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PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- . 1 Supply and install a complete telecommunications cabling system based on a physical star wiring topology that is designed in accordance with and supported by a 20 year manufacturer backed warranty and certification as specified herein.
- . 2 The structured cabling system to be standards compliant based upon a structured cabling system and should be composed of the following interdependent sub-systems:
 - . 1 Cross-connect System.
 - . 2 Horizontal cabling system.
 - . 3 Telecommunications outlet/connector associated cords and adapters.
 - . 4 Patch panels.
 - . 5 Backbone cabling system.
 - . 6 Refer to Section 27 10 05

1.2 DESCRIPTION OF WORK

- . 1 Data cabling system for the Building as indicated herein and which generally includes but is not limited to cabling terminations, cross connects, backbone cabling, horizontal cabling, BIX panels, racks/frames/enclosures, cable management, ethernet switch, fibre interface UPS, patch cables, etc.

1.3 QUALIFICATION OF CONTRACTOR

- . 1 All installation staff must show proof of certification with New Brunswick Department of Labour for low voltage installations. Obtain an installation permit from the Electrical Inspection Department for the work on this Project
- . 2 All structured cabling, termination hardware, and connecting cords shall be sourced from the certifying manufacturer to assure quality control and validity of the manufacturer's warranty.
- . 3 Structured cabling system to be Belden/CDT, System 2400.
- . 4 The vendor, will accept complete responsibility for the design, installation, certification, and support of the cabling system. Contractor must show proof that vendor has the certifying manufacturer's support on all of these issues.
- . 5 Qualified vendors must provide technical field services in compliance with labour standards (e.g. Communications Cabling Specialist CCS).
- . 6 Vendors to comply with all applicable NB Workers Compensation requirements.
- . 7 Vendors must maintain current NB Construction Safety Association NBCSA compliant status.
- . 8 Qualified vendors to maintain current Building Industry Constructions

Services International (BICSI) membership.

. 9 Qualified vendors to maintain manufacturer recognition as a certified installation contractor for the telecommunications product solution being implemented.

1.4 QUALIFICATION OF SYSTEM

. 1 The cabling system, materials and installation practices must strictly conform to the current issue of industry standards, CSA-T568.1 and EIA/TIA 568, EIA/TIA 568-B.2-1, CSA C22.1 Canadian Electrical Code Part 1. All performance requirements of this document must be followed. In addition, workmanship and installation methods used shall be equal to or better than those found in the BICSI (Building Industry Consulting Service International) TDM Manual (latest edition).

. 2 The cabling system must conform to applicable local building and electrical safety codes. The vendor shall apply and receive acceptance for the installation by the electrical inspector as per the Canadian Electrical Code.

1.5 REFERENCES

. 1 CAN/CSA C22.1-12, Canadian Electrical Code.

. 2 CAN/CSA C22.2 No. 226-92(R2011), Protectors in Telecommunications Networks.

. 3 ANSI/TIA/EIA Standards TIA 526 7-2002, Measurement of Optical Power Loss of Installed Singlemode Fibre Cable Plant.

. 4 TIA 526 14-2009, A Optical Power Loss Measurements of Installed Multimode Fibre Cable Plant.

. 5 ANSI/TIA/EIA 568Set, Commercial Building Telecommunications.

. 6 ANSI/TIA 569-2012, B Commercial Building Standard for Telecommunications Pathways and Spaces.

. 7 ANSI/TIA/EIA 606-2012, Administration Standard for Commercial Telecommunications Infrastructure.

. 8 BICSI Telecommunications Distribution Methods Manual (TDMM).

. 9 BICSI Information Transport Systems Installation Methods Manual (ITSIMM).

1.6 PRODUCT DATA

. 1 Submit product data indicating system components, mounting method, grounding and special attachments including tie ins to all external facilities.

1.7 SUBMITTALS

. 1 Submit:

. 1 A complete telecommunications cabling system layout, including cable routing, telecommunications closet(s) and

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telecommunications outlet/connector designations. The layout shall detail locations of all equipment and indicate all wiring pathways.

- .2 Manufacturer's technical documentation on all devices used in cabling system.
- .3 Results of all tests for review. Contractor will conduct and pay for all required testing as indicated herein.

1.8 IDENTIFICATION

- .1 Telecommunications Spaces:
 - .1 Uniquely identify telecommunications spaces within a building as part of a complete administration system.
 - .2 Use the room designation number within the administration system identifier as follows and use "lamicoid" type nameplate minimum 50mm X 300mmL.

Example: TR-110

Where TR denotes Telecommunications Room

110 denotes room number

- .3 For the Main Telecommunications room, use 'MTR' as the abbreviation for the room type.
- .4 The lamicoid nameplate shall be secured to the exterior of the door entering that space.
- .5 All telecommunications equipment racks within each telecommunications space require a unique component identifier as part of the administration system by a "lamicoid" type nameplate, minimum (50mm H) X (600mm L) shown and secured to the upper horizontal rail of the equipment rack.

Example: TR-110-Rack 1

Where Rack 1 denotes rack position in bay

110 denotes architectural room number

TR denotes Telecommunications room

- .6 All telecommunications termination hardware within the telecommunications space requires a unique component identifier as part of the administration system. Identifiers are to be self adhesive thermal transfer type (minimum 300mm long x 50mm high) and placed appropriately to indicate all ports.

