled directly by the Owner.

R13: CPS Energy impact fees are to be paid directly by the owner and should be excluded from Contractor proposal.

Question 14: Deductive Alternates listed in CivCast Bid Form does not follow Alternates per Specification Section 012300. Alternate No. 3 Mudslab and Vapor Barrier listed on CivCast is not present in Specifications. Please review and advise.

R14: Please refer to CoSA response for how to document additional alternate pricing.

For deductive alternate to omit the mudslab and vapor barrier, the replacement scope is as follows:

-No vapor barrier required.
-Compacted subgrade sloped to drain.
-Installation of subgrade drain piping as indicated on construction documents.
-Drain model to be equivalent to specified domed metal grate.

Question 15: Unit Prices per Specification Section 012200 are not present in the current CivCast Bid Form. Please advise if Unit Price Form will be provided or if General Contractor is to provide this item as a separate attachment

R15: Please include unit pricing as a separate attachment.

Question 16: Specifications and Plan Sheets A7.5-A7.6 do not indicate if concealed Gypsum Board layers require fire tape between layers. Please confirm if this is necessary.

R16: Double layer gypsum board is provided for installation of decorative reveals and does not require fire tape between layers.

Question 17: Please provide AV specifications

R17: Division 27 specifications have been issued as a part of this Addendum 02.

Question 18: Please provide kitchen equipment schedule listing the kitchen equipment items

R18: Please refer to provided equipment schedule on sheet A1.4.

Question 19: Plans call to remove, store, and re-use 'No Parking' sign at the SE driveway approach. The referred signage is faded with lettering not visible for re-use. Please confirm the desire to save or dispose of the referred signage.

R19: Existing signage at the SE driveway is to be removed and disposed of. Existing signage along the ROW near new sidewalk is to be removed, stored, and re-installed.

Question 20: Along Dora St., there is a Power or ATT line down. Confirm whether this line is to be repaired and utilized to provide power/tele to new building, removed, or be addressed by others?

R20: The wire in question is extra communications wiring to be addressed by the managing communications company. Power is being brought to the building from a different riser pole on the rear East side.

Question 21: There are below grade perimeter beam walls and retainer blocks, but no waterproofing detailed. Typically, these areas are covered with some sort of waterproofing. Please advise.

R21: Waterproofing is not required at the below grade perimeter beam walls. The underfloor mudslab is sloped to drain, refer to details for water management intent.

Question 22: Regarding z-furring behind metal panels: Is there a specific furring product intended to be used or just a metal z-furring as outlined under 2.5.A of spec section 074113.16? What will the on-center spacing be (16" or 24" O.C. typical)? And will the z-furring be installed vertically or horizontally?

R22: Product can be custom fabricated or premade at contractor's option subject to requirements outlined in specifications (18 gauge / 0.0478" thickness). Provided product to be installed laying horizontally at 24" on center minimum pending confirmation by approved metal panel manufacturer.

Question 23a: There are below grade perimeter beam walls and retainer blocks, but no waterproofing detailed. Typically, these areas are covered with some sort of waterproofing. Please advise.

R23a: Waterproofing is not required at the below grade perimeter beam walls. The underfloor mudslab is sloped to drain, refer to details for water management intent.

Question 23b: Is there a specific furring product intended to be used or just a metal z-furring as outlined under 2.5.A of spec section 074113.16? What will the on-center spacing be (16" or 24" O.C. typical)? And will the z-furring be installed vertically or horizontally?

R23b: Product can be custom fabricated or premade at contractor's option subject to requirements outlined in specifications (18 gauge / 0.0478" thickness). Provided product to be installed laying horizontally

at 24" on center minimum pending confirmation by approved metal panel manufacturer.

Question 23c: Include the fluid-applied air barrier with transition membrane flashing scope of work?

R23c: Yes. All detailed waterproofing is required to be included.

Question 23d: All thru-wall flashings are detailed to be installed over the insulation board, but flashing needs to be in conjunction with the air barrier for proper water/moisture passage.
Base of wall is detailed to have both self-adhered, stainless-steel faced flashing and a stainless-steel thru-wall flashing are these both required or could a single product and drip be substituted?

R23d: Insulation includes taped seams per details to work in conjunction with thru-wall flashing. Both self-adhered & thru-wall flashing are included at the base of the wall as 'double lines of defense' for water penetration.

Question 23e: Provide exterior building sealants, interior CMU latex sealants, and site sealants?

R23e: All listed sealants are required and to be installed by single source contractor.

Question 24: All thru-wall flashings are detailed to be installed over the insulation board, but flashing needs to be in conjunction with the air barrier for proper water/moisture passage.
Base of wall is detailed to have both self-adhered, stainless-steel faced flashing and a stainless-steel thru-wall flashing are these both required or could a single product and drip be substituted?

R24: Insulation includes taped seams per details to work in conjunction with thru-wall flashing. Both self-adhered & thru-wall flashing are included at the base of the wall as 'double lines of defense' for water penetration.

Question 25: Please clarify the exact limits/locations included in Deductive Alternate 'Mud Slab and Vapor Barrier'. If the deduct alternate is accepted, please confirm the required replacement scope (subgrade prep/base course requirements and whether vapor barrier is omitted entirely or replaced with alternate material/protection).

R25: For deductive alternate to omit the mudslab and vapor barrier, the replacement scope is as follows:

-No vapor barrier required.
-Compacted subgrade sloped to drain.
-Installation of drain piping as indicated on construction documents.
-Drain model to be equivalent to specified domed metal grate.

Question 26: Clarify on site personnel requirements.

R26: Refer to CoSA response.

Question 27: Please clarify whether the new Fire Alarm and BAS systems for this project are intended to operate as standalone systems or if they are required to integrate with the Owner's existing campus systems. If integration is required, please confirm:

- The existing campus Fire Alarm and BAS manufacturers and system types.
- Whether the Contractor is responsible for furnishing and installing all network cabling/fiber between this building and the existing systems.
- Who is responsible for system programming, software licensing, and front-end integration.

- Whether work must be performed by the Owner's existing service vendor and, if so, whether those costs will be carried in an Owner allowance.

  R27: The new fire alarm system for this project is intended to be a new complete standalone system and not integrated into a larger campus system. The design does not include a BAS and purposefully does not include a BAS specification. Controls as described in the drawings (especially M1.1 keynotes and M7.1) are required but are to be standalone.

Question 28: Flat panel display and projection screen sizes are missing.

R28: Please refer to attached Technology schedule.

Question 29: On page A8.6 section 7, the rail calls for 1inx2in solid bar with 2inx2in solid bar post. Please confirm is this is to be fabricated out of solid square bar or tubing.

R29: Please provide a solid bar as noted on the drawings.

Question 30a: Please clarify in detail the required hardware for the three 6' opening Double Swing Gates associated with the welded wire fences. The elevation depictions on Det.2/A6.1 and Det.15/A2.3 imply a keyed lockbox, but those gate openings are not included in the Door or Hardware Sets.

R30a: The double swing gates are to be equipped with a padlock hasp. Keyed lever sets are not required.

Question 30b: The Double Swing Gates associated with the Mechanical Yard are depicted as being 6' 6" tall, which is an extra cost feature. Please confirm the height requirement.

R30b: A standard 6'-0" high double swing gate is acceptable.

Question 31: Please clarify the following regarding the project specifications. The specifications reference a Schedule of Allowances; however, it is unclear how these amounts should be addressed in the bid. Should the listed allowances be included in the base bid amount, or will the bid form be revised to allow the allowances to be entered / acknowledged separately? Please advise on the correct approach so the bid can be prepared accordingly.

R31: Refer to CoSA response.

Question 32: The project plans reference a total of seven (7) alternates; however, the bid form lists only five (5) alternates. Please clarify the correct number of alternates that should be included for this project.

R32: Refer to CoSA response.

Question 33: Please provide specification for Glass Encased Bulletin Board that is keynoted 25 on sheet A3.1

R33: Ghent 2-door enclosed fabric bulletin boards with standard locking satin frames measuring 4' x 5'. Equal product substitution may be submitted for owner / architect approval. Fabric color selection from manufacturer options.

Question 34: Please provide specification for bike rack keynotes 10 on sheet A2.3.

R34: Refer to detail 5 on sheet A2.3. Provide heavy-duty, galvanized, in-ground mount wave rack by Dero or approved equivalent.

Question 35: Does spec section 08 83 00 Mirrors include the mirrors in the Toilet Accessories schedule? Or is it in regards to mirrors elsewhere in the project?

R35: Related specification section has been removed from the project. Mirrors listed in the toilet accessories schedule are by schedule only.

Question 36: Please provide specifications for the privacy curtain and curtain track as keynoted 5 on sheet A7.2.

R36: Construction specialties traditional 74" high curtain with a 69" panel width and 18" mesh height. (PS.CCTC.1023) Narrow line anodized aluminum track, ceiling suspended mounted. (PS.CCNT.1023) Equivalent product may be submitted for approval.

Question 37: Equipment Schedule on sheet A1.4 states to see electrical/tech sheets for comments on TV and Projector. But there is nothing in those sheets regarding those items. Please clarify what TV and Projector that is wanted.

R37: Refer to attachments for updated drawings, schedules and specifications.

Question 38: On the aluminum frames for the wood doors (Type F frames), are these to be storefront frames? The only specifications available are for the aluminum storefront frames; nothing for frames that are being used with wood doors. Please clarify.

R38: Refer to door schedule for related door frame type. Frame type 'F0' is an aluminum metal frame to utilize Trifab 451.

Question 39: Originally distributed Construction Documents contain a range of dates and references to Addendum 1. Please confirm that we are to consider incorporated documents labeled as "Addendum #1" as part of the Original Set.

R39: Yes, incorporated documents labeled as 'addendum 1' are to be included as part of the original set.

Question 40: Are there any mirrors to be provided and installed in Activity Room 127? Please advise.

R40: No mirrors are to be provided and installed in Activity Room. Related specification section has been removed from the project.

Question 41: Structural Sheet S3.2 references recommendations per Geotechnical Report by Professional Services Industries, Inc. (PSI Project No. 0312-3570) dated May 30,2025. Geotechnical Report provided in Attachment A part of Addendum 1 is by Arias Associates dated July 20,2012. Please review and provide updated report by PSI.

R41: Refer to attached 2025 Geotechnical report by Intertek PSI.

Question 42: Specification Section 081416 – Flush Wood Doors, Section Part 1-General, Subsection 1.5 Quality Assurance, item A, is calling for the manufacturer to be certified for chain of custody by an FSC-accredited certification body. Please review and advise if this is a mandatory requirement for this project.

R42: Yes, please ensure the door manufacturer is certified for chain of custody by an FSC-accredited certification body.

Question 43: On page A8.6 section 7. On the rail it calls for 1inx2in solid bar with 2inx2in solid bar post. Is this to be fabricated out of solid square bar or tubing?

R43: Please provide a solid bar as noted on the drawings..

Question 44: Please clarify the staffing requirements identified in the IFB regarding the Estimator and Scheduler positions. Based on our review of the solicitation documents, these roles are listed among the project personnel requirements. Please confirm whether the duties associated with the Estimator and Scheduler positions may be performed by the Project Manager, rather than requiring separate dedicated personnel for each role.

R44: Refer to CoSA response.

Question 45: The contract documents indicate spaces for AV equipment and infrastructure; however, a detailed Audio Visual (AV) system specification or equipment schedule does not appear to be included in the bid documents.

- Please confirm whether the Contractor is responsible for furnishing and installing the AV system as part of this project. If AV equipment and systems are to be included in the Contractor's scope, please provide the applicable specifications, drawings, and system requirements necessary for bidding.
- If the AV system is to be furnished and/or installed by the Owner or a separate vendor, please confirm that the Contractor's responsibility is limited to providing required infrastructure (power, conduit, and pathways) as indicated in the documents.

R45: Refer to attachments for updated drawings, schedules and specifications.

PMY.

03-05-2026

Addendum 02 Attachment B

Project Name: Kenwood Senior & Community Center

Architect: Beaty Palmer Architects

Client: City of San Antonio

NOTICE TO PROPOSERS:

A. This Addendum shall be considered part of the contract documents for the above-mentioned project as though it had been issued at the same time and incorporated integrally therewith. Where provisions of the following supplementary data differ from those of the original contract documents, this Addendum shall govern and take precedence.
B. Proposers are hereby notified that they shall make any necessary adjustments in their estimate on account of this Addendum. It will be construed that each Proposer's proposal is submitted with full knowledge of all modifications and supplemental data specified therein. Acknowledge receipt of this addendum in the space provided on the proposal form. Failure to do so may subject Proposer to disqualification.

REFERENCE IS MADE TO THE DRAWINGS AND THE PROJECT MANUAL AS NOTED:

DRAWINGS:

No. 1: Sheet #T101: Changes to device inclusions/locations:

- Speaker changes throughout:
  - S1 PA speakers removed throughout.
  - S2 speakers relabeled as S1.
  - S4 speakers relabeled as S2.
  - Note: S3 speaker was previously unused.
- Room 100
  - FP3 display removed. Rough-in to be provided. See keynote 01.
- Room 115
  - FP4/AV2 location added.
- Room 125
  - CP1 control panel added by FP1.
  - AV2 input replaced by AV1.
  - (1) S4 speaker replaced by (2) S2 speakers in new locations.
- Room 126
  - S1 speakers removed.
  - Locations of S4 speakers modified.

    - AV1 inputs added at FP1 locations.
    - AV1 removed from plan west wall.
    - CP1 relocated to plan east wall.
- Room 127:
    - Single lens security camera relocated from ceiling to plan west wall.

No. 2: Sheet #T7.00– TECHNOLOGY DETAILS added to drawings.

Inclusions:

- Displays Schedule
- Loudspeaker Schedule
- Projection Schedule

No. 3: Sheet #7.01 – Unused Technology details removed from sheet.

No. 4: Sheet #7.02 – AV Schematic for Computer Classroom 125 added.

No. 5: Sheet #7.03 – AV schematic details corrected throughout.

PROJECT MANUAL:

No. 1: Specification sections added as follows:

- 27 40 00
- 27 41 00

Attachment:

ADDENDUM 02 - REVISED DRAWINGS

ADDENDUM 02 – REVISED SPECIFICATION

AUDIO/VISUAL MULTIMEDIA LEGEND

SYMBOL	DESCRIPTION
A## V##	WALL AV ROUGH-IN DETAIL
A## V##	CEILING AV ROUGH-IN DETAIL
A## V##	FLOOR AV ROUGH-IN DETAIL
IWB IWB	INTERACTIVE WHITE BOARD - WALL - CEILING
PJ PJ	MULTIMEDIA PROJECTOR
FPR FPR	MULTIMEDIA FLAT PANEL DISPLAY
S S	LOUDSPEAKER, WALL MOUNTED AND CEILING MOUNTED RESPECTIVELY - # INDICATES TYPE
CP#	CONTROL PANEL
TP#	TOUCH PANEL
M	MICROPHONE, CEILING MOUNTED - # INDICATES TYPE
VC	VOLUME CONTROL
WB	WALL BOX ENCLOSURE
D1 A1	D1 = DIGITAL SINGLE SIDED CLOCK / A1 = ANALOG SINGLE SIDED CLOCK
D2 A2	D2 = DIGITAL DOUBLE SIDED CLOCK / A2 = ANALOG DOUBLE SIDED CLOCK
ENC	CEILING AV ENCLOSURE
C C	PRESENTATION CAMERA - CEILING - WALL MOUNTED

PREMISE SECURITY LEGEND

SYMBOL	DESCRIPTION
CR	CARD READER
CR M	CARD READER MULLION
KP	INTRUSION DETECTION KEYPAD
IC	INTERCOM (1 DATA CABLE)
IC MS	INTERCOM MASTER STATION (1 DATA CABLE)
PB	PANIC/DURESS BUTTON
LD	LOCK DOWN BUTTON
MD	MOTION DETECTOR
GB	ACCOUSTICAL GLASS BREAK SENSOR
BM	BIOMETRIC READER
RX	REQUEST TO EXIT - SURFACE PIR
KS	KEY SWITCH
LA	LOCAL ALARM SOUNDER
RG	RED/GREEN INDICATOR LIGHT
DB	DOORBELL
DH	MAGNETIC DOOR HOLD
DR	DOOR RELEASE
RX	REQUEST TO EXIT - INTEGRAL TO DOOR HARDWARE
DC	DOOR CONTACT / MONITOR
ES EL EH	ELECTRIFIED STRIKE - ELECTRIFIED LATCH - ELECTRIFIED HARDWARE (REFER TO SCHEDULES)
C C	STANDARD IP SURVEILLANCE CAMERA, (1) CABLE
C C	180° MULTI-IMAGER IP SURVEILLANCE CAMERA, (1) CABLE
C	360° MULTI-IMAGER IP SURVEILLANCE CAMERA, (1) CABLE
C	360° FISHEYE LENS CAMERA
IR	IR ILLUMINATOR

STRUCTURED CABLING LEGEND

SYMBOL	DESCRIPTION
#	TELECOMMUNICATIONS OUTLET, # =NUMBER OF DATA CABLE(S)/JACK(S)
#/#	TELECOMMUNICATIONS OUTLET, #/# = NUMBER OF VOICE CABLE(S)/JACK(S) AND NUMBER OF DATA CABLE(S)/JACK(S)
#	TELECOMMUNICATIONS OUTLET, # =NUMBER OF VOICE/DATA CABLE(S)/JACK(S), SURFACE MOUNT
#/#	TELECOMMUNICATIONS OUTLET, #/# = NUMBER OF VOICE CABLE(S)/JACK(S) AND NUMBER OF DATA CABLE(S)/JACK(S), SURFACE MOUNT
W	WALL MOUNT PHONE (1 CABLE/JACK)
W	WALL MOUNT PHONE, SURFACE MOUNT (1 CABLE/JACK)
#	FLOOR MOUNTED OUTLET, # =NUMBER OF VOICE/DATA CABLE(S)/JACK(S) (FLOOR BOX BY E.C.)
#/#	FLOOR MOUNTED OUTLET, #/# = NUMBER OF VOICE CABLE(S)/JACK(S) AND NUMBER OF DATA CABLE(S)/JACK(S) (FLOOR BOX BY E.C.)
#	CEILING MOUNTED DATA OUTLET, # =NUMBER OF VOICE/DATA CABLE(S)/JACK(S)
AP#	CEILING MOUNTED OUTLET FOR WIRELESS ACCESS POINT #=NUMBER OF CABLE(S)/JACK(S)
AP#	WALL MOUNTED OUTLET FOR WIRELESS ACCESS POINT #=NUMBER OF CABLE(S)/JACK(S)
	CABLING SLEEVE(S)
	TYPICAL LADDER RACK
	TYPICAL CABLE TRAY, BASKET STYLE

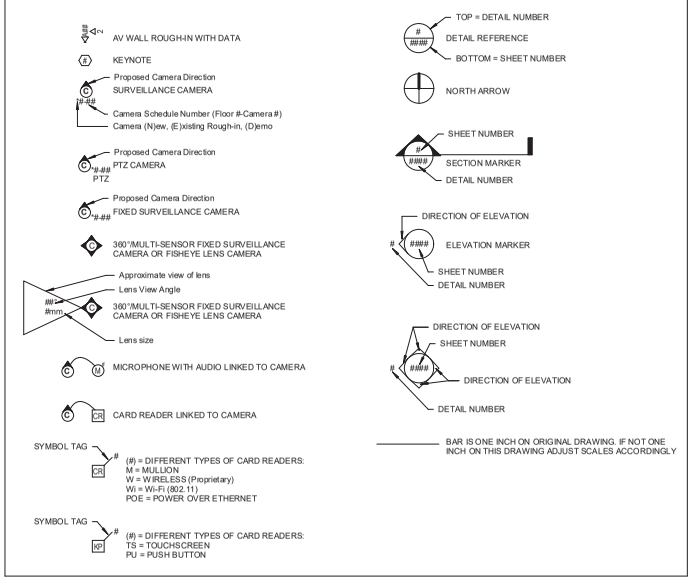
GENERAL ANNOTATION LEGEND

SYMBOL	DESCRIPTION
MER	MAIN EQUIPMENT ROOM
TR	TELECOMMUNICATION ROOM
MDF	MAIN DISTRIBUTION FRAME
IDF	INTERMEDIATE DISTRIBUTION FRAME
ETR	EXISTING TO REMAIN
PBO	PROVIDED BY OTHERS
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AC	ABOVE COUNTER
EC	ELECTRICAL CONTRACTOR
PSC	PREMISE SECURITY CONTRACTOR
SCC	STRUCTURAL CABLING CONTRACTOR
AVC	AV/MULTIMEDIA CONTRACTOR
UNO	UNLESS NOTED OTHERWISE
ACS	ACCESS CONTROL SYSTEM
VSS	VIDEO SURVEILLANCE SYSTEM

TECHNOLOGY SHEET INDEX

TECHNOLOGY SYMBOLS LEGEND

NOT ALL SYMBOLS ARE USED



TECHNOLOGY - GENERAL NOTES

1. EACH KEYNOTE MAY NOT BE UTILIZED ON EVERY SHEET.
2. ALL CONDUIT MEASUREMENTS REFER TO STANDARD CONDUIT TRADE SIZES.
3. ALL CABLES SHALL BE CONCEALED.
4. EACH CONTRACTOR SHALL PROVIDE AND INSTALL ALL NECESSARY SLEEVES, WHETHER OR NOT SPECIFICALLY NOTED ON PROJECT DRAWINGS. ALL SLEEVES SHALL BE 2" UNLESS NOTED OTHERWISE ON THE DRAWINGS. CABLE FILL PERCENTAGE SHALL COMPLY WITH NEC.
5. DEVICE LOCATIONS ARE APPROXIMATE. CONTRACTOR SHALL REVIEW CONDITIONS AND COORDINATE WITH OTHER TRADES AS NECESSARY FOR EXACT PLACEMENT.

TECHNOLOGY - INDEX SHEET

consultant

revisions

1	ADDENDUM 01	02/06/2026
2	ADDENDUM 02	03/05/2026

100% CONSTRUCTION DOCUMENTS

KENWOOD SENIOR & COMMUNITY CENTER

305 DORA STREET
SAN ANTONIO, TEXAS 78212
CITY OF SAN ANTONIO

project number
24-04
date
09-16-25

Beaty Palmer Architects, Inc.
110 Broadway, Suite 600
San Antonio, Texas 78205
Voice 210.212.8022
Fax 210.212.8018
www.beatypalmer.com

sheet number

T000

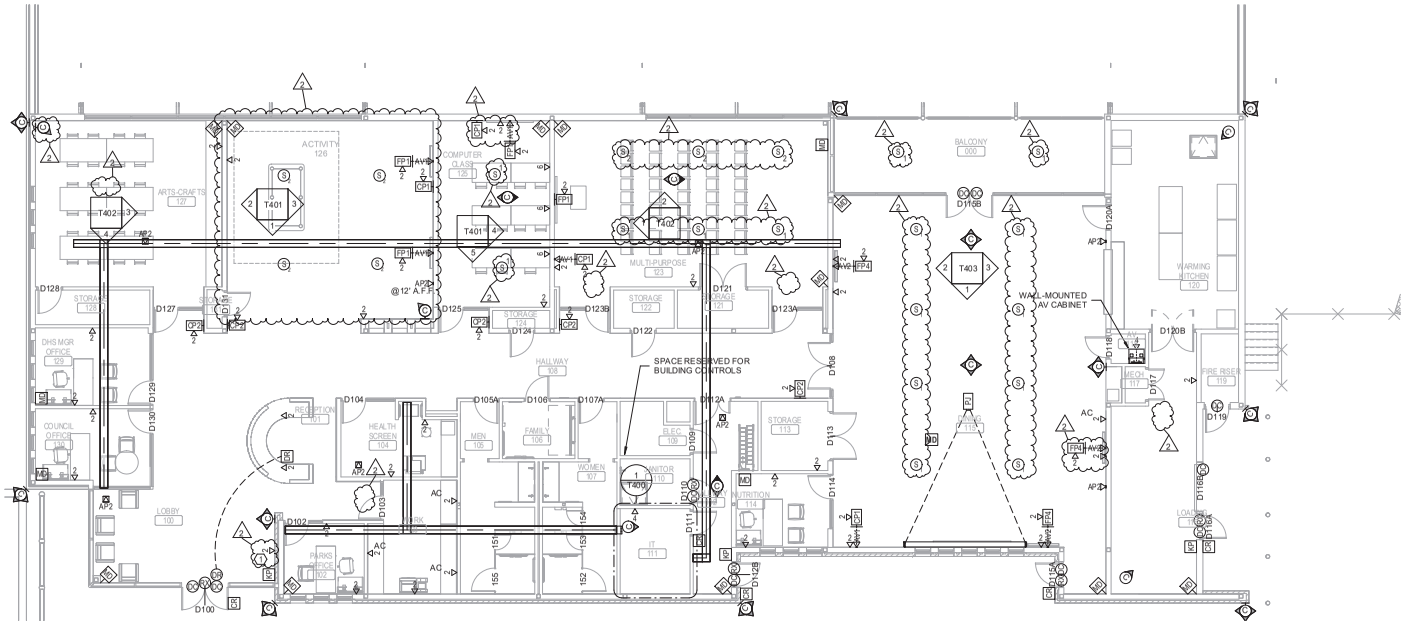
BEATY PALMER ARCHITECTS

TECHNOLOGY - FLOOR PLAN - GENERAL NOTES

1. Equipment not related to the support of the MDF/Telecommunications room (E.G. Piping, Ductwork, Pneumatic Tubing) shall not be installed in, pass through, or enter the MDF/Telecommunications room.
2. All walls shall be covered with 4-feet x 8-feet x ¾-inch AC Grade Void Free Fire- R e t a r d a n t Plywood, aligned vertically starting at 12 inches above the finished floor.
3. The plywood shall be installed with the "A" grade side exposed and the "C" grade side against the building or structure. The plywood shall be painted with two coats of fire-retardant paint and one stamp from each sheet shall be masked during the painting and uncovered after the paint has dried so the fire rated plywood stamps are visible for inspection.
4. Vertical section of ladder rack shall be attached to the wallboard to manage backbone cables, or cables as they transition from the entrance conduits or other building in a campus environment to overhead ladder rack.
5. Electrical service outlets shall be labeled with the associated panel and circuit information. Power shall be in two categories: dedicated and convenience.
6. Dedicated (2) 208 VAC J-boxes shall be mounted to a uni-strut above the equipment cabinets or relay racks at 12" above the ladder rack and shall be provided with a 7-foot "SO Type" cord with a female NEMA L6-20R core cap on the end.
7. (2) 120 VAC J-box shall be mounted to a uni-strut above the equipment cabinets or relay racks at 12" above the ladder rack and shall be provided with a 7-foot "SO Type" cord with a female NEMA 5-20R core cap on the end.
8. The originating electrical panel shall be properly sized for the loads calculated and shall be in the nearest Electrical Room.
9. Additional power circuits to be allocated to security panels, paging systems, A/V racks, CATV, and service provider equipment shall be considered and coordinated at the time of building design.
10. Convenience
    The MDF/IDF shall be equipped with 120-volt 20 Amp duplex NEMA 5-20R receptacles, with maximum (3) receptacles on each circuit. The originating electrical panel shall be equipped with a 20 Amp breaker per circuit.
11. A duplex receptacle shall be spaced at least 1 foot from an adjacent wall and every 6 feet thereafter. A minimum of (1) duplex receptacle shall be placed in each wall and be flush mounted to the finished wall surface at 18 inches above finished floor.

TECHNOLOGY - KEYNOTES

1. PROVIDE EC WITH CHIEF PAC BACKBOX AND ROUGH-IN TYPICAL OF FP3. MOUNT, DISPLAY, AND SIGNAGE PLAYER TO BE OFOI AT A LATER TIME.



1 FINISH FLOOR - CEILING PLAN
SCALE: 1/8" = 1'-0"

BICSI REGISTERED COMMUNICATIONS DISTRIBUTION DESIGNER
Brian C Porter
BICSI ID # 256657
EXPIRES 12-31-27
RCDD

TECHNOLOGY - LEVEL ONE

consultant

revisions

1	ADDENDUM 01	02/06/2026
2	ADDENDUM 02	03/05/2026

100% CONSTRUCTION DOCUMENTS

KENWOOD SENIOR & COMMUNITY CENTER

305 DORA STREET
SAN ANTONIO, TEXAS 78212
CITY OF SAN ANTONIO

project number
24-04
date
09-16-25

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sheet number
T101

BEATY PALMER ARCHITECTS

SYMBOL	PURPOSE/LOCATION	MANUFACTURER/MODEL	DIAGONAL SIZE	MOUNT	BACKBOX	BOX HEIGHT AT CENTER OF BOX
FP1	MEETING ROOM DISPLAYS	SAMSUNG QM85R	85"	CHIEF LTM1U	CHIEF PAC526FCW	APPROX 72" AFF
FP2	RESERVED					
FP3	DIGITAL SIGNAGE/LOBBY	SAMSUNG QM55R	55"	CHIEF MTM1U	CHIEF PAC526FCW	APPROX 50" AFF
FP4	AUXILIARY DISPLAYS/DINING ROOM	SAMSUNG QM55R	55"	CHIEF LTM1U	CHIEF PAC526FCW	APPROX 65" AFF
GENERAL NOTES: ALL DISPLAY HEIGHTS TO BE CONFIRMED WITH ARCHITECT AND OWNER.						

1 DISPLAY SCHEDULE
SCALE: NTS

	ROOM	PROJECTION SCREEN (BY DIVISION 27 41 00 AV CONTRACTOR)				PROJECTOR (BY DIVISION 27 41 00 AV CONTRACTOR U.N.O.)				
SYMBOL	NAME	MODEL	SIZE	SCREEN SURFACE	COMMENTS	MODEL	LUMENS	LENS*	MOUNT	DISTANCE (SCREEN TO LENS)*
PJ	DINING 115	DRAPER ACCESS V 140042	198"	DRAPER XT1000VB		EPSON EB-PU2116W	16000	ELPLW06	CHIEF VCMUW	APPROX 17' 9"
GENERAL NOTES: FIELD VERIFY THROW DISTANCE AND SCREEN DROP IN ALL LOCATIONS.										