- .2 Horizontal Distribution System:
 - .1 Uniquely identify all horizontal cabling with a wrap type self laminating adhesive label with mechanically generated (not hand written) identifier.
 - .2 Horizontal cable identifiers to denote basic telecommunications system application and the originating telecommunications space termination equipment port:

Example: D-024

where 'D' denotes 'data', '024' denotes

'Termination Equipment port number'

- .3 For other telecommunications cabling system other than data, use the following abbreviations:
 - .1 V=Voice

- .2 DB=Data Backbone
- .3 VB=Voice Backbone
- .4 DMR=Demarcation Backbone

.3 Work Area:

- .1 For the purposes of system administration, the work area includes the telecommunications outlet faceplate and all outlet termination hardware.
- .2 All telecommunications outlet faceplates to be standard four port configuration with port assignments as shown.
- .3 All Telecommunications Outlet (TO) locations require a unique component identifier as part of the administration system by a "lamicoid" type etched vinyl nameplate, minimum 120mm H X 70mm L and secure to the wall-space centered and above min. 12mm the telecommunications outlet faceplate.
- .4 Telecommunications work area outlet identifiers must denote basic telecommunications system application, originating telecommunications space and termination equipment port:

Example: TR-118 D-012

Where: TR denotes telecommunications room
118 denotes room number
D denotes data
012 denotes termination equipment port
number

.4 Backbone System:

- .1 For the purposes of system administration the backbone system shall include all backbone system cabling only.
- .2 Uniquely identify all backbone system cabling with a wrap type self laminating adhesive label with mechanically generated (not hand written) identifier.
- .3 Backbone cable identifiers to denote basic telecommunications system application and originating telecommunications space.

.5 Telecommunications Demarcation Facilities:

- .1 For the purposes of system administration, the telecommunications demarcation facilities will include three basic components;
 - .1 Building cross-connect hardware.
 - .2 Building demarcation backbone cable.
 - .3 Building demarcation termination hardware.
- .2 All Building cross-connect hardware within the telecommunications space requires a unique component identifier as part of the administration system. Identifiers must be self adhesive thermal transfer type and placed appropriately to indicate applicable pair assignments as shown;
- .3 All administration system requirements for associated termination hardware located within the telecommunications spaces are addressed in clause 1.8.1.
- .4 Uniquely identify all telecommunications demarcation backbone cabling with a wrap type self- laminating adhesive

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- label with mechanically generated (not hand written) identifier.
- . 5 All telecommunications demarcation backbone cable identifiers to denote basic telecommunications system application and originating telecommunications space.

PART 2 - PRODUCTS

2.1 BACKBONE CABLING

- . 1 Backbone cabling general:
- . 2 The data backbone cabling extends from the communication rack in building F-58 to the communications room in the new facility. Backbone cables to consist of 1-24 (12 Pr.) multi-mode 62.5micrometer fibre optic cable.
- . 3 Configure the backbone cabling as a physical star, with separate dedicated cables to each remote telecommunication cabinet. Identify all backbone cables with permanent labels at both ends. Label will indicate building and room.
- . 4 Fibre optic cabling to consist of 62.5micrometer, multi-mode, OM3 cable. All fibre optic cable to be run in innerduct or conduit (as indicated on drawings) at all times. Each end of all fibre runs shall contain a slack loop of at least 1m of cable. Terminate fibres in rack mounted fibre optic patch panels with rugged construction ST type connectors. Provide strain reliefs.
- . 5 Data backbone cables to be orange in colour. Incoming voice backbone cables to be green in colour.
- . 6 Provide all cables complete with a minimum FT6 jacket.
- . 7 Voice backbone to be 12 PR CTP cables.

2.2 TERMINATION SUB-SYSTEMS

- . 1 Telecommunications Cabinets (TC's) and horizontal cross-connect:
 - . 1 Set up TCs should to allow for standards compliant cabling systems and usable areas for cable management.
 - . 2 The TCs will house, various telecommunications equipment, in addition to the cross-connecting hardware. Provide free standing enclosure per specifications. Provide telecommunications (LAN) enclosures in the Communications Room as indicated. Enclosures are to be Standard EIA 19" wide and with 150mm wide vertical cable management with hinged cover on both sides of the rack and horizontal cable management. The copper cross-connect system shall be sized to support the telecommunications outlet/connectors served by that closet. The layout shall be sized for 25% growth.
 - . 3 Supply and install "blank" dust covers in all unused openings in patch panels. Colour to match patch panel.
 - . 4 Patch panels to be Cat. 6A, 24 or 48 port patch panel, designed for mounting in 19" racks.

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- . 2 Work area telecommunications outlet/connector:
 - . 1 The work area telecommunications outlet/connector is the interface between the horizontal wiring and the work area device (via line cord).
 - . 2 Install all telecommunications outlet/connectors in an appropriate faceplate.
 - . 3 Face plates to be clean in appearance. Mounting hardware must not be visible on the faceplate, if at all possible. Face plates in walls shall be made of vertically brushed stainless steel.
 - . 4 Flush mounted faceplates must accommodate modular telecommunications outlet/connectors as indicated and be provided with required number of connectors. No additional mounting hardware will be required to mount outlet/connectors into faceplate. Standard outlet to accommodate four (4) data ports.
 - . 5 The eight-position modular UTP telecommunications outlet/connector and its pin assignments must meet the requirements described in the standards CSA T568A and be CAT 6 compliant.
 - . 6 Uniquely label each telecommunications outlet. The label forms an integral part of the faceplate.
 - . 7 All work area telecommunications outlets shall have their modular outlets colour coded as follows:
 - . 1 Data to be white.
 - . 2 Voice to be blue.
 - . 8 Supply and install "blank" dust covers in all unused openings in face plates. Colour to match face plate.

2.3 CONNECTORS

- . 1 Telecommunications outlet/connector (modular jacks):
 - . 1 Connectors shall have as a minimum all of the performance parameters outlined in EIA/TIA 568-B.2-1.
 - . 2 Colour coding at TC terminations:
 - . 1 Orange for UTP data backbone.
 - . 2 Green for incoming UTP voice backbone.
 - . 3 Blue for UTP data horizontal cabling.
 - . 4 White for UTP voice horizontal cabling.
 - . 3 Colour coding at work area outlet:
 - . 1 Blue for data.
 - . 2 White for voice.
- . 2 Fibre optic connectors:
 - . 1 The fibre interconnect system in the Telecommunications racks shall be sized to accommodate 12 or 24 fibres as required.
 - . 2 Fit the fibre optic patch panels with ST type connectors and should be rugged and provide strain relief for fibre connections.
 - . 3 The optical fibre patch panels should accommodate storage and management of at least 2.0m of slack per fibre.
 - . 4 Make fibre connections with field installable connectors or fibre splices and pigtailed.

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- . 5 Equip fibre patch cords with appropriate connectors and shall use either single or dual fibre cables. Use buffered fibre overlaid with kevlar and a second PVC jacket. Maximum loss not to exceed manufacturer specified values.

2.4 HORIZONTAL CABLING

- . 1 Horizontal cables consists of eight (8) #23 AWG insulated, solid conductors, formed into four (4) individually twisted pairs. Refer to drawings for location and quantity of horizontal data cables.
- . 2 The horizontal cable length from the telecommunications rack to the farthest workstation area shall be limited to 90m.
- . 3 Installation of the horizontal cable to follow the appropriate recommendations covered in the respective manufacturer's design guide and the appropriate standards documents. This is done in order to ensure adequate protection from electromagnetic interference (EMI) sources and to confirm all components and cables are in good condition after installation.
- . 4 UTP data cabling shall be CAT 6 cable and meet or exceed the transmission and electrical characteristics of the EIA/TIA 568-B.2-1 requirements for horizontal cabling for Extended Frequency LANs. The UTP cable to be minimum FT6 rated cable. The UTP cable consists of #23 AWG thermoplastic insulated solid conductors formed into four individually twisted pairs and enclosed in a thermoplastic jacket.
- . 5 Provide conduit, pull boxes as indicated or as required by code.
- . 6 Provide technology all face plates and appurtenances necessary for the installation of telecommunications outlets in wall boxes. Install conduit and boxes in walls where indicated. Where telecommunications outlets are installed in systems furniture, provide wall box complete with faceplate and flexible conduit feed to furniture raceway or fire rated pole through furniture feed device.
- . 7 All data and voice cabling to be home runs (1 cable per drop) from the telecommunications closet to the work area.
- . 8 Horizontal data cabling to be white in colour. Horizontal voice cabling to be blue in colour.

2.5 MODULAR LINE AND PATCH CORDS

- . 1 General:
- . 2 Modular line/patch cords consist of #23 AWG insulated, solid or stranded conductors formed into four individually twisted pairs and enclosed in a jacket CAT 6. No cord may degrade the required channel performance characteristics as per CSA T529. All cords shall be covered by the manufacturer's warranty and certification. All cords shall maintain the appropriate polarity.
- . 2 Total line and patch cord lengths per channel must not exceed 10m.
- . 3 Work area (line cords):
 - . 1 Use modular line cords to attach each workstation network

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- interface card to a telecommunications outlet/connector, 3m in length. Terminate line cords with eight (8) position modular plugs at both ends. The modular plugs to comply with CSA T529. Pin configuration to be T568A (as per CSA T529).
- . 2 Use manufacturer factory built and tested connectorized cords.
- . 3 Provide 3m long line cords.
- . 4 Provide sufficient quantity of line cords for total number of horizontal data cables installed.
- . 4 Telecommunications closets (patch cords):
 - . 1 Modular patch cords shall be used to patch within each cross-connect. They shall be 610mm in length. Terminate patch cords with eight (8) position modular plugs at both ends.
 - . 2 Provide 1.5m long patch cords unless noted otherwise. Coordinate colours with Owner.
 - . 3 Use manufacturer factory built and tested connectorized cords.
 - . 4 Provide sufficient quantity of patch cords for crossing over all horizontal data and backbone cables in telecommunications room.
- . 5 Specifications:
 - . 1 All copper line and patch cords to be manufacturer backed, built and tested with Category 6A characteristics which comply with EIA/TIA 568- B.2-1.

PART 3 - EXECUTION

3.1 INSTALLATION

- . 1 Label all telecommunications outlet/connectors, patch panels, cross connects, cabinets, and other components in accordance with the specifications. Regardless of the numbering scheme, every cable must have the same permanent identifier on its termination hardware at both ends. Numbering scheme to be approved by Departmental Representative.
- . 2 Label cross-connect ports to correspond to workstation address and riser cable. Use the BICSI colour code standard unless noted otherwise.
- . 3 Properly bond each equipment/distribution rack in the TCs to a ground bus in accordance with the applicable code requirements as per CSA T527 and Section 26 05 00.
- . 4 Provide basket trays and install in the communications room to manage cable concentrations above the racks in an orderly fashion. Install cable management in racks and on walls.
- . 5 Perform installation in a professional manner using the best practices in the industry. Best practices include, but are not limited to:
 - . 1 All cabling to be continuous without joints, or splices from the work area to the telecommunications closet.

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- . 2 Install all cables in technology J-hooks, in conduits in walls, and in areas with open ceilings. Confirm cables above T-bar are within reach (750mm) of T-bar ceiling. Provide cable trays where noted on the drawings. The maximum number of bends between cable pulling points shall be two ninety degree bends over a maximum of 30m.
- . 3 Horizontal fill ratios for conduit, cable trays, raceways and ducts shall conform with standards and manufacturer recommendations plus 25% spare for future installation. Minimum conduit sizes to be 27mm dia.
- . 4 Standards for separation distances between cables and sources of electromagnetic interference should be followed.
- . 5 Handle, install and support all cables in accordance with the manufacturer's guidelines. During the laying of the cable, take care not to overstress the cable. After the cable is installed, make sure that all parts of the cable are supported properly and shall be stress free at both ends and throughout their length.
- . 6 Give appropriate attention to the handling of all cables to ensure that bending radius conforms to the manufacturer's requirements. At no time shall the cable's static or dynamic bending radius be exceeded.
- . 7 Securely mount all telecommunications outlet/connectors at all work area locations and shall be located so that the cable required to reach the work area equipment will be no longer than three meters.
- . 8 Co-ordinate Work with that of other trades.
- . 9 Terminate all four pairs of unshielded twisted pair (UTP) cable on a single port. The splitting of cable pairs between different jacks is not permitted.
- . 10 Provide a 3m service loop at the Telecommunications Room. The loop to have a minimum bend radius of 225mm.
- . 11 Install all optical fibre backbone cabling inside 32mm diameter inner-duct. Inner-duct to be orange in colour and minimum FT-6 rated complete with pull tape. Install inner-duct in conduit.
- . 12 Terminate voice backbone cables with two (2) pairs per port.