2 PROJECTION SCHEDULE
SCALE: NTS

		PRODUCT			CONNECTED TO...		DIVISION	
NUMBER	TYPE/LOCATION	MANUFACTURER	MODEL	DESCRIPTION	PAGING	PROGRAM/LOCAL	PROVIDED BY	COMMENTS
S1	PROGRAM/MULTIPURPOSE ROOM	ATLAS IED	FC-8D	IP 8" CEILING MOUNT LOUDSPEAKER		X	27 41 00	SUPPORT FROM GRID AND STRUCTURE ABOVE USING MANUFACTUER APPROVED HARDWARE, COORDINATE COLOR WITH ARCHITECT
S2	PROGRAM/DINING & RECREATION	ATLAS IED	DA-PM8G/D	8" PENDANT LOUDSPEAKER		X	27 41 00	USE DANTE VARIANT WHERE REQUIRED, COORDINATE COLOR WITH ARCHITECT

3 LOUDSPEAKER SCHEDULE
SCALE: NTS

REGISTERED COMMUNICATIONS DISTRIBUTION DESIGNER
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BICSI ID # 256657
EXPIRES 12-31-27
RCDD

TECHNOLOGY - AV DETAILS

consultant

revisions
2 ADDENDUM 02 03/05/2026

100% CONSTRUCTION DOCUMENTS

KENWOOD SENIOR & COMMUNITY CENTER

305 DORA STREET
SAN ANTONIO, TEXAS 78212
CITY OF SAN ANTONIO

project number
24-04
date
09-16-25

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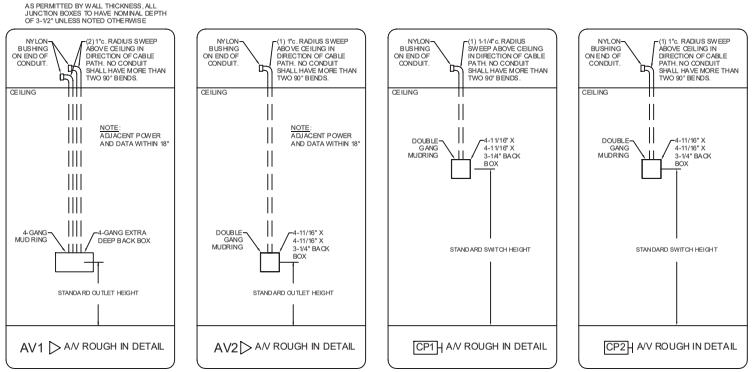
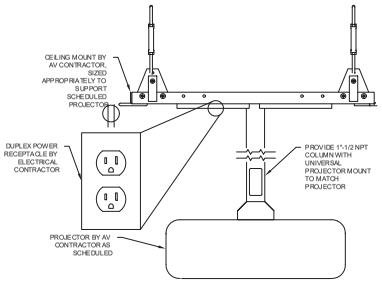
sheet number
T700

BEATY PALMER ARCHITECTS



1 A/V ROUGH-IN DETAILS
SCALE: NTS PROVIDED AND INSTALLED BY ELECTRICAL CONTRACTOR UNLESS NOTED OTHERWISE



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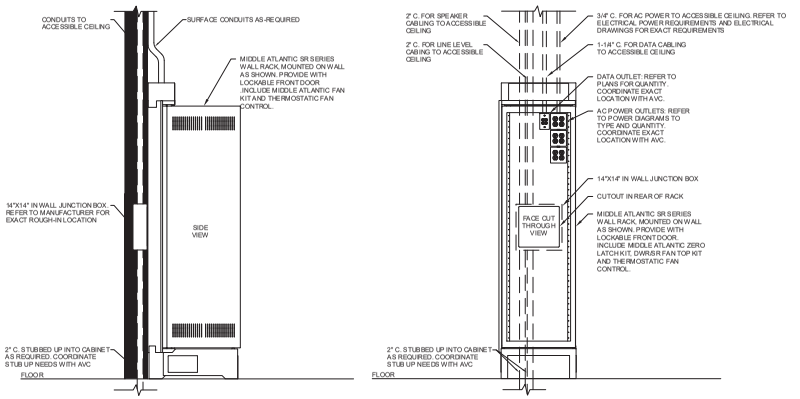
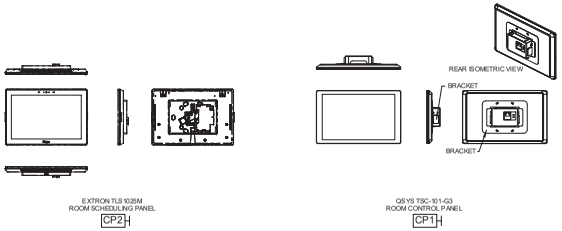
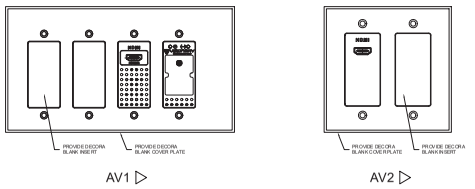
SCALE: NTS PROVIDED AND INSTALLED BY ELECTRICAL CONTRACTOR UNLESS NOTED OTHERWISE



3 TYPICAL MIDDLE ATLANTIC SR SERIES SOUND RACK ROUGH-IN DETAIL
SCALE: NTS



4 CP1 AND CP2 CONTROL PANELS
SCALE: NTS



5 AV1 AND AV2 INPUT PLATES
SCALE: NTS

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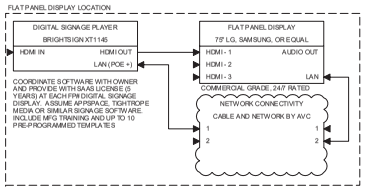
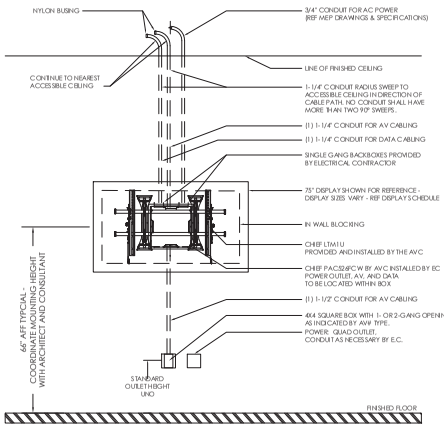
BEATY PALMER ARCHITECTS

TECHNOLOGY - AV GENERAL NOTES

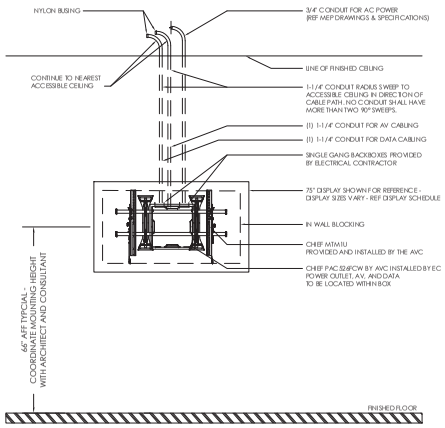
1. ADD COAX TO ALL DISPLAYS
2. PAC501 IN-WALL ACCESSORY (NO SEPARATE INTERFACE BRACKET NECESSARY FOR THE PNRIWUB, THIS COMES WITH THE PSBUB)



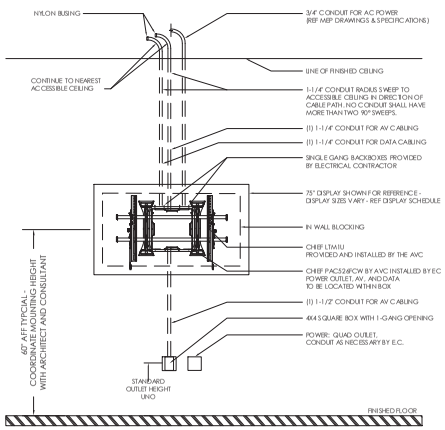
1 DIGITAL SIGNAGE DISPLAY - AV SCHEMATIC
SCALE: NTS



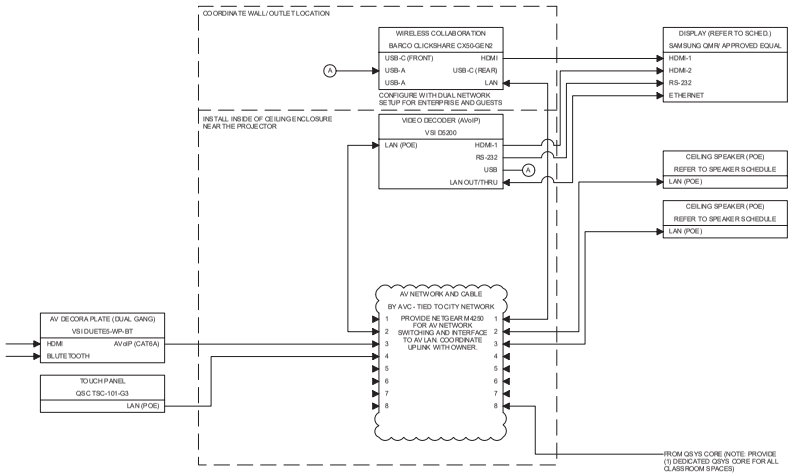
2 FP1 - WALL-MOUNTED DISPLAY ROUGH-IN DETAILS
SCALE: NTS



3 FP3 - DIGITAL SIGNAGE WALL-MOUNTED DISPLAY ROUGH-IN DETAILS
SCALE: NTS



4 FP4 - WALL-MOUNTED DISPLAY ROUGH-IN DETAILS
SCALE: NTS



5 COMPUTER CLASSROOM 125 - AV SCHEMATIC
SCALE: NTS
DECODER TO BE MOUNTED AT DISPLAY AND OUTPUT LOCATIONS

BICSI REGISTERED COMMUNICATIONS DISTRIBUTION DESIGNER
Brian C Porter
BICSI ID # 256657
EXPIRES 12-31-27
RCDD

TECHNOLOGY - AV DETAILS

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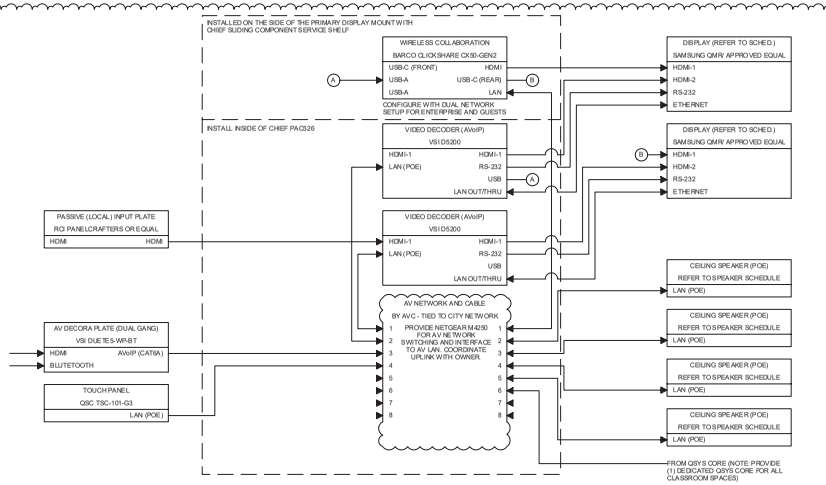
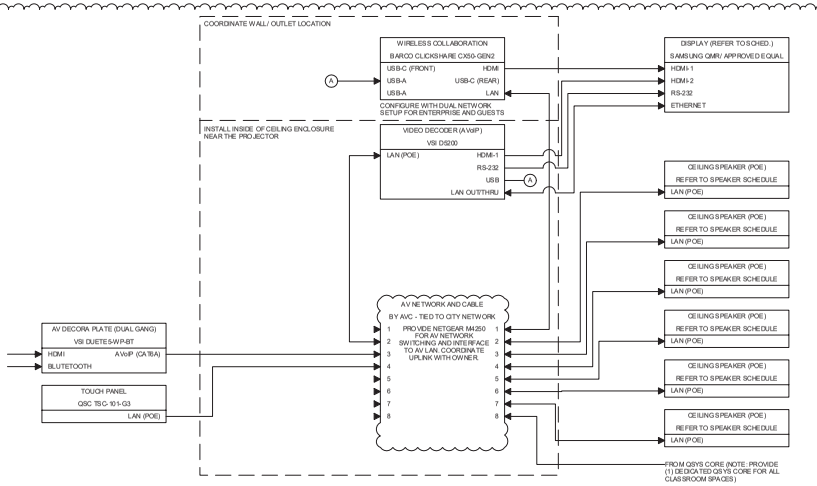
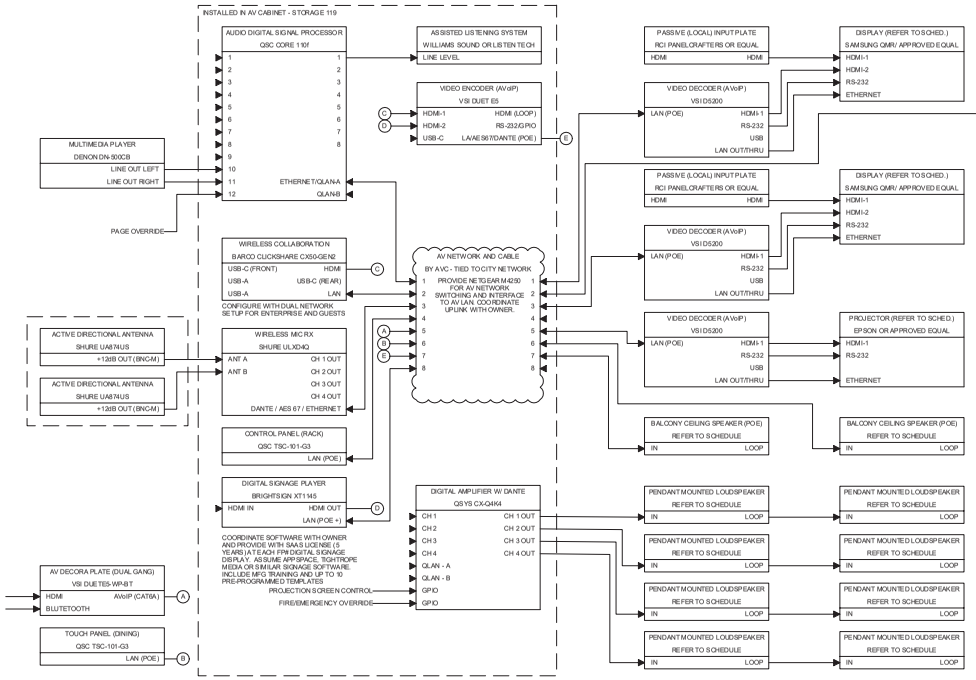


1 ACTIVITY 124 - AV SCHEMATIC
SCALE: NTS
DECODER TO BE MOUNTED AT DISPLAY AND OUTPUT LOCATIONS



2 MULTI-PURPOSE 120 - AV SCHEMATIC
SCALE: NTS
DECODER TO BE MOUNTED AT DISPLAY AND OUTPUT LOCATIONS



3 DINING 116 - AV SCHEMATIC
SCALE: NTS
DECODER TO BE MOUNTED AT DISPLAY AND OUTPUT LOCATIONS

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BICSI ID # 256657
EXPIRES 12-31-27
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TECHNOLOGY - AV DETAILS

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BEATY PALMER ARCHITECTS

ATTACHMENT B to
COSA ADDENDUM 02

PMY Table of Contents

Division 27

SECTION 270000 – GENERAL TECHNOLOGY REQUIREMENTS

PART 1 - GENERAL

1.1 PROJECT SUMMARY

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

1.2 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.

1.3 RELATED WORK

A. Section 270500 – Communications General Requirements

B. Section 270526 – Grounding and Bonding for Technology Systems

C. Section 270528 – Pathways for Technology Systems

D. Section 270537 – Firestopping for Technology Systems

E. Section 271100 – Communications Equipment Rooms

F. Section 271300 – Communications Backbone Cabling

G. Section 271500 – Communications Horizontal Cabling

H. Section 271600 – Communications Connecting Cords

I. Section 271800 – Communications Labeling and Identification

J. Section 274000 – AV/Multimedia General Requirements

K. Section 274100 – Audio Visual Systems

L. Section 275100 – Distributed Communications Systems

M. Section 276000 – Physical Security General Requirements

N. Section 276200 – Electronic Access Control System

O. Section 276400 – Video Surveillance System

P. Section 276600 – Intrusion Detection System

1.4 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.

1.5 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.

1.6 QUALIFICATIONS

A. Refer to related sections for specific requirements.

1.7 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.

1.8 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.

1.9 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 2020 (floor plans)
2. Autodesk AutoCAD MEP 2018 (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 (WebEx 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 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 2010 editable .dwg format, PDF and hard copy.
    a. Hard copy shall indicate the applicable region served by the MDF and/or IDF, all ports origination and destination, and shall be laminated and provided in MDF and each IDF for reference.
2. Operation and Maintenance Manuals – USB flash drive.
3. End User Software – USB flash drive.
4. Documentation of testing and system certification – USB flash drive with .PDF, .XLS and Linkware files.

I. Closeout Submittal Format and Distribution: Upon approval of closeout submittals and prior to final acceptance, Contractor shall provide a total of three (3) bound hard copies and one (1) digital copy with labeled dividers of all record drawings (full-size sheets) and operation and maintenance manuals, three (3) copies to Owner and one (1) digital copy to Consultant. Title on front and spine of binder 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

2.1 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.

2.2 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.

2.3 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.

2.4 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.

2.5 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.

2.6 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.

2.7 GROUNDING HARDWARE

A. Refer to Section 270526 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.

2.8 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.

2.9 LICENSES

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

2.10 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

3.1 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.

3.2 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.

3.3 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.

3.4 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.

3.5 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.

3.6 DEMOLITION

A. General: The Contractor shall be responsible for removal, collection, transportation, and recycling of all cabling and components that become abandoned as a result of this project. This shall include the delivery of cable and components to the proper recycling centers. If material is to remain on site for more than seven days after removal, Contractor shall coordinate with Owner for an acceptable storage location.

B. Verification: Contractor shall field-verify existing conditions prior to beginning demolition work. Any discrepancies shall be reported to the Consultant prior to the start of work in order to prevent disturbance of existing installation(s). Beginning work shall indicate acceptance of existing conditions. Contractor is responsible for immediately restoring any outages caused as a result of removing or damaging adjacent cabling, systems, or services.

C. Abandoned Cable: The Contractor shall remove all abandoned cable back to the headend. Where it is not possible to remove cables without damaging other cables that are to remain, such as in a shared conduit, the Contractor shall report these conditions to the Consultant for approval. These cables shall be cut at entry and exit points, leaving a minimum of 24" of cable at each end.

D. Cover Plates: The Contractor shall provide and install blank cover plates for any outlets or junction boxes that are to be left in place and from which all cables have been removed. Cover plates shall match the Project standard color and finish.

E. Equipment: The Contractor shall remove all equipment abandoned as part of this project. The Contractor shall be responsible for the delivery of this equipment to a proper recycling facility. Any electrical service connected to the equipment shall be properly decommissioned and labeled to prevent any safety issues.

F. Right of Refusal: The Owner shall have first right of refusal to any abandoned cable or equipment. The Owner has the right to remove any components from the equipment before it is recycled.

3.7 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.

3.8 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.

3.9 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.

3.10 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.

3.11 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 20ft (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.

3.12 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.

3.13 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.

3.14 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.

3.15 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.

3.16 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.

3.17 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.

3.18 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.

3.19 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

3.20 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.

3.21 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.

3.22 GROUNDING

A. Refer to Section 270526 for specific Grounding and Bonding installation requirements.

3.23 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 forth 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.

3.24 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 four (4) 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

SECTION 270500 – COMMUNICATIONS GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

A. Refer to Section 270000 for additional project scope information.

B. This section describes the products and execution requirements related to furnishing and installing Category 5e/6/6a Cabling and Termination Components and related subsystems as part of a Structured Cabling System.

C. 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.

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

E. 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.

F. 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).

G. 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.

H. 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.

1.2 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270526 – Grounding and Bonding for Technology Systems

C. Section 270528 – Pathways for Technology Systems

D. Section 270537 – Firestopping for Technology Systems

E. Section 271100 – Communications Equipment Rooms

F. Section 271300 – Communications Backbone Cabling

G. Section 271500 – Communications Horizontal Cabling

H. Section 271600 – Communications Connecting Cords

I. Section 271800 – Communications Labeling and Identification

J. Section 274000 – AV/Multimedia General Requirements

K. Section 274100 – Audio Visual Systems

L. Section 275100 – Distributed Communications Systems

M. Section 276000 – Physical Security General Requirements

N. Section 276200 – Electronic Access Control System

O. Section 276400 – Video Surveillance System

P. Section 276600 – Intrusion Detection System

1.3 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

1.4 REFERENCE STANDARDS AND CODES

A. Refer to Section 270000 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

1.5 QUALIFICATIONS

A. Refer to Section 270000 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. Contractor and staff shall possess relevant past-experience and references for a minimum of (5) projects of similar size and scope to that of the City of San Antonio.

E. Contractor shall have a local office within a 75-mile radius of the project site.

F. Certifications
1. The Contractor shall be a current authorized Panduit Certified Installer and certified by Panduit to provide and furnish a 20-year performance warranty for structured cabling and connectivity components.
2. The Contractor shall have an RCDD (Registered Communication Distribution Designer) on staff assigned to manage this Project; documented proof shall accompany the proposal response.
3. 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.
4. The Contractor's technicians shall be certified and trained in the connectivity hardware which is being installed.
5. 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.
6. Sub-contractors to the primary structured cabling contractor shall meet the same requirements for the primary structured cabling contractor as identified above.

1.6 PRE-CONSTRUCTION SUBMITTALS

A. Shop Drawings in addition to requirements in Section 270000:
1. Equipment rack elevation details
2. Elevations of telecommunication room walls with planned mounted equipment
3. Outlet faceplate details for all outlet configurations, sizes, and cable types
4. Overhead telecommunication room enlargements, providing dimensions of room and clearance for maintenance and operation

1.7 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for requirements.

1.8 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 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. As-built drawings (Printed/laminated in each TR)
      d. Detailed test results in original tester format (e.g. Fluke Linkware)
      e. Detailed cable test results in PDF format
   3. Warranty certification from connectivity manufacturer

1.9 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

2.1 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 270000.

2.2 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. Labeling for Cabling
1. 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.
a. Manufacturers:

i. Brady

ii. Panduit

E. Labeling for Innerduct or Fiber Optic Cabling
1. Labels used to identify fiber optic cable or innerduct carrying fiber optic cable shall be labeled with a durable yellow polyethylene self-laminating tag that reads "CAUTION Fiber Optic Cable" and includes blank spaces for adding (1) fiber count and (2) destination information.
a. An example of a compliant product is VIP Products' "Caution Write-On Coverall Tag."

b. Secure with Panduit Dome-Top Ty Marker

F. Labeling for Patch Panels
1. Manufacturer:
a. Panduit Component Label

b. Or approved equal

PART 3 - EXECUTION

3.1 TESTING

A. Refer to Section 270000 for additional requirements.

3.2 TRAINING

A. Refer to Section 270000 for additional requirements.

3.3 WARRANTY

A. Refer to Section 270000 for additional requirements.

B. The Contractor shall provide to the Owner a manufacturer's 20-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, parch 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 twenty (20) 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 twenty (20) 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.

3.4 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.

3.5 INSTALLATION REQUIREMENTS

A. Refer to Section 270000 for additional requirements.

3.6 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.

3.7 LABELING

A. General
   1. The Contractor shall match the Owner's standard labeling scheme. Verify Owner's final room numbering scheme prior to generating labels.
   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, TR100-1 would be the first rack in TR100.

   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 with an adhesive dot (color coordinated with cables jacket color) 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. Ground System Labeling
   a. 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.

3.8 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.

3.9 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 270526 – GROUNDING AND BONDING FOR TECHNOLOGY SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. Refer to Section 270000 for additional project scope information.

1.2 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270500 – Communications General Requirements

C. Section 270526 – Grounding and Bonding for Technology Systems

D. Section 270528 – Pathways for Technology Systems

E. Section 270537 – Firestopping for Technology Systems

F. Section 271100 – Communications Equipment Rooms

G. Section 271300 – Communications Backbone Cabling

H. Section 271500 – Communications Horizontal Cabling

I. Section 271600 – Communications Connecting Cords

J. Section 271800 – Communications Labeling and Identification

K. Section 274000 – AV/Multimedia General Requirements

L. Section 274100 – Audio Visual Systems

M. Section 275100 – Distributed Communications Systems

N. Section 276000 – Physical Security General Requirements

O. Section 276200 – Electronic Access Control System

P. Section 276400 – Video Surveillance System

Q. Section 276600 – Intrusion Detection System

1.3 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

1.4 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 270000 for additional requirements.

1.5 QUALIFICATIONS

A. Refer to Section 270000 for additional requirements.

1.6 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.7 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.8 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

PART 2 - PRODUCTS

2.1 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 270000.

2.2 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. Acceptable manufacturers:
1. Superior Essex

2.3 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
8. Manufacturer:
   a. Chatsworth 40153-020

   b. Or approved equal

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
8. Manufacturer:
   a. Chatsworth 13622-012

   b. Or approved equal

C. Cable Runway Ground Strap Kit
1. Bonding strap with minimum 8" length and green insulated stranded copper conductor with helical yellow stripe.
2. Two-hole compression lugs at both ends of strap.
3. Provide with all necessary screws, washers, nuts and other accessories.
4. Manufacturer:
   a. Chatsworth 40164-001

   b. Or approved equal

D. One Mounting Hole Ground Terminal Block
1. Zinc-plated terminal block
2. Sized to accept up to 4 AWG conductor.
3. Manufacturer:
   a. Chatsworth 08009-001

   b. Or approved equal

E. Horizontal Equipment Rack or Cabinet Busbar for Wall-mount Cabinets
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
5. Manufacturer:
   a. Chatsworth 10610-019

   b. Or approved equal

F. 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

2.4 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.

2.5 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

2.6 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

3.1 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.

3.2 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.

3.3 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. 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

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.

3.4 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.

3.5 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.

3.6 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.

3.7 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.

3.8 OPTICAL FIBER CONDUCTIVE CABLES

A. Conductive fiber-optic cables should be bonded and grounded as specified in the NEC.

3.9 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 270500 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 270000 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 270000 for additional requirements.

3.15 WARRANTY

A. Refer to Section 270000 for additional requirements.

END OF SECTION

SECTION 270528 – PATHWAYS FOR TECHNOLOGY SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. Refer to Section 270000 for additional project scope information.

1.2 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270500 – Communications General Requirements

C. Section 270526 – Grounding and Bonding for Technology Systems

D. Section 270528 – Pathways for Technology Systems

E. Section 270537 – Firestopping for Technology Systems

F. Section 271100 – Communications Equipment Rooms

G. Section 271300 – Communications Backbone Cabling

H. Section 271500 – Communications Horizontal Cabling

I. Section 271600 – Communications Connecting Cords

J. Section 271800 – Communications Labeling and Identification

K. Section 274000 – AV/Multimedia General Requirements

L. Section 274100 – Audio Visual Systems

M. Section 275100 – Distributed Communications Systems

N. Section 276000 – Physical Security General Requirements

O. Section 276200 – Electronic Access Control System

P. Section 276400 – Video Surveillance System

Q. Section 276600 – Intrusion Detection System

1.3 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

1.4 REFERENCE STANDARDS AND CODES

A. Refer to Section 270000 for additional requirements.

1.5 QUALIFICATIONS

A. Refer to Section 270000 for additional requirements.

1.6 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.7 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.8 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

PART 2 - PRODUCTS

2.1 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 270000.

2.2 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

2.3 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.

Provide separate hooks for each media type:
1. Backbone Fiber
2. Backbone Copper
3. Horizontal Data
4. Horizontal Wireless
5. Horizontal Audio/Visual
6. Horizontal Security

K. Cable hooks shall be B-Line series BCH21, BCH32 or other manufacturer that meets these specifications

2.4 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. Non-Metallic raceway systems:

1. Non-metallic surface raceway shall have an adhesive-applied base and have a hinged snap-on cover. The raceway shall be manufactured of natural PVC compounds.
2. The raceway system shall be made up of the following components:
   a. Raceway channel shall be Panduit LD5.
   b. Surface mount outlet boxes shall be Panduit JBX3510EI-A.
   c. Dropped ceiling connectors shall be Panduit DCF5EI-X or DCEFXEI-X.
   d. Right angle fittings shall be Panduit RAFC5EI-X.
   e. Coupler fittings shall be Panduit CFX5EI-X.

I. All raceway systems shall be installed complete as specified herein and in manufacturer recommendations.

2.5 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 a metallic sleeve(s) as required to maintain a maximum 40% fill ratio.

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.

2.6 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

2.7 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.

2.8 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.

2.9 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

3.1 TESTING

A. Refer to Section 270000 for additional requirements.

3.2 TRAINING

A. Refer to Section 270000 for additional requirements.

3.3 WARRANTY

A. Refer to Section 270000 for additional requirements.

3.4 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.

3.5 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 at a minimum of 4-5 feet staggered on center. 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.

3.6 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.

3.7 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.

3.8 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.

3.9 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 270537 – FIRESTOPPING FOR TECHNOLOGY SYSTEMS

PART 1 - GENERAL

1.1 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 270000 for additional project scope information.

1.2 RELATED WORK

A. Division 7 - Firestopping

B. Section 270000 – General Technology Requirements

C. Section 270500 – Communications General Requirements

D. Section 270526 – Grounding and Bonding for Technology Systems

E. Section 270528 – Pathways for Technology Systems

F. Section 270537 – Firestopping for Technology Systems

G. Section 271100 – Communications Equipment Rooms

H. Section 271300 – Communications Backbone Cabling

I. Section 271500 – Communications Horizontal Cabling

J. Section 271600 – Communications Connecting Cords

K. Section 271800 – Communications Labeling and Identification

L. Section 274000 – AV/Multimedia General Requirements

M. Section 274100 – Audio Visual Systems

N. Section 275100 – Distributed Communications Systems

O. Section 276000 – Physical Security General Requirements

P. Section 276200 – Electronic Access Control System

Q. Section 276400 – Video Surveillance System

R. Section 276600 – Intrusion Detection System

1.3 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

1.4 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 270000 for additional requirements.

1.5 QUALIFICATIONS

A. Refer to Section 270000 for additional requirements.

1.6 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.7 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.8 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

PART 2 - PRODUCTS

2.1 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 270000.

2.2 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.

2.3 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, the following products are acceptable:
1. Specified Technologies Inc. (STI) SpecSeal Series SSS or LCI Sealant.
2. Hilti

C. Firestop Putty: Intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers or silicone compounds, the following products are acceptable:
1. Specified Technologies Inc. (STI) SpecSeal Series SSP Putty.
2. 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, the following products are acceptable:
1. Specified Technologies Inc. (STI) SpecSeal Series SSB Pillows.
2. 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. Specified Technologies Inc. (STI) EZ-Firestop Grommets.
2. 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, the following products are acceptable:
1. Specified Technologies Inc. (STI) EZ-PATH Fire Rated Pathway.
2. 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, the following products are acceptable:
1. Specified Technologies Inc. (STI) EZ-PATH Smoke & Acoustical Pathway.
2. 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. The following products are acceptable:
1. Specified Technologies, Inc. (STI) E-Wrap™ Endothermic Wrap
2. Hilti

PART 3 - EXECUTION

3.1 TESTING

A. Refer to Section 270000 for additional requirements.

3.2 TRAINING

A. Refer to Section 270000 for additional requirements.

3.3 WARRANTY

A. Refer to Section 270000 for additional requirements.

3.4 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.

3.5 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 271100 – COMMUNICATIONS EQUIPMENT ROOMS

PART 1 - GENERAL

1.1 SCOPE

A. Refer to Section 270000 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

1.2 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270500 – Communications General Requirements

C. Section 270526 – Grounding and Bonding for Technology Systems

D. Section 270528 – Pathways for Technology Systems

E. Section 270537 – Firestopping for Technology Systems

F. Section 271100 – Communications Equipment Rooms

G. Section 271300 – Communications Backbone Cabling

H. Section 271500 – Communications Horizontal Cabling

I. Section 271600 – Communications Connecting Cords

J. Section 271800 – Communications Labeling and Identification

K. Section 274000 – AV/Multimedia General Requirements

L. Section 274100 – Audio Visual Systems

M. Section 275100 – Distributed Communications Systems

N. Section 276000 – Physical Security General Requirements

O. Section 276200 – Electronic Access Control System

P. Section 276400 – Video Surveillance System

Q. Section 276600 – Intrusion Detection System

1.3 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

1.4 REFERENCE STANDARDS AND CODES

A. Refer to Section 270000 for additional requirements.

1.5 QUALIFICATIONS

A. Refer to Section 270000 for additional requirements.

1.6 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.7 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.8 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

PART 2 - PRODUCTS

2.1 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 270000.

2.2 CATEGORY 6 PATCH PANELS

A. Cables shall be terminated at the telecommunication closets on high-density integrated patch panels incorporating Category 6 jacks (non-keyed 8-pin), meeting the specifications for the telecommunications outlet detailed in the section above.

B. Patch panel configuration shall be 48 ports.

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. Panduit CPP48FMWBLY
2. Or approved equal

2.3 CATEGORY 6A PATCH PANELS

A. Cables shall be terminated at the telecommunication closets on high-density integrated patch panels incorporating Category 6a rated jacks (non-keyed 8-pin), meeting the specifications for the telecommunications outlet detailed in the section above.

B. Patch panel configuration shall be 48 ports.

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. Panduit

2.4 VOICE PATCH PANELS

A. At the MDF and each IDF the voice backbone cables originating from the primary distribution point shall be terminated on rack mounted voice patch panels.

B. Backbone cables 25-pair or less shall be terminated on 24-port patch panels and backbone cables greater than 25-pair shall be terminated on 48-port patch panels.

C. The voice patch panel shall utilize 25-pair Amphenol connectors on the rear and RJ-45 jacks on the front.

D. Manufacturers:
1. Panduit VP24382TV25Y

2.5 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, terminate by splicing factory-terminated cable assemblies ("pigtails"). 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.
   1. Manufacturer: Panduit F9TBN1NNNSZM001
      a. Panduit F9B10NM1Y shall NOT be used.

K. Fiber optic patch panels shall be Panduit Opticom FRMEXX or approved equal.

L. Singlemode LC adaptor panels shall be Panduit Opticom FAP6WBUDLCZ or approved equal.
   1. Provide Panduit Opticom blank adapter panels as necessary to blank unused panels within enclosure, Panduit FAPB

2.6 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. 4-Post Equipment Racks

a. The Contractor shall provide and install 4-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 Consultant and 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.

d. Rack shall be constructed of aluminum.

e. 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.

f. Rack shall be supplied with at least 24 spare screws.

g. Rack shall be supplied with a vertical ground bar and #6 AWG ground lug.

h. Manufacturers:

i. Panduit CMR4P84

ii. Or approved equal.

2. 4-Post Server Racks

a. The Contractor shall provide and install 4-post adjustable server racks to house cable termination components (e.g., copper data and fiber optic), network electronics (by others) and servers. Prior to installation, the Contractor shall coordinate exact placement with Consultant and 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.

d. Rack shall be constructed of aluminum.

e. Rack shall be double side drilled and tapped to accept square-punched .375" equipment mounting holes. 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").

f. Rack shall be supplied with at least 24 spare screws.

g. Rack shall be supplied with ground lugs.

h. Provide with cable waterfall and vertical cable managers

i. Contractor shall provide 100 cage nuts and screws with each rack.

j. Manufacturers:

i. Chatsworth F-Series TeraFrame Gen3 Cabinet, Part # FF2J-113B-C22A with finger cable managers #39112-C14

ii. Or approved equal.

3. 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. Panduit CMR19x84NU

      ii. Or approved equal.

2.7 WALL MOUNT EQUIPMENT CABINET

A. Where indicated on Project Drawings, the Contractor shall provide and install wall mount cabinet to house cable termination panels and network electronics. The Contractor shall also provide and install one (1) ¾" plywood backboard for support when mounting cabinet.
   1. Plywood sheet shall extend beyond the parameter of the cabinet for a minimum of three (3) inches on all sides and to the overhead runway utilizing manufacturer recommended hardware and methods.
   2. ¾" x 8' h x 4' w Sheets of A/C grade Fire Rated Plywood with Fire Rated Stamp painted with white fire rated paint

B. The Contractor shall coordinate with Electrical Contractor to install a power outlet into cabinet.

C. Cabinets shall be equipped with fans and thermostatic fan controller.

D. Wall mounted cabinets shall be standard with solid metal door and lock, one pair of special double tapped rails (one leg tapped 10-32 and one leg tapped 12-24), a double fan kit and a rack mounted power strip with transformer spacing.

E. Wall mounted cabinets shall be utilized based on the capacity need for the design and future growth.

F. Wall mounted cabinets shall have enough cable slack to comfortably open the back of the cabinet without placing any strain on the cables.

G. Manufacturers:
1. Cabinet shall be Chatsworth, Part # 11996-736.
a. When mounted in a room that is not access-controlled, the contractor shall provide the cabinet with a security system electronic lock kit. Contact manufacturer for custom part number.

b. Provide with Chatsworth Fan Kit for Cube-iT Plus and Chatsworth Power Strip

2.8 VERTICAL CABLE MANAGEMENT

A. 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.

B. 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.

C. Vertical cable management system shall feature the following:
1. 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.
2. Edge-protected pass-through ports designed for easy routing of cable from front channel to back.
3. Vertical slots along the center separator to allow securing cable bundles neatly with management straps.
4. 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.
5. Movable wire retainers to retain the cables during cover removal.

D. Vertical cable management at the end of rack rows shall be 6" and 10" in between racks.
a. Acceptable manufacturers:

i. Panduit PR2VD06

ii. Panduit PR2VD10

iii. Or approved equal

2.9 POWER DEVICES

A. Power devices (PDUs) will be owner-furnished, owner-installed.

2.10 SHALLOW WALL MOUNT CABINET

A. Where Indicated on Project Drawings, the Contractor shall provide and install a shallow wall mount cabinet to house cable termination panels and network electronics. The Contractor shall also provide and install ¾" plywood backboard for support when mounting cabinet.

B. The Contractor shall coordinate with General Contractor to install power outlet into cabinet.

C. Cabinets housing active equipment shall be equipped with a fan and fan controller.

D. Manufacturers:
1. Panduit TrueEdge Vertical Wall Mount Enclosure, Part # WME6BL
2. Or approved equal

2.11 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. Panduit Net Manager Double Sided High Capacity, #NCMH2
2. Or approved equal.

2.12 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.

2.13 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 at minimum 5ft intervals.

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

2.14 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

2.15 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. Plywood shall be painted. The paint shall be UL 723 rated white 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 12" AFF to 108" AFF and anchored to all studs.

PART 3 - EXECUTION

3.1 TESTING

A. Refer to Section 270000 for additional requirements.

3.2 TRAINING

A. Refer to Section 270000 for additional requirements.

3.3 WARRANTY

A. Refer to Section 270000 for additional requirements.

3.4 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).

3.5 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.

E. Contractor shall wall-mount vertical section of ladder rack for managing vertical cable transitions above entrance conduits or other areas of vertical transition greater than 12".

END OF SECTION

SECTION 271300 – COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 SCOPE

A. Refer to Section 270000 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. 50-micron Multimode Fiber Optic Cable
2. Singlemode Fiber Optic Cable
3. Multi-Pair Copper Voice Backbone Cable

1.2 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270500 – Communications General Requirements

C. Section 270526 – Grounding and Bonding for Technology Systems

D. Section 270528 – Pathways for Technology Systems

E. Section 270537 – Firestopping for Technology Systems

F. Section 271100 – Communications Equipment Rooms

G. Section 271500 – Communications Horizontal Cabling

H. Section 271600 – Communications Connecting Cords

I. Section 271800 – Communications Labeling and Identification

1.3 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

1.4 REFERENCE STANDARDS AND CODES

A. Refer to Section 270000 for additional requirements.

1.5 QUALIFICATIONS

A. Refer to Section 270000 for additional requirements.

1.6 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.7 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.8 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.9 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

2.1 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 270000.

2.2 BACKBONE VOICE CABLING

A. The voice backbone cable shall link the Main Closet and Telecommunications Rooms serving the building. The cables shall be CMP rated where required.

B. Voice backbone cable shall incorporate 24 AWG solid annealed copper conductors insulated with a polyvinyl chloride skin over expanded polyethylene. Conductors shall be twisted to form pairs and fully color-coded.

C. The voice backbone cable shall be sized as detailed on the Drawings.

D. Conductors shall be identified by the insulation color of each conductor. The color code shall follow the industry standard composed of ten (10) distinctive colors to identify 25 pairs in accordance with ICEA publication S-80-576-1988. Marking of each mate of the primary conductor in a pair with the color of that primary conductor is optional.

E. The voice backbone cable shall meet or exceed the EIA/TIA Category 3 performance requirements.

F. When cables of larger than 25 pairs are required, the core shall be assembled into 25-pair subunits, each color-coded in accordance with ICEA publication S-80-576-1988. Cables with over 600 pairs shall have 25-pair binder groups combined into super units. These super units shall be wrapped with a solid color thread that follows the primary color scheme of white, red, black, yellow, and violet. Binder color code integrity shall be maintained wherever cables are spliced.

G. All cables and equipment shall be furnished, installed, wired, and tested by the Contractor.

H. Manufacturers:
1. Belden
2. Berk-Tek
3. General Cable
4. Superior Essex

5. Or approved equal

2.3 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 +70°C. The installation/operating temperature range for riser cables shall be -20 to +70 °C. 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 +70°C.The installation/operating temperature range for plenum cables shall be 0 to +70°C.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 °C and +50 °C. 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 °C) 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. Panduit
2. Chromatic
3. Commscope
4. Corning
5. Systimax
6. Or approved equal.

2.4 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.

2.5 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

3.1 TESTING

A. Refer to Section 270000 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)
Multimode 62.5/125 µm	850	3.5
	1300	1.5
Multimode OM3 50/125 µm	850	3.5
	1300	1.5
Multimode OM4 50/125 µm	850	3.0
	1300	1.5
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. Multimode backbone links shall be tested at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A.
7. 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.
8. Multimode backbone links are designed to be used with network applications that use laser light sources (underfilled launch conditions). However, the link attenuation equation has been based upon the use of a light source categorized as Category 1, Overfilled.
9. 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.

3.2 TRAINING

A. Refer to Section 270000 for additional requirements.

3.3 WARRANTY

A. Refer to Section 270000 for additional requirements.

3.4 FIBER OPTIC CABLE INSTALLATION REQUIREMENTS

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.

END OF SECTION

SECTION 271323 – INTERBUILDING OSP BACKBONE CABLING AND PATHWAYS

PART 1 - GENERAL

1.1 SCOPE

A. Refer to Section 270000 for additional project information.

B. 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

1.2 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270500 – Communications General Requirements

C. Section 270526 – Grounding and Bonding for Technology Systems

D. Section 271100 – Communications Equipment Rooms

E. Section 27 13 00 – Communications Backbone Cabling

F. Section 271600 – Communications Connecting Cords

G. Section 271800 – Communications Labeling and Identification

1.3 DEFINITIONS

A. OSP – Outside Plant.

1.4 REFERENCE STANDARDS AND CODES

A. Refer to Section 270000 for additional requirements.

1.5 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 270000 for additional requirements.

1.6 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.7 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.8 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.9 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

2.1 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 270000.

2.2 OUTSIDE PLANT (OSP) INTERBUILDING FIBER OPTIC CABLE

A. All cabling shall be rated for the environment it is installed.

B. For underground installation, Contractor shall use Armored Fiber Optic Cable. Cable shall incorporate a corrugated Steel Armor Tape to provide for resistance to rodent attack. Armored Fiber Optic Cable shall be filled with a water-blocking compound.

C. All Outside Plant Segments shall have armored jacket to provide rodent protection.

D. Each 4" conduit shall receive three (3) 3" 3-cell Maxcell detectable innerduct

E. General: Loose tube fiber optic backbone cable shall be used for connectivity between buildings. Cable will be run within innerduct in underground conduit between buildings. If MDF/IDF is more then 50 feet from the building fiber entrance, the cables shall be installed in a rigid metal conduit.

F. Fiber construction shall consist of both singlemode and OM4 multimode with a core/cladding size of 9.0/125 micron singlemode and 50.0/125 micron multimode in a composite cable. Contractor shall furnish and install the appropriate fan out or breakout materials as required and dictated by the application and fiber optic cable type.

G. The total number of fibers supplied in each cable run shall equal the total number of fibers shown on the contract drawings. The cable structure shall be such that the fibers are grouped for easy handling. The cable shall contain appropriate

strength members to satisfy the mechanical and environmental specifications provided herein.

H. The core shall consist of filled buffer tubes surrounding a central dielectric strength member. Water-Swellable and Flame-Retardant Tape and yarns shall surround the fibers to provide further weather and mechanical protection. The Contractor shall ensure that the core construction of the cable proposed for installation is such that the environmental and mechanical requirements of the installation are met.

I. The maximum attenuation of loose tube fiber optic strands shall be:

J. 50.0/125 multimode (850 nanometers): 3.0 dB/km, (1300 nanometers): 1.0 dB/km

K. 9.0/125 singlemode (1310 nanometers): 0.4 dB/km, (1550 nanometers): 0.3 dB/km

L. The minimum OFL bandwidth of OM4 multimode cable shall not be less than 3000 MHz-km @ 850 nm and 500 MHz-km @ 1300 nm.

M. The minimum Laser bandwidth of OM4 multimode cable shall not be less than 4700 MHz-km @ 850 nm and 500 MHz-km @ 1300 nm.

N. All finished fibers must be color-coded by the manufacturer for identification. The fibers shall be connectorized utilizing field-installed terminations or spliced pigtails. The nominal connector loss using either termination method shall not be greater than 0.40 dB per mated pair.

O. The fiber cable shall be able to withstand a short-term tensile load of 2700 N (600 lbf.) and a long-term tensile load of 600 N (135 lbf.) with maximum elongation of less than 0.5% and no breakage of fibers.

P. The minimum static or no load (0-180 lb.) bending radius for the cable shall be no less than 10 times the outside diameter of the cable. Cables shall be able to withstand being flexed at their minimum static bending radius +/- 90 degrees for at least 20 cycles at 20-40 cycles per minute at 20 degrees C. The minimum dynamic or loaded (181-600 lb.) bending radius shall be no greater than 20 times the outside diameter of the cable.

Q. The cable shall be able to withstand twisting of +/-360 degrees over a length of 2 meters for at least 10 cycles at 10 cycles per minute. The cable shall be able to withstand storage and operating temperatures of -40 to +70 degrees C. The cable shall withstand a compressive force of 600 N/cm without breakage, and there shall be no attenuation increase after the force is removed.

R. Acceptable Product:
1. Panduit
2. Chromatic
3. Commscope
4. Corning
5. Systimax
6. Or Approved equivalent

2.3 VOICE BACKBONE CABLING

A. The voice backbone cable shall link campus buildings to the campus MDF.

B. Voice backbone cable shall incorporate 24 AWG solid annealed copper conductors. The overall cable shall be shielded with corrugated copper or

aluminum tape applied with an overlap. Cable shall be fully flooded with a solid core and moisture resistant.

C. Conductors shall be twisted to form pairs and fully color-coded.

D. The voice backbone cable shall be sized as detailed on the Drawings.

E. Conductors shall be identified by the insulation color of each conductor. The color code shall follow the industry standard composed of ten (10) distinctive colors to identify 25 pairs in accordance with ICEA publication S-80-576-1988. Marking of each mate of the primary conductor in a pair with the color of that primary conductor is optional.

F. The voice backbone cable shall meet or exceed the EIA/TIA Category 3 performance requirements.

G. When cables of larger than 25 pairs are required, the core shall be assembled into 25-pair subunits, each color-coded in accordance with ICEA publication S-80-576-1988. Cables with over 600 pairs shall have 25-pair binder groups combined into super units. These super units shall be wrapped with a solid color thread that follows the primary color scheme of white, red, black, yellow, and violet. Binder color code integrity shall be maintained wherever cables are spliced.

H. All cables and equipment shall be furnished, installed, wired, and tested by the Contractor.

I. Manufacturers:
1. General
2. Mohawk
3. Superior
4. Systimax
5. Or approved equal

2.4 FIBER OPTIC SPLICE CLOSURE

A. A fiber optic splice closure and associated hardware shall be used to restore the mechanical and environmental integrity of an optical fiber cable following a splicing operation. In addition, a splice closure shall provide the necessary facilities for organizing and storing optical fiber and splices.

B. The splice closure shall feature gel sealing technology for cable terminations.

C. The splice closure shall be re-usable and enable easy cables removal.

D. The fiber optic splice closure shall meet the following requirements:
1. Single-ended design.
2. Available in 288 splices size.
3. Base and dome shall be sealed with a clamp and O-ring system.
4. Six (288 splices version) round cable ports shall be available in a wrap-around block with pre-installed gel profile for cable sealing.
5. The block shall be designed as to allow multiple entrances into splice enclosure without the need to remove or replace the gel.
6. Splice trays shall be hinged for access to any splice without disturbing other trays.
7. Enable uncut or expressed fibers be stored in storage baskets.
8. No stress shall be placed on finish splices within trays.
9. Accommodate fiber bend radii 1.5 inch.

10. Accommodate bonding/grounding.

E. Provide separate splice enclosures for singlemode and multimode fiber optic cabling.

F. The fiber optic splice enclosure shall be Commscope FOSC 450 or other approved products, which meet these specifications.

2.5 COPPER SPLICE ENCLOSURE

A. The pressurized closure system shall be a complete pressure-tight system for enclosing copper splice connections for underground applications

B. Closure system shall be equipped with the following features:
1. Pressure-tight.
2. Re-enterable.
3. Uses industry common tools for assembly and re-entry.
4. Impact and corrosion resistant plastic.
5. Suitable for straight and branch splice configurations
6. Designed for underground and manhole applications

C. Contractor shall size closure appropriately for application and provide appropriate rear entry plates.

D. Closure shall be 3M 2-Type 505 or other approved products, which meet these specifications.

2.6 COPPER SURGE SUPPRESSION

A. The copper surge suppression system shall be a complete wall-mounted system capable of protecting from surges induced on OSP copper cabling.

B. The surge system should have the following features:
a. 16 AWG Powder Coated Steel Construction

b. Equipped with an Internal 26 AWG Fuse Link

c. External Ground Connectors That Accept 6 - 14 AWG Wire

d. Standard 5 Pin Design

e. Stackable with Connection Grommets Included

f. 110 Connector That Accept 22 - 26 AWG Wire

C. Contractor shall provide enough surge suppression capacity at each location where cable terminates to support all pairs.

D. Surge Suppressor shall be Circa Telecom 1880ECA1-XX with Circa Telecom 3B1S-300 modules or other approved products, which meet these specifications.

2.7 SCHEDULE 80 PVC CONDUIT

A. 4" PVC Schedule 80 conduit shall be manufactured from a Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784.

B. The conduits shall be supported to permit adequate lineal movement to allow for expansion and contraction of conduit due to temperature change.

C. All compound components shall be listed with NSF® and meet the requirements of NSF/ANSI Standard 61-G as suitable for fiber optic infrastructure and is considered Lead Free.

D. The conduit shall be manufactured in strict compliance to ASTM D1785, consistently meeting the Quality Assurance test requirements of this standard with regard to material, workmanship, burst pressure, flattening, and extrusion quality.

E. Any conduit bells shall meet the requirements of ASTM D2672.

F. The conduit must also meet the requirements of NSF Standard 14 and shall bear the NSF mark.

G. All appropriate fittings shall be provided by the contractor to enable proper installation of the conduits per the manufacturer recommendations

H. The contractor shall provide 90º, 45º and 30º elbows. Each elbow shall feature 36" radius plain end. The elbows shall be installed per the manufacturer recommendations

I. The contractor shall use of cement for proper solvent cement joints. The Cement shall be prepared particularly for the manufacturer of the conduits, fittings and elbows

J. The conduits, fittings and elbows shall be manufactured in the USA by an ISO 9001 certified manufacturer.

2.8 UNDERGROUND MANHOLE ENCLOSURES

A. Underground enclosures with exterior dimensions of 6'W x 12'L x 7'D shall be constructed of pre-cast 6" thick concrete.

B. Underground enclosures shall be rated for use at sidewalk, driveway, and parking lot areas.

C. Underground enclosures shall:
1. Be equipped with cable racks, conduit entrances and strut inserts.
2. Have a neck in the center of manhole.
3. Have a long enough neck (34" minimum height) to that manhole cover is flush with finished grade or pavement
4. Have a cover that:
5. Weighs a minimum of 200 pounds but no more than 250 pounds.
6. Can withstand vehicular traffic (Rating of H-20).
7. Is Factory cast with the label "COSA COMMUNICATIONS #" where # designates a specific numbering scheme to be determined by Owner. Field labeling with a welder is not acceptable.
8. Have installed a single 8 foot minimum electrode consisting of a ground rod made of solid copper or copper clad steel with a resistance to ground of less than 25 ohms.
9. Be designed for a long life over a wide range of temperature extremes.
10. Feature interlock for concrete or asphalt sidewalk retention.
11. Contain a center drain with sump capable of completely draining manhole.
12. Have a 7/8" diameter galvanized pull iron.

13. Be equipped with a ladder that:
14. Is permanently attached to the inside of the manhole.
15. Is equipped with a retractable safety grab post that is capable of extending up to three feet from the top of the manhole.
16. Is constructed of aluminum.

2.9 HANDHOLES

A. Underground enclosures shall be constructed of a polymer concrete material and have the same strength rating as concrete handholes of the same proportions.

B. Underground enclosures shall be rated for use at sidewalk, driveway, and parking lot areas.

C. Underground enclosures shall:
1. Be flush-mounted to the existing grade and constructed with a load rating of AASHTO H-20.
2. Be equipped with a locking keyed mechanism.
3. Be equipped with cable racks, conduit entrances, and strut inserts.
4. Be designed for a long life over a wide range of temperature extremes.
5. Feature interlock for concrete sidewalk retention.
6. Be labeled "COSA COMMUNICATIONS"

D. 24"x36"x48" underground enclosures shall be Hubbell PD2436BA48 with PG2436HA00 cover. or other equivalent products, which meet these specifications.

E. 30"x48"x36" underground enclosures shall be Hubbell PG3048BA36 with PG3048HS00 cover. or other equivalent products, which meet these specifications.

2.10 LABELING

A. Labels must be rigid vinyl, self-laminating, be slotted for fastening with nylon ties and intended for long-term outdoor use.

B. Labels shall be XpressTags TG-2109, Panduit PST-FOBLNK or other product which meets these specifications.

PART 3 - EXECUTION

3.1 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.

3.2 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.

3.3 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.

3.4 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.

3.5 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.

3.6 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.

3.7 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.

3.8 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.

3.9 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.

L. Conduit systems shall:
1. Contain no more than the equivalent of two (2) 90 degree bends between pull boxes.
2. Maintain a minimum bend radius of 10 times the diameter of the conduit.
3. Not exceed 40 percent fill ratio.
4. Be interrupted by an adequately sized manhole or pull box at least every 600 feet for sections containing up to (1) 90 degree of bend, and at least every 350 feet for sections with the equivalent of (2) 90 degree bends.

3.14 OUTDOOR FIBER SPLICE ENCLOSURE

A. This work shall consist of installing an Outdoor Fiber Splice Enclosure at the splice handholes/manholes. The locations of the splice handholes/manholes are shown on the drawings

B. Mounting the Outdoor Fiber Splice Enclosure in the splice vault requires a L-bracket to be constructed to fit the opening to the splice handhole/manhole. The objective of this L bracket is to keep the splice enclosure off the floor of the handhole/manhole.

C. Fusion type splices shall be utilized. Mechanical splices shall be prohibited.

D. Fiber optic cable splicing is allowed in locations denoted in the drawings. Additional locations shall require the approval of the Consultant.

E. The Contractor shall adhere to the fiber optic cable manufacturer's methods, commendations, materials, and techniques for splicing.

F. All splicing equipment shall be in good working order, properly calibrated, and meet all industry standards and safety regulations.

G. The fiber optic cable preparation, splice enclosure installation, and splicing shall be accomplished in accordance with industry standards.

H. Mechanical stress and splicing locations shall be minimized by training the fiber optic cable into final position, concurrently observing the minimum bending radii of the fiber optic cable. The minimum bending radii of the fiber optic cable shall be 20 times the diameter of the cable or as per the manufacturer's requirements, whichever is greater.

I. Cleanliness and freedom from contamination shall be strictly observed with respect to splicing materials and joint construction. Upon completion of the splicing operation, all waste material shall be deposited in suitable containers, removed from the job site, and disposed of in an environmentally acceptable manner.

3.15 CABLE SLACK

A. Provide 10ft service loop at both ends of each cable (MDF and IDF). Store on the wall above or below the ladder rack.

B. All other handholes/manholes used for installation assistance shall contain twenty feet (20') of cable slack unless otherwise noted in the drawings. Cable slack of one hundred feet (100') shall be provided in each splice point.

C. At handholes/manholes, cable slack should be placed vertically in a hole.

D. This excess slack shall provide added cable for restorations or reconfigurations without digging up large parts of the cable system.

3.16 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-TELECOMMUNICATIONS." The tape shall be placed directly above the conduit to alert any excavator of the presence of an underground facility.

3.17 TEST STATION

A. The test station shall be installed at each splice location (splice points and at the locations of the fiber reels splice).

B. The TriGrip Anchor Flaps™ shall be extended prior to burial of the post. Soil shall be compacted during placement of marker post.

C. Hole shall be 8" in diameter and a minimum of 12" in depth.

3.18 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.

3.19 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 Engineer'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.

3.20 CABLE TERMINATION - FIBER OPTIC

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.

3.21 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.

3.22 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.

3.23 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.
4. The coordinate system shall be the State Plane Texas South Central FIPS 4204 Feet coordinate system.
5. For the projects located not in the State Plane Texas South, a designer shall change the paragraph 3.24.B.4 to "The coordinate system shall be the Pre-Defined County Coordinate System."

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.

3.24 LABELING

A. 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.

B. The size, color, and contrast of all labels should be selected to ensure that the identifiers are easily read.

C. Descriptive identifiers shall include a combination of the following:
1. Identify the item that the fiber is traveling to by name.
2. Identify the fiber count and mode.
3. Identify the direction the majority of the fiber optic cable travels from a handhole/manhole.

D. 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.

E. Each cable shall be labeled within 18 inches from the end of the splice enclosure.

F. 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."

G. The following provisions shall apply to labeling Fiber Distribution Components:
1. Label the front of the patch panels with the fiber optic cable number, direction, and fiber count.
2. 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.
3. Label the front of the splice panels with the fiber optic cable number, direction, and fiber count.
4. Label splice trays/splice wheels with the cable ID and fiber numbers contained in the tray/wheel.

3.25 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 271500 – COMMUNICATIONS HORIZONTAL CABLING

PART 4 - GENERAL

4.1 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

4.2 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270500 – Communications General Requirements

C. Section 270526 – Grounding and Bonding for Technology Systems

D. Section 270528 – Pathways for Technology Systems

E. Section 270537 – Firestopping for Technology Systems

F. Section 271100 – Communications Equipment Rooms

G. Section 27 13 00 – Communications Backbone Cabling

H. Section 271600 – Communications Connecting Cords

I. Section 271800 – Communications Labeling and Identification

J. Section 27 40 00 – AV/Multimedia General Requirements

K. Section 27 41 00 – Audio Visual Systems

L. Section 27 51 00 – Distributed Communications Systems

M. Section 27 60 00 – Physical Security General Requirements

N. Section 27 62 00 – Electronic Access Control System

O. Section 27 64 00 – Video Surveillance System

P. Section 27 66 00 – Intrusion Detection System

4.3 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

4.4 REFERENCE STANDARDS AND CODES

A. Refer to Section 270000 for additional requirements.

4.5 QUALIFICATIONS

A. Refer to Section 270000 for additional requirements.

4.6 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 270000 for additional requirements.

4.7 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

4.8 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

PART 5 - PRODUCTS

5.1 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 270000.

5.2 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 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. The jacket color for data cables shall be WHITE in color.

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. General Cable Genspeed 6000
2. Panduit

K. For use in wireless access point (AP) applications exceeding 295 feet:
1. The horizontal balanced twisted pair cable shall meet or exceed the Category 6 transmission characteristics per issue of ANSI/TIA/EIA-568.2-D
2. Four balanced pairs of 22AWG solid copper conductors.
3. Combined with the Category 6 series termination hardware, the channel assembly must be capable of supporting 2.5 GB/ Second up to 656 feet and 10 MB/ Second up to 850 feet.
4. Manufacturers:
   a. Paige Game Changer Cat 6 UTP OSP Cable, Black (Part # 258330804)
      i. Contractor shall terminate with Paige approved plugs:
         a. Simply45 S45-1700P
         b. Platinum tools 100029C

5.3 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 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. Panduit Mini-com TX6 Plus UTP Jack Modules
        i. Network Access
            a. Telecom Room End, Black, Panduit #CJ688TGBL
            b. Field End, Ivory, Panduit #CJ688TGEI
        ii. Wireless Access Points
            a. White, Panduit #CJ688TGWH
        iii. AV Access
            a. Violet, Panduit #CJ688TGVL
        iv. IP Security
            a. Red, Panduit #CJ688TGRD

C. Outlet Faceplates
1. Faceplates shall match the electrical outlets for material type and color. If unknown at the time of bidding, contractor shall assume stainless steel for pricing purposes and verify finish during submittals.
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. Wall phone faceplates shall be manufactured by modular jack manufacturer:
   a. Panduit KWP6PY

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:
   a. Panduit - Grey – Coordinate exact color with owner.

D. 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.
   a. Provide Panduit CMBWH-X.

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:
   a. Panduit CBXJ2HW-A

PART 6 - EXECUTION

6.1 TESTING

A. Refer to Section 270000 for additional requirements.

B. Testing of Paige Gamechanger shall comply with manufacturer testing requirements.

6.2 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 5E, 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 5e, 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.

6.3 TRAINING

A. Refer to Section 270000 for additional requirements.

6.4 WARRANTY

A. Refer to Section 270000 for additional requirements.

6.5 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 20 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.

6.6 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.

6.7 ELEVATOR INTERFACE

A. The Contractor shall furnish and install an elevator interface box outside of the elevator equipment room.
1. The Contractor shall provide an elevator telecommunications junction box located outside of the Elevator Machine Room, for interface of telecommunication cable to the elevator cab(s). This requirement complies with ANSI A17.1 code which prevents work within the Elevator Machine Room, other than specific elevator work.
2. Telecommunications J-box shall include a keyed lockable door. Additionally, the J-box shall have proper punch down blocks and data jacks suitable for terminating all cables within the J-box.
3. The Contractor shall provide any voice/data cables to this enclosure as required.
4. Electronics or cable for other systems such as security shall not be placed within this enclosure.
5. Coordinate exact location of elevator security junction box with the Elevator Contractor, Architect, and Consultant, prior to installation.
6. Cables entering the elevator telecommunications J-box and elevator equipment room shall be appropriately labeled by the Contractor, so that the Elevator Contractor can connect the appropriate wires to the elevator controllers. Wires should be individually labeled to separate them from other elevator functions and to assist the Elevator Contractor in making proper connection points.

6.8 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.

6.9 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.

6.10 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 5e/6/6a and above shall be performed to confirm proper functioning and performance.

F. Testing of the transmission performance of station cables (Category 5e/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

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)
200.0	26.1	36.9	34.3	18.2	15.2
250.0	29.5	35.3	32.7	16.2	13.2

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 271600 – COMMUNICATIONS CONNECTING CORDS

PART 1 - GENERAL

1.1 SCOPE

A. This section describes the products relating to high quality Category 6 voice and data patch cords.

B. In this section the term patch cords refers to the cords that connect Owner provided data network electronics to the horizontal cable infrastructure.

C. It is important that the horizontal cable system and the provided patch cords work as one complete system for guaranteed channel performance. Patch cords shall be manufactured by the same manufacturer as the jack and patch panels.

D. The Contractor shall provide and deliver all cords as listed in this section. The Owner will be responsible for installation of cords.

1.2 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270500 – Communications General Requirements

C. Section 270526 – Grounding and Bonding for Technology Systems

D. Section 270528 – Pathways for Technology Systems

E. Section 270537 – Firestopping for Technology Systems

F. Section 271100 – Communications Equipment Rooms

G. Section 27 13 00 – Communications Backbone Cabling

H. Section 271500 – Communications Horizontal Cabling

I. Section 271800 – Communications Labeling and Identification

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

1.3 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

1.4 REFERENCE STANDARDS AND CODES

A. Refer to Section 270000 for additional requirements.

1.5 QUALIFICATIONS

A. Refer to Section 270000 for additional requirements.

1.6 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.7 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.8 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

PART 2 - PRODUCTS

2.1 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 270000.

2.2 CATEGORY 6 AND 6A 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 28 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 manufacturer of the cords shall be the same as the manufacturer for UTP termination hardware (jacks & patch panels). Cords shall be highest quality patch cords available by connectivity manufacturer.

F. The patch cords shall match the Category rating of the jack and cable it will be connecting to.

G. This Contractor shall provide the following patch cords (for pricing purposes only; refer to article 3.04 below):

Qty	Length	Notes
2 for each terminated cable plus 25% spare parts	15ft	Non-Plenum 28 AWG Cat 6/6A - Black

2.3 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).
3. Have 8-9-micron OS2 core.
4. Manufacturer:
   a. Panduit
   b. Corning
   c. Or approved equal

C. This Contractor shall provide the following patch cords (for pricing purposes only; see article 3.04 below):

Qty	Length	Notes
2 for each strand plus 25% spare parts	3m	SM Non-Plenum

PART 3 - EXECUTION

3.1 TESTING

A. Refer to Section 270000 for additional requirements.

3.2 TRAINING

A. Refer to Section 270000 for additional requirements.

3.3 WARRANTY

A. Refer to Section 270000 for additional requirements.

3.4 ORDERING AND DELIVERY

A. Prior to ordering patch cords the Contractor shall schedule meeting with Owner and Consultant to verify patch cord lengths, colors and quantities.

B. 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.

END OF SECTION

Section 274000 – AV Multimedia General Requirements

Part 1 - General

1.01 Scope

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

B. Successful bidder shall provide, install, configure, and provide warranty service for audiovisual systems, including displays, audio/video/graphics switching and distribution systems, integrated control systems, and other equipment as described herein.

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 15 00 – Communications Horizontal Cabling

G. Section 27 41 00 – Audio Visual Systems

1.03 Reference

A. In addition to any requirements below, Contractor shall abide by requirements delineated in 27 00 00 including but not limited to:

1. General: Definitions, reference standards and codes, qualifications, pre-construction submittals, construction progress submittals, closeout submittals, and correction period.

2. Products: Substitutions, product specifications, miscellaneous material, cable, connectors, power devices, and interface panels.

3. Execution: Coordination, testing, training, warranty, and cable management.

1.04 Definitions

A. HDCP: High-bandwidth Digital Content Protection or a security protocol designed to limit unauthorized use of protected content. Where applicable, HDCP compliant devices shall be utilized per design specifications. Use of HDCP compliant systems designed herein is the responsibility of the end user and compliance with Owner's Fair Use policies.

B. EDID, E-EDID: Extended Display Information Data, Enhanced-Extended Display Information Data or a remotely readable (read by a source) data file that resides in a

display or specialized audiovisual device – commonly referred to as a "sink" – describing the capabilities of the sink to a connected source.

C. Configuration: the software and firmware programming that defines and creates the functionality, levels, presets, and settings of devices.

D. Configure: To define functionality, levels, presets, and settings of device(s) using software and/or firmware.

E. Programmer: Contractor personnel engaged in developing the configuration of systems.

F. DSP: Digital Signal Processing, or Digital Signal Processor.

G. AEC: Acoustic Echo Cancellation.

H. Fixed Architecture: Referring to software providing fixed processing paths with adjustable processing objects in a predetermined sequence.

I. Open Architecture: Referring to software providing infinitely variable Programmer selected processing paths with adjustable processing objects arranged in any sequence deemed appropriate by Programmer.

1.05 Reference Standards and Codes

A. Giddings, G. H. Philip. *Audio Systems – Design and Installation*.
Focal Press, 1990.
Focal Press, Elsevier Inc.
30 Corporate Drive, Suite 400
Burlington, MA 01803

B. *AV Installation Handbook, Second Edition.*
InfoComm International, 2009.
11242 Waples Mill Road, Ste. 200
Fairfax, VA 22030

C. *Audiovisual Systems Performance Verification (ANSI/Infocomm 10:2013)*
InfoComm International, 2013.
11242 Waples Mill Road, Ste. 200
Fairfax, VA 22030
http://www.infocomm.org/cps/rde/xchg/infocomm/hs.xsl/35975.htm

D. *Dashboard for Controls Template, Design Reference, and Integrators Guide.*
InfoComm International.
www.infocomm.org/cps/rde/xchg/infocomm/hs.xsl/35324.htm

E. Copyright Act of 1976
U.S. Copyright Office
101 Independence Ave. S.E.
Washington, DC 20559
Phone: (202) 707-3000

1.06 Qualifications

A. Primary AV Contractor shall have at least one (1) employee assigned to the project in a design or management role, and at least one (1) employee assigned to the project in an installing technician role, holding at least one of the follow certifications:

1. CTS (InfoComm International)
2. CTS-I (InfoComm International
3. CTS-D (InfoComm International)
4. EST-L2 (National Systems Contractor Association)

B. DSP and Automation/Control Systems Programmer

1. Training: Programmer shall have received manufacturer-provided and/or manufacturer-approved training in the configuration of the DSP and Automation/Control systems being provided and interfaced with.
2. Certification: Programmer shall hold the highest applicable manufacturer programming certification(s) for the DSP and Automation/Control systems hardware being provided and/or being programmed.
3. At minimum, the awarded contractor shall possess:
   a. For Audinate: Dante Level 2 Certified (required), or Level 3 (preferred).
   b. For QSC: Q-SYS Level 2, Q-SYS Control 201, and Q-SYS Quantum Certified

C. Control System Programmer

1. Training: Programmer shall have received manufacturer-provided and/or manufacturer-approved training in the configuration of the integrated control systems being provided.
2. Certification: Programmer shall hold the applicable manufacturer programming certification(s) or be an authorized independent programmer of the integrated control systems.
   a. For AMX: AMX Certified Expert (ACE Programming Expert)
   b. For Crestron: Crestron Certified Programmer
   c. For Extron: Extron Control Professional
   d. Or approved equal

D. Refer to subsequent sections for section specific qualification requirements.

1.07 Pre-Construction Submittals

A. Refer to Section 27 00 00 for additional requirements

B. Structurally Mounted Elements: Including but not limited to monitors, projectors, projection screens, and loudspeakers.

C. Frequency Assignment Plans: Provide for all wireless microphones.

D. Custom Engraving: Layout and labeling/engraving of custom products including wall plates and interconnection panels. Provide engraving detail with material and finish detail.

E. Power Distribution: Plan for distribution and switching of AC and DC power to all audiovisual devices, including sequencing order of outlets and banks. Time delay to be field configured as necessary for proper system power up and down.

F. Colors: Confirm color option selections with Architect per location for items such as speakers, projectors, plates, etc.

G. Layouts of physical and virtual user controls in graphical format. This shall include:

1. Engraved buttons and overlays
2. Machine-printed adhesive labels
3. Graphical user interfaces for touch panels or web interfaces
4. Descriptive write-up of function(s) of each button for each page.

H. Copy of manufacturer configuration software, or link to manufacturer website download page for accessing configuration software.

1. Version: Submitted software shall be identical version used to create Audio DSP configuration.

I. Integrated control system review shall be done via web conference with Consultant.

J. Contractor shall make changes as requested by Consultant in pre-construction submittal review.

1.08 Construction Progress Submittals

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

1.09 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.

1.10 Correction Period

A. Length of Period: Contractor shall offer a one year correction period to Owner for this system. Contractor shall repair all equipment and cabling problems at no additional cost to Owner during the correction period.

B. Commencement: Correction period shall begin at date of Final Acceptance.

C. Final Acceptance: shall be defined as the date at which all contract work (save for a correction period) is complete, including punch list completion & verification, closeout submittals, and written verification by the Owner is obtained by the Contractor that the systems have been accepted.

D. Response: Contractor shall respond by phone within two (2) hours to calls for service or assistance from Owner during normal business hours for the duration of the correction period.

E. On-site Response: Contractor shall respond on-site within eight (8) business hours from the time of the initial phone contact in the event that the issue cannot be resolved over the phone.

F. Equipment on Loan: Contractor shall loan equipment for any broken, defective, or non-functional equipment that cannot be repaired and returned within one week. Contractor shall provide shipping, delivery, and integration at no additional cost to Owner. Equipment shall be comparable in size, speed, brightness, and relevant performance specifications, as determined by Owner.

G. Projection Lamps: Projection lamps are to be warranted by Contractor for a minimum of 90 days, or the rated life expectancy of the lamp, whichever comes first.

H. Damaged Equipment: Equipment that is damaged due to intentional misuse, abuse or negligence is not covered under this warranty; however, Contractor shall assist Owner in putting the system back in working order in the shortest possible timeframe while charging normal service rates for labor and equipment.

1.11 Ownership

A. Property Rights: Contractor assigns to Owner any and all intellectual property rights and applications made by Contractor, or its agents or employees in connection with the performance of this contract. Contractor also acknowledges and agrees that services rendered in connection with the performance of this contract shall be a "work made for hire" within the meaning of Section 201 inventions of the Copyright Law of 1976.

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 Product Specifications

A. Provisions: Product specifications are provided in subsequent sections to Contractor for the appropriate configuration and/or provision of accessories as well as for a guide to indicate key features for possible substitutions.

B. Where wireless microphone systems are specified, Contractor shall determine optimal frequency range for final product selection and submit Manufacturer's recommended frequency band for Owner and Consultant approval prior to ordering equipment. Contractor shall provide congruent frequency band products where like systems are specified for interoperability of components. Where three (3) or more wireless microphones are specified within the same system, Contractor shall provide and install necessary antennae distribution for optimal performance, to be submitted for Owner and Consultant approval during pre-construction phase.