3.2 RCDD PROJECT MANAGER

- . 1 General:
- . 2 The successful Telecommunications Distribution System contractor is required to retain the services of one (1) Registered Communications Distribution Designer (RCDD) for the duration of the project. The RCDD must be identified and the successful vendor must provide a copy of the RCDD current certificate and BICSI membership on a timely basis prior to the commencement of work.
- . 3 The RCDD will maintain responsibility for the following;
 - . 1 Review and accept the Telecommunications Distribution System materials, hardware and related components proposed. Review the proposed pathways and spaces and accept the size and location of all Telecommunications Spaces (TS). Notify the Departmental Representative of any issues or concerns related to CAN/CSA, IEE and TIE/EIA

- specification compliance.
- . 2 Review and approve Telecommunications Distribution System material shop drawings prior to submission to the Departmental Representative.
- . 3 Attend regularly scheduled project construction and job meetings as requested by the project Departmental Representative.
- . 4 Ensure system installation practices and procedures comply with all applicable CAN/CSA, IEE and TIA/EIA specifications and procedures.
- . 5 Provide regular project status reports and updates as requested by the project Departmental Representative.
- . 6 Observe testing and certification procedures and provide manufacturers assurance and warranty.
- . 7 Review and approve all project as-built documentation including drawings, test reports, details and provide current RCDD seal on all.

3.3 INSPECTION AND FIELD TESTING

- . 1 Provide commissioning verification, inspection and certification.
Conduct and pay for all tests required.
- . 2 Conduct end-to-end testing for UTP copper for 100% of pairs as follows:
 - . 1 Balanced twisted-pair cable testing:
 - . 1 Testing procedures used are to be applicable to the horizontal cabling configuration to meet field test compliance. Consolidation/Transition points are optional interface points as specified and permitted under CAN/CSA and ANSI/TIA/EIA specifications and are considered a seamless link for acceptance testing.
 - . 2 The field testing acceptance parameters for balanced twisted-pair cabling are as follows:
 - . 1 Wire map (continuity).
 - . 2 Length.
 - . 3 Insertion loss.
 - . 4 NEXT Loss.
 - . 5 ELFEXT.
 - . 6 Propagation delay and delay skew.
 - . 7 Return loss.
 - . 8 Power sum near-end crosstalk (PSNEXT) loss.
 - . 9 Power sum equal level far-end crosstalk (PSSELFEXT).
 - . 3 Level III field test instruments are required for measurements up to Category 6 and class E cabling.
 - . 4 Acceptance testing results are to be documented and provided.
 - . 2 UTP Backbone cable testing:
 - . 1 Backbone cabling involving lengths within the performance and acceptance requirements are to be

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- tested for length, opens and shorts of all pairs terminated within the cable sheath.
- . 2 For Category 6, UTP backbone lengths and channels that do not exceed the length limits for horizontal cables, the test parameters for horizontal cabling must be used.
- . 3 Document and provide acceptance testing results.

. 3 Complete field testing of fibre optic cable after the fibre is installed as follows:

- . 1 Optical Fibre Cable Testing
 - . 1 Conduct:
 - . 1 Attenuation testing (after fibre is installed.)
 - . 2 OTDR testing.
 - . 3 Acceptance testing results are to be documented and provided.
- . 4 Verify labelling of all wiring at all termination points.

3.4 CERTIFICATION AND TESTING

- . 1 Vendors providing services shall reference and comply with all requirements for telecommunications system certification and testing as specified in this Section.
 - . 1 Provide a Product Manufacturer's Application Warranty for a minimum of Twenty-five (25) Years.
 - . 2 Provide RCDD Letter of Certification for the complete Telecommunications Cabling System as facilitated for the project.
 - . 3 Certification and testing documentation shall be provided as a complete part of the Project Documentation requirements as specified within this document.

3.5 PROJECT DOCUMENTATION

- . 1 As-built Drawings:
- . 2 Provide record drawings in both hard copy and electronic format.
- . 3 Provide drawings in AutoCAD .dwg file format by the Departmental Representative to the vendor for preparation of the "As-built" drawings.
- . 4 Provide record drawings with the following information:
 - . 1 All work area telecommunications outlet locations as constructed.
 - . 2 Project administration system identifiers for telecommunications outlets as specified within this document.
 - . 3 Project administration system identifiers for telecommunications spaces (TR and MTR) as specified within this Section.
- . 5 Provide hard copy format record drawings in "C" size drawings in two (2) complete sets as defined;
 - . 1 One (1) complete floor plan drawing set black and white (color optional).
 - . 2 One (1) complete floor plan drawing set black and white (color optional) laminated (encapsulated) to be

- placed in all associated telecommunications spaces).
- . 6 Laminated hard copy record drawings may be provided in sections (C size sheet) related to the telecommunications space servicing a specific floor section or area.

. 2 Test Results:

- . 1 Vendors to provide Test Results in electronic format as part of compliance with this requirement.
- . 2 Provide test result for compliance of this section.