C. Interconnections: Contractor shall be responsible for providing populated, grommeted, or blank cover plates for all wall and floor box openings intended for audiovisual systems.

D. Twisted Pair (TP) Category Cabling: Contractor shall use twisted pair Category cable as recommended by manufacturer of transmission equipment for optimal bandwidth and signal timing. Where cable type is not specified by manufacturer, Contractor shall use shielded twisted pair Category 6 cabling. Cable type shall be detailed in pre-construction submittals with any deviations from manufacturer recommendations expressly noted.

E. Mounts: Contractor shall fabricate mounts for projectors, monitors, loudspeakers, cameras, etc. as necessary, and shall modify standard mounts as required for optimal mounting configurations. Intended hardware shall be detailed in shop drawing submittals.

1. Custom mounting configurations shall be submitted in shop drawings for review.

2. Contractor shall provide all hardware as necessary, including flanges, Unistrut, threaded pipe, column extensions, yokes, clamps, threaded rod, aircraft cable, and any other hardware required to securely mount equipment.

3. All ceiling tile penetrations shall be neatly finished with a plate, grommet and/or escutcheon ring.

2.03 Miscellaneous Material

A. Required Equipment: Contractor shall provide additional system components typically and reasonably required to make system operational even though not specifically indicated in Drawings, Appendices or Specifications including, but not limited to, cable, connectors, connecting accessories, adaptors, power supplies, power strips, rack mounting adapters and shelves, cover plates and closure panels, relays and switches, remote antenna mounts, terminal blocks, and related connector and termination hardware required by but not supplied with the equipment.

B. Blank Fill Panels: Contractor shall provide blank fill panels to cover any openings in equipment racks provided under this contract whether specified in the equipment schedules or not. Fill panels shall match finish of specified rack hardware.

C. Power Distribution Strips: Contractor shall provide power distribution strips as necessary for distributing power within equipment racks and consoles. Strips shall be UL listed, be securely mountable, and appropriate for professional installation.

D. Wall Openings: Contractor shall provide blank faceplates to cover any unused openings within the project area. Faceplate type and finish to match electrical outlets in the project.

E. Input Cables: Contractor shall provide all interconnection cables shown on the project drawings, as well as end-user input cables at all locations where laptops and other user devices are intended to be connected.

F. Keys: Keys for like equipment shall be identical.

G. Wireless Transceivers: Where wireless transceivers are specified (including, but not limited to wireless microphones, wireless assistive listening devices, etc.) Contractor shall verify frequency band range of existing Owner wireless systems. Contractor shall provide wireless transceiver system(s) compatible with existing equipment for interoperability.

H. Cables shall be Liberty Cable.

I. Cable Sleeving:

1. Shall be black expandable sleeving, with ends neatly turned under 2", held in place either by nylon tie-wrap, or heat-shrink tubing. Tie wraps, if used, shall not deform cables within the umbilical. Cables requiring sleeving include:

a. Exposed cabling outside of wire management in console furniture.

b. Cable umbilicals connecting to or from wall, floor, or ceiling plates consisting of more than one wire.

2. Contractor shall coordinate as necessary so that all low-voltage cabling (including Ethernet) are included in a single umbilical

2.04 Power Devices

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

B. All large venue audio amplifiers shall be on sequenced outlets.

2.05 Fire Stopping Materials

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

Part 3 - Execution

3.01 Equipment

A. As required by Section 27 00 00.

1. Safety: Contractor shall use proper structural installation techniques and maintain a minimum 5:1 safety margin.

2. Custom Mounting Finish: Custom mounting hardware shall be painted by Contractor to match either color of wall, ceiling or equipment, at Consultant's discretion.

3.02 Interconnection

A. As required by Section 27 00 00.

1. Interpretation: Contractor shall make system interconnections as indicated on Drawings and specified herein. Contractor shall interpret Drawings using an understanding of the equipment and general system topology (both existing and future/specified). Contractor shall provide 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.

2. Additional: Contractor shall be responsible for associated equipment signals not specifically documented in provided drawings. These include synchronizing signals, transmitting and receiving antennas, and LAN connections to equipment provided and/or installed by Contractor.

3. Mass Notifications: Contractor shall ensure that audio systems are appropriately managed by emergency notifications so that emergency notifications are not impeded by the audio system.

3.03 Cable Management

A. As required by Section 27 00 00.

1. Above Ceiling: Cabling located above ceilings shall be tied off to and supported by ceiling supports or other structures at a minimum of eighteen (18) inches above the ceiling.

2. Not on Ceiling: Cabling shall not lie on the ceiling.

3. Wall Cabling: Cables installed in a horizontal fashion along wall surfaces shall be installed in surface raceway approved by Owner and Consultant.

4. Floor Cabling: Cabling placed at floor level such as microphones shall be installed on the floor in the shortest possible route to the nearest wall considering traffic patterns and in an enclosure designed for that use and offering protection from foot traffic.

5. Desk Cabling: Where a cable is installed inside desk furniture, a means of protecting the cables and holding cabling to a fixed surface shall be installed.

6. Grommets: Holes in horizontal furniture surfaces for cable pass-through shall be provided with appropriate sized grommet. Grommet shall be black unless otherwise specified or required.

7. Stub-ups: Where conduit is stubbed-up through the floor and exposed, Contractor shall wrap cables with black expandable sleeving and secure at least three (3) inches below level of conduit top.

a. Where conduit is stubbed-up through floor and concealed within furniture, Contractor shall install tether comprised of aircraft cabling to limit the distance furniture may be moved away from stubbed-up conduit. Cabling service loop exiting stubbed-up conduit and entering furniture shall be longer than the

corresponding tether, providing protection against movement of furniture that would otherwise damage installed cabling.

8. Umbilicals: Exposed cable umbilicals, such as those between instructional furniture and a floor- or wall-mounted plate, shall be covered in black expandable sleeving, with neatly finished ends (heat-shrink or Consultant-approved method).

3.04 Connector Termination

A. As required by Section 27 00 00.

1. Video Connectors: Video connectors (BNC, RCA, and F) shall be terminated using a crimp tool or dies designed specifically for the connectors being applied.

2. XLR Connectors: Terminate XLR type connectors wired pin 2 high, pin 3 low, and pin 1 shield.

3. UTP: UTP cable shall be terminated with appropriate crimps tools or tools specified by manufacturer.

3.05 Grounding

A. Audiovisual equipment racks shall be grounded to the telecommunication grounding system with a minimum 6 AWG grounding cable. Refer to Section 27 00 00 for additional grounding requirements.

3.06 Testing & Inspection

A. General Information: As required by Section 27 00 00.

B. Notification: Prior to start of testing, provide a list to Consultant of test equipment make, model numbers and calibration dates that will be used.

C. Testing: Contractor shall perform complete testing on system before inspection. Selected systems may be retested during inspection at Owner's discretion.

D. Display/Output checks: Contractor shall verify that visual and audio outputs from the system are high-quality and without noticeable distortion or feedback at normal operating levels.

E. Wiring and Labeling: Contractor shall check all inputs and outputs for correct wiring and labeling.

F. Loudspeakers: Contractor shall measure the impedance of each speaker line leaving the equipment racks. For full range devices, use a frequency of 1000 Hz. For band limited devices, use a frequency appropriate for the operating range of the transducer. When documenting results, Contractor shall include the calculated impedance based on number of units on a line and the size and distance of the run. Contractor shall correct any field readings that differ more than 20% from the calculated impedance. Contractor shall use an electronic polarity checker to test each reinforcement speaker. Speakers shall have the same relative polarity.

3.07 Computer Graphics

A. Computer graphics shall be crisp and focused with respect to color alignment. If color alignment is not registered properly, Contractor shall identify source of problem and correct. EDID and other auto-registration features shall be set within AV equipment where required for optimal system performance.

3.08 Training

A. General Information: As required by Section 27 00 00 and following section(s).

B. Coordination and Personnel: Training shall be coordinated with Owner's schedule, and Contractor personnel who provide training are subject to Owner's approval.

3.09 Project Closeout

A. Completion: System shall be considered complete when all of the following has occurred:

1. Testing has been completed to the satisfaction of Owner and Consultant.
2. Punch-listed items have been addressed to the satisfaction of Owner.
3. As-built drawings and system documentation has been turned over to Owner and Consultant.
4. Complete operational training has been conducted with Owner's staff.
5. System Commissioning Process has been completed.

B. Acceptance: Contractor shall secure written Acceptance of systems in the form of authorized Owner signature on Acceptance Document. This shall constitute the Date of Acceptance.

End of Section

Section 274100 – Audio Visual Systems

Part 1 - General

1.01 Scope

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

B. Provide audio visual systems as well as training and warranty services for those systems as described herein.

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 15 00 – Communications Horizontal Cabling

G. Section 27 40 00 – AV Multimedia General Requirements

1.03 Reference

A. In addition to any requirements below, Contractor shall abide by requirements delineated in 27 00 00 and 27 40 00 including but not limited to:

1. General: Definitions, reference standards and codes, qualifications, pre-construction submittals, construction progress submittals, closeout submittals, and correction period.

2. Products: Substitutions, product specifications, miscellaneous material, cable, connectors, power devices, and interface panels.

3. Execution: Coordination, testing, training, warranty, and cable management.

1.04 Correction Period

A. General Information: Products shall be covered by Contractor correction period as required by Sections 27 00 00 and 27 40 00.

B. Correction Period: Contractor's obligation for correction period shall not abrogate manufacturers' warranty periods.

C. Commencement: Correction Period begins on Date of Acceptance.

1.05 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.

1.06 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. Qualifications

1. Provide certificates for employees working on this project that show they meet the necessary qualifications described in 27 40 00 Part 1, including AVIXA CTS/CTS-I/CTS-D, control system programming certifications, digital signal processor certifications, Dante certifications, and 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.

2. Provide a separate schedule of materials for each system or room type.

D. Color Selection List

1. Provide a list of all audiovisual 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 speakers, projectors, projection screen cases, cameras, antennas, control panels, input plates, microphones, ceiling enclosures, wall enclosures, specialty furniture, monitor arms, cable cubbies or grommets, rigging, mounts, and wireless access points.

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. Provide a separate list for each room type. The same product may require a different color in different rooms to match the aesthetics of the space.

4. The AV 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

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. Equipment Rack/Cabinet & Wall Equipment Elevations: Include placement of all rack/cabinet or wall-mounted equipment, drawn to scale.

   d. Structurally Mounted Elements: Include a plan view of placement and a detail of the structural mounting techniques to be used.

   e. Furniture: For all Contractor-provided furniture, include dimensional drawings, cable management, and finishes with samples for Owner approval.

1.07 Construction Progress Submittals

A. Network Device Schedule

1. Provide a schedule of AV devices requiring IP addresses from the Owner. The schedule shall include columns for relevant information such as Manufacturer, Model, MAC Address, Serial Number, Description, Location, etc. The Contractor shall provide additional information when required by the Owner to assist them in assigning IP addresses.

B. Touch Panel Layouts

1. Provide a submittal with proposed touch panel page layouts. Include notes that narrate the functionality of each button.

2. Include separate layouts for each differing room type.

3. The Consultant shall review this submittal first and may require resubmittals to address concerns. Once the layouts are acceptable to the Consultant, the Contractor shall meet with the Owner and Consultant and present the touch panels for the Owner’s consideration.

4. Approval of the touch panel layouts does not exempt the Contractor from making additional changes once the system is installed. The Owner reserves the right to request additional changes to the system programming and graphical user interface (GUI) for three (3) months after the initial system training, and the Contractor is required to make these changes at no additional cost to the Owner.

1.08 Ownership

A. General: Upon completion of the project, all programming and configuration of control hardware, touch panels, and other devices shall be the property of the Owner.

B. Property Rights: Contractor assigns to Owner any and all intellectual property rights and applications made by Contractor, or its agents or employees in connection with

the performance of this contract. Contractor also acknowledges and agrees that services rendered in connection with the performance of this contract shall be a "work made for hire" within the meaning of Section 201 inventions of the Copyright Law of 1976.

C. No Passwords: Contractor shall not use any passwords to prevent access to code files except as specified herein.

1.09 Turn-Over Cables

A. Contractor shall provide an end-user input cable for every wall plate connection or other end-user input location.

B. Turn-over cables shall match the quality and requirements of the main cable run for that signal type; refer to 27 40 00.

C. Turn-over cables shall be 10-feet in length except where noted otherwise or where required for system functionality.

1.10 Manufacturer Coordination

A. Contractor shall contact the manufacturer(s) to obtain master quote information if available. Master quotes often contain additional products that may not explicitly appear in the specifications.

1.11 System Descriptions

A. General

1. This specification is intended to describe the general system types/locations and components, not every connection or room. The technology drawings more fully describe these systems and must be reviewed thoroughly in conjunction with the specification.

2. The technology floor plans indicate AV device locations, including input plates, speakers, projectors, flat panel displays, wall controllers, AV cabinets, etc.

3. The technology schematics (located on the "Technology Details" drawing sheets) indicate AV components in each system type and how they are connected. The components are described generally (ex: "AMPLIFIER") with the specified model indicated below. Some device model numbers are not indicated in these written AV specifications and must be found on the technology drawing schematics located in the detail sheets. The schematics also indicate specific installation and functional requirements not shown elsewhere.

4. The loudspeaker schedule (located on the "Technology Details" drawing sheets) indicates speaker models and other requirements. It specifies which model speaker shall be provided at each location type by using numbered identifiers that appear on the symbols on the floorplans (ex: "S1" for speaker type 1).

5. The display schedule (located on the "Technology Details" drawing sheets) indicates the anticipated display size for a given location, as well as the intended use and a reference to the associated AV schematic drawing. For example, "FP1" will be defined here to tell you the purpose, size, height, and associated AV system detail that applies anywhere you see an "FP1" symbol on the floor plans. Be aware that a room's name on the architectural floor plans may not match the system name for the space. Use the flat panel numbers to determine what system is required.

6. Each system description includes a list of anticipated equipment. This list generally describes the type and quantity of major components. For detailed specification requirements regarding these components, refer to Part 2 as well as the AV schematic line drawings. Interconnecting cables are generally not listed as "major components" but are required and assumed to be included

Part 2 - Products

2.01 Additional Specified Products

A. Many AV products are specified on the technology drawings and not necessarily listed in this specification. AV products shown in the drawings shall be considered part of this specification regardless of whether they are also listed below.

B. If a specific product manufacturer and/or model is indicated on the drawings and other manufacturers are listed in this specification, the product shown on the drawings shall be the basis of design. Equal products by the other listed manufacturers may be considered via the substitution process outlined in 27 00 00.

C. AV products specified in the drawings typically appear on the AV detail sheets, either in a schematic line drawing, a loose equipment list, or a schedule (ex: speakers, displays, etc.).

D. Not all AV products appear on the drawings. Products listed in this specification but not shown on the drawings are still required as part of a comprehensive AV bid package.

2.02 AV Network Switches

A. Provide network switches for AV systems as necessary.

B. Switches shall be sized to match the number of connections and PoE/PoE+ load.

C. For AV systems where the AV manufacturer publishes a list of recommended or approved switches, the network switches must be on this list. For AV systems where the AV manufacturer does not publish a list, the network switches must meet the minimum specifications required by the AV equipment and recommended by the manufacturers.

D. Manufacturer: Netgear M4250 Series

2.03 Bluetooth Extender Plates

A. Single-gang, Decora style in-wall Bluetooth audio interface

B. One button pairing/connect with LED indicator

C. Serial control protocol for integration with control system

D. Defeatable pairing button for restricted use applications with control system

E. Balanced mono/stereo analog outputs

F. Compatible with smartphones, Apple iPads, and Android tablets

G. Manufacturer: Attero Tech by QSC or approved equal

2.04 Cable

A. Cable shall be provided and installed as detailed herein. Cable installed that does not conform to these standards or that has not been given prior approval by Consultant shall be removed by Contractor and replaced at Contractor's sole expense.

B. Plenum: Plenum-rated cables shall be used where required by code or by best practices. All cables run beneath raised floor shall be plenum-rated.

C. High-Definition Digital Video (HDMI)

1. Due to HDMI distance limitations, anywhere the cable distance exceeds 20 feet, an acceptable solution shall include some form of extension. Extension shall be via UTP/XTP extenders. Contractor shall provide extenders where cables exceed 20 feet regardless of whether they are explicitly shown or specified. At locations where the end-to-end cable distance is 20 feet or less, commercial-grade passive HDMI cables may be used. Provide a cable channel that is reliable and functions with all source devices the Owner may use.

2. Acceptable solution shall support HDMI 2.0a and 4K@60Hz 4:4:4 at minimum.

3. Acceptable solution shall be manufactured by a Pro AV manufacturer with 5+ years in the AV industry and an existing install base in the region.

4. Manufacturers:

a. Atlona

b. Broadata

c. Crestron

d. Extron

e. Liberty AV

D. USB

1. Due to USB distance limitations, anywhere the cable is routed within the wall or above the ceiling, an acceptable solution shall include some form of extension. Extension shall be via UTP/XTP extenders. Contractor shall provide extenders where cables route through walls or ceilings regardless of whether they are explicitly shown or specified.

2. Acceptable solution shall support at a minimum USB 2.0 except where noted otherwise.

3. Acceptable solution shall be manufactured by a Pro AV manufacturer with 5+ years in the AV industry and an existing install base in the region.

4. Manufacturers:

a. Atlona

b. Broadata

c. Crestron

d. Extron

e. Liberty AV

E. Installed Video: Video signal coaxial cables shall have #18 solid copper center conductor, gas-injected high density Polyethylene or Fluorinated Ethylene Propylene insulation, copper braid shield of at least 95% coverage and 100% dual-sided foil and black PVC jacket unless color is otherwise noted. Cable shall be designed as a low loss serial digital video cable. Belden 1694A, WestPenn 6350, Canare L-5CFB, Liberty 18-CMR-SD, or equal. Plenum cable, Belden 1695A, WestPenn 256350, Liberty 18-CMP-VID-COAX, or equal.

F. Flexible Video: Short video cables that are intended to be moved or adjusted on a regular, frequent basis may be constructed of a stranded bare copper center conductor RG-59/equivalent cable with >94% copper braid shield and polyethylene dielectric. Canare LV-61S, Belden 1505A, WestPenn 819, or equal. Plenum cable, Belden 1506A, WestPenn 25819, or equal.

G. High Resolution RGBHV Graphics/Video: Cable type and size shall be selected to provide a minimum of 250 MHz bandwidth (-3dB) at over the length of each RGBHV signal path from source to display, including losses and gains through cable loss, signal processing, switching and distribution equipment. Manufacturer shall designate cable as suitable for high-resolution use. Extron MHR-5, Liberty RGB5C-25-CM or equal. Plenum cable, Extron MHR-5P, Liberty RGB5C-25-CMP, or equal.

H. Installed Line Level and Microphone (single line): Audio signal cable shall have twisted pair #22 stranded tinned copper conductors, polyethylene conductor insulation, aluminum-polyester foil shield, #24 stranded tinned copper drain wire and chrome PVC jacket. Belden 8761, West Penn 291, Canare L-2T2S, Liberty 24-2P-STAR, or equal. Plenum cable, Belden 88761 or equal.

I. Portable Microphone, Enclosure and Breakout Line Level Audio: Cable shall have 4 conductors per channel arranged in star quad double-balanced pairing, #24 stranded conductors of at least 40 tinned annealed copper wires, 100% coverage wrap shield, tinned copper braid shield of approximately 50% coverage, uniformly round form and black PVC jacket. Canare L-4E6S, Belden 8723, WestPenn 355, or equal. Plenum Cable, Belden 88723, Liberty 24-4P-PLCSH-WHT, or equal.

J. Broadband Video Antenna Cable: For runs shorter than 15', RG-59. For runs 15'-50', RG-6.

K. Wireless Microphone Antenna Extension Cable: 50-Ohm coaxial cable, or as directed by microphone manufacturer.

L. Loudspeaker Wire: 14 AWG minimum.

M. Subwoofer Wire: 10 AWG minimum.

N. UTP Cable: Shall be consistent with specific recommendations by hardware manufacturer of transmission equipment. Where no clear recommendation is made, the cable shall at a minimum meet the Category 6 performance requirements outlined in 27 15 00.

O. Control: Shall be as recommended by equipment manufacturer, with the appropriate number of conductors for the application.

P. Cable Construction: Contractor shall fabricate interconnecting cables using products defined in this section unless equipment manufacturer-provided cable is of a specialized or proprietary nature. Pre-manufactured cables are subject to prior approval by Consultant.

Q. Labels: Labels shall include a white paper or vinyl slip with typed or machine printed designations, secured in place with a wider section of clear heat shrink tubing or integral clear adhesive-backed plastic.

R. Terminations: Provide specialized terminating hardware as required.

S. Schedule: Contractor shall submit schedule prior to installation for Consultant review indicating cable types that will be used on the project

2.05 Ceiling Enclosure Box

A. Certain locations noted on plans shall receive a large flush-mount ceiling box that replaces a 2'x2' ceiling tile. This box shall function as a centralized location for display connectivity (data, power, AV) as well as a space to house any electronics feeding or controlling the display.

B. The ceiling box shall include knockouts where single-gang boxes can be attached on at least three sides.

C. Contractor shall be responsible for proposing an enclosure that accommodates all anticipated equipment and includes sufficient passive or active ventilation for the heat load generated.

D. Manufacturers: Chief, FSR, Legrand Wiremold, Premier Mounts, or approved equal

1. FSR CB-224S – provide at any location where a single component is greater than 1 RU or where the sum of the components is greater than 2 RU

2.06 Connectors

A. Connectors shall be provided and installed as detailed herein. Connectors installed that do not conform to these standards or that have not been given prior approval by Consultant shall be removed by Contractor and replaced at Contractor's sole expense.

B. HDMI (Video/Audio/Control): Cables to be factory-terminated with molded strain relief.

C. BNC (Video): Video signal BNC connectors shall be 3-piece crimp-on type with insertion barrel and ferrule, and gold flashed crimp-on center pin. Barrel shall provide full circumferential contact with the braid. Fittings shall be sized to fit the cable. Canare BCP-C series or equal. Crimping and die tools shall be Canare TC-1 Hand Crimp Tool with appropriate TCD die sets or equal.

D. RCA (Video): Video signal RCA connectors shall be 3-piece crimp-on type with gold flashed center pin, Canare RCAP-C series or equal. Crimping and die tools shall be Canare TC-1 Hand Crimp Tool with appropriate TCD die sets or equal.

E. F (Video): Video signal F connectors shall be 3-piece crimp-on type with gold flashed crimp-on center pin. Canare FP-C series or equal. Crimping and die tools shall be Canare TC-1 Hand Crimp Tool with appropriate TCD die sets or equal.

F. BNC (RGBHV Graphics): Graphics signal BNC connector shall be crimp-on type with insertion barrel and ferrule, and gold flashed crimp-on center pin. Barrel shall provide full circumferential contact with the braid. Fittings shall be sized to fit the cable. BNC manufacturer, model and tools as recommended by the manufacturer of the RGBHV/graphics cable.

G. XLR: Strain relief shall be sized to fit the cable. Connector shell shall be isolated from all contacts. Neutrik CA-NC series or equal.

H. Mini-XLR: Strain relief shall be sized to fit the cable. Connector shell shall be isolated from all contacts. Switchcraft or equivalent.

I. Phono (RCA): Phono/RCA connectors shall have gold contact and solid center pin with metal strain relief. Canare F-10 or Canare F-09 or equal.

J. Phone (1/4 inch): Reinforced one-piece body shall have brass bar running length of handle. Canare F-15 (TS) or Canare F-16 (TRS) or equal.

K. Mini (1/8 inch): Shall be Canare F-11 (TS) or Canare F-12 (TRS) or equal.

L. RJ45: RJ45 jacks that are field-terminated shall be punch-down type. All flexible connectivity to AV devices shall be factory-molded patch cables. Where a field-terminated plug is required by manufacturer recommendations, Contractor shall use appropriate connector type to the type of cable used (solid vs. stranded).

M. Shielded cable to be terminated with shielded connectors or as required by manufacturer recommendations.

N. DM, DM8G+: Shall be Crestron shielded RJ-45 and fiber connectors, as recommended by manufacturer of DM or DM8G+ system.

O. Schedule: Contractor shall submit schedule prior to installation for Consultant review indicating connectors that will be used on the project.

2.07 Digital Signage System

A. Provide digital signage players at displays where noted on the plans. For all such displays, include a full-feature signage license

B. Signage Player Manufacturer: BrightSign XT1144 or approved equal

C. Software Manufacturer: Carousel

2.08 Digital Signal Processor

A. Minimum 4 input, 4 output audio DSP. Provide larger model and/or additional expansion I/O modules as necessary to support the number of connections in a given system.

B. Supports Acoustic Echo Cancellation on microphone inputs

C. RS-232 and/or Ethernet control to interface with AV control system.

D. Dante support where applicable

E. Manufacturers: Allen & Heath, Biamp, Extron, QSC, or Symetrix

2.09 Equipment Racks

A. Sized to fit all system equipment with space for airflow and future expansion

B. Casework/millwork locations

1. Sized to fit all system equipment with space for airflow and future expansion
2. Coordinated to fit inside of casework; refer to architectural plans
    a. Fan kit with thermostatic fan control
    b. Coordinate active cooling and ventilation with millwork contractor
    c. Ventilation shall include passive air intake at the bottom and exhaust at the top
3. Manufacturer: Middle Atlantic SRSR Series

C. Instructor lectern locations

1. Rack shall be built into the lectern.
2. All finishes shall be coordinated with Owner. An approved proof of concept is required prior to ordering.
3. AV Contractor shall coordinate with Architect and furniture provider to ensure the appropriate rack space and cable pathways are provided.

D. Fixed wall locations

1. Provide with:
    a. 1 RU vented blank panels between all major components (e.g. amplifiers) and equipment groupings (e.g. wireless receivers, media players, etc.)
    b. 4 RU rack drawer for housing microphones and cables
    c. Locking vented front door
    d. Quiet fan kit with thermostatic fan control
2. Manufacturers: Middle Atlantic SR-Series or equal

2.10 Equipment Rack Header Panel

A. Header panel shall be laser-etched with white print and shall include Consultant logo and website as well as Contractor's logo and website information.

B. Header panel shall include service port if applicable. Otherwise provide with port cover.

C. Manufacturer: RCI Custom #TNCG-RACK-HEADER or equal

2.11 Flat Panel Displays

A. Displays

1. Flat panel displays shall be commercial grade. Any displays used in common spaces shall be rated for 24/7 operation. All other locations shall be rated for 16/7 operation.
2. Flat panel displays shall support all necessary connections, including – at a minimum – two HDMI inputs and RS-232 control.
3. Flat panel displays shall have a minimum of 3840x2160p resolution (Ultra High Definition) except where noted otherwise

4. Flat panel displays shall have built-in speakers, except where the display is connected to a separate sound system
5. Manufacturers:
    a. LG, NEC, Samsung, Viewsonic, or approved equal

B. Mounts

1. Commercial grade mounts shall be used for all flat panel displays
2. Mounts shall match the size and load of the display
3. All mounts shall have downward tilt
4. Total depth of mount and display off the wall shall not exceed ADA allowed distance for protruding objects
5. Manufacturer:
    a. Extending mounts – Chief Thinstall Dual Swing Arm Series or approved equal
    b. Fixed mounts – Chief Fusion Series or approved equal

C. In-Wall Equipment Box

1. Each display location shall receive a large flush-mount wall box. This box shall function as a centralized location for display connectivity (data, power, AV) as well as a space to house any electronics feeding or controlling the display.
2. The wall box shall include knockouts where single-gang boxes can be attached on at least three sides.
3. Manufacturer: Chief, FSR, Hoffmann, Legrand Wiremold, or approved equal

D. Storage

1. In rooms without a ceiling storage box or equipment rack, all AV equipment shall be mounted behind the flat panel display
2. Provide appropriate quantity and size of mounting accessories to securely mount all AV equipment components
3. Manufacturer: Chief component storage panels or approved equal

2.12 Power Solutions

A. Large Systems

1. Rack mount main sequencer with additional modules as necessary. Provide power sequencers at all large venue AV racks or any rack with an audio amplifier greater than 50W. Does not apply to systems where the amplifier is intended to remain on; ex: Energy Star amplifiers in ceiling enclosures.
2. Power output shall match recommended input power for system equipment. Main sequencer shall have 120V/20A output. Additional modules with 120V/30A or 220V/20A output may be required for certain amplifiers.
3. Provide with surge protection and remote switch
4. Minimum of six rear outlets and three sequenced groups of outlets
5. RS-232 and/or Ethernet control to interface with AV control system

6. Manufacturers: Furman, Middle Atlantic, Surge-X

B. Small Systems

1. Provide a rack mount 1 RU horizontal power strip with surge suppression at each equipment rack
2. Manufacturers: Furman, Middle Atlantic, Surge-X

C. Power Strips for Discrete AV Systems

1. Power strips shall be UL listed, surface mounted, rated for 115V-120V line voltage with a minimum current rating of 15A, and over-voltage auto shutdown AC surge protection at minimum.
2. To be used behind wall-mounted displays, within credenzas, or any location where commercial-grade, industry-standard power distribution is not a viable solution.
3. Provide type and quantity of power strips necessary to power all system equipment.
4. Manufacturers: Surge-X Flatpak, Tripp-Lite, Furman

2.13 Uninterruptible Power Supply (UPS)

A. Provide a UPS battery backup for continuous operation during power failure for 30 minutes at half load.

B. Manufacturers:

1. APC
2. Middle Atlantic
3. Tripp-Lite

2.14 User Connectivity Interfaces

A. Provide at furniture locations to allow users to connect to power, data, and AV inputs without having to reach down to floor boxes or wall outlets.

B. Applies to conference tables, lecterns, and other furniture where noted in the AV system descriptions or on the drawing set.

C. Confirm exact model, color, and components with Architect prior to ordering.

D. Guidelines for configuration:

1. Include One Touch Retractors for HDMI and USB signals
2. Include at least one USB-C/A charging module
3. Include at least one Cat6 connector plate
4. Include at least one US Dual power module at lectern locations and at least two US Dual power modules at conference table locations
5. Include mounting shelf
6. Include ‘cloak’ cover

E. Manufacturer: Crestron FlipTop2 Active Series

1. Basis of design: FT2-700-PTL model

2.15 Wall Plates

A. All faceplates and plate devices shall be coordinated with the architect to ensure that the finish is consistent with the aesthetic of the space

B. All device plates shall support the same signal transmission requirements as the interconnecting cables. Refer to the "Cables" sections for more information.

C. Passive HDMI plates shall include a pigtail on the back to facilitate appropriate bend radius and smooth transition into conduit.

D. Contractor shall provide custom plates where necessary to support the designed signal and/or connector types.

E. Manufacturers: Crestron, Extron, Liberty AV, or approved equal

Part 3 - Execution

3.01 Equipment Location

A. Coordination: Where device locations are not shown on rack/console elevations and project drawings, Contractor shall coordinate with Consultant to identify desired/optimal locations.

B. Contractor shall verify all wall-mounted monitor mounting heights on preconstruction submittals.

3.02 Aesthetic Requirements

A. Printing: Button labels shall be engraved where applicable, or machine-printed where no engraved button/bezel is available. Handwritten labels are not acceptable.

B. Graphics: Icons and graphic representations of equipment and functions shall be crisp, sharp, and easy to identify. Icons shall be used wherever possible.

C. Text: ICS screens shall not use uncommon abbreviations. Text shall be sans serif and shall be sized to be clearly readable.

3.03 Equipment Configuration

A. Labeling: Contractor shall configure all equipment for normal use, including setting of levels and presets. Small adhesive labels shall be affixed to equipment indicating nominal levels and settings.

B. EDID, E-EDID: Where devices allow for the customization of EDID information, Contractor shall configure EDID settings of all applicable devices such that the audiovisual system is optimized.

C. Software: Contractor shall utilize Manufacturers official current version of configuration software. Special exemption may be obtained from Consultant if current version contains known issues. In such event, the version immediately preceding shall be utilized.

D. IP Interface: Contractor shall configure/modify IP-based monitoring software to allow Owner to monitor all rooms installed as part of this work. Automatic timed system

shutdown shall be configured as part of this software. Shutdown time(s) to be coordinated with Owner.

E. Control System: Contractor shall make adjustments to programming as required by Consultant up to issuance of substantial completion punch list at no additional charge, so long as changes relate to equipment in this bid package.

3.04 Digital Signal Processor

A. Processor power required of DSP shall not exceed 80% total processing capacity. If processing power required exceeds available processing power, Contractor shall immediately notify Consultant during pre-installation phase.

B. Functional Requirements

1. Functions: The DSP shall be configured to provide:

a. Pre-amplification

b. Filtering and Equalization

c. Dynamics processing

d. Gating

e. Mixing, Automatic mixing – gain sharing or gated

f. Zoning

g. Mix-minus

h. Delay

i. AEC

j. Volume control

k. Emergency/Alarm muting

l. Signal metering

m. Logic functions

2. Gain Structure: The DSP shall be configured to obtain and maintain unity gain structure from input pre-amplification stage to output stage or associated end-user volume control.

3. AEC: The DSP shall be configured to provide AEC for all microphones detecting echo in conferencing and specialty DSP applications. AEC shall be configured per DSP Manufacturer's recommendations and best practices.

4. AEC and Pre-AEC: Where microphones used for speech / sound reinforcement are part of a conferencing system requiring AEC processing, the "Pre-AEC" audio path shall be utilized for speech / sound reinforcement while a separate path processed for AEC shall be utilized for conferencing.

5. Organization: Referring to open-Architecture DSP platforms. Processing objects shall be clearly labeled and organized clearly to follow the intended signal path from left to right, top to bottom. Connection lines between objects shall be routed in an organized fashion.

6. Multiple DSP: Where designs include more than one DSP linked via virtual multi-channel audio buss or digital audio network, all signals shall be routed to a central processor for master routing and 3rd party control. All control points being controlled by ICS controls shall be located on a single DSP operating as the master unit.

7. Latency: Also known as propagation delay, Programmer shall utilize sufficient and efficient processing paths to achieve intended results whilst minimizing latency from input to output.

C. DSP Controls

1. Contractor shall coordinate work of ICS Programmer and DSP Programmer.

2. Volume controls shall be range limited within DSP to provide end-user with adequate adjustment range (typically +/-6dB for microphones and +/-10dB for presentation sources). Operation of DSP from end-user standpoint shall be seamless with ICS system operation.

3. Processing objects within Audio DSP configuration shall be clearly identified where controlled by ICS. Text objects or similar shall identify these objects.

3.05 IT Coordination

A. General: Where connection between components or control features are accomplished over the Owner's LAN, Contractor shall coordinate with Owner's IT department for IP addresses, firewall access, and other issues pertaining to successful integration.