. 3 Manufacturers Warranty:

- . 1 Vendors to provide a manufacturer generated and supported Product Warranty and Application Assurance certificates upon completion of installation and acceptance by the Departmental Representative.
- . 2 Product Warranty and Application Assurance shall provide coverage of materials and labour for a minimum of Twenty-five (25) Years from date of installation and acceptance regardless of installing agent/vendor status.

. 4 RCDD Project Certification:

- . 1 Vendors to provide RCDD Project Certificate in hard copy format.
- . 2 Provide the RCDD certification.

END OF SECTION

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

- . 1 Telecommunications raceways system consists of outlet boxes, cover plates, terminal distribution cabinets, conduits, pull boxes, sleeves and caps, fish wires..
- . 2 Overhead distribution system.

PART 2 - PRODUCTS

2.1 MATERIAL

- . 1 Conduits: to Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- . 2 Outlet boxes: to Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- . 3 Fish wire: polypropylene type.

PART 3 - EXECUTION

3.1 INSTALLATION

- . 1 Install basket tray and raceway system, including fish wire, outlet boxes, pull boxes, cover plates, conduit, sleeves and caps, miscellaneous and positioning material to constitute complete system and in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- . 2 All data cabling to be installed in approved raceway. Cable tray only permitted in telecom closet.
- . 3 Use EMT in areas with unfinished or inaccessible ceiling systems and in all walls. Size in accordance with cable manufacturers recommendations. Under no circumstance, install more than 40% fill ratio in any conduit. Allow for 25% spare cables. Install bond conductor in all EMT conduits. All bonding conductors installed as per the latest edition of the CEC.
- . 4 Provide nylon insulated bushings at conversion of EMT to cable tray in telecom room.
- . 5 Where the "grouping" of various systems outlets or multiple type outlets in dry-wall type construction is specified, the use of "box mounting brackets" are to be installed between, and secured to both metal studs. To install suitably sized 100mm square and/or 119mm boxes complete with raised tile rings as may be required.
- . 6 Minimum conduit size shall be 21mm diameter.
- . 7 All Telecommunications outlet boxes shall be sized 100mm square and shall be complete with single gang square raised tile ring.

END OF SECTION

PART 1- GENERAL

1.1 RELATED SECTIONS

- .1 Submittal Procedures: Section 01 33 00
- .2 Environmental and Waste Management Plan: Section 01 74 22

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-C22.2 No. 214-08, Communications Cables (Bi-National standard with UL 444).
 - .2 CSA-C22.2 No. 232-2009, Optical Fiber Cables.
- .2 Telecommunications Industry Association (TIA)
 - .1 TIA-606-(2007), Administration Standard for the Commercial Telecommunications Infrastructure.
 - .2 TIA-TSB-140-2004, Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems.
 - .3 TIA-568 Set-2011, Commercial Building Telecommunications Cabling Standard Set (Contains: Tia-568-C.0, Tia-568-C.1, Tia-568-C.2, Tia-568-C.3 and Tia-568-C.4 - with Addendums and Erratas).
 - .4 TIA-598-(2005), Optical Fiber Cable Color Coding (Also See Munsell Color Charts, Munsell 10100, and Eia-359).

1.3 DEFINITIONS

- .1 Refer to TIA/EIA-598, Annex A for definitions of terms: optical-fiber interconnect, distribution, and breakout cables.

1.4 SYSTEM DESCRIPTION

- .1 Structured telecommunications wiring system consist of unshielded-twisted-pair, terminations, connectors, cross-connection hardware and related equipment installed inside building for occupant's telecommunications systems, including voice (telephone) and data.
- .2 Installed in physical star configuration with separate horizontal and backbone sub-systems.
 - .1 Horizontal cables link work areas to telecommunications racks located in the same tenant area of building.
 - .2 Local area telecommunications racks linked to main terminal/equipment racks by backbone cables.
 - .3 Main building terminal/equipment racks also linked to service provider demarcation point by backbone cables.

1.5 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00, including:
 - .1 Patch panels.
 - .2 Outlets for voice and data.
 - .3 Cable.
 - .4 Cover plates.
- .2 Construction Record Drawings and Records:
 - .1 Provide database reflecting cable installation and cross-connections.
 - .2 Provide electronic drawings in AutoCAD 2013 format depicting all construction.
 - .3 Provide two (2) bound complete hard-copy sets of as-built records to the Departmental Representative.
 - .4 Provide and place one hard copy of as-built records for each

telecommunications rack in plan holder in each location.

**1.6 DELIVERY,
STORAGE AND HANDLING**

- . 1 Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 22.

PART 2 - PRODUCTS

**2.1 FOUR-PAIR 100
OHM BALANCED TWISTED
PAIR CABLE**

- . 1 Four-pair, 100 ohm balanced unshielded-twisted-pair (UTP) cable, flame test classification FT6 or MPG or CMG to: CSA-C22.2 No. 214, Category 6 (Cat 6) and TIA/EIA-568.

**2.2 MULTI-PAIR
OHM BALANCED
TWISTED PAIR CABLE**

- . 1 100 ohm, 100 pairs, sheath consists of thermoplastic jacket without underlying metallic shield, Category 3 to: TIA/EIA-568, flame test classification FT6 or MPG or CMG to: CSA-C22.2 No. 214.

**2.3 WORK AREA
TELECOMMUNICATIONS
OUTLET/CONNECTOR**

- . 1 The work area telecommunications outlet/connector is the interface between the horizontal wiring and the work area device (via line cord).
- . 2 All telecommunications outlet/connectors shall be installed in an appropriate faceplate.
- . 3 Face plates shall be clean in appearance. Mounting hardware shall not be visible on the faceplate, if at all possible. Face plates in walls shall be made of vertically brushed stainless steel.
- . 4 Flush mounted faceplates shall accommodate modular telecommunications outlet/connectors and other multimedia outlets as indicated and be provided with required number of connectors. No additional mounting hardware shall be required to mount outlet/connectors into faceplate. Standard outlet shall accommodate four (4) ports (voice/data as indicated on Drawings).
- . 5 The eight-position modular UTP telecommunications outlet/connector and its pin assignments shall meet the requirements described in the standards CSA T529 as T568A and shall be CAT 6 compliant.
- . 6 Each telecommunications outlet shall be uniquely labelled.
- . 7 Supply and install "blank" dust covers in all unused openings in face plates. Colour to match face plate.
- . 8 Acceptable Manufacturer: Belden/CDT.