B. Permission: It is Contractor's responsibility to obtain necessary information and permissions to implement their system. Any delays or problems with gathering information or coordinating access to the LAN or WAN shall be brought to Consultant immediately for resolution.

C. Wireless Access Points: In systems where there is a dedicated AV network with it's own WAP(s), the Contractor shall coordinate with the Owner's IT department for all WAP channel configuration, placement, and coverage. Ensure audio visual control system WAP is not treated as a rogue WAP by the Owner's wireless management system.

3.06 System Testing

A. Contractor shall check that all cables are properly labeled and secured prior to substantial completion inspection.

B. Contractor shall ensure that all work areas are clear of all debris, tools, empty boxes, and extra parts prior to substantial completion inspection.

C. Prior to the substantial completion inspection, Contractor shall notify the Consultant that all items listed below are complete:

1. Contractor shall ensure that all standard functions of equipment are functional.

2. Contractor shall verify all input and outputs of the system for signal quality.

3. Audio: Contractor shall verify all sources are free of destructive noise (excessive noise floor, hiss, grounding interference) and that speakers function properly. The audio system shall be consistent in terms of volume and tone and shall be optimized for the space(s) served by the audio system.

a. Control functionality, verification of presets, volume controls, mute controls, etc.

b. Stable operation, completely free of feedback and distortion throughout entire range of available ICS controls.

c. Correct routing of all signals to intended destinations.

d. Unity gain structure.

e. Output transducer (speaker) protection processing functionality.

f. AEC functionality.

g. Provide measurement test results per ANSI/InfoComm 1M-2009 ACU.

h. Outdoor sound system measurements shall be provided at a minimum of one measurement location per 50 seats. Measurements shall be performed using pink noise test signal at a volume congruent with nominal system operation. Measurements shall indicate:

i. Site plan map of seating areas and test locations.

ii. Frequency response from 80Hz-16kHz in 1/3 octave resolution.

iii. SPL (A weighted) of the test signal as measured from each location.

iv. Weather conditions at time of test; including temperature, humidity and average wind speeds.

4. Video: Contractor shall verify that all EDID and EDID-D information has been configured at each video transmission and processing device. Where signal processing is present, Contractor shall optimize the video system to native resolution of display devices.

D. Testing & Adjusting

1. The Contractor will be responsible for adjusting the installed system and notifying the Consultant when system adjustments have been completed:

a. In accordance with Construction Documents

b. As required, to provide the Owner a fully functional system at system turnover

c. As directed by the Consultant

2. Audio System Equalization

a. Using a Real-Time audio frequency spectrum analyzer, such as Audio Control SA-3052 or equivalent, with both 1/3 band and narrow band display, equalize all loudspeaker systems to provide a suitable frequency response as follows:

i. For each indoor sound system measurements shall be provided at a minimum of one measurement location per room quadrant - (approximately 100 square feet). Measurements shall be performed using a pink noise test signal at a volume congruent with nominal system operation.

ii. Measurements shall indicate:

a. Floor plan map of room, seating areas and test locations.

b. Flat Frequency response from 60 Hz to 20 kHz + or – 1-1/2db with a 1db per 1/3 octave roll off after 2kHz.

c. SPL (A weighted) of the test signal as measured from each location.

d. Load and save the final normal settings in the DSP as preset one and record same settings including system gain and amplifier level settings in the As-Built Project Manual

E. Notification: When above tests have been completed and system is ready for inspection, notify Consultant in writing at least seven working days prior to inspection. Include in this notice copies of all data recorded, date each test was completed and results of each test. All test data shall be available during inspection process.

F. Immediately prior to final inspection, in the presence of Consultant and/or Owner representative, Contractor shall load DSP program and integrated control system program from Closeout Submittal media and demonstrate full system functionality.

3.07 Firmware

A. Firmware upgrades shall be dated the same as Date of Acceptance. Contractor shall upgrade firmware and software as necessary during project so that latest versions are installed as of Date of Acceptance.

3.08 Training

A. General Information: As required by Sections 27 00 00 and 27 40 00.

B. Contractor shall provide one (1) 60-minute training session for each unique audiovisual room type. Training sessions shall comprise of one half of the time dedicated to instructor led training with the remainder of the session to be used for instructor supervised hands-on end user operation of the system(s):

1. Identification of input locations, source devices, control locations, displays, and other devices requiring end user interaction for successful system operation.

2. Use of control system.

3. Use of source devices and input locations.

4. Switching inputs for each display.

5. Training shall include operation of system in event of control system malfunction – all manual switching and use of remotes.

6. Basic troubleshooting for common user errors.

C. Scheduling: Training shall be scheduled with Owner at least ten (10) days in advance.

D. Quick-Reference Guides: Contractor shall compile quick-reference guide for system operation and basic troubleshooting. Quick-reference guide shall be provided at the training session, and training shall include walking through quick-reference guide steps.

END OF SECTION

SECTION 276000 – PHYSICAL SECURITY GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

A. Refer to Section 270000 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.

1.2 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270500 – Communications General Requirements

C. Section 270526 – Grounding and Bonding for Technology Systems

D. Section 270528 – Pathways for Technology Systems

E. Section 270537 – Firestopping for Technology Systems

F. Section 271100 – Communications Equipment Rooms

G. Section 271500 – Communications Horizontal Cabling

H. Section 271600 – Communications Connecting Cords

I. Section 271800 – Communications Labeling and Identification

J. Section 27 51 00 – Distributed Communications Systems

K. Section 27 62 00 – Electronic Access Control System

L. Section 27 64 00 – Video Surveillance System

M. Section 27 66 00 – Intrusion Detection System

N. Section 27 68 00 – Detention Security Systems

1.3 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

1.4 REFERENCE STANDARDS AND CODES

A. Refer to Section 270000 for additional requirements.

1.5 QUALIFICATIONS

A. Refer to Section 270000 for additional requirements.

C. Training: Programmer shall have received manufacturer-provided and/or manufacturer approved training in the configuration of the physical security system(s) being provided.

D. Certification: Programmer shall hold the highest applicable manufacturer programming certification(s) offered by the manufacturer(s) of the physical security system(s).

E. Submittal: Certification certificate shall be submitted with physical security system(s) submittals.

1.6 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 270000 for additional requirements.

C. 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

1.7 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.8 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 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

2.1 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 270000.

2.2 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.

2.3 REFER TO INDIVIDUAL SECTIONS FOR ADDITIONAL PRODUCT INFORMATION.

2.4 FIRE STOPPING MATERIALS

A. Refer to Section 270000 for additional requirements.

PART 3 - EXECUTION

3.1 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. The Contractor shall use software such as NetTime (www.timesynctool.com) installed on the servers and dedicated workstations.

C. The Contractor shall coordinate with the Owner for a NTP server connection address.

3.2 TESTING

A. Refer to Section 270000 for additional requirements.

3.3 TRAINING

A. Refer to Section 270000 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.

3.4 WARRANTY

A. Refer to Section 270000 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.

3.5 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.

3.6 INSTALLATION REQUIREMENTS

A. Refer to Section 270000 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.

3.7 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.

3.8 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.

3.9 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 276200 – ELECTRONIC ACCESS CONTROL SYSTEM

PART 1 - GENERAL

1.1 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 270000 for additional project scope information.

1.2 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.

1.3 RELATED WORK

A. Division 08 - Door Hardware

B. Section 270000 – General Technology Requirements

C. Section 270500 – Communications General Requirements

D. Section 270526 – Grounding and Bonding for Technology Systems

E. Section 270528 – Pathways for Technology Systems

F. Section 270537 – Firestopping for Technology Systems

G. Section 271100 – Communications Equipment Rooms

H. Section 271500 – Communications Horizontal Cabling

I. Section 271600 – Communications Connecting Cords

J. Section 271800 – Communications Labeling and Identification

K. Section 27 60 00 – Physical Security General Requirements

L. Section 27 64 00 – Video Surveillance System

1.4 DEFINITIONS

A. ACS – Access Control System

B. IDS – Intrusion Detection System

C. VMS – Video Management System

D. Refer to Section 270000 for additional definitions.

1.5 REFERENCE STANDARDS AND CODES

A. IEC 60839-11-5:2020 - Open Supervised Device Protocol (OSDP)

B. Refer to Section 270000 for additional requirements.

1.6 QUALIFICATIONS

A. 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.

B. Refer to Section 270000 for additional requirements.

1.7 PRE-CONSTRUCTION SUBMITTALS

A. The Contractor shall submit the access control hardware layouts which includes the number of controllers, sub-panels and other associated devices per location.

B. The Contractor shall submit full power calculations which includes 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.

C. Refer to Section 270000 and 27 62 00 for additional requirements.

1.8 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 270000 and 28 00 00 for additional requirements.

1.9 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 requirements.

1.10 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

PART 2 - PRODUCTS

2.1 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 on Identiv Velocity Security Management 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 EPACS Controller.
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.
   a. Mx-2

   b. Mx-4

   c. Mx-8

2. Basis of design is Intelligent multi door Controller, compatible with the EPACS application software, with a flash ROM module, power supply, battery standby, and Communications Module, as described herein.
3. PoE+ Intelligent Controller option: A single door controller that can operate on PoE+ power input or 12VDC and 24VDC. Controller shall support 1 door with ENTRY and EXIT readers via Wiegand or OSDP RS485 communications. The door relay shall be a dry output utilizing external lock power, or optionally through onboard settings provide "wet" 12 VDC voltage output for powering a lock with a current rating the meets the power budget available.
4. Contractor shall review drawings and specifications with the Project Representative, and may propose changes to the topology of the system based on device layout, where such changes improve performance or functionality of the system. CLIENT has final authority as to the final approach for system topology.
5. Reader Support: Controller shall be configurable for 2, 4, or 8 doors, supporting readers for ENTRY and EXIT at all doors. Enclosure, controller board, and accessories shall be the same for 2, 4, or 8 reader configuration for consistency in system hardware layout. Controllers shall be field upgradeable from 2 to 4 to 8 doors through firmware upgrade.

6. Provide Boolean logic functions for input/output points for primary and downstream controllers without need for host server
7. Dedicated encryption processor to enable PKI based certificate level encryption between controllers and host server. Encryption shall also include encrypted communication to readers with embedded encryption processor
8. The controller shall have integrated network communications with onboard Ethernet port.
9. High security supervised alarm points.
10. Configurable output relays
11. Expansion capability within standard controller enclosure footprint:
    a. Memory up to 132,000 users
    b. 8 input Alarm Expansion Boards – up to 4
    c. 8 output Relay expansion boards – up t0 5
12. The controller shall support Entry and Exit readers at all controlled doors, using dual reader interface boards, wiegand or RS485 cabling
13. Readers connected to the controller over the reader interface board or RS485 connections may be installed up to 1200 feet from the controller:
14. CODE/Buffer: The controller shall be capable of expanding the CODE database up to a maximum of 132,000 Users with the addition of a memory expansion board. The board shall be mounted in the controller cabinet and connect to the controller board via an expansion bus cable
    a. Event Transaction Buffer: The controller shall be capable of expanding the event transaction buffer up to a maximum of 20,000 events and 2,000 alarms with the addition of a memory expansion board. The board shall be mounted in the controller cabinet and connect to the controller board via an expansion bus cable
    b. Controllers shall utilize flash downloadable firmware that may be updated from the server as manufacturer updates are released
15. Access Control Features: The controller shall include the following access control features at a minimum:
    a. Restrict access by: time of day; day of week; door; holiday
    b. Momentary Access of door up to 8100 seconds
    c. Extended Access for User Definable Momentary Access duration (requires ScramblePad). ScramblePad will display time remaining on the minute, and annunciate at the defined "Warning Time"
    d. Special Needs Time Extension to provide additional time for Momentary Access and Door Open Too Long for selected people
    e. Unlock/Re-lock of door by CODE, card, or Time Zone
    f. Door status monitoring shall allow for: door forced monitoring; door-open-too-long monitoring; door-open-too-long while door is unlocked; and auto-re-lock of door when opened or closed
    g. Request-to-exit masks alarm and/or unlocks door
    h. 2 person requirement by door. A user can be defined as Normal, A/B Rule A, A/B Rule B, or Executive Override. Can be disabled by Time Zone
    i. 63 Passback Zones. Can be disabled by Time Zone. A User can be designated with Passback Executive Override

j. Use Count limits on users

k. Absentee Rule limits on users

l. Temporary Day limits on users

m. Occupancy Counting / Minimum & Maximum limits per Passback Zone

n. Deadman CODE / Timer

o. Threat Levels – 99 Levels may be defined. Based on the Level in effect for the facility, selected readers may be disabled, dual readers in Card/Code Only During Time Zone can require dual, and selected User's Credentials can be disabled

p. Timed Anti-Passback

16. Alarm Management Features: The controller shall include the following alarm management features at a minimum:
    a. Momentarily mask alarm by CODE and/or card

    b. Mask/unmask alarm by CODE and/or card or by Time Zone

    c. Alarm device supervised while masked

    d. Tamper switch on alarm device monitored while masked

    e. Tamper Input may be configured to operate as a "Latch Monitor" with the appropriate door lock hardware

    f. Entry/Exit delay per alarm input

    g. Alarm input triggers relays

17. Relay Control Features: The controller shall include the following relay control features at a minimum:
    a. CODE and/or card, input, or other relay triggers relays

    b. Trigger relays by time zone

    c. Relay may be normally de-energized or energized

    d. Disable relays during time zone

    e. Clear relay at end of time zone.

18. Controller Connectivity
    a. Controllers shall support connection to the security LAN/WAN using TCP/IP protocol, and shall also support connection to the manufacturer's standard data communications protocol (RS-232, RS-485, or RS-422)

    b. TCP/IP-connected controllers may act as a network "gateway", to re-transmit controller data via the manufacturers standard data communications protocol (RS-232, RS-485, or RS-422), to other EPACS controllers located within the same site. Provide controllers which support the manufacturer's standard data communications protocol, RS-232/RS-485, as required

    c. LAN/WAN Interface Board: 10/100/1000 Mbps interface with 256-bit FIPS140-2 AES encryption

19. Reader Connections: Controllers communicate with readers in the following ways, depending upon readers used, distance and wiring conditions:
    a. Direct wiegand cabling and data to the main controller board
    b. MATCH2 reader interface connections, which provide extended distances (up to 1500 feet between interface and controller), support for mag stripe data formats, exit reader capability at a single door using wiegand output readers and hash encryption of card data between MATCH interface and controller
    c. RS485 OSDP communications between OSDP readers and controller. Supports Entry and Exit readers at doors, extended distances and card data encryption between reader and controller
20. Alarm Inputs: The controller shall monitor the status of all doors it controls, and be capable of accepting up to 32 additional supervised alarm inputs, in increments of eight (8). The sensitivity of the line supervision shall be 2% AA with appropriate alarm line modules. The alarm expansion boards shall be mounted in the controller cabinet and connect to the controller board via an expansion bus cable
21. Relay Output: The access control controllers shall be capable of accepting up to 32 additional Form C, 2 Amp rated relay outputs in increments of 8. These outputs shall be used for control applications other than standard door access, such as elevator floor control, local door annunciators, HVAC interface, etc. The relay expansion boards shall be mounted in the controller cabinet and connect to the controller board via an expansion bus cable
22. Controller Power Supply: Controllers shall an include an internal panel supply provided by the controller manufacturer and sized to support the controller requirements. Systems that require external supplies or plug-in transformers are not acceptable
23. Battery Back-up: Controllers shall be equipped with internal UPS battery systems to operate the controller and maintain controller programming in the event of a power failure. Power and UP systems shall be monitored by the system, generating alerts when power is lost, power is restored, and when UPS systems are running low
24. Controller Tamper Switch: Provide a tamper switch on the Controller enclosure. Connect to the system as an individual alarm point
25. Terminations: Provide all connections to labeled screw barrier terminal blocks
26. Secure all devices within the Controller enclosure. Dress all wiring in a neat and competent manner. Label all conductors to match documentation
27. Card Readers and Authentication Devices: The controllers shall support a variety of authentication devices, including card readers, keypads, scramble keypads and biometric devices, including multi-frequency contactless card reader(s) shall be designed to securely read, decipher, and authenticate user card data from 13.56 MHz and 125 kHz proximity cards.
    a. Controllers shall support readers that communicate to the controllers via wiegand data format (26-200 Bits), clock and data and RS485 OSDP formats
    b. Supported reader technologies include magnetic stripe readers, wiegand, low frequency proximity, high-frequency secure contactless smart card and biometric technologies including fingerprint, hand geometry, vein pattern, iris and facial recognition

c. Controllers shall support Entry and Exit readers at each door controlled without sacrificing door capacity

d. Supports programming and re-flashing through RS-485 data protocol or over TCP/IP

e. ScramblePad Digital Keypad: The controller shall be capable of using scrambling keypad readers. The keypad shall incorporate the following features:

i. Scrambling display of numbers 0 - 9 (numbers appear in different location every time it is used); +/- 4 degrees horizontal and +/- 26 degrees vertical viewing restriction; accept 3 - 15 digit CODEs simultaneously; be disabled for 1 minute and report CODE Tamper violation (guessing CODEs); be disabled and report Physical Tamper violation (attempt to remove keypad from mounting box); silent CODE duress; status LEDs for reporting granted, denied, and overridden transactions, AC Fail, Programming Mode active, responses to Status Request of Alarm Inputs and Relay Outputs; weather-resistant; supervised by controller; and built-in diagnostics. The ScramblePad shall include the MATCH Universal Reader Interface functionality enabling Entry and EXIT control

ii. A version of the scrambling keypad shall be available for use in high ambient lighting conditions, or where the front is subject to direct sunlight. This version shall have a +/- 12 degrees horizontal and +/- 26 degrees vertical viewing restriction

iii. Scrambling keypads shall be available with an integrated internal contactless card reader, which support card, PIN and dual card and PIN authentication models. Internal readers can be low frequency (125KHz) proximity, 13.56 MHz contactless smart card, or both

iv. A version of the scrambling keypad with high intensity display shall be available with an integrated Indala compatible proximity card reader. Presentation of the card shall automatically auto-start the scrambling display

2.2 ACS SYSTEM SOFTWARE

A. Operating System Requirements: Shall operate in conjunction with and be compatible with Microsoft Windows Server 2019 operating systems.

B. Support for Microsoft Active Directory Integration.
1. Provide all licenses, professional services and integration required for active directory integration.
2. Provide with forms designer to bring in all Owner required forms and fields.

C. Support for virtualization.
1. System shall support VMware and Microsoft Hyper V virtualization.
2. Provide with a virtual machine client/admin license in addition to the concurrent license count for solutions that require this license.
3. The Contractor shall provide the Owner with server requirements.

D. Software shall include:

1. Graphical user interface to show pull-down menus and a menu tree format.
2. Password-protected operator login and access.

E. Access Control Application Software: Shall provide interface between the ACS Host Workstation, IP based Reader-Controllers, inputs, and outputs in order to monitor sensors operate displays, report alarms, generate reports and provide all other system functions as follows:

1. Overall Access Control System Parameters:
   a. Number of access control readers per system: Unlimited
   b. Number of client work stations per system: Unlimited
   c. Number of cardholders: 64,000 per reader stand-alone mode, unlimited in network mode.
   d. Number of credentials per cardholders: Unlimited
   e. Number of cardholder groups: Unlimited
   f. Number of system inputs: Unlimited
   g. Number of system outputs: Unlimited
   h. Reader Inputs: Door sense, request to exit, auxiliary, optical tamper, RS-232
   i. Reader Outputs: (2) outputs; TTL1 and TTL2

2. Access Control Software Functions: The system software shall provide for the following features and functions:
   a. Door Programming Functions
      i. Extended open alarms Individual Extended open timers per door.
      ii. Personal Identification Number (PIN) Codes – Up to 9 digits.
      iii. Device Support: Supports selected serial RS-232 and Wiegand devices.
      iv. Number of Door Groups: Unlimited
   b. Shifts
      i. Number of shifts: Unlimited
      ii. Interval assignments: Any day of the week.
   c. Permissions
      i. Number of Permissions: Unlimited
   d. Holidays: The software shall provide for an unlimited number of holidays.
   e. Door Control: The software shall provide the following types of area control functions:
      i. Door control based on dual-authentication rules.
      ii. Support requiring credentials belonging to two people
      iii. Support requiring two credentials belong to same person

iv. Cardholder use limits

v. Elapsed Time based

vi. Number of usage based

vii. Configurable individual door strike times.

viii. Configurable extended individual door hold open times.

f. Elevator Control: The software shall provide elevator control for an unlimited number of floors.

g. System Graphical Tree: The software shall provide for graphical tree displays of the configured field hardware.

h. System Partitioning: The system shall support an unlimited number partitions. Each building shall be its own partition at a minimum.

i. Alarm and Event Logging: The software shall provide for logging of all system alarms and events chronologically including time and date stamp.

j. System Scheduling: The system shall provide for scheduling of events including:

i. Open Door, Open Door Group

ii. Deactivate Badges

k. Help Documentation: The software shall include complete documentation through a searchable help menu.

l. Alarm attributes: The software shall provide for programming of the following alarm and monitoring attributes:

i. Display of alarm events at the ACS Host workstation, or support networked workstation.

ii. Require the reader-controller, which generated the alarm to be restored to its normal state before the alarm is cleared.

iii. Require acknowledgment of an alarm to clear the alarm.

iv. Support auto-clearing of network related communication alarms.

v. Trigger a programmed system actions(s) when the alarm is acknowledged.

vi. Require a User Logon for Acknowledgment.

m. Programming Downloads: The software shall provide for downloading of programming from the ACS Host to the Reader-controller-controllers as follows:

i. Credential holders and authorized time zones

ii. Time zones.

iii. Alarm configurations.

iv. Latch intervals.

v. TTL output on REX, Tamper, Unauthorized.

vi. Beep on events (REX, Tamper, Reject)

vii. Complete database download of 10,000 cardholder records in less than 15 minutes with system continuing to operate normally during this time.

n. Reader-controller Programming Options: Provide the following minimum reader-controller programming functions:

i. Request to exit and door position switch: Provide programming for independent supervision of request to exit and door position switch.

ii. Manual activation of outputs: Provide for configurable activation of outputs from a credential presentation.

iii. User definable door strike time: Provide user definable/ programmable door strike functionality for each reader-controller.

iv. In/ out Reader-controller configuration: Reader-controller programmed as either an in reader or out reader for recording of time in and time out data.

v. Program use Limits: Limiting the number of times that cardholders may use their credential to gain access at the Reader-controller.

vi. Input/output linking: Provide programming for linking of reader outputs with inputs.

3. ACS Host Software Functions: The system ACS Host software shall provide for the following features and functions:

a. Device Status Monitoring

i. Alarm Status Indication: Provide real time status display that indicates the current status of all devices in the device tree.

ii. Reader-controller status: Provide display of Reader-controllers that are off line.

b. Device Group Programming

i. Reader-controller Groups: Provide for programming of Reader-controller groups.

ii. Input Groups: Provide for programming of input groups.

iii. Output Groups: Provide for programming of output groups.

c. Trace

i. Historical Trace: Provide for historical trace on any Reader-controller or cardholder.

d. Test Utilities: Provide system test utilities to allow for testing of the following functions:

i. Alarm inputs status.

ii. Output operations.

iii. Credential Presentations.

iv. LED and buzzer operations

e. Real-Time Graphical Maps: Provide graphical maps that display reader-controller status and allow for manual operation of the reader-controller.

i. Map Device Icons: Icons shall dynamically change to reflect the current state of the devices.

f. Map Formats: Support import of maps to include the following file formats:

i. JPEG (.jpg)

ii. Windows Metafile (.wmf)

iii. Windows Bitmap (.bmp)

g. Web Browser Support

i. Support commonly used ACS functions from a standard workstation HTML5 based internet browser.

4. Credential Management Software Functions: The system credential management software shall provide for the following features and functions:

a. Modification of cardholder records: Add, Modify and Delete records based upon permissions.

b. Access and Credential Management: Provide for the following credential management functions:

i. Assignment of single or multiple active badges.

ii. Programming personnel groups.

iii. Programming of group access permissions.

iv. Programming of individual access permissions

c. Badge Design: Provide badge design software that is integral to the access control source code with the following badge layout tools:

i. Complete Badge design and Layout.

ii. Image Import.

d. Badge Printers: Provide support for industry standard USB and Ethernet printers and Microsoft Certified Windows printer drivers.

e. The system shall be capable of a minimum of ## concurrent credential and credential printing users.

F. The ACS shall be provided with a 5-year software maintenance service agreement to last through the duration of the project. The Owner shall be able to receive all major and minor software updates at no additional cost for the duration of the project. At the completion of the project the Owner shall have the option to receive a final software update to the latest version before the project is paid in full.

G. Manufacturer:
1. Hirsch Identiv

2.3 ACS CLIENT SOFTWARE

A. Logging into the client software shall be done via Microsoft Active directory and enables features based on user roles and privileges.

B. The look and feel of the interface shall be customizable on a per user basis and enabled on log-in.

C. The software shall include a reporting interface to view historical events based on activity. The user shall be able to perform actions such as generating and printing a report and troubleshooting a specific event from the reporting view. The user shall be able view audit trails that show a history of user and administrator changes.

D. The software shall support graphical maps with multiple hierarchies to facilitate navigation within and between various sites and buildings. The Contractor shall set up these maps to include all cameras and integrated devices like video surveillance, access control, intercom and intrusion detection.

E. The software shall support the following additional minimum capabilities:
1. Monitoring the events from a live security system.
2. Monitoring and acknowledging alarms.
3. Creating and editing incidents and generating incident reports.
4. Executing actions from a dynamic graphical map and floor plan.
5. Management and execution of hot actions and macros.
6. Customizable display tiles with drag and drop capabilities.
7. The software shall support a minimum of 6 active displays.
8. Intercom with duplex audio through integrated intercom system or camera equipped with or connected to a microphone and speaker.

F. The Contractor shall provide, install and configure client software on the following computers. The Contractor shall coordinate with the Owners to determine privileges. The Contractor shall provide the Owner with recommended workstation/laptop performance levels early in the project so they may evaluate if hardware updates are required to their existing workstations.
1. The system shall be capable of a minimum of 50 concurrent users including alarm management users.

2.4 ACS WEB CLIENT

A. The web client shall be a true HTML5 thin client with no download required.

B. The Contractor shall provide any mobile web servers and licenses required to support this functionality.

C. The web client shall support the latest versions of the following browsers:
1. Microsoft Edge
2. Google Chrome
3. Mozilla Firefox
4. Apple Safari

D. The web client shall support Microsoft Active Directory integration.

E. The system shall be capable of a minimum of 50 concurrent web users.

2.5 ACS MOBILE CLIENT APP

A. The Contractor shall provide any mobile web servers and licenses required to support this functionality.

B. The mobile client shall support the following operating systems:
1. Apple iOS
2. Google Android

C. The mobile client shall support the following minimum functionalities:
1. Remote alarm monitoring and acknowledgment.
2. Door lock/unlock.

D. The Contractor shall provide, install and configure mobile client software apps on up to ## mobile devices of the Owners choosing.

E. The system shall be capable of a minimum of 50 concurrent mobile users.

2.6 MAPPING SOFTWARE

A. The ACS software shall be provided with native integrated mapping software.

B. The mapping software shall be compatible with PDF, JPEG and PNG.

C. 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.

D. The Contractor shall be responsible to provide all the labor to setup these maps and place all the devices.

E. The Contractor shall get sign-off from the Owner and Consultant on the finished maps.

F. The Contractor shall obtain the building plans from the Consultant for their use.

2.7 ELECTRONIC ACCESS CONTROL SERVER

A. The Contractor shall coordinate with the Owner to install any required antivirus or other software on the servers before it is connected to the network. The Contractor shall also provide the Owner with any required antivirus on-access scanning exclusions for files/folders/processes.

B. The servers shall be virtualized on Owner furnished virtual servers.

C. The physical servers shall meet the minimum following requirements:
1. The physical servers shall be rack mountable and provided with all accessories to properly and securely mount to a rack. If the server will be mounted to a 2-post rack, the contractor shall provide with a 4-post to 2-post conversion kit. Not applicable for virtual servers. The servers shall be provided with a 5-year warranty with next day onsite service. Provide any warranty extensions/additions required.
2. The servers shall be an enterprise grade physical server with the minimum following specifications:
a. Intel Xeon processor(s) Silver series, latest generation.

b. 8 GB 1333MHz UDIMMS, Advanced ECC DDR3 RAM Multiple SSD hard drives in a RAID 1 configuration.

c. 8 MB Cache Dual power supplies.

d. Raid Controller (Supports RAID 0, 1,and 10): Embedded 6GB/s SAS, w/512MB cache Workstations or Computers are forbidden to be used.

e. Manufacturer:

i.

3. The primary ACS Server shall be a standalone physical server.
4. The failover ACS server shall be a standalone server and be identical to the primary server.

2.8 WORKSTATIONS

A. Workstations will be Owner furnished and installed. The Contractor shall install the software on the Owner's workstations as required.

B. The Contractor shall provide the Owner with minimum workstation configurations and operating system requirements for the remote workstations and the master workstation.

2.9 CONTACTLESS 13.56 MHZ SMART CARD 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. Adjustable OSDP Baud rate from 9,600 to 115,200. The contractor shall set the card readers to communication at a minimum of 38,400 Baud rate. The default 9,600 is not acceptable.

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. Card readers shall be HID Signo Model 40 for standard applications and Model 20 for mullion/jamb applications.

O. Card readers with integrated keypad shall be HID Signo Model 40K for standard applications and Model 20K for mullion/jamb applications.

2.10 HID READER MANAGER

A. The Contractor shall register the end user for the reader manager portal and application. If the Owner is already registered, the Contractor shall request access.

B. The Contractor shall obtain the security keys from the reader manager portal and load them onto the card reader to allow the Contractor and Owner to manage the readers via Bluetooth without rebooting the reader.

2.11 SURGE PROTECTION FOR LOW VOLTAGE AC/DC POWER

A. The Contractor shall provide a surge protector for all exterior devices being supplied by low voltage power. This does not include devices directly connected to a building where the risks of surges are negligible.

B. There shall be a minimum of a 36" shielded 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. Nominal voltage rating of 24V AC/DC. Provide correct module per required voltage level if different from 24V.
2. 20,000A surge current rating.
3. Protects 2-pair per module.
4. Accepts up to 10AWG cable
5. Connect directly to ground.
6. UL 497B listed
7. Provide quantity of modules as required for the application.
8. Provide base mounting plate as required for the application.
9. Manufacturer:
   a. Ditek DTK-2MB Mounting Base
   b. Ditek DTK-2MHLP24B Surge Module
   c. Or approved equal

2.12 SURGE PROTECTION FOR 120 VAC POWER

A. The Contractor shall provide a surge protector for all 120VAC supplied panels and enclosure when there is a critical risk of surges. This does not include interior panels which only serve interior devices or devices connected directly to a building where the risks of surges are negligible.

B. There shall be a minimum of a 36" of cable from the surge protector to the load to allow for adequate clamping time.

C. Exterior, enclosure or other mounted:
1. Nominal voltage rating of 120VAC, single-phase, 20A continuous load.
2. Parallel connected.
3. 50,000 A surge current rating.
4. UL 1449 Type 1 SPD listed
5. LED indicator.
6. NEMA 4X rated.
7. Maintain a minimum of 3' of cable from the surge protector to the load.
8. Manufacturer:
   a. Ditek DTK-120HW
   b. Or approved equal

D. Interior, wall mount:
1. Nominal voltage rating of 120VAC, single-phase, 20A continuous load.
2. Series connected.
3. 54,000 A surge current rating.
4. 35db of EMI/RFI filtering.
5. UL 1449 Type 2 SPD listed
6. UL 1289 EMI/RFI Noise Filtering listed.
7. LED indicator.
8. Form C dry contacts for remote monitoring.
9. Include with NEMA 4X enclosure.
10. Maintain a minimum of 3' of cable from the surge protector to the load.
11. Manufacturer:
    a. Ditek DTK-TSS4D
    b. Or approved equal

2.13 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. Enclosures
1. Shall be capable of accommodating power supplies, sub-assemblies and other manufactures access control controller boards when required.
2. Wall mountable.
3. Include a cam-lock and tamper switch.
4. Include with rocker switches to control power to the power supplies.
5. Altronix Trove 2 or 3 enclosures to house access control electronics along with power supply and distribution components. Lifesafety Power Unified enclosers are an approved alternate.

C. Power Supplies
1. 115 VAC input
2. 12VDC or 24VDC selectable outputs at:
   a. 4 amp continuous power @ 12VDC or 24VDC.
   b. 6 amp continuous power @ 12VDC or 24VDC.
   c. 10 amp continuous power @ 24VDC.
3. High capacity battery charging circuit.
4. Form "C" supervision contacts for AC Low, AC Fail, and battery presence.
5. Supervised Fire Disconnect.

6. Low power Disconnect.
7. Class 2 aux. output.
8. UL 294 listed sub-assembly for access control.
9. Furnish and install with power rocker switches for each power supply.
10. Manufacturer:
    a. Altronix AL600ULACM

D. Batteries
1. The Contractor shall provide a minimum of (2) 12V, 7ah, sealed Absorbent Glass Mat (AGM) style batteries with F style terminals per 24VDC power supply and (1) 12V, 7ah per 12VDC 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

E. Sub-Assemblies
1. The Contractor shall provide all sub-assemblies to meet the project requirements
2. Access Control Module
    a. Independently controlled fused protected outputs:
        i. Fail-Safe and/or Fail-Secure power outputs.
        ii. Dry form "C" 5 amp rated relay outputs (fused).
        iii. Any combination of the above
3. Access Control System trigger inputs:
    a. Normally open (NO) inputs.
    b. Open collector sink inputs.
    c. Any combination of the above.
4. Fire Alarm Disconnect:
    a. Individually selectable for any or all outputs.
    b. Latching or non-latch input FACP disconnect.
    c. Normally open (NO), normally closed (NC) dry contact or polarity reversal from FACP signaling circuit trigger input.
    d. LED indicates that the Fire Alarm Disconnect has been activated.
    e. Form "C" relay output for auxiliary reporting.
5. Multi-Output Power Distribution Module
    a. Single input distributed over eight (8) outputs.
    b. Fused protected outputs.
    c. Output terminals shall accommodate up to 12AWG wires.
6. Multi-Output Power Distribution Module with Dual Inputs
    a. Two (2) inputs distributed over eight (8) outputs.
    b. Outputs shall be configurable by input.

c. Fused protected outputs.

d. Output terminals shall accommodate up to 12AWG wires.