**2.4 TERMINATION AND
CROSS-CONNECTION
HARDWARE FOR UTP**

- . 1 IDC Terminal strips, 25 pair, for terminating 4 pair 100 ohm balanced twisted pair cables and supporting cross-connections using jumper wires or compatible plug-ended patch cords Category 6 to: TIA/EIA-568.
- . 2 Mount or block for housing 12 IDC terminal strips, mounted on wall rack or cabinet.
 - . 1 Distribution rings or channels capable of externally mating with the above mount for managing cross-connection wires.
- . 3 Patch panel, for rack mounting, ports:
 - . 1 Each port equipped with factory installed "RJ-45" jacks, type

		. 2	T568A T568B Category 6 to: TIA/EIA-568. Horizontal cable-management unit for every 48 ports.
		. 4	Consolidation point, terminates 12 UTP horizontal cables from telecommunications room on IDC terminations. Cables extending to work areas terminate on RJ-45 jacks type T568A Category 6 to: TIA/EIA-568.
2.5 UTP CROSS-CONNECT WIRE		. 1	Category 6, four (4) pairs to: TIA/EIA-568.
2.6 UTP PATCH CORDS		. 1	3 metres long, with factory-installed male plug at one end to mate with "RJ-45" jack terminal strip and with factory-installed male plug at other end to mate with "RJ-45" jack Category 6, 4 pairs to: TIA/EIA-568.
2.7 UTP EQUIPMENT CABLE		. 1	3m long, each end equipped with "RJ-45" plug Category 6 to: TIA/EIA-568.
2.8 OPTICAL-FIBER CABLE		. 1	Distribution multi-mode 50/125, 500 MHz km capacity strands to: CSA-C22.2 No. 232 and TIA/EIA-568, flame test classification FT6 or OFNR, each end terminated with ST connectors. Number of fibre strands as indicated in Drawing(s).
2.9 OPTICAL-FIBER PATCH PANEL		. 1	Mounted in rack capable of terminating six (6) pairs of fiber, equipped with ST compatible adapters.
2.10 OPTICAL-FIBRE PATCH CORDS		. 1	Interconnect cable, two (2) strands, 1.5 metres long, each end equipped with ST connectors. Multi-Mode 62.5micrometers to: TIA/EIA-568.
2.11 CABLE TV (CATV) CABLING		. 1	Not required.
2.12 FAST ETHERNET SWITCH		. 1	Fast ethernet switch is to be a 48 port managed switch with power over ethernet PoE (Power Over Ethernet) capability. Switch is to have the following features:
		. 1	48 10/100 BASE-TX ports supporting 802.3af PoE.
		. 2	Two (2) combo 10/100/1000 BASE-SFP (fibre ports).
		. 3	Rack mountable 1U enclosure.
		. 2	Standard of acceptance: AVAYA ERS 4550T-PWR, or equivalent alternate.
2.13 RACK MOUNT UNINTERRUPTABLE POWER SUPPLY		. 1	Uninterruptable power supply (UPS) is to be an online type with the following features:
		. 1	700VA, 630W.
		. 2	120V with NEMA 5-15P plug.
		. 3	Full load efficiency ~95%, 86% in online mode minimum.
		. 4	Output distortion less than 3%.
		. 5	Sine wave output.
		. 6	Six (6) NEMA 5-15R Outputs.
		. 7	Built in bypass mode.

2.14 RACKS AND ENCLOSURES

- .8 Minimum 1.83m cord length.
- .9 Maintenance free sealed lead acid battery with suspended electrolyte.
- .10 USB connection to PC for monitoring and setup.
- .11 LED status display showing current mode, load, battery level, and alarms.
- .12 Remote emergency power off (REPO).
- .13 Optional external expansion battery pack modules (EBM) for extended runtime, (2U) in size.
- .14 Rack mountable in a 2U enclosure.
- .15 Unit to be complete with communications card(s) for direct control and remote monitoring via SNMP based networks, web browser interface, relay card(s) for integration into existing Building Management System.
- .2 Standard of acceptance: EATON 700VA UPS: PW9130L700R-XL2U.
- .1 Free standing racks shall be black, four post style with a minimum vertical capacity of 44U (U=1.75 inches/45mm), to be complete with front and rear lockable doors, mounting hardware and rack-mounted power strips. (Middle Atlantic Products PD915R, or equivalent alternate).
- .2 Bond all racks and enclosures as indicated on the drawings.
- .3 Complete with vertical cable management, 250mm ventilation fan, back and front temper glass, and two (2) additional shelves for future.
- .4 Free standing rack standard of acceptance:
- .1 Middle Atlantic Products Mod#: DRK19-44-42, complete with lockable doors (plexi) Model #: PFD-44 or equivalent alternate.

PART 3 - EXECUTION

3.1 INSTALLATION OF TERMINATION AND CROSS-CONNECT HARDWARE

- .1 Install termination and cross-connect hardware on wall and in rack as indicated and according to manufacturers' instructions. Identify and label as indicated to: TIA/EIA-606.
- .2 Install consolidation points, as indicated according to manufacturer's instructions. Identify and label as indicated to: TIA/EIA-606.