7. Network Communication Modules
   a. Power Supply Network Interface
      i. Interface for up to two (2) eFlow power supply/chargers.
      ii. Two (2) Network controlled From "C" relays.
      iii. Event timers.
   b. Network Power Distribution Module
      i. Two (2) inputs distributed over eight (8) outputs.
      ii. Outputs shall be configurable by input.
      iii. Fused protected outputs.
      iv. Emergency disconnect interface by output.
      v. Selectable battery back-up by output.
      vi. Output terminals shall accommodate up to 12AWG wires.
   c. Common monitoring features
      i. Network interface via LAN/WAN.
      ii. Centralized dashboard for monitoring all power supplies. Provide appropriate hardware/software required.
      iii. Remote reporting of status via email and/or SNMP trap messaging.
      iv. AC, low battery and battery presence monitoring.
      v. Alert messages of System Service required.
      vi. System log.
      vii. On demand determination of system status.
      viii. Reset of individual outputs as required for remote diagnostics.
      ix. Monitor enclosure temperature.
      x. Static or DHCP IP address configuration.
      xi. SSL Secure Sockets Layer encryption.
8. Voltage Regulator
   a. The Contractor shall provide a voltage regulator to provide constant 5VDC or 12VDC outputs for access control boards, modules or other applicable components as well as a voltage regulator for door hardwiring or controllers requiring 12VDC.
   b. 24vdc Input.
   c. Selectable 5 or 12VDC output.
   d. Output rating of 6amp max.

e. Stackable with both Networkable and dual input power distribution modules for space savings.

9. Power supplies and sub-assemblies shall be manufactured by Altronix or approved equal:
   a. eflow4NB - 4amp 12vdc/24vdc power supply (UL listed Sub-assembly).
   b. eFlow6NB - 6amp 12vdc/24vdc power supply (UL listed Sub-assembly).
   c. eFlow104NB - 10amp 24vdc power supply (UL listed Sub-assembly).
   d. ACM8 - Eight (8) output, fused Access Control Module (UL listed Sub-assembly).
   e. ACMS8 – Dual input, eight (8) output, fused Access Control Module (UL listed Sub-assembly).
   f. Linq2 - Network Communication Module (UL listed Sub-assembly).
   g. Linq8PD - Dual input, eight (8) output, fused Network Communication Module (UL listed Sub-assembly).
   h. PDS8 - Dual input, eight (8) output, fused power distribution module (UL listed Sub-assembly).
   i. VR6 - Voltage Regulator (UL listed Sub-assembly).
   j. RSB2 – Rocker switches with mounting bracket.

2.14 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) #658AFS
      b. 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

G. Exterior OSDP cables for exterior electronic access-card reader only doors not requiring composite cabling 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 power - 2 conductor, 16 awg unshielded
3. Manufacturer (OSDP):
   a. West Penn # 1PR485D+

   b. Or approved equal

H. 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.

I. 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.

J. 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.

K. Cables for magnetic door hold opens shall be 18-gauge, two-conductor, unshielded, stranded cable. The cable shall be white in color and plenum rated.

L. Cables for key switches shall be 18-guage, 4-conductor, unshielded, stranded cable. The cable shall be white in color and plenum rated.

M. Cables for emergency strobes shall be no smaller than 18-guage and shall be increased in size up to 12-guage as voltage drop, distance and the total circuit capacity requires.

N. Cables for PoE locks shall be installed by the Division 27 cabling contractor. Horizontal cable shall be terminated above the door within a j-box to provide a disconnect point for the patch cable to the PoE hinge.

2.15 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. Door contacts shall be appropriately sized for any established holes within door frames.

D. Parts provided are basis of design. Determination of final part number is the responsibility of Contractor.

E. Provide color that matches door as close as possible.

F. Provide recessed switch whenever possible.

G. Provide armored whip for surface mount contacts.

H. Provide with a 1k/2k end of line (EoL) pre-built resistor pack. GRI (George Risk Industries, Inc.) 6644 series or approved equal.

I. Provide GRI (George Risk Industries, Inc.) 180 Series for recessed applications.
1. Magnasphere
2. Nascom
3. Or approved equal.

J. Provide GRI (George Risk Industries, Inc.) 4400 series for surface mount applications.
1. Magnasphere
2. Nascom
3. Or approved equal.

K. Provide GRI (George Risk Industries, Inc.) MC-180 Series for hollow top channel applications.
1. Magnasphere
2. Nascom
3. Or approved equal.

L. Provide GRI (George Risk Industries, Inc.) 4532 Series for overhead door applications.
1. Magnasphere
2. Nascom
3. Or approved equal.

2.16 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 Assa Abloy Securitron XMS Exit Motion Sensor
1. Or approved equals.

2.17 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.

2.18 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" 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

2.19 MAGNETIC DOOR HOLDS

A. The Security Contractor shall be responsible for the connection of all electrified magnetic door hold open intended for security to the access control system. This shall include providing centralized power supplies located next to or integral to the access control panels when required for standalone operation, connecting to the fire alarm system for interface, or interrupting directly at the mag hold with a relay to interrupt power locally. The Contractor shall coordinate with the door hardware specifications, schedules and fire alarm drawing/specifications for additional information.

B. Die cast housing

C. Mounting options include:
1. Floor-mounted
2. Recessed wall-mounted
3. Surface wall-mounted

D. 35 pound holding force

E. Fail-safe

F. 24V powered

G. UL listed

H. Manufacturer:
1. Allegion LCN
a. Sentronic SEM 7800 Series

b. Coordinate finish options with Owner, Architect and Consultant.

c. Provide appropriate mounting options as required.

d. Provide with appropriate extensions as required.

i. LCN SEM series, or equivalent, for short length extensions, stack as required.

ii. Edwards 1500 series, or equivalent, for mid length extensions.

iii. Utilize mag hold open extension chains for long extensions.

iv. Floor mounting may be required when other options to not work.

2. Assa Abloy Rixon
3. Or approved equal

2.20 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

2.21 DOOR POWER TRANSFER LOOPS

A. Provide new power transfer loops at the top of the doors for retrofit applications.

B. Provide all necessary materials and labor to connect existing electrified panic hardware and new access control system where appropriate.

C. Power transfer loop shall be armored stainless steel door loop with metal end caps.

D. Minimum interior diameter of 3/8" and exterior diameter of 1/2".

E. Field verify the lengths required for each door.

F. Provide Alarm Controls DL-2
1. Or approved equal.

PART 3 - EXECUTION

3.1 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.

3.2 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 mapping software shall be licensed to use Microsoft Bing maps, Google Maps, Open Street Maps or similar. Coordinate with the Owner to assist with the obtaining these licenses.

C. The maps shall have links to the other levels/sections as well as the global map.

D. Integrated cameras shall show their approximate field of view.

E. The floor plans shall include all access-controlled doors, controlled overhead doors and integrated devices.

F. Alarm icons for lockdown, panic and other alarms.

G. Contractor shall create toggles for IO control Including:
1. Lighting control
2. Water control

H. Contractor shall create interlock overrides on the maps for interlock door control.

I. Contractor shall create non-card reader doors for non-card reader door unlock and status monitoring.

J. Contractor shall create map entities for intercoms.

K. Contractor shall create Elevator control including:
1. Door Status
2. Door Control
3. Level Control

L. Contractor shall map integrated intrusion detection devices, areas and alarms.

3.3 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.

3.4 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.

3.5 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.

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.

3.6 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.

3.7 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.

3.8 MAGNETIC DOOR HOLD OPEN INTERFACE

A. Magnetic door hold opens identified to be controlled by the security system shall be interfaced to the access control system via I/O expansion modules.

B. These shall be capable of being controlled by schedule or by override in the event of an emergency.

C. Contractor shall provide all necessary cable, hardware, I/O modules, power supplies, interfaces, and system programming to support all necessary functionality.

3.9 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.

3.10 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 end-of-line termination requirements.

1. Repurposed reader communication cable shall adhere to RS-485 end-of-line termination requirements, but does not require compliance to RS-485 cable standards.

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.

3.11 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.

3.12 TESTING

A. Refer to Section 270000 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.

3.13 TRAINING

A. Refer to Section 270000 for additional requirements.

B. Provide system operations, administration, and maintenance training by factory-trained personnel qualified to instruct.
1. Contractor shall provide up to 6 hours of scheduled and dedicated training time in three (3) two (2) hour sessions for administration and investigation.
2. The Contractor shall provide up to 2 hours of dedicated training time for badge creation, printing and printer maintenance.

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.

3.14 WARRANTY

A. Refer to Section 270000 for additional requirements.

3.15 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.

3.16 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.

3.17 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.

3.18 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.

3.19 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.

3.20 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 20-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.

3.21 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.

3.22 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.

3.23 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.

3.24 LABELING

A. Contractor shall neatly label all security devices and cabling at both ends. All labels shall be on Project as-built drawings.

3.25 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.

3.26 PRE-CHECK OUT

A. The Contractor shall demonstrate the following to Owner during system demonstration.
   1. The card readers are fully installed and functional.

3.27 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.

3.28 FINAL PROCEDURES

A. Perform final procedures in accordance with section 27 60 00.

END OF SECTION

SECTION 276400 – VIDEO SURVEILLANCE SYSTEM

PART 1 - GENERAL

1.1 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 270000 for additional project scope information.

1.2 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.

1.3 RELATED WORK

A. Section 270000 – General Technology Requirements

B. Section 270500 – Communications General Requirements

C. Section 270526 – Grounding and Bonding for Technology Systems

D. Section 270528 – Pathways for Technology Systems

E. Section 270537 – Firestopping for Technology Systems

F. Section 271100 – Communications Equipment Rooms

G. Section 271500 – Communications Horizontal Cabling

H. Section 271600 – Communications Connecting Cords

I. Section 271800 – Communications Labeling and Identification

J. Section 27 60 00 – Physical Security General Requirements

K. Section 27 62 00 – Electronic Access Control System

1.4 DEFINITIONS

A. Refer to Section 270000 for additional definitions.

1.5 REFERENCE STANDARDS AND CODES

A. Refer to Section 270000 for additional requirements.

1.6 QUALIFICATIONS

A. Refer to Section 270000 for additional requirements.

1.7 PRE-CONSTRUCTION SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.8 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.

1.9 CONSTRUCTION PROGRESS SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.10 CLOSEOUT SUBMITTALS

A. Refer to Section 270000 for additional requirements.

1.11 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. 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.

D. 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.

1.12 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.

1.13 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.

C. Cameras shall meet the following standards:
1. MPEG-4:
a. ISO/IEC 14496-10 AVC (H.264)

2. Networking:
a. IEEE 802.3af (Power over Ethernet)

3. Network Video:
a. ONVIF Profile S or better

PART 2 - PRODUCTS

2.1 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 270000.

2.2 VMS GENERAL REQUIREMENTS

A. The VMS shall be a server/client model and be based on a true open architecture that shall allow for use of non-proprietary workstation and server hardware, non-proprietary network infrastructure and non-proprietary storage.

B. The VMS shall support video encoded in MPEG-4, MPEG-2, MJPEG, H.264, H.265/HEVC and Wavelet compression formats.

C. The VMS shall support audio encoded in g711 (u-law), g721, g723 or AAC compression formats.

D. The VMS shall support and be configured for multicast. Coordinate with the Owner on multicast network requirements.

E. The VMS shall be licensed for active directory.

F. The VMS shall synchronize to a common NTP server as the cameras and other security systems.

G. The system shall log all actions on a per user basis, all alarms and notifications on a per device basis and all errors and failures on a per device basis. These logs shall have the ability to be extracted to a document that can be emailed to an administrator.

H. The system shall support custom rules and actions.

I. The VMS shall be provided with mapping features. The Contractor shall acquire drawings from the Consultant to utilize for the mapping.

J. The VMS shall fully support H.264 and H.265/HEVC Smart Coding with dynamic GOP and Dynamic Frame Rate.

K. The VMS shall support full API level integration with all cameras utilized. Integrating via ONVIF is not acceptable.

L. The VMS shall have native API level support for fisheye cameras and client side dewarping. The VMS shall not utilize the video stream to detect a fisheye camera.

M. The system shall log all actions on a per user basis, all alarms and notifications on a per device basis and all errors and failures on a per device basis. These logs shall have the ability to be extracted to a document that can be emailed to an administrator.

N. The VMS shall be provided with a 5-year software maintenance service agreement to last through the duration of the project. The Owner shall be able to receive all major and minor software updates at no additional cost for the duration of the project. At the completion of the project the Owner shall have the option to receive a final software update to the latest version before the project is paid in full.

O. Manufacturer:
1. Genetec Security Center Enterprise Omnicast
2. Or approved equal

2.3 VMS DIRECTORY MANAGEMENT SOFTWARE

A. The server software shall launch automatically when operating system is booted and run in the background regardless if a user is logged on.

B. The VMS shall include Microsoft Active Directory integration. The Contractor shall coordinate with the Owner on permissions, roles and integration.

C. The directory management server shall be compatible with Microsoft Windows Server Standard 2019.

D. The database server shall be compatible with Microsoft SQL Server 2014 or above.

E. The VMS Directory Management server shall be compatible with virtual environments including VMware and Microsoft Hyper-V Server.

F. The administrator shall be able to perform the following actions from the interface:
1. Manage the system licenses.
2. Configure the database and database server
3. Manually back up the databases, restore the server databases, and configure scheduled backups of the databases.
4. Define the client-to-server communications security settings.
5. Configure the network communications hardware, including connection addresses and ports.
6. Configure mail server SMTP settings and port. The Contractor shall coordinate with the Owner on email accounts to be added.
7. Configure event and alarm history storage options.

G. The software shall support the configuration and management of users and user groups. An administrator shall be able to add, delete, or modify a user or user group.

H. The software shall support partitions and limit what users can view in the configuration database. The administrator shall be allowed to segment a system into multiple security partitions. The Contractor shall coordinate with the Owner on required partitions.
1. A user who is given access to a specific partition shall only be able to view component within that partition.
2. A user or user group can be assigned administrator rights over the partition.
3. It shall be possible to specify user and user group privileges on a per partition basis.

I. The software shall send an email notifying the administrator of a problem. The Contractor shall coordinate with the Owner on desired notifications and configure the system.

2.4 VMS ARCHIVER RECORDING SOFTWARE

A. The directory management server shall be compatible with Microsoft Windows Server Standard 2019.

B. The Archiver Recording Server shall be compatible with Microsoft SQL Server 2016.

C. All recorded video shall be digitally signed.

D. The Archiver Recording Server shall provide the ability to configure key frame (I-Frame) interval.

E. The Archiver Recording Server shall have the ability to assign independent pre and post alarm recording on a per camera basis.

F. The Archiver Recording Server shall have the ability to assign motion detection zones on a per camera basis.

G. The Archiver Recording Server shall have the ability to redirect audio/video streams to active viewing clients on the network using UDP or TCP.

H. The Archiver Recording Server shall have the ability to store video at a reduced frame rate for long term storage.

I. The Archiver Recording Server shall have the ability to utilize and manage edge recording on supported cameras.

J. The Archiver Recording Server shall have the ability to utilize an Auxiliary Archiver Recording Server to use for redundant archives for video, events and bookmarks on a per camera basis.

2.5 SOFTWARE MAINTENANCE

A. The system shall be provided with a 5-year software maintenance agreement. The Owner shall be able to receive all major and minor software updates at no additional cost for the duration of the project. At the completion of the project the Owner shall have the option to receive a final software upgrade to the latest version (including all devices) before the project is paid in full.

2.6 VMS CLIENT SOFTWARE

A. Logging into the client software shall be done via Microsoft Active directory and enables features based on user roles and privileges.

B. The look and feel of the interface shall be customizable on a per user basis and enabled on log-in.

C. The software shall include a reporting interface to view historical events based on activity. The user shall be able to perform actions such as generating and printing a report and troubleshooting a specific event from the reporting view. The user shall be able view audit trails that show a history of user and administrator changes.

D. The software shall support graphical maps with multiple hierarchies to facilitate navigation within and between various sites and buildings. The Contractor shall set up these maps to include all cameras and integrated devices like access control, intercom and intrusion detection.

E. The operator shall be able to bookmark multiple cameras and create an incident report with the associated cameras and integrated devices attached. The bookmarks shall be protected from overwriting until the user manually deletes them. The bookmarks shall be ab le to be moved to a separate storage drive for long term archiving. The user shall be able to pull up a list of all bookmarks saved for easy management of them.

F. The software shall be able to export multiple video clips to a single file system with a self-contained player. These clips shall include the option to be encrypted. The self-contained player shall support multiple and selectable video tiles with the ability to digitally zoom. The user shall be able to build an incident by placing additional video clips into this file system for convenient storage.

G. The software shall support the following additional minimum capabilities:
1. Monitoring the events from a live security system.
2. Monitoring and acknowledging alarms.
3. Creating and editing incidents and generating incident reports.
4. Executing actions from a dynamic graphical map and floor plan.
5. Management and execution of hot actions and macros.
6. Customizable display tiles with drag and drop capabilities.
7. The software shall support a minimum of 6 active displays.
8. Intercom with duplex audio through integrated intercom system or camera equipped with or connected to a microphone and speaker.
9. Control of physical and virtual PTZ cameras with mouse control or PTZ joystick/keyboard control.
10. Client side dewarping of ImmerVision 360 enabled cameras with multiple view areas and virtual PTZ control.
11. Display all cameras from associated with the system and federated systems.
12. Create snapshots from live or recorded video. These snapshots shall be automatically saved to a snapshot folder.
13. Link cameras in live and recorded views for seamless tracking of a subject throughout a facility. The Contractor shall configure the links for all cameras within and outside of the facility.

H. The Contractor shall provide, install and configure client software on the following computers. The Contractor shall coordinate with the Owners to determine viewing privileges. The Contractor shall provide the Owner with recommended

workstation/laptop performance levels early in the project so they may evaluate if hardware updates are required to their existing workstations.

1. The system shall be capable of a minimum of zzz concurrent users.

2.7 VMS WEB CLIENT

A. The web client shall be a true thin client with no download required other than web browser plug-ins.

B. The Contractor shall provide any mobile web servers and licenses required to support this functionality.

C. The web client shall support the latest versions of the following browsers:
1. Microsoft Edge
2. Google Chrome
3. Mozilla Firefox
4. Apple Safari

D. The web client shall support Microsoft Active Directory integration.

E. The web client shall support the minimum following functionalities:
1. Live and recorded video playback.
2. Video export.
3. Multiple video tiles.
4. PTZ mouse controls.

F. The system shall be capable of a minimum of 50 concurrent web users.

2.8 VMS MOBILE CLIENT APP

A. The Contractor shall provide any mobile web servers and licenses required to support this functionality.

B. The mobile client shall support the following operating systems:
1. Apple iOS
2. Google Android

C. The mobile client shall support the following minimum functionalities:
1. Live video monitoring with a minimum of 4 video tiles.
2. Dynamic resolution.
3. Receive mobile push alarm notifications, view and acknowledge alarms.
4. PTZ control with finger.
5. Save snapshots.
6. Video streaming push back to VMS recording server.

D. The Contractor shall provide, install and configure mobile client software apps on up to 50 mobile devices of the Owners choosing.

E. The system shall be capable of a minimum of 50 concurrent mobile users.

2.9 VMS SYSTEM AVAILABILITY MONITOR

A. The Contractor shall provide, install and configure health monitoring software to be installed on each server running the VMS or a service required for the VMS operation.

B. The Server Monitoring Service shall be a Windows service that automatically launches at system startup, irrespective of whether a user is logged in not.

C. The health monitoring software should be installed on a server that is not the directory server.

D. The health monitoring service shall notify the system administrators of any problem or maintenance required.

E. The health monitoring service shall upload data to the cloud for monitoring and historical data.

2.10 VMS UPDATE SERVICE

A. The Contractor shall provide, install and configure a live update service tool which monitors all servers and workstations for software updates.

B. The Owner shall be able to update all system components to the latest version from this update service.

2.11 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.

2.12 VMS SERVERS

A. General Server Requirements
1. The Contractor shall coordinate with the Owner to install any required antivirus or other software on the servers before it is connected to the network. The Contractor shall also provide the Owner with any required antivirus on-access scanning exclusions for files/folders/processes.
2. The servers shall be rack mountable and provided with all accessories to properly and securely mount to a rack. If the server will be mounted to a 2-post rack the contractor shall provide with a 4-post to 2-post conversion

kit. The servers shall be provided with a 5-year warranty with next day onsite service. Provide any warranty extensions/additions required.

4. The servers shall be purpose built for surveillance, video optimized storage and management. The manufacturer shall guarantee performance with the system design at the time of purchase.
5. Workstations or PC Computers shall not be used as a server.

B. VMS Directory Management Servers
1. The servers shall be virtualized on Owner furnished virtual servers.
2. The servers shall be an enterprise grade physical server with the minimum following specifications:
   a. Intel Xeon processor(s) Silver or greater, latest generation.
   b. 32gb Registered ECC memory
   c. Multiple SSD hard drives in a RAID 1 configuration.
   d. Quad NIC ports in a dual teamed configuration.
   e. Dual power supplies.
   f. Windows Server Standard 2019 operating system.
   g. Workstations or Computers are forbidden to be used.
3. The primary Directory Management Server shall be a standalone physical server.
4. The failover Directory Management Server shall be a standalone server and be identical to the primary server.
5. Directory Management Server Manufacturer:
   a. BCD Video
   b. Seneca
   c. Or approved equal

C. VMS Archiver Recording Server
1. The servers shall be a physical enterprise grade standalone server with Intel Xeon processors.
2. The servers shall use enterprise class Serial Attached SCSI (SAS) hard drives with a minimum MTBF of 1 million hours and error recovery time limit of approximately 8 seconds or less. Enterprise class SATA hard drives may be used when connected to a SAS backplane.
3. Servers for Genetec shall utilize SSD drives in a RAID-1 for the OS and RAID-5 for the archiver drives.
4. Genetec server shall have a minimum of 32gb of Registered ECC RAM.
5. Refer to the VMS Video Storage Requirements section for recording requirements and criteria.
6. The camera load shall be distributed evenly across all servers not based on quantity of cameras but throughput.
7. The servers shall be provided with remote health monitoring and management software.
8. The Contractor shall provide the quantity of Archiver Recording Servers required to handle the total storage load and throughput required.
9. Refer to the VMS Video Storage Requirements section for recording requirements and criteria.
10. Manufacturer:
    a. BCD Video
    b. Seneca

c. Or approved equal

D. VMS Web and Mobile Server
1. The server shall be virtualized on Owner furnished virtual server. Other system services such as a health monitor and/or SIP server may be installed on this same server. The Contractor shall coordinate performance requirements with the Owner and Consultant.
2. The servers shall be an enterprise grade physical server with the minimum following specifications:
a. Intel Xeon processor(s) Silver or greater, latest generation.
b. 32gb Registered ECC memory
c. Multiple SSD hard drives in a RAID 1 configuration.
d. Quad NIC ports in a dual teamed configuration.
e. Dedicated Nvidia Quadro graphics card.
f. Dual power supplies.
g. Windows Server Standard 2019 operating system.
h. Workstations or Computers are forbidden to be used.
i. The servers shall be provided with a 5-year warranty with next day onsite service. Provide any warranty extensions/additions required.
3. Directory Management Server Manufacturer:
a. BCD Video
b. Seneca
c. Or approved equal

2.13 VMS VIDEO STORAGE

A. Provide a minimum of thirty-one (31) days of storage calculated at the following resolution and rates. Provide all hardware, software and configuration needed to accomplish this.
1. The system shall be enabled for an automatic video cleanup at 31 days.

B. Record stream using Unicast RTP/TCP on stream 1.

C. Pre and post record buffer of 5 seconds.

D. Provide an additional ~20% storage for additional space for overhead, bookmarked video, etc.

E. Utilize the following for storage calculations:
1. Interior Cameras:
a. 10 fps
b. 1 keyframe (I-Frame) per 4 seconds
c. Max resolution
d. 100% recording with motion enabled for metadata.
e. VBR or framerate priority with cap appropriate to resolution and quality

f. H.264 Main Profile compression

g. Smart codec enabled at the following settings:

i. Medium (50%) dynamic compression setting

ii. Dynamic GoP of up to 30 seconds

iii. Dynamic frame rate enabled

h. No data rate cap when smart codecs are enabled.

2. Exterior Cameras:

a. 10 fps

b. 1 keyframe (I-Frame) per 4 seconds

c. Max resolution

d. 100% recording with motion enabled for metadata.

e. VBR or framerate priority with cap appropriate to resolution and quality

f. H.264 Main Profile compression

g. Smart codec enabled at the following settings:

i. Medium (50%) dynamic compression setting

ii. Dynamic GoP of up to 30 seconds

iii. Dynamic frame rate disabled

h. No data rate cap when smart codecs are enabled.

2.14 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 system shall be configured for multicast. All cameras shall have a multicast Time To Live (TTL) setting of at least 64.
5. The Contractor shall select the appropriate mounting hardware for the situation.
6. 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.
7. Multi-sensor 180 and 360 cameras shall have each sensor optimally calibrated independently to the conditions.
8. All cameras shall be vandal proof and appropriate for the environment it is being installed in.
9. 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.

10. The contractor shall coordinate with the owner for IP addressing, network configuration and multicast network configuration.
11. 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.
12. 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.
13. Cameras and devices shall not be an OEM or "white label" product. The camera or device shall be manufactured by the named manufacturer.
14. 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.
15. 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
   1. Dome camera.
   2. Native resolution of pixels.
   3. Be designed to provide at least two video streams in all resolutions at a selectable range up to 30 frames per second (60Hz mode) using H.265, H.264 and MJPEG.
   4. Integrated video analytics with object detection and classification for person and vehicle including car, bus, truck, motorcycle, bicycle and license plate (not LPR).
   5. Integrated audio analytics with scream, gunshot, explosion and glass break classification.
   6. Minimum horizontal view angle of wide°-narrow°.
   7. Supports hallway/corridor view mode (90°/270°).
   8. Mechanical day/night IR cut filter with integrated IR up to xxx'.
   9. Integrated varifocal lens, automated iris functionality and remote focus functionality.
   10. Be equipped with true multi-frame wide dynamic range (WDR).
   11. Camera shall be capable of smart codecs on the H.265 and H.264 streams including dynamic GoV and Dynamic FPS.
   12. Input power: PoE up to W.
   13. Interior dome camera with IP52 and IK08 ratings.
   14. 5-year warranty.
   15. Manufacturer:
       a. Interior – Axis P3265LV

2.15 CAMERA 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.

2.16 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.

2.17 CAMERA EDGE STORAGE

A. Where video surveillance devices are connected via Wireless ethernet components, the Contractor shall provide, install, and configure edge storage both in the camera and Genetec VMS.

B. Edge storage shall be capable of recording during periods where the connection is lost between the video surveillance device and the primary video storage.

C. The contractor shall configure the VMS for transfer of edge stored video to the primary video storage. Video stored locally on the edge device shall be transferred upon restoration of the connection. The transfer shall be over IP communication and shall take place automatically.

D. Edge storage shall be high-endurance, minimum speed class 10 and purpose built for video surveillance.

E. Read Speed up to 100MB/s, Write speed up to 40MB/s.

F. Operating range of -13 degrees to 185 degrees Fahrenheit.

G. 3-year warranty.

H. Confirm camera edge storage capacity limits prior to ordering.

I. Manufacturer and model:
1. Axis Surveillance MicroSD Card, 128GB
2. WD Purple MicroSD Card, 128GB

2.18 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 control panels or at the door when required.

PART 3 - EXECUTION

3.1 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.

3.2 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.

3.3 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.

3.4 VMS VIDEO STREAMING

A. All cameras shall have the following VBR streams configured. If a camera or VMS is not capable of the quantity of streams listed below when they shall be set for dual streaming at the Record settings and Live viewing settings.

B. The VMS and cameras shall be setup and enabled for multicast.
1. Stream 1 (Record and High Resolution)
a. Interior Cameras:

i. 10 fps

ii. 1 keyframe (I-Frame) per 4 seconds

iii. Max resolution

iv. 100% recording with motion enabled for metadata.

v. VBR with no cap or high cap when smart codecs are enabled.

vi. H.264 Main Profile compression

vii. Smart codec enabled at the following settings:

viii. Medium (50%) dynamic compression setting

ix. Dynamic GoP of up to 30 seconds

x. Dynamic frame rate enabled

b. Exterior Cameras:

i. 10 fps

ii. 1 keyframe (I-Frame) per 4 seconds

iii. Max resolution

iv. 100% recording with motion enabled for metadata.

v. VBR with no cap or high cap when smart codecs are enabled.

vi. H.264 Main Profile compression

vii. Smart codec enabled at the following settings:

viii. Medium (50%) dynamic compression setting

ix. Dynamic GoP of up to 30 seconds

x. Dynamic frame rate disabled

2. Stream 2 (Live)
a. 10 frames per second

b. ~850x450 resolution for 16:9 aspect ratio cameras and 640x480 for 4:3 aspect ratio cameras. Always maintain the native aspect ratio of the camera.

c. H.264 Main Profile compression

d. Smart codec enabled at a medium setting with a dynamic GoP of up to 8 seconds.

e. 1 key frame per 4 seconds

f. Automatic stream selection with dynamic resolution (resolution of camera window on VMS client)

3. Stream 3 (Low Resolution)
   a. 10 frames per second

   b. ~1280x720 resolution for 16:9 aspect ratio cameras and 1024x768 for 4:3 aspect ratio cameras. Always maintain the native aspect ratio of the camera.

   c. H.264 Main Profile compression

   d. Smart codec enabled at a medium setting with a dynamic GoP of up to 8 seconds.

   e. 1 key frame per 4 seconds

   f. Automatic stream selection with dynamic resolution (resolution of camera window on VMS client)

4. Stream 4 (Web/Remote/Mobile Client)
   a. 5 frames per second

   b. MJPEG at 50% quality when VMS requires for web or mobile clients to avoid transcoding from H.264.

   c. ~850x450 resolution for 16:9 aspect ratio cameras and 640x480 for 4:3 aspect ratio cameras. Always maintain the native aspect ratio of the camera.

   d. Data rate cap or as appropriate based on available bandwidth and use case.

   e. Automatic stream selection with dynamic resolution (resolution of camera window on VMS client)

3.5 CAMERA POSITIONING PROCEDURES

A. The Contractor shall provide an initial aim, zoom, field of view adjustment, rotation and focus immediately after the camera is installed following the design intent on the drawings and camera schedule.

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 Consultant's feedback and update the screen shots.

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 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.

3.6 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.

3.7 TESTING

A. Refer to Section 270000 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.

3.8 TRAINING

A. Refer to Section 270000 for additional requirements.

B. Provide system operations, administration, and maintenance training by factory-trained personnel qualified to instruct.
1. Contractor shall provide up to 12 hours of scheduled and dedicated training time in three (3) four (4) hour sessions for administration and investigation.
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.

3.9 WARRANTY

A. Refer to Section 270000 for additional requirements.

3.10 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.

3.11 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.

3.12 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 270500 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 20-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

GEOTECHNICAL ENGINEERING REPORT

TO-8148 Kenwood Community Center
305 Dora Street
San Antonio, Texas

PSI Project No. 0312-3570

PREPARED FOR:

City of San Antonio, Public Works Department
P.O. Box 839966
San Antonio, Texas 78235-3966

May 30, 2025

BY:

PROFESSIONAL SERVICE INDUSTRIES, INC.
3 Burwood Lane
San Antonio, Texas 78216
Phone: (210) 342-9377

Professional Service Industries, Inc.
3 Burwood Lane
San Antonio, Texas 78216
Office – (210) 342-9377

May 30, 2025

City of San Antonio, Public Works Department
P.O. Box 839966
San Antonio, Texas 78235-3966

Attn: Ms. Alicia Gomez

RE: GEOTECHNICAL ENGINEERING REPORT
TO-8148 Kenwood Community Center
305 Dora Street
San Antonio, Texas
PSI Project No. 0312-3570

Dear Ms. Gomez:

Professional Service Industries, Inc. (PSI), an Intertek company, is pleased to submit this Geotechnical Engineering Report for the above-referenced project. This report includes the results from the field and laboratory investigation along with recommendations for use in preparation of the appropriate design and construction documents for this project.

PSI appreciates the opportunity to provide this Geotechnical Engineering Report and looks forward to continuing participation during the design and construction phases of this project. PSI also has great interest in providing materials testing and inspection services during the construction of this project and will be glad to meet with you to further discuss how we can be of assistance as the project advances.

If there are questions pertaining to this report, or if PSI may be of further service, please contact us at your convenience.

Respectfully submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.
Texas Board of Professional Engineers Certificate of Registration # F003307

Louis Ratcliffe, E.I.T.
Project Engineer
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May 30, 2025

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1.0 PROJECT INFORMATION

1.1 PROJECT AUTHORIZATION

Professional Service Industries, Inc. (PSI), an Intertek company, has completed a field exploration and geotechnical evaluation for the proposed TO-8148 Kenwood Community Center project. Ms. Alicia Gomez, representing City of San Antonio, Public Works Department, authorized PSI's services on May 12, 2025, by issuing Task Order #8148 approving PSI Proposal No. 446050. PSI's proposal contained a proposed scope of work, lump sum fee, and PSI's General Conditions.

1.2 PROJECT DESCRIPTION

Based on information provided by Mr. Cory Hawkins, AIA, representing Beaty Palmer Architects, and PSI's review of the document titled "24-04 Kenwood Community Center_SD_11.08.24" prepared by Beaty Palmer Architects, a summary of our understanding of the proposed project is provided below in the following Project Description table.

TABLE 1.1: PROJECT DESCRIPTION

Project Items	Approx. 8,500 SF single-story community center Associated parking and drives
Building Construction Types	1-story building is anticipated steel frame or masonry construction
Existing Grade Change within Building Pad	± 1 Foot Estimated (Google Earth Pro)
Finished Floor Elevations	Not available at this time. Anticipated to match existing
Requested or Anticipated Foundation Types	Straight shaft drilled piers with suspended slab on carton forms
Maximum Design Column Loads	150 kips
Maximum Design Wall Loads	3.0 kips per Lineal Foot
Pavement for Parking and Drives	Flexible Asphalt (HMAC) and/or Rigid Concrete Pavement
Design Traffic Load	15,000 ESALs for 20-Year Pavement Design Life

The geotechnical recommendations presented in this report are based on the available project information, structure locations, and the subsurface materials encountered during the field investigation. If the information presented above is incorrect, please inform PSI so that the recommendations presented in this report can be amended, as necessary. PSI will not be responsible for the implementation of provided recommendations if not notified of changes in the project.

1.3 PURPOSE AND SCOPE OF SERVICES

The purpose of this study is to evaluate the subsurface conditions at the site and develop geotechnical engineering recommendations and guidelines for use in preparing the design and other related construction documents for the proposed project. The scope of services included drilling soil borings, performing laboratory testing, and preparing this geotechnical engineering report.

This report briefly outlines the available project information, describes the site and subsurface conditions, and presents the following:

- General site development and subgrade preparation recommendations.
- Estimated potential soil movements associated with collapsing, shrinking and swelling soils.
- Recommendations for site excavation, fill compaction, and the use of on-site and imported fill material under the structure.
- Recommendations for drilled shaft/pier design criteria including end bearing and skin friction values, as well as LPILE design values for lateral load analysis.
- Recommendations for suspended slab cast on carton forms.
- Recommendations for the design of flexible asphaltic and rigid concrete pavement systems for the proposed parking and drive areas.
- Seismic design site classification per the 2018 International Building Code.

The scope of services for this geotechnical exploration did not include an environmental, mold nor detailed seismic/fault assessment for determining the presence or absence of wetlands, or hazardous or toxic materials in the soil, bedrock, surface water, groundwater, or air on or below, or around this site. Statements in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes. The report also does not include a detailed settlement analysis or slope stability analysis.

2.0 SITE AND SUBSURFACE CONDITIONS

2.1 SITE DESCRIPTION

The following table provides a generalized description of the existing site conditions based on visual observations during the field activities, as well as other available information.

TABLE 2.1: SITE DESCRIPTION

Site Location	305 Dora Street, San Antonio, Texas GPS Coordinates: Latitude: 29.4748°, Longitude: -98.4961°
Site History	Site consisting of a recently demolished building
Existing Site Ground Cover	Pavements and flatwork
Existing Site Features	Relatively flat
Existing Grade/Elevation Changes	Slightly sloping down to the southwest
Site Geology (Geologic Atlas of Texas)	Pecan Gap Chalk (Kpg)
Site Boundaries/Neighboring Development	North: Park East: Railroad Alignment South: Dora Street West: Park
Ground Surface Soil Support Capability for Operational Stability and Site Access	Anticipated to be Firm Enough for Field Equipment when Dry

2.2 FIELD EXPLORATION

Field exploration for the project consisted of drilling a total of **four (4) borings**. The boring design element, approximate depths and drilling footage are provided in the following table.

TABLE 2.2: FIELD EXPLORATION SUMMARY

Design Element	Number of Borings	Boring Depth (ft)	Drilling Footage (feet)
New Community Center	2	30	60
New Pavements	2	6	12
TOTAL:	**4**	**---**	**72**

The boring locations were selected by PSI personnel and located in the field using a recreational-grade GPS system. Elevations of the ground surface at the boring locations were not provided and should be surveyed by others prior to construction, if required. We have estimated ground surface elevations at the boring locations from the topographic survey provided (or from Google Earth) and estimate an approximate 1-foot accuracy. The references to elevations of various subsurface strata are based on depths below existing grade at the time of drilling. The approximate boring locations are depicted on the Boring Location Plan provided in the Appendix.

TABLE 2.3: FIELD EXPLORATION DESCRIPTION

Drilling Equipment	Truck-Mounted Drilling Equipment
Drilling Method	Continuous Flight-Auger
Field Testing	Hand Penetrometer Standard Penetration Test (ASTM D1586)
Sampling Procedure	ASTM D1587/1586
Sampling Frequency	Continuously to a Depth of 10 Feet and at 5-foot Intervals Thereafter
Frequency of Groundwater Level Measurements	During and After Drilling
Boring Backfill Procedures	Soil Cuttings
Sample Preservation and Transportation Procedure	General Accordance with ASTM D4220

During field activities, the encountered subsurface conditions were observed, logged, and visually classified (in general accordance with ASTM D2487). Field notes were maintained to summarize soil types and descriptions, water levels, changes in subsurface conditions, and drilling conditions.

2.3 LABORATORY TESTING PROGRAM

PSI supplemented the field exploration with a laboratory testing program to determine additional engineering characteristics of the subsurface soils encountered. The laboratory testing program included:

TABLE 2.4: LABORATORY TESTING PROGRAM

Laboratory Test	Procedure Specification
Visual Classification	ASTM D2488
Moisture Content	ASTM D2216
Atterberg Limits	ASTM D4318
Material Finer than No. 200 Sieve	ASTM D1140
Sulfate Content	Tex-145-E

The laboratory testing program was conducted in general accordance with applicable ASTM Test Methods. The results of the laboratory tests are provided on the Boring Logs in the Appendix. Portions of samples not altered or consumed by laboratory testing will be discarded 60 days from the date shown on this report.

2.4 SITE GEOLOGY

We reviewed the **San Antonio Sheet of the Geologic Atlas of Texas** in an effort to determine the geologic setting of the project site and surrounding areas. The Geologic Atlas of Texas was developed by the Bureau of Economic Geology at The University of Texas using aerial photography, data from various oil and gas exploration companies, and very limited ground reconnaissance. Our review indicates that the project site is located in the **Upper Cretaceous Pecan Gap Chalk (K_{pg})** geological formation. The San Antonio Sheet generally describes the formation as being chalk, chalky marl and marl that are white to yellowish brown in color.

2.5 SUBSURFACE CONDITIONS

The results of the field and laboratory investigation have been used to develop a generalized subsurface profile at the project site. The following subsurface descriptions highlight the major subsurface stratification features and material characteristics.

TABLE 2.5: SUMMARY OF EXISTING PAVEMENT THICKNESSES

Boring Location	Asphalt Thickness (in)	Flexible Base (in)
P-01	2	6
P-02	2	6

TABLE 2.6: GENERALIZED SUBSURFACE PROFILE TABLE – NEW COMMUNITY CENTER

Top (ft)	Bot. (ft)	Soil Type	ω (%)	LL (%)	PI	-200 Sieve (%)	N	PP
0	1.5	Fill: Clayey Sand with Gravel	4 – 11	28	12	25	10 – 19	--
1.5	30	Fat Clay	17 – 32	64 – 87	43 – 66	97 – 99	7 – 27	4 – 4.5

TABLE 2.7: GENERALIZED SUBSURFACE PROFILE TABLE – NEW PAVEMENT AREA

Top (ft)	Bot. (ft)	Soil Type	ω (%)	LL (%)	PI	-200 Sieve (%)	PP
0	0.7	Existing Pavement	--	--	--	--	--
0.7	6	Fat Clay	17 – 29	74 – 81	51 – 59	76 – 97	2 – 4
		Fat Clay with Sand					

Note:

1. *ω = Moisture Content (%)*
2. *LL= Liquid limit (%)*
3. *PI = Plasticity Index*
4. *-#200 Sieve = % Passing the #200 Sieve*
5. *N = Standard Penetration Test blow count (blows/foot)*
6. *PP = Hand Penetrometer (tsf)*

The boring logs included in the Appendix should be reviewed for specific information at the boring locations. The boring logs include soil descriptions, stratifications, locations of the samples, and field and laboratory test data. The descriptions provided on the logs only represent the conditions at the specific boring location. The stratifications represent the approximate boundaries between subsurface materials. The actual transitions between strata may be more gradual and less distinct. Variations will occur and should be expected across the site.

2.5.1 GROUNDWATER INFORMATION

Water level measurements were performed during drilling and after completion of drilling. Specific information concerning groundwater is noted on each boring log presented in the Appendix of this report. Groundwater **was not** encountered during the field investigation of this site.

Groundwater levels fluctuate seasonally as a function of rainfall, proximity to creeks, rivers and lakes, the infiltration rate of the soil, seasonal and climatic variations and land usage. In relatively pervious soils, such as sandy soils, the indicated depths are a relatively reliable indicator of groundwater levels. In relatively impervious soils, water levels observed in the borings may not provide a reliable indication of groundwater

elevations, even after several days. If a detailed water level evaluation is required, observation wells or piezometers can be installed at the site to monitor water levels.

The groundwater levels presented in this report were measured at the time of PSI field activities. The contractor should be prepared to control groundwater, if encountered during construction activities.

3.0 GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

3.1 GEOTECHNICAL DISCUSSION

Based upon the information gathered from the soil borings and laboratory testing, the clay soils encountered at this site within the seasonally active zone (estimated to extend to a depth of approximately 15 feet below the existing ground surface) have a **very high** potential for expansion. PSI recommends the expansive potential (i.e. Potential Vertical Movement (PVM)) of these soils be addressed in the design and construction of this project to reduce the potential for foundation movements.

PSI recommends that the proposed community center be supported on deep drilled piers with a suspended slab on carton forms in order to reduce the potential for detrimental settlement.

The following design recommendations have been developed based on the previously described project characteristics and subsurface conditions encountered. If there are changes in the project criteria, PSI should be retained to determine if modifications in the recommendations will be required. The findings of such a review would be presented in a supplemental report. Once final design plans and specifications are available, a general review by PSI is recommended to observe that the conditions assumed in the project description are correct and to verify that the earthwork and foundation recommendations are properly interpreted and implemented within the construction documents.

3.2 POTENTIAL VERTICAL MOVEMENT OF EXPANSIVE SOILS (PVM)

The soils encountered at the soil boring locations exhibit a **very high** potential for volumetric changes, due to fluctuations in soil moisture content. PSI has conducted laboratory testing on the soils to estimate the expansive soil potential with soil moisture variations. These soil moisture variations are based on historical climate change data for a particular site. Determining the soil potential for shrinking and swelling, combined with historical climate variation, aids the engineer in quantifying the soil movement potential of the soils supporting the floor slab and shallow foundations based on climate variations. Shrink/swell movement procedures using two soil modeling systems, the Post Tensioning Institute's (PTI) "Design of Post-Tensioned Slabs-on-Ground, 3rd Edition" and Texas Department of Transportation (TxDOT) method TEX-124-E, were utilized to approximate the Potential Vertical Movement (PVM) for this location.

The anticipated shrink/swell movement (PVM) is a soil movement estimated in consideration of soil properties and climatic moisture changes at a particular geographic location. Foundations on expansive soils are designed with sufficient stiffness to resist these soil movements to an acceptable magnitude.

3.2.1 SHRINK/SWELL MOVEMENT (PVM) ESTIMATE

Based on laboratory testing results and the TEX-124-E and the PTI methods, the potential vertical movement within the proposed project area was estimated to be approximately **6 inches.**

It is not possible to accurately quantify actual soil moisture changes and resulting shrink/swell movements. The PVM and referenced structural movement values provided should be considered approximate values based on industry standard practice and experience. Extreme soil moisture variations could occur due to unusual drought severity, leaking water or sewer lines, perched groundwater infiltration, or seasonal springs. Also, soil transpiration from trees located adjacent to or previously underneath the building, downspouts

directing roof discharge under the foundation, poor drainage or irrigation line breaks could lead to excessive movements.

Therefore, because of these unknown factors, the shrink/swell potential of soils can often be significantly underestimated using the previously mentioned methods of evaluating PVM.

The unknown factors previously mentioned cannot be determined at the time of the geotechnical study. Therefore, estimated shrink/swell movements are calculated only in consideration of historical climate data related to soil moisture variations from climate changes. Movements in excess of those estimated should be anticipated and regular maintenance should be provided to address these issues throughout the life of the structure.

3.3 FOUNDATION RECOMMENDATIONS DISCUSSION

Based on information provided to PSI, information obtained during the field operations, results of the laboratory testing, and PSI's experience with similar projects, recommendations for a drilled pier foundation with a suspended slab on carton forms are presented in this report If an alternative foundation type is desired, PSI can provide alternative recommendations in a supplemental letter upon request.

3.3.1 BUILDING PAD EARTHWORK RECOMMENDATIONS FOR EXISTING CONDITIONS

Building pad preparation should consist of proofrolling the exposed subgrade then placement of on-site soils in moisture conditioned compacted lifts to achieve finish floor grade, as needed. A minimal amount of site earthwork is expected at this site since the proposed structure is to be supported on a drilled pier foundation with a suspended slab on carton forms. The following table provides general recommendations for the installation of a building pad based on the site's existing conditions.

TABLE 3.1: RECONDITIONING METHOD FOR EXISTING CONDITIONS

Application	Structural Slab with Suspended Floor Slab on carton forms
Building pad preparation	The loose soils should be removed and stockpiled for use, provided the material properties meet the requirements listed.
Foundation Improvement Method	Remove and replace loose soils with moisture conditioned compacted on-site soils.
Minimum Over-Excavation	**As required to remove loose soils**
Horizontal Undercut Extent beyond foundation perimeter	5 feet
Subgrade Proof-Rolling	Proof-roll subgrade with rubber-tired, 20-ton (loaded) construction equipment; Alternate Equipment can be used with Geotechnical Engineer Approval. Remove rutting or excessively deflecting soils; Replace failing soils with moisture conditioned compacted on-site soils
Exposed Subgrade Treatment	Proof-roll
Building pad fill thickness	**As required to achieve the finished building pad elevation**
Fill requirements	On-site soils or imported materials may be used as fill. Refer to Table 3.2 for compaction requirements. On-site or imported materials should meet the following specifications: Allowable PI from 12 to 40 Percent Passing No. 200 Sieve > 25% Max Particle Size < 3”
Vapor Retarder Material	Approved by Architect/Structural Engineer
Maximum Loose Lift Thickness	8 inches

3.3.2 COMPACTION AND TESTING RECOMMENDATIONS FOR FOUNDATION PAD AREAS

The following table outlines foundation pad compaction recommendations in consideration of appropriate vertical movement reduction method.

TABLE 3.2: COMPACTION RECOMMENDATIONS

Location	Material	Density Test Method	Plasticity Index	Percent Compaction	Optimum Moisture Content	Testing Frequency
Building Pad Areas	Subgrade, Reconditioned Fill	ASTM D698	PI ≥ 25	94% to 98%	≥ +2%	1 per 5,000 SF; min. 3 per lift
			PI < 25	≥ 95%	0 to +4%	

3.4 DESIGN MEASURES TO REDUCE CHANGES IN SOIL MOISTURE

The design and construction of a grade-supported foundation should include the following elements:

- Roof drainage should be controlled by gutters and carried well away from the structure.
- The ground surface adjacent to the building perimeter should be sloped and maintained a minimum of 5% grade away from the building for 10 feet to result in positive surface flow or drainage away from the building perimeter. In areas adjacent to the building controlled by ADA, concrete flatwork slopes should not be more than 2% within 10 feet of the building.
- Hose bibs, sprinkler heads, and other external water connections should be placed well away from the foundation perimeter such that surface leakage cannot readily infiltrate into the subsurface or compacted fills placed under the proposed foundations and slabs.
- No trees or other vegetation over 6 feet in height shall be planted within 15 feet of the structure unless specifically accounted for in the foundation design.
- Utility bedding should not include gravel near the perimeter of the foundation. Compacted clay or flowable fill trench backfill should be used in lieu of permeable bedding materials between 2 feet inside the building to 4 feet beyond the exterior of the building edge to reduce the potential for water to infiltrate within utility bedding and backfill material.
- Paved areas around the structure are helpful in maintaining soil moisture equilibrium. It will be very beneficial to have pavement, sidewalks or other flatwork located immediately adjacent to the building to both reduce intrusion of surface water into the more permeable select fill and to reduce soil moisture changes along the exterior portion of the floor due to soil moisture changes from drought, excessive rainfall or irrigation, etc.
- Flower beds and planter boxes should be piped or watertight to prevent water infiltration under the building.
- Experience indicates that landscape irrigation is a common source of foundation movement problems and pavement distress. Repairing irrigation lines as soon as possible after leakage commences will benefit foundation performance greatly.
- Building pad and pavement subgrade should be protected and covered within 48 hours to reduce changes in the natural moisture regime from rainfall events or excessive drying from heat and wind.

3.5 FOUNDATION DESIGN RECOMMENDATIONS

The following sections outline geotechnical design requirements for the recommended foundation options.

3.5.1 DRILLED PIER RECOMMENDATIONS

Drilled shafts are a recommended foundation system for the proposed community center. The axial load carrying capacity of a drilled shaft can be computed using the static method of analysis. According to this method, axial capacity, Q, at a given penetration is taken as the sum of the skin friction on the side of the shaft, Q_f, and the end or point bearing at the shaft tip, Q_{eb}, so that:

$$Q = Q_f + Q_{eb} = f \cdot A_s + q \cdot A_p$$

where A_s and A_p represent, respectively, the embedded surface area and the end area of the shaft; f and q represent, respectively, the unit skin friction and the unit end or end bearing capacities.

The total allowable axial capacity in compression will be the summation of the allowable frictional capacity and the allowable end bearing capacity. The total allowable axial capacity in tension will be the allowable frictional capacity alone neglecting the end bearing component.

3.5.1.1 STRAIGHT SHAFT DRILLED PIERS

PSI recommends that the proposed community center be supported on deep straight shaft drilled piers to minimize the potential for undesirable settlement and to reduce potential foundation movements as the structure support will be based below the seasonal active zone. The following illustration and tables outline the requirements for drilled shaft design and construction considerations for support of these structures.

FIGURE 3.1: STRAIGHT SHAFT DRILLED PIER

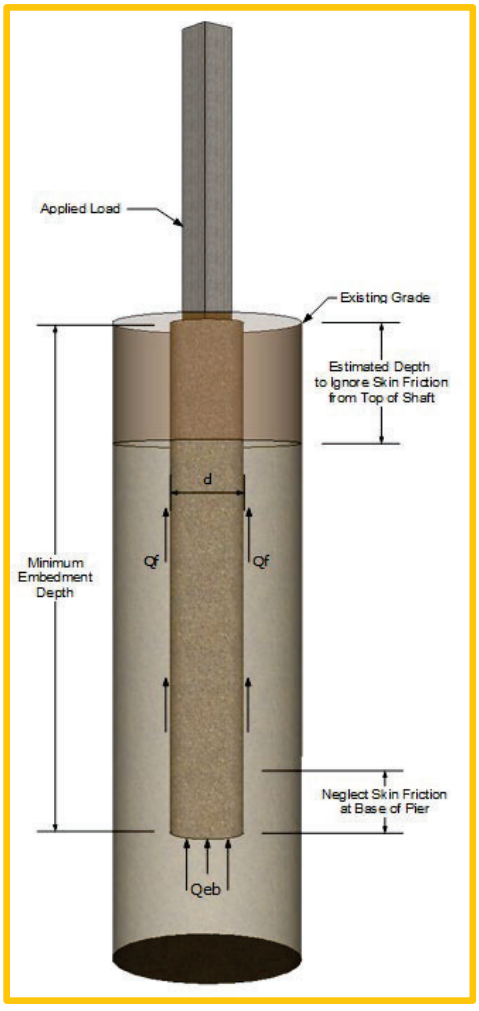


TABLE 3.3: PARAMETERS FOR AXIAL DESIGN

Material	Depth, feet	Allowable Skin Friction, Q_f, psf (F.S. = 2)	Allowable End Bearing, Q_{eb}, psf (F.S. = 3)	Uplift Force of Soil, kips
Clay	0 to 5	—	—	45d with d in feet
Clay	5 to 30	600	7,500	

TABLE 3.4: GEOTECHNICAL RECOMMENDATIONS FOR STRAIGHT SHAFT PIER DESIGN

Neglect Skin Friction from Top of Shaft	5 feet
Minimum Embedment Depth Below Original Grade	15 feet
Minimum Shaft Diameter, d	18 inches
Thickness to Neglect Skin Friction at Base of Shaft	1 Shaft Diameter
Uplift Resistance	Pier Weight + Dead Load + Allowable Skin Friction Below Active Zone
Minimum Shaft Spacing (center to center)	3 Shaft Diameters (3·d)
Possible Group Effect	If spacing < 3d consult Geotechnical Engineer
Min. Pier Vertical Reinforcing Steel	1% of gross cross-sectional area and as needed to resist uplift forces
Pier Tensile Reinforcing Steel	As Per ACI Code
Estimated Settlement Total Settlement Differential Settlement	 Less than 1 inch Less than 0.5 inch

Notes: Detailed Settlement Analysis is outside of project scope

The minimum embedment depth was selected to locate the pier base below the depth of seasonal moisture change and within a specified desired stratum. Actual pier depths may need to be deeper depending upon the actual compressive loads on the pier.

3.5.1.2 LPILE DESIGN CRITERIA

Piers having lateral loads should be designed utilizing the following LPILE input parameters for this project.

TABLE 3.5: PARAMETERS FOR LATERAL DESIGN USING LPILE

Soil Type	Depth, feet	γ_e, pcf	c, psf	k_s, pci	k_c, pci	ε_{50}
Fat Clay	0 – 5	110	1,250	500	300	0.007
Fat Clay	5 – 30	115	2,500	1,000	500	0.005

Note: γ_e: Effective Soil Unit Weight
c: Undrained Cohesion for Clay
k_s: Clay Static Loading Modulus of Subgrade Reaction (LPILE Manual Table 3-3)
k_c: Clay Cyclic Loading Modulus of Subgrade Reaction (LPILE Manual Table 3-3)
ε_{50}: Axial Strain Factor for Soil (LPILE Manual Table 3-2 and 3-4)

3.5.1.3 GENERAL PIER CONSTRUCTION RECOMMENDATIONS

TABLE 3.6: DRILLED PIER INSTALLATION CONSIDERATIONS

Recommended Installation Procedure	FHWA-NHI-10-016, May 2010
High-Torque Drilling Equipment Anticipated	Yes, in hard clay stratum
Groundwater Anticipated	Possible
Verification of Groundwater before Installation	Yes
Temporary Casing Anticipated	No
Concrete Placement after Drilling	Same Day as drilling. If concrete cannot be poured the same day as excavation, temporary casing or slurry may be needed to maintain an open excavation. Concrete should not be allowed to ricochet off the pier reinforcing steel nor off the side walls of excavation.
Concrete Slump	7 inches ± 1 inch
Permissible Water Accumulation in Excavation	Less than 2 inches
Concrete Installation Method for Water Infiltration	Tremie or pump to displace water
Reinforcing and Excavation to Cage Separation	3 times maximum size of coarse aggregate
Centralizers Recommended for Reinforcement	Yes
Cross Bracing within Reinforcement Cage	Not Recommended
Quality Assurance Monitoring by Geotechnical Engineer or Representative	Observe drilling of all piers During drilling, record tip of shaft depth Observe base material and cleanliness of base Observe placement of reinforcement

3.5.1.4 PIER FOUNDATION STRUCTURALLY SUSPENDED FLOOR CONSIDERATIONS

A drilled pier with a suspended floor slab has additional design considerations as outlined in this section. Although suspending the floor and the bottom of the grade beam spanning the piers will greatly reduce foundation movements compared to a soil-supported slab, consideration must be given to proper techniques in utilizing carton forms in order to reduce damage or collapse during wet weather construction. Consideration should also be given to reducing the possibility of water intrusion under the foundation. This can lead to floor moisture infiltration through the floor and possibly mold issues. Also, water infiltration under the floor can cause foundation movements if the swelling soils heave the piers.

Since the pier-supported buildings on deep drilled pier foundations are relatively fixed, any adjacent sidewalks or flatwork would be exposed to the estimated PVM movements; therefore, it is an important design consideration to mitigate the flatwork to an acceptable magnitude.

TABLE 3.7: SUSPENDED FLOOR SLAB CONSIDERATIONS TABLE

Initial Site Stripping	Upper 6 inches of organics and deleterious material including debris, tree roots, etc. to expose clean subgrade
Upper 9" Prepared Subgrade Compaction Requirements	At least 90% of the max standard Proctor (ASTM D-698) dry density at 0 to +4% of omc
Any General Fill Required to Achieve Grade: Placement and Compaction	Max. 9" loose lifts, compacted to at least 92% of the standard Proctor (ASTM D-698) maximum dry density at 0 to +4% of optimum moisture content
Min. Void Under Grade Beam and Floor Slab	8" minimum void to isolate the slab and grade beams from expansive soils from cardboard carton forms
Void Options Under Grade Beam and Floor	Carton forms (void boxes), soil retainers or formwork
Void Box Considerations	Care must be taken not to damage the boxes prior to or during concrete placement. The void boxes should have a tight fit to the pier foundations. They should be designed to deteriorate properly after construction so that pressures from swelling soils will collapse the carton forms rather than be transmitted to the overlying grade beams and/or floor slab. Thin layers of lean concrete are often placed over the void boxes to protect them from moisture during rebar placement operations. The contractor should be familiar with the proper installation and protection of the carton form system. The carton form supplier should provide technical assistance in order to instruct the workforce in proper carton form construction techniques.
Soil Retainers	Precast concrete panels or similar barrier material should be placed vertically along the exterior grade beams to prevent soil from sloughing under the grade beams and reduce the risk of significant water from migrating into the void space under the floor system.
Backfill Against Retainers and Exterior Grade Beams	Should consist of compacted clay soil to minimize movement of outside surface water from infiltrating under the floor system. The backfill clay soil should be compacted to at least 95 percent of the Standard Proctor max. dry density (ASTM D 698) at 0 to +4% of optimum moisture content.

TABLE 3.8: SUSPENDED FLOOR SLAB CRAWL SPACE AND ADJACENT FLATWORK CONSIDERATIONS

Crawlspace Formwork Option Considerations	Provision should be made to collect and dispose of any water that may enter in the crawl space. This can be accomplished by constructing a 3-4-inch-thick, lean concrete slab "mudmat" on the surface of the crawl space. The "mudmat" should be sloped to drain to a sump where the water can be collected and pumped away from the building. Proper ventilation should be provided to help limit moisture from collecting in the crawl space. In some instances, forced-air-ventilation/circulation is used to reduce moisture accumulation and humidity in the crawl space. Mold growth may occur if the crawl space is not adequately ventilated.
Drainage Considerations	Final grading should promote positive drainage away from the structure. Positive drainage should be provided for the building so that surface water does not enter beneath the foundation or enter into air vents that may be situated in the exterior grade beam. Roof drains should be tied to storm drains or be discharged on top of pavements well outside of the building footprints. Soil landscaped areas within ten (10) feet of the structure should slope at a minimum of five (5) percent away from the building. Adjacent concrete flatwork or pavement should slope at a minimum two (2) percent away from the building.
Adjacent Sidewalks and Flatwork PVM Reduction to 2"	Where flatwork will be constructed adjacent to fixed structures, we recommend that the upper 4.0 feet of existing soils be removed and replaced with compacted select fill. In addition to the placement of select fill, we recommend that the sidewalk have a deepened reinforced beam at the outside edge.
Select Fill Requirements for Adjacent Flatwork	Provisions should be taken to reduce the potential for water collecting underneath the sidewalk at the bottom of the select fill. The PI of the select fill under the sidewalk should be in the range of 10 to 20 and this material should contain at least 40% passing the #200 sieve and contain no particles greater than 3" dia.
Flatwork Select Fill Compaction Requirements	The select fill should be compacted to at least 95% of the maximum standard Proctor (ASTM D-698) dry density at 0 to +4% of optimum moisture content

PVM reduction will not eliminate movement of the flatwork. Rather, it will help to reduce those movements to acceptable levels. Differential movements would still be expected to occur between grade-supported flatwork and the building foundations. Doweling the flatwork to the building foundation at common openings will further help to reduce the potential for differential movements and trip hazards. However, when doweling grade-supported flatwork to a suspended structure, movements of the flatwork can cause cracking in the flatwork itself. We recommend that if grade-supported flatwork is dowelled to the foundation, the connections be designed such that they are flexible to rotate. Alternatively, flatwork areas adjacent to pier-

supported structures can also be structurally suspended above grade and supported by drilled pier foundations.

TABLE 3.9: COMPACTION RECOMMENDATIONS FOR UNDERCUT AND REPLACE METHOD

Location	Material	Density Test Method	Plasticity Index	Percent Compaction	Optimum Moisture Content	Testing Frequency
Foundation Pad Areas Below Pour Strips	Subgrade and General Fill Soil	ASTM D 698	PI ≥ 25	94% to 98%	0 to +4%	1 per 5,000 SF; min. 3 per lift
			PI < 25	≥ 95%	0 to +4%	
	Select Fill (Item 247 or Pit Run)	ASTM D 698	PI ≤ 20	≥ 95%	-1 to +3%	

3.6 SIDEWALKS AND FLATWORK

Other sidewalks or other flatwork located adjacent to grade-supported foundations, the undercutting and select fill placement operations for the building should extend beyond the perimeter of the building and pavements to at least the width of the adjacent sidewalk or flatwork. (max. 10 feet)

Any other sidewalks or flatwork not adjacent to buildings should be placed on an improved subgrade meeting or exceeding the pavement subgrade improvement methods previously recommended. If the sidewalk subgrade consists of material with a plasticity index of 25 or greater, 12 inches of select fill (provided in Section 3.3.1) should be placed below the sidewalk. The material should be compacted to 95% or greater than the maximum dry unit weight and contain a moisture content between -1 and +3% optimum moisture content.

Proper drainage around grade-supported sidewalks and flatwork is also very important to reduce potential movements. Elevating the sidewalks where possible and providing rapid, positive drainage away from them will reduce moisture variations within the underlying soils and will therefore provide valuable benefit in reducing the full magnitude of potential movements from being realized.

3.7 CORROSION POTENTIAL

Both metal and concrete elements in contact with soil are subject to corrosion or degradation due to the chemical activity of the soil. Therefore, buried metal and concrete elements should be designed to resist this chemical activity.

3.7.1 CHEMICAL ATTACK POTENTIAL FOR DEGRADATION OF CONCRETE

The concentration of water-soluble sulfates is considered to be a good indicator of the potential for chemical attack on concrete. Based on ACI Manual of Concrete Practice (ACI 201.2R-10) or (ACI 318/318R-33), the amount of water-soluble sulfate in soil can be used to evaluate the need for protection of concrete based on the following table.

TABLE 3.10: REQUIREMENTS FOR CONCRETE EXPOSED TO SULFATE

Water Soluble Sulfate in soil (percent by weight)	Sulfate Exposure
0.00 to 0.10	Negligible or Class 0 Exposure
0.10 to 0.20	Moderate or Class 1 Exposure
0.20 to 2.00	Severe or Class 2 Exposure
Over 2.0	Very Severe or Class 3 Exposure

The results of the laboratory sulfate ion concentration tests performed on soil samples obtained at the site are as follows.

TABLE 3.11: SULFATE TEST RESULTS

Boring Locations	Depth (ft)	Sulfate Content		Cement Type
		mg/kg	Percent by Wt.	
B-02	0 – 1.5	<100	0.0	Type I

Based on the test result of a selected soil sample, the sulfate ion concentration is negligible and the potential for reactions within concrete exposed to sulfates is **negligible** with a Class 0 Exposure. Evaluations of soluble sulfate content contained within the selected samples suggest that Type I cement should be utilized. **The actual cement type to be used shall be determined by the project Civil Engineer**

3.8 SITE SEISMIC DESIGN RECOMMENDATIONS

For the purposes of seismic design, based on the encountered site conditions and local geology, PSI interpreted the subsurface conditions to satisfy the **Site Class D** criteria for use at this site as defined by the International Building Code (IBC). The site class is based on the subsurface conditions encountered at the soil borings, the results of field and laboratory testing, experience with similar projects in this area, and considering the site prepared as recommended herein. The table below provides recommended seismic parameters for the project based on IBC 2018/ASCE 7-16.

TABLE 3.12: RECOMMENDED DESIGN SEISMIC PARAMETERS

Project/Structure Centroid Coordinates (WGS84 - Decimal Degree)	29.4748°; -98.4961°
Seismic Parameter	**IBC 2018/ASCE 7-16**
Site Class	D
Risk Category	II
0.2 sec (S_S)	0.05
1.0 sec (S_1)	0.023
Site Coefficient 0.2sec, F_a	1.6
Site Coefficient 1.0 sec, F_v	2.4
0.2 sec (S_{DS})	0.054
1.0 sec (S_{D1})	0.037

4.0 PAVEMENT DESIGN RECOMMENDATIONS

4.1 PAVEMENT DESIGN PARAMETERS

PSI understands this project will consist of renovating the pavement structure throughout the existing shopping center. The pavement repair areas can be constructed by reclaiming existing pavement materials, although due to the relatively minimal thickness of the asphalt surfacing this option may not be economically practical.

PSI understands that total reconstruction using flexible and rigid pavements will be considered for this project. Therefore, pavement design recommendations for several levels of traffic loading were developed based on assumptions of potential traffic, drive paths or patterns and anticipated soil support characteristics of pavement subgrades. PSI utilized the "AASHTO Guide for Design of Pavement Structures" published by the American Association of State Highway and Transportation Officials to evaluate the pavement thickness recommendations in this report. This method of design considers pavement performance, traffic, roadbed soil, pavement materials, environment, drainage and reliability. Each of these items is incorporated into the design methodology. PSI is available to provide laboratory testing and engineering evaluation to refine the site-specific design parameters and sections, upon request.

Specific design traffic types and volumes for this project were not available to PSI at the issuance of this report. This traffic information is typically used to determine the number of 18-kip Equivalent Single Axle Loads (ESAL) that is applied to the pavement over its design life. Furthermore, the scope of services for this project did not include California Bearing Ratio (CBR) testing. In lieu of project specific design parameters, general traffic and subgrade parameter assumptions were used for this design. Based on this information, PSI has provided recommended pavement sections for "light duty" and "heavy duty" pavements constructed on stable and properly prepared/compacted subgrades. Flexible pavement options with and without geogrid options are also provided for consideration. Details regarding the basis for this design are presented in the table below.

TABLE 4.1: PAVEMENT DESIGN PARAMETERS AND ASSUMPTIONS (RIGID AND FLEXIBLE)

Reliability, percent	70
Initial Serviceability Index, Flexible Pavement	4.2
Initial Serviceability Index, Rigid Pavement	4.5
Terminal Serviceability Index	2.0
Traffic Load for Pavement Design	15,000 equivalent single axle loads (ESALs)
Standard Deviation, Flexible Pavement	0.45
Standard Deviation, Rigid Pavement	0.35
Concrete Compressive Strength	4,000 psi
Subgrade California Bearing Ratio (CBR)	2.0 for high plasticity clay subgrade
Subgrade Modulus of Subgrade Reaction, k in pci	75 for high plasticity clay subgrade

Asphaltic concrete pavements founded on top of expansive soils will be subjected to PVM soil movements estimated and presented in this report. These potential soil movements are typically activated to some degree during the life of the pavement. Consequently, pavements can be expected to crack and require periodic maintenance to reduce damage to the pavement structure.

Light duty areas include parking and drive lanes that are subjected to passenger vehicle traffic only and exclude entrance aprons and general and single access roadway drives to the parking lot area. Heavy duty areas include areas subjected to 18-wheel tractor trailers, including loading and unloading areas, and areas where truck turning, and maneuvering may occur.

Eight-inch thick concrete pavement is recommended for dumpster pad areas and that area leading up to the dumpster pad.

During the paving life, maintenance to seal surface cracks within concrete or asphalt paving and to reseal joints within concrete pavement should be undertaken to achieve the desired paving life. Perimeter drainage should be controlled to prevent or retard influx of surface water from areas surrounding the paving. Water penetration leads to paving degradation. Water penetration into base or subgrade materials, sometimes due to irrigation or surface water infiltration leads to pre-mature paving degradation. Curbs should be used in conjunction with asphalt paving to reduce potential for infiltration of moisture into the base course. Curbs should extend the full depth of the base course and should extend at least 3 inches into the underlying clayey subgrade. The base layer should be tied into the area inlets to drain water that may collect in the base.