3.2 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES

- .1 Install horizontal cables as indicated in conduits from telecommunication rooms to consolidation point individual work-area jacks or MUTOA. Identify and label as indicated to: TIA/EIA-606.
- .2 Support horizontal cables at intervals not exceeding 1.5 metres.
- .1 Where raceways are used to distribute cables to each zone, provide supplementary hangers to support cables at intervals not exceeding 1.5 metres.
- Install horizontal cables from consolidation point to individual work-area jacks. Identify and label as indicated to: TIA/EIA-606.
- .3 Terminate horizontal cables in telecommunications room and at consolidation point, individual work-area jacks and MUTOA.
- .1 Identify and label as indicated to: TIA/EIA-606.

3.3 INSTALLATION OF BACKBONE CABLES

- . 4 Coil spare cables and store in ceiling space in zone.
- . 5 Harness slack cable in cabinets, racks, and wall-mounted termination and cross-connection hardware.
- . 1 Install backbone cables from each telecommunications rack to main terminal/equipment room as indicated and according to manufacturers' instructions.
 - . 1 Identify and label as indicated to: TIA/EIA-606.
- . 2 Install backbone cables from main rack to carrier demarcation point in as indicated and according to manufacturer's instructions.
 - . 1 Identify and label as indicated to: TIA/EIA-606.

3.4 IMPLEMENT CROSS-CONNECTIONS

- . 1 Implement cross-connections using jumper wires or patch cords as specified.

3.5 FIELD QUALITY CONTROL

- . 1 Test horizontal UTP cables as specified below and correct deficiencies provide record of results as hard copy and electronic record on CD.
 - . 1 Perform tests for Permanent Link on installed cables, including spares:
 - . 1 Category 6 using certified level III tester to: TIA/EIA-568.
 - . 2 Perform tests for Channel on 20% of cross-connected data horizontal cabling installed from each telecommunications room, including shortest and longest drops from each telecommunications room: should more than 5% of tested cables fail, test remaining cross-connected data cables.
 - . 1 Category 6 using certified level III tester to: TIA/EIA-568.
- . 2 Test backbone UTP cables as specified below and correct deficiencies: provide record of results as hard copy and electronic record on CD.
 - . 1 Perform tests for Permanent Link on 4-pair cables:
 - . 1 Category 6 using certified level III tester to: TIA/EIA-568.
 - . 2 Perform Wire Map tests on multi-pair UTP cables to: TIA/EIA-568-B.1.
- . 3 Test Optical-fiber strands for attenuation to: TIA/EIA-568-B.1 and correct deficiencies: provide record of results as electronic record on CD.
 - . 1 Test horizontal links need at only one wavelength (850 nm or 1300 nm) and in one direction.
 - . 1 Attenuation to be less than 2.0 dB, unless consolidation point is used.
 - . 2 If consolidation point is used, attenuation test result to be less than 2.75 dB when testing between horizontal cross-connect and telecommunications outlet/connector.
 - . 2 Test backbone links in both directions. Backbone links:
 - . 1 Test multi-mode fiber at both applicable wavelengths (850 nm and 1300 nm).
 - . 2 Test single-mode fiber at both applicable

- wavelengths (1550 nm and 1310 m).
- . 3 Maximum attenuation: Cable attenuation + Connector loss +
Splice loss.
 - . 1 Multi-mode-fiber attenuation coefficients:
 - . 1 3.5 db/km @ 850 nm; and
 - . 2 1.5 db km @ 1300 nm
 - . 2 Maximum connector insertion loss: 0.75 db per pair
and maximum splice insertion loss: 0.3 db.
- . 4 Perform additional Tier 2 tests using optical time domain
reflectometer (OTDR) on backbone fiber pairs to: TSB-140.
 - . 1 Correct deficiencies.
 - . 2 Provide record of results as described in
SUBMITTALS.
- . 5 Provide record of results as electronic record on CD to:
TIA/TSB-140.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

- . 1 Industry Canada - Terminal Attachment Program
 - . 1 CS-03-1996, Telecommunication Apparatus Compliance Specification, Issue 8.

1.2 SYSTEM DESCRIPTION

- . 1 Existing Bogen system to be expended to allow new speakers.

1.3 SHOP DRAWINGS

- . 1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- . 2 Include, riser diagram, block diagram of complete public address system.
- . 3 Public address system design criteria.

1.4 CLOSEOUT SUBMITTALS

- . 1 Provide operation and maintenance data for public address system for incorporation into manual specified in Section 01 77 00 - Closeout Submittals.
- . 2 Provide
 - . 1 Operation instructions.
 - . 2 Description of system operation.
 - . 3 Description of each subsystem operation.
 - . 4 List specifying each piece of equipment in system or subsystem by its original manufacturer name and model number.
 - . 5 Parts list specifying parts used in equipment by identification numbers that are standard to electronic industry.

1.5 WASTE MANAGEMENT AND DISPOSAL

- . 1 Separate and recycle waste materials in accordance with Section 01 74 22 - Construction/Demolition Waste Management And Disposal.
- . 2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- . 3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- . 4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.
- . 5 Fold up metal banding, flatten and place in designated area for recycling.

1.6 SYSTEM STARTUP

- . 1 Manufacturer's factory service engineer to instruct:
 - . 1 Maintenance personnel in maintenance of system.
 - . 2 Operating personnel in use of system.

1.7 SERVICE

. 1 The supplier of the Public Address System shall be represented in the Province of New Brunswick by an established firm in the business of selling and providing maintenance on this type of equipment. This company shall have factory-trained personnel on staff who are knowledgeable with the equipment being supplied under this contract.

. 2 The technicians carrying out the installation, testing, commissioning and training on the system are to be factory trained by the manufacturer of the equipment. Include at the shop drawings submittals stage, a copy of those persons' training certificates.

PART 2 - PRODUCTS

2.1 MATERIALS

. 1 Conduits: to Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

. 2 Communications, conductors, cabling and rack units: as indicated, to Section 27 10 05.

2.2 COMPONENTS

. 1 Continuous duty cycle.