Material specifications, construction considerations, and section requirements are presented in following sections.

The presented recommended pavement sections are based on the field and laboratory test results for the project, local pavement design practice, design assumptions presented herein and previous experience with similar projects. The project Civil Engineer should verify that the ESAL and other design values are appropriate for the expected traffic and design life of the project. PSI should be notified in writing if the assumptions or design parameters are incorrect or require modification.

4.2 Pavement Section Recommendations

PSI anticipated that the parking areas will be used primarily by passenger vehicles and delivery vehicles. PSI is providing parking and drive area sections based on experience with similar facilities constructed on similar soil conditions for the design traffic loading anticipated.

4.2.1 Flexible Pavement

Recommendations for flexible asphaltic concrete pavement for parking areas are provided below.

Figure 4.1: Option 1 Flexible Pavement Typical Section

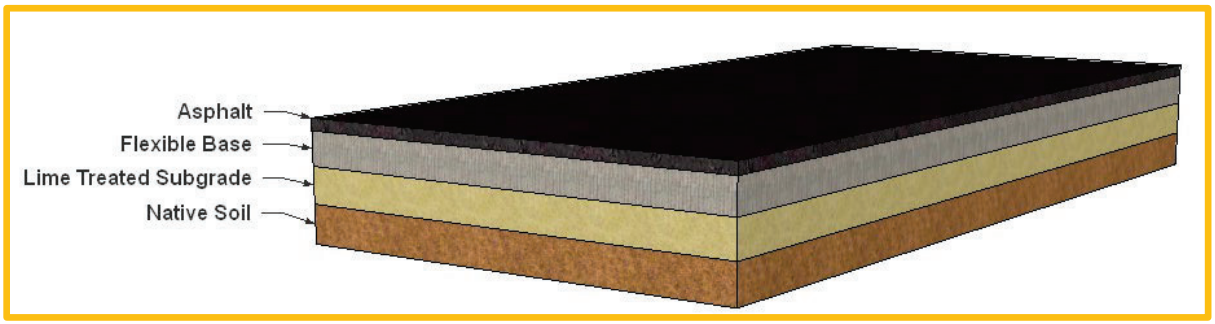


FIGURE 4.2: OPTION 2 FLEXIBLE PAVEMENT TYPICAL SECTION

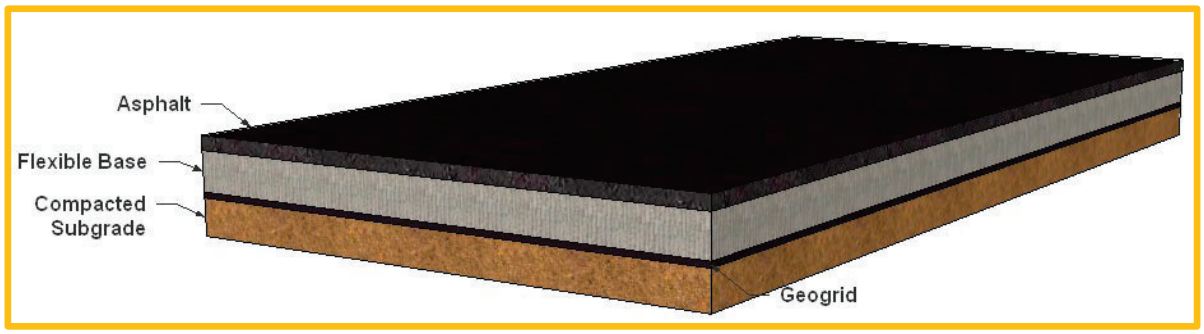


TABLE 4.2: FLEXIBLE PAVEMENT SECTION OPTIONS

Material	Option 1	Option 2
Hot Mix Asphaltic Concrete	2”	2”
Import Flexible Base	7”	6”
Lime Stabilized Subgrade	8”	No
Geogrid	No	Yes
Compacted Subgrade	—	8”

4.2.2 RIGID PAVEMENT

The proposed parking areas for this project may also be constructed with rigid concrete pavement. Recommendations for rigid concrete pavement for roadways and parking areas are provided below.

FIGURE 4.3: OPTION 1 RIGID PAVEMENT TYPICAL SECTION

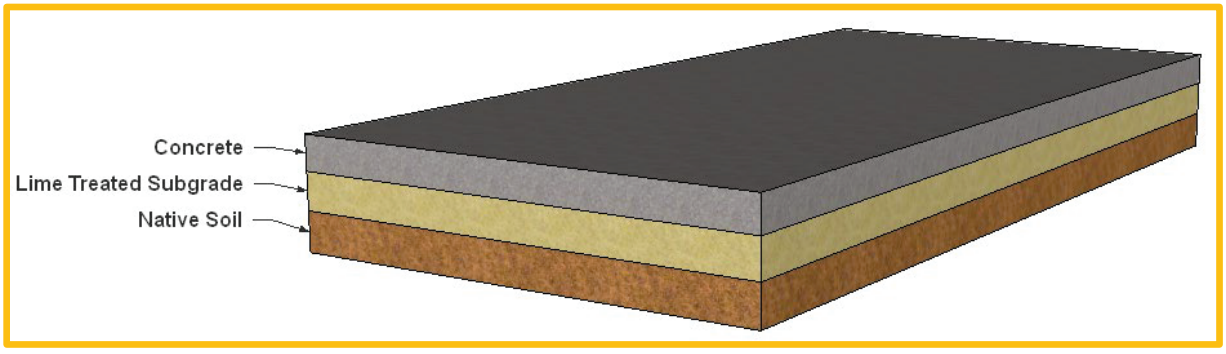


TABLE 4.3: RIGID PAVEMENT SECTION OPTIONS

Material	Option 1	Option 2
Portland Cement Concrete	5”	6”
Lime Stabilized Subgrade	6”	--
Compacted Subgrade	--	8”

4.2.3 GENERAL PAVEMENT DESIGN AND CONSTRUCTION RECOMMENDATIONS

TABLE 4.4: PAVEMENT DESIGN AND CONSTRUCTION RECOMMENDATIONS

Minimum Undercut Depth	6 inches or as needed to remove roots
Reuse Excavated Soils	Must be free of roots and debris and meet material requirements of intended use
Undercut Extent	2 feet beyond the paving limits
Exposed Subgrade Treatment	Proof-roll subgrade with rubber tired 20-ton (loaded) construction equipment Alternate Equipment can be used with Geotechnical Engineer Approval
Proof-Rolled Pumping and Rutting Areas	Excavate to firmer materials and replace with compacted general or select fill under direction of a representative of the Geotechnical Engineer
General Fill	Materials free of roots, debris, and other deleterious materials with a maximum rock size of 4 inches with a CBR greater than 3
Minimum General Fill Thickness	As required to achieve grade
Maximum General Fill Loose Lift Thickness	9 Inches
Lime Stabilization	Performed in general accordance with TxDOT Item 260. Subgrade soils stabilized with lime should achieve a pH of 12.4 or greater. Sulfate testing should be conducted before placement of lime.
Geogrid	Geogrid should meet TxDOT Item DMS – 6240 and be pulled and punched. The subgrade should be leveled and smoothed prior to geogrid placement on compacted subgrade.
Flexible Base	TxDOT Item 247, Type A, Grade 1-2
Maximum Flexible Base Loose Lift Thickness	9 Inches
Hot Mix Asphaltic Concrete	TxDOT Item 340, Type D
Concrete Minimum Recommended Strength	4,000 psi (avg. 28-day comp. strength)
Concrete Contraction Joint Min. Reinforcement (Intended to assist in countering cracking and swelling soil pressures)	No. 3 bars at 18-inch on center each way Located in top half of concrete section Minimum 2 inches cover
Concrete Construction Joint Min. Reinforcement	¾-inch diameter dowels 14 inches long Spaced 12 inches on-center along the joint

Contraction Joint Spacing (In General Accordance with ACI 330)	Maximum joint spacing should be less than 30 times the thickness of the concrete pavement or 15 feet, whichever is smaller.

TABLE 4.5: COMPACTION AND TESTING RECOMMENDATIONS FOR PAVEMENT AREAS

Location	Material	Density Test Method	Soil Type	Percent Compaction	Optimum Moisture Content	Testing Frequency
Pavement Areas	Subgrade, General Fill Soil	ASTM D698	PI ≥ 25	94% to 98%	0 to +4%	1 per 10,000 SF; min. 3 tests
			PI < 25	≥ 95%	0 to +4%	
	Flexible Base Material	ASTM D1557	Item 247	≥ 95%	±3%	1 per 5,000 SF; min. 3 per lift
		TEX-113-E	Item 247	≥ 100%	±2%	

5.0 CONSTRUCTION CONSIDERATIONS

Geotechnical Engineer Involvement at the Time of Construction – Foundation pad preparation recommendations on expansive clay sites in this area depend on the soil moisture conditions that exist due to the prevailing climate at the time of construction as well as the expansive properties of the clay.

It is recommended that the foundation pad recommendations presented in this report be confirmed immediately prior to construction by the Geotechnical-Engineer-of Record (GER). Wetter climate conditions near the time of construction can lead to a significant reduction in pad preparation requirements which can often be a substantial percentage of site development cost.

Having a Geotechnical Engineer retained to review the earthwork recommendations in the Construction Documents and be an active participant in team meetings near the time of construction can often result in project cost savings. Therefore, PSI recommends that an AASHTO accredited 3rd party laboratory with qualified professional engineers who specialize in geotechnical engineering be retained to provide observation and testing of construction activities involved in the foundations, earthwork, pavements and related activities of this project. As the GER, PSI's services can be retained as the 3rd party laboratory. PSI's participation would be advantageous to the project flow and value engineering during construction since we are most familiar with the existing soil conditions at the site.

The geotechnical engineer often does not have available all design information at the time of writing the original report since the report is done very early in the design process. The GER can be of great benefit immediately prior to construction since definitive information regarding the location of the building, surrounding flatwork, pavements, planned landscaping, and drainage features is available at that time. The GER can then write Supplement letters to the original geotechnical report often resulting in less risk and significant project cost savings.

PSI cannot accept responsibility for conditions which deviate from those described in this report, nor for the performance of the foundations or pavements if not engaged to also provide construction observation and materials testing for this project. The PSI geotechnical engineer of record should also be engaged by the Design Team during construction, even if periodic on-call testing is contracted with PSI Construction Services.

5.1 Initial Site Preparation Considerations

5.1.1 Subgrade Preparation for Site Work Outside Building Pad and Pavement Areas

Grade adjustments outside of the foundation pad and pavement areas can be made using select or general fill materials. The clean excavated onsite soils may also be reused in areas not sensitive to movement.

Table 5.1: Subgrade Preparation for Non-Structural - General Fill

Minimum Undercut Depth	6 inches or as needed to remove roots, organic and/or deleterious materials
Exposed Subgrade Treatment	Proof-roll subgrade with rubber-tired 20-ton (loaded) construction equipment Alternate Equipment can be used with Geotechnical Engineer Approval
Proof-Rolled Pumping and Rutting Areas	Excavate to firmer materials and replace with compacted general or select fill under direction of a representative of the Geotechnical Engineer
General Fill Type	Any clean material free of roots, debris and other deleterious material with a maximum particle size of 4 inches
Maximum General Fill Loose Lift Thickness	8 inches

Table 5.2: Fill Compaction Recommendations Outside of Building and Pavement Areas

Location	Material	Test Method for Density Determination	Plasticity Index	Percent Compaction	Optimum Moisture Content	Testing Frequency
Outside of Structure / Pavement Areas	General Fill	ASTM D698	PI ≥ 25	94% to 98%	0 to +4%	1 per 10,000 SF; min. 3 per lift
			PI < 25	≥ 95%	0 to +4%	

5.1.2 Existing Site Conditions

The following table outlines construction considerations in consideration of demolition of existing paving, procedures for abandoning old utility lines and removing trees.

Table 5.3: Considerations for Demolition, Abandoning Utilities and Tree Removal

Existing Pavement	
Former paving located within footing of proposed structures	Remove concrete and/or HMAC surface course and base entirely or review impact on case by case basis
Former paving located within footprint of proposed new paving	Remove concrete and/or HMAC surface course and evaluate if base can be reused
Abandoned Utilities	
Utilities of former structures located within new footprint of proposed structure	Remove pipe, bedding and backfill and then replace with select fill placed using controlled compaction
Utilities of former structures located outside of footprint of proposed structure	Abandon in place using a grout plug
Tree Removal	

Trees located within proposed building footprint; roadways, parking, and sidewalk areas; and within 15 feet of building area	Remove root system for full vertical and lateral extent and extend removal for at least 3 feet beyond presence of root fragments and replace void with compacted general fill or flowable fill

5.2 MOISTURE SENSITIVE SOILS/WEATHER RELATED CONCERNS

Soils are sensitive to disturbances caused by construction traffic and changes in moisture content. During wet weather periods, increases in the moisture content of the soil can cause significant reduction in the soil strength and support capabilities. In addition, soils which become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. It will, therefore, be advantageous to perform earthwork, foundation, and construction activities during dry weather. A relatively all-weather compacted crushed limestone cap having a thickness of at least 6 inches should be provided as a working surface.

5.3 EXCAVATION OBSERVATIONS

Excavations should be observed by a representative of PSI prior to continuing construction activities in those areas. PSI needs to assess the encountered materials and confirm that site conditions are consistent with those discussed in this report. This is especially important to identify the condition and acceptability of the exposed subgrades under foundations and other structures that are sensitive to movement. Soft or loose soil zones encountered at the bottom of the excavations should be removed to the level of competent soils as directed by the Geotechnical Engineer or their representative. Cavities formed as a result of excavation of soft or loose soil zones should be backfilled with compacted select fill or lean concrete.

After opening, excavations should be observed, and concrete should be placed as quickly as possible to avoid exposure to wetting and drying. Surface run-off water should be drained away from the excavations and not be allowed to pond. Excavations left open for more than 48 hours should be protected to reduce evaporation or entry of moisture.

5.4 DRAINAGE CONSIDERATIONS

Water should not be allowed to collect in or adjacent to foundation excavations, on foundation surfaces, or on prepared subgrades within the construction area during or after construction. Proper drainage around grade-supported sidewalks and flatwork is important to reduce potential movements. Excavated areas should be sloped toward one corner to facilitate removal of collected rainwater, groundwater, or surface runoff. Providing rapid, positive drainage away from the building reduces moisture variations within the underlying soils and will aid in reducing the magnitude of potential movements.

5.5 EXCAVATIONS AND TRENCHES

Excavation equipment capabilities and field conditions may vary. Geologic processes are erratic and large variations can occur in small vertical and/or lateral distances. Details regarding “means and methods” to accomplish the work (such as excavation equipment and technique selection) are the sole responsibility of the project contractor. The comments contained in this report are based on small diameter borehole observations. The performance of large excavations may differ as a result of the differences in excavation sizes.

The Occupational Safety and Health Administration (OSHA) Safety and Health Standards (29 CFR Part 1926, Revised October 1989), require that excavations be constructed in accordance with the current OSHA guidelines. Furthermore, the State of Texas requires that detailed plans and specifications meeting OSHA standards be prepared for trench and excavation retention systems used during construction. PSI understands that these regulations are being strictly enforced, and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, State, and Federal safety regulations.

PSI is providing this information as a service to the client. PSI does not assume responsibility for construction site safety or the contractor's or other parties' compliance with local, State, and Federal safety or other regulations. A trench safety plan was beyond the scope of our services for this project.

6.0 REPORT LIMITATIONS

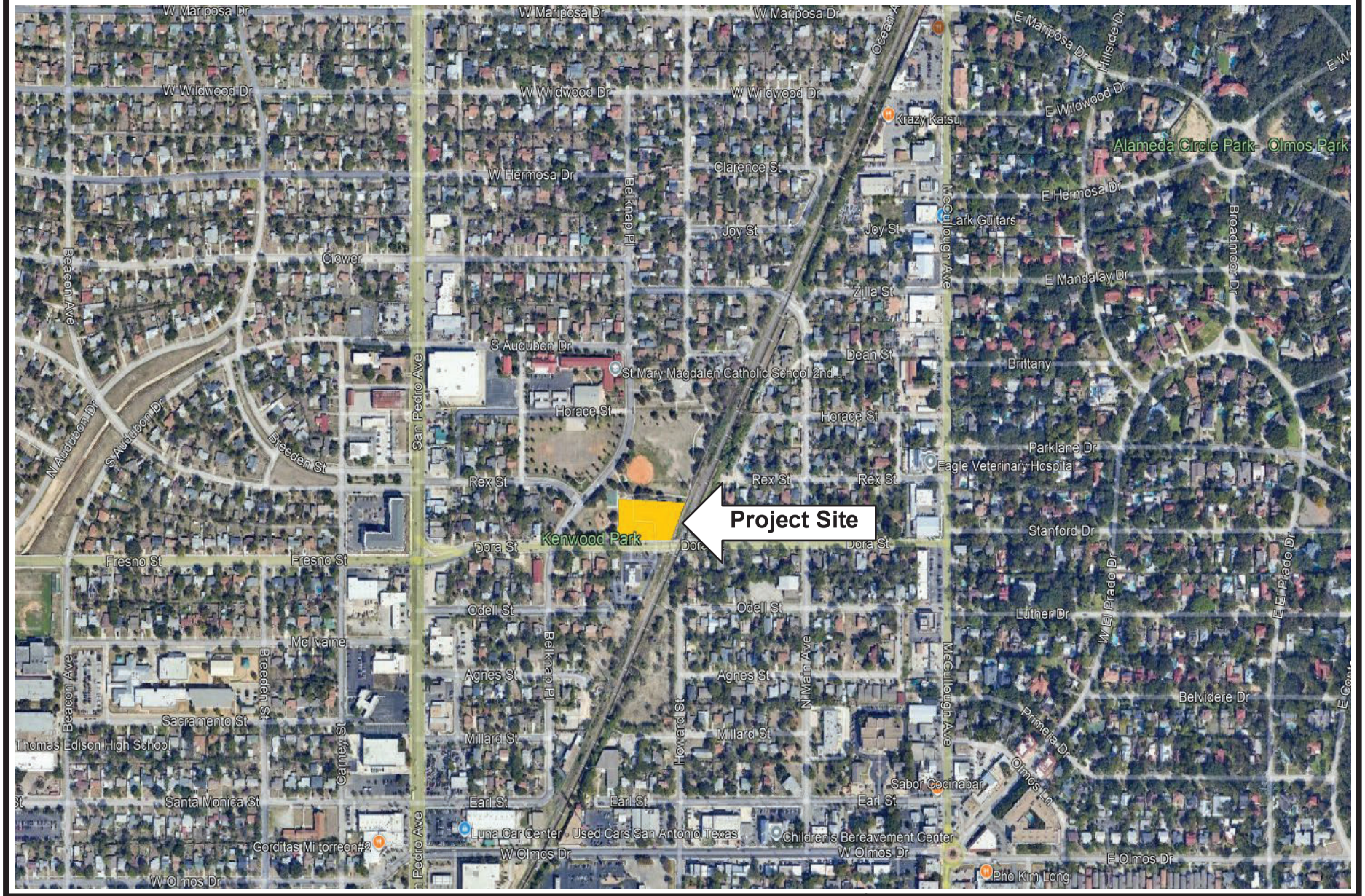
The recommendations submitted in this report are based on the available subsurface information obtained by PSI and design details furnished by the client for the proposed project. If there are revisions to the plans for this project, or if deviations from the subsurface conditions noted in this report are encountered during construction, PSI should be notified immediately to determine if changes in the foundation recommendations are required. If PSI is not notified of such changes, PSI will not be responsible for the impact of those changes on the project.

The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional Geotechnical Engineering practices in the local area. No other warranties are implied or expressed. This report may not be copied without the expressed written permission of PSI.

After the plans and specifications are more complete, the Geotechnical Engineer should be retained and provided the opportunity to review the final design plans and specifications to check that the engineering recommendations have been properly incorporated in the design documents. At this time, it may be necessary to submit supplementary recommendations. If PSI is not retained to perform these functions, PSI will not be responsible for the impact of those conditions on the project.

This report has been prepared for the exclusive use of City of San Antonio, Public Works Department for specific application to the proposed TO-8148 Kenwood Community Center to be constructed at 305 Dora Street in San Antonio, Texas.

APPENDIX



intertek psi
3 Burwood Lane, San Antonio, Texas
(210) 342-9377 FAX (210) 342-9401

Site Vicinity Map

Kenwood Community Center
305 Dora Street
San Antonio, Texas
PSI Project No.: 0312-3570

NOT TO SCALE

N

intertek psi
3 Burwood Lane, San Antonio, Texas
(210) 342-9377 FAX (210) 342-9401

Boring Location Plan

Kenwood Community Center
305 Dora Street
San Antonio, Texas
PSI Project No.: 0312-3570

NOT TO SCALE

N

Boring Logs

TO-8148 Kenwood Community Center
305 Dora Street, San Antonio, Texas
Project No. 0312-3570

BORING B-01

LOCATION: See Boring Location Plan

DEPTH, FT.	SYMBOL	SAMPLES	WATER	SOIL DESCRIPTION Elevation:	MOISTURE CONTENT	% RETAINED #4	% PASSING #200	SPT (N) & TCP (T) VALUES	% REC	%RQD	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	HAND PEN (TSF) ○ UNC CMP (TSF) ● 2.0 4.0 6.0 PL 20 WC 40 LL 60	UNCONF. COMP. (TSF)	UNIT DRY WT. (LB/CU FT)
				FILL: CLAYEY GRAVEL (GC) with SAND, tan, medium dense	11	39	25	10			28	16	12			
				FAT CLAY (CH), brown, firm to hard												
					28			7								
5					28	0	97	7			87	21	66			
				- Transitions to a tan color at 6.5 feet	23			20								
					25	0	99	12			76	23	53			
10																
					30											
15																
					17											
20																
					28											
25																
					27											
30				Boring terminated at approximately 30 feet.												
35																

COMPLETION DEPTH: 30.0 Feet
DATE: 5/19/25

intertek psi

DEPTH TO GROUND WATER
SEEPAGE (ft.): NONE ENCOUNTERED
END OF DRILLING (ft.): NONE ENCOUNTERED
DELAYED WATER LEVEL (FT): NONE ENCOUNTERED

TO-8148 Kenwood Community Center
305 Dora Street, San Antonio, Texas
Project No. 0312-3570

BORING B-02

LOCATION: See Boring Location Plan

DEPTH, FT.	SYMBOL	SAMPLES	WATER	SOIL DESCRIPTION Elevation:	MOISTURE CONTENT	% RETAINED #4	% PASSING #200	SPT (N) & TCP (T) VALUES	% REC	%RQD	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	HAND PEN (TSF) ○ UNC CMP (TSF) ● 2.0 4.0 6.0 PL 20 WC 40 LL 60	UNCONF. COMP. (TSF)	UNIT DRY WT. (LB/CU FT)
				FILL: CLAYEY GRAVEL (GC) with SAND, tan, medium dense	4			19								
				FAT CLAY (CH), brown, stiff to hard	32	0	97	11			87	27	60			
5					25			13								
				- Transitions to a tan color at 6.5 feet	20	0	99	22			64	21	43			
					23											
10																
					24											
15																
					27	0	98				86	21	65			
20																
					26											
25																
					25			27								
30				Boring terminated at approximately 30 feet.												
35																

COMPLETION DEPTH: 30.0 Feet
DATE: 5/20/25

intertek psi

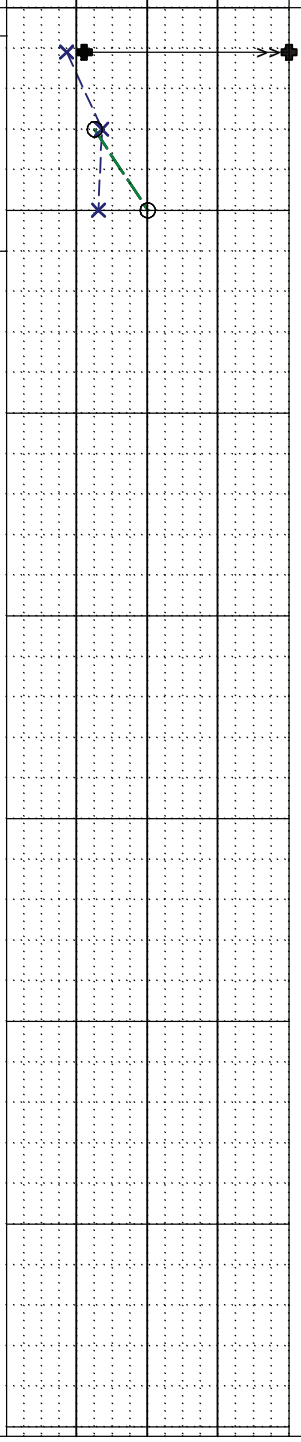
DEPTH TO GROUND WATER
SEEPAGE (ft.): NONE ENCOUNTERED
END OF DRILLING (ft.): NONE ENCOUNTERED
DELAYED WATER LEVEL (FT): NONE ENCOUNTERED

TO-8148 Kenwood Community Center
305 Dora Street, San Antonio, Texas
Project No. 0312-3570

BORING P-01

LOCATION: See Boring Location Plan

DEPTH, FT.	SYMBOL	SAMPLES	WATER	SOIL DESCRIPTION Elevation:	MOISTURE CONTENT	% RETAINED #4	% PASSING #200	SPT (N) & TCP (T) VALUES	% REC	%RQD	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	HAND PEN (TSF) ○ UNC CMP (TSF) ● 2.0 4.0 6.0 / PL WC LL 20 40 60	UNCONF. COMP. (TSF)	UNIT DRY WT. (LB/CU FT)
				2" HMAC 6" BASE												
				FAT CLAY (CH) with SAND, brown, firm to very stiff	17	7	76	5			81	22	59			
					27											
5				- Transitions to a tan color at 4 feet	26											
				Boring terminated at approximately 6 feet.												



COMPLETION DEPTH: 6.0 Feet
DATE: 5/19/25

DEPTH TO GROUND WATER
SEEPAGE (ft.): NONE ENCOUNTERED
END OF DRILLING (ft.): NONE ENCOUNTERED
DELAYED WATER LEVEL (FT): NONE ENCOUNTERED

TO-8148 Kenwood Community Center
305 Dora Street, San Antonio, Texas
Project No. 0312-3570

BORING P-02

LOCATION: See Boring Location Plan

DEPTH, FT.	SYMBOL	SAMPLES	WATER	SOIL DESCRIPTION Elevation:	MOISTURE CONTENT	% RETAINED #4	% PASSING #200	SPT (N) & TCP (T) VALUES	% REC	%RQD	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	HAND PEN (TSF) ○ UNC CMP (TSF) ● 2.0 4.0 6.0 PL 20 WC 40 LL 60	UNCONF. COMP. (TSF)	UNIT DRY WT. (LB/CU FT)
				2" HMAC 6" BASE												
				FAT CLAY (CH), brown, very stiff	27											
					29	0	97				74	23	51			
5					23											
				Boring terminated at approximately 6 feet.												
10																
15																
20																
25																
30																
35																

COMPLETION DEPTH: 6.0 Feet
DATE: 5/19/25

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DEPTH TO GROUND WATER
SEEPAGE (ft.): NONE ENCOUNTERED
END OF DRILLING (ft.): NONE ENCOUNTERED
DELAYED WATER LEVEL (FT): NONE ENCOUNTERED

KEY TO TERMS AND SYMBOLS USED ON LOGS

ROCK CLASSIFICATION

RECOVERY

DESCRIPTION OF RECOVERY	% CORE RECOVERY
Incompetent	< 40
Competent	40 TO 70
Fairly Continuous	70 TO 90
Continuous	90 TO 100

ROCK QUALITY DESIGNATION (RQD)

DESCRIPTION OF ROCK QUALITY	RQD
Very Poor (VPo)	0 TO 25
Poor (Po)	25 TO 50
Fair (F)	50 TO 75
Good (Gd)	75 TO 90
Excellent (ExInt)	90 TO 100

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	N-VALUE (Blows/Foot)	SHEAR STRENGTH (tsf)	HAND PEN VALUE (tsf)
Very Soft	0 TO 2	0 TO 0.125	0 TO 0.25
Soft	2 TO 4	0.125 TO 0.25	0.25 TO 0.5
Firm	4 TO 8	0.25 TO 0.5	0.5 TO 1.0
Stiff	8 TO 15	0.5 TO 1.0	1.0 TO 2.0
Very Stiff	15 TO 30	1.0 TO 2.0	2.0 TO 4.0
Hard	>30	>2.0 OR 2.0+	>4.0 OR 4.0+

SOIL DENSITY OR CONSISTENCY

DENSITY (GRANULAR)	CONSISTENCY (COHESIVE)	THD (BLOWS/FT)	FIELD IDENTIFICATION
Very Loose (VLo)	Very Soft (VSo)	0 TO 8	Core (height twice diameter) sags under own weight
Loose (Lo)	Soft (So)	8 TO 20	Core can be pinched or imprinted easily with finger
Slightly Compact (SlCmpt)	Stiff (St)	20 TO 40	Core can be imprinted with considerable pressure
Compact (Cmpt)	Very Stiff (VSt)	40 TO 80	Core can only be imprinted slightly with fingers
Dense (De)	Hard (H)	80 TO 5"/100	Core cannot be imprinted with fingers but can be penetrated with pencil
Very Dense (VDe)	Very Hard (VH)	5"/100 to 0"/100	Core cannot be penetrated with pencil

DEGREE OF PLASTICITY OF COHESIVE SOILS

DEGREE OF PLASTICITY	PLASTICITY INDEX (PI)	SWELL POTENTIAL
None or Slight	0 to 4	None
Low	4 to 20	Low
Medium	20 to 30	Medium
High	30 to 40	High
Very High	>40	Very High

BEDROCK HARDNESS

MORHS' SCALE	CHARACTERISTICS	EXAMPLES	APPROXIMATE THD PEN TEST	
5.5 to 10	Rock will scratch knife	Sandstone, Chert, Schist, Granite, Gneiss, some Limestone	Very Hard (VH)	0" to 2"/100
3 to 5.5	Rock can be scratched with knife blade	Siltstone, Shale, Iron Deposits, most Limestone	Hard (H)	1" to 5"/100
1 to 3	Rock can be scratched with fingernail	Gypsum, Calcite, Evaporites, Chalk, some Shale	Soft (So)	4" to 6"/100

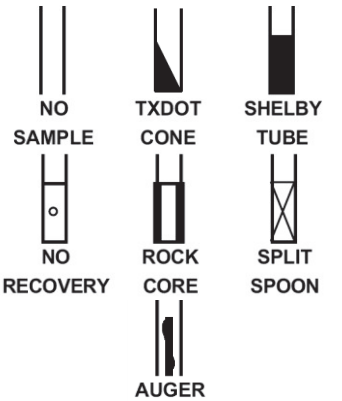
MOISTURE CONDITION OF COHESIVE SOILS

DESCRIPTION	CONDITION
Absence of moisture, dusty, dry to touch	DRY
Damp but no visible water	MOIST
Visible free water	WET

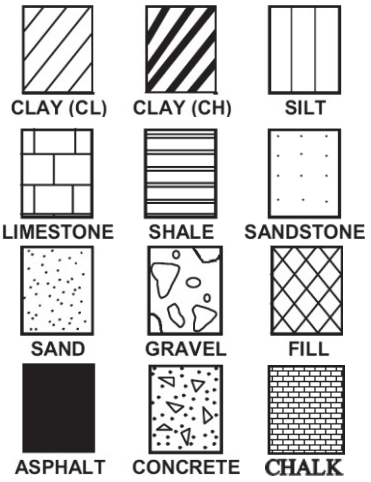
RELATIVE DENSITY FOR GRANULAR SOILS

APPARENT DESNITY	SPT (BLOWS/FT)	CALIFORNIA SAMPLER (BLOWS/FT)	MODIFIED CA. SMAPLER (BLOWS/FT)	RELATIVE DENSITY (%)
Very Loose	0 to 4	0 to 5	0 to 4	0 to 15
Loose	4 to 10	5 to 15	5 to 12	15 to 35
Medium Dense	10 to 30	15 to 40	12 to 35	35 to 65
Dense	30 to 50	40 to 70	35 to 60	65 to 85
Very Dense	>50	>70	>60	85 to 100

SAMPLER TYPES



SOIL TYPES



ABBREVIATIONS

PL – Plastic Limit
LL – Liquid Limit
WC – Percent Moisture

Q_P – Hand Penetrometer
Q_U – Unconfined Compression Test
UU – Unconsolidated Undrained Triaxial

Note: Plot Indicates Shear Strength as Obtained By Above Tests

WATER SEEPAGE

WATER LEVEL AT END OF DRILLING

CLASSIFICATION OF GRANULAR SOILS

U.S. STANDARD SIEVE SIZE(S)

6"	3"	3/4"	4	10	40	200	
BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY / CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	

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Assuring site and subsurface conditions meet the criteria for purchase, development and construction.

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Industry professionals provide a variety of acoustic, fire, AV, roofing system and enclosure consulting services to ensure proper design and installation of a building's critical systems.

Decommissioning & Due Diligence

Supporting the redevelopment and transfer of property assets via environmental and property assessments and engineering services.

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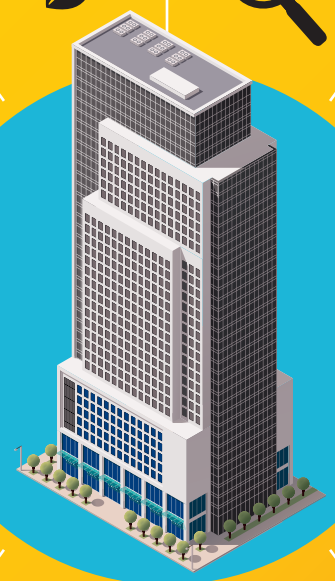
Providing testing for virtually all types of building products, construction materials, and systems for safety, retail, code, and performance purposes.



Property Management Support Services

Providing a variety of building systems testing, inspection, and consulting services to optimize the value and life of the property asset.

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The ETL and Warnock Hersey Marks show a product or system's conformance to code and ensures the on-going verification of compliance.

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Design and construction professionals provide solutions to reduce the potential for premature building failure, increase a building's energy efficiency, and expected life cycle.

Industrial Hygiene Services

Assessing a building or facility for a variety of sources (air, asbestos, lead, mold) to minimize the risk of factors adverse to human health.

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As a leader in providing comprehensive solutions to industries around the globe, Intertek-PSI prides itself on bringing the expertise and services necessary for our clients to meet all of their needs across their entire operation. **Our Assurance, Testing, Inspection, and Certification (A.T.I.C.)** suite of services ensures that whatever your needs may be – assurance, testing, inspection, certification, or all of the above, that those needs will be met by Intertek-PSI.

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Building Product & Construction Materials
The most comprehensive suite of testing and certification services for construction materials and building products.

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