. 2 Modular system design.

. 3 Solid state, and suitable for rack mounting.

. 4 Maximum operating temperature: 65 degrees C.

. 5 Provide hardware for mounting of new amplifier and zone paging module.

2.3 ZONE PAGING SYSTEM

. 1 The zone paging module to be compatible with existing Bogen system

. 2 Zone Paging Modules: Provide zone paging modules for each zone indicated on the drawings. Each zone paging module with features as shown:

. 1 Built in DIP switches to set talk back on/off for each zone.

. 2 Power on LED, low power background music volume control, background music in/out jumper field, local BGM selection jumpers and high power/low power operation selector switch.

. 3 Screw type terminals for connection to background music and zone wiring.

2.4 POWER BOOSTER AMPLIFIER

. 1 Integral overload and output short circuit protection.

. 2 120VAC input with detachable cord.

. 3 Power output: 120W RMS at 1% harmonic distortion over frequency range 25 to 18,000 Hz plus or minus 1 dB.

. 4 Signal and noise level: 80 dB below rated output.

. 5 Maximum gain: 75 dB.

. 6 Outputs: 25W, 70V and 4 ohm speaker outputs.

. 7 Controls and indicators:

**2.5 STANDARD
CEILING SPEAKERS:
MAIN SYSTEM**

- .1 Volume control screwdriver adjustable.
- .2 ac power switch.
- .3 Fused primary.
- .4 'ON' indicator light.
- .8 Pre-Amp Out/Power Amp In insert jacks for connecting external signal processors.
- .9 Module slots for plug in modules to accommodate inputs noted.
- .1 Driver 140 mm Woofer 50 mm Tweeter, full range, 15 watts.
- .2 Power Taps:1.0, 1.5, 2.5, 5.0, 10.0 watts, 8 ohm.
- .3 Frequency Range: 80 - 20,000 Hz.
- .4 Voltage: 70 volts.
- .5 Complete with line matching transformer.
- .6 Complete with backbox and t-bar support or gypsum board support as required. Color: White.
- .7 Sensitivity (1W/1M): 86dB.
- .8 Shape: round.
- .9 Dimensions: 20.5 mm X 130 mm
- .10 Metallic construction.

**2.6 HORN TYPE
SPEAKERS: MAIN
SYSTEM**

- .1 Power rating: 16 watt continuous, 20 watt equalized.
- .2 Frequency Response: 120Hz to 16,000 Hz, +/- 6 dB.
- .3 Impedance: 25/70 volts, 8 ohm.
- .4 Maximum sound pressure level: 90 dB at 1 meter.
- .5 Dispersion: 110 . Aluminum construction with stainless steel screws and U-bracket for mounting.
- .6 Suitable for indoor and outdoor use. Sensitivity 90dB, 1 watt, 1 meter.
- .7 Tapsetting: 8 ohm, 2w, 4w, 8w, 16w at 70/25 volt.
- .8 Colour: White.

2.7 CABLES

- .1 Speaker Wiring: #12/2 twisted unshielded in 21 mm conduit.

PART 3 - EXECUTION

3.1 INSTALLATION

- . 1 Locate and install all devices and components.
- . 2 Coordinate the location of all devices with other devices and equipment in the area.
- . 3 Insure AC power outlets are located to properly serve the equipment.
- . 4 Supply all components necessary to constitute a complete system.

3.2 WIRING

- . 1 Wire and connect all devices and equipment.
- . 2 Install all wire in conduit to Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

3.3 TESTS

- . 1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- . 2 Test all system functions.
- . 3 Conduct intelligibility tests.
- . 4 Provide written test results in Operation and Maintenance Manuals.

3.4 SETUP AND PROGRAMMING

- . 1 Include in the tender price for the manufacturer's factory representative to verify the system operation and setup the system to meet the Departmental Representative's requirements. At the end of the project, provide a letter to the Departmental Representative confirming that the system has been checked out and set up as per the Departmental Representative's requirements and that the demonstration and training function has been carried out.

3.5 DEMONSTRATION AND TRAINING

- . 1 Demonstrate the upgraded system operation to the satisfaction of the Departmental representative.

3.6 COMMISSIONING

- . 1 Provide manufacturer's representative and one electrician (wiring/cabling alterations, installations, allocation of equipment, etc.) as required for commissioning as per Section 01 91 01 - Commissioning.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

- .1 FCC Part 90, CE and IC compliance
- .2 CSA certified

1.2 SYSTEM DESCRIPTION

- .1 Operations:
 - .1 Personal Duress:
 - .1 Upon pushing of a button sends an RF signal to a receiver.
 - .2 Receivers in turn sends signal to the existing central control
 - .3 Non-locatable FLASH system

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Include, devices, description of modifications to existing system to include new building.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for personal protection alarm system for incorporation into manual specified in Section 01 77 00 - Closeout Submittals. Operation instructions.
- .2 Include:
 - .1 Description of system operation.
 - .2 Description of each subsystem operation.
 - .3 List specifying each piece of equipment in system or subsystem by its original manufacturer name and model number.
 - .4 Parts list specifying parts used in equipment by identification numbers that are standard to electronic industry.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 22 - Construction/Demolition Waste Management And Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

1.6 SYSTEM STARTUP

- .1 Manufacturer's factory service engineer to instruct:
 - .1 Maintenance personnel in maintenance of system.
 - .2 Operating personnel in use of system.

1.7 SERVICE

- . 1 The supplier of the PPA system shall be certified by Senstar to maintain the system. This company shall have factory-trained personnel on staff who are knowledgeable with the equipment being supplied under this contract.
- . 2 The technicians carrying out the installation, testing, commissioning and training on the system are to be factory trained and certified by the manufacturer of the equipment. Include at the shop drawings submittals stage, a copy of those persons' training certificates.
- . 3 Contractor to provide and install the RF Receiver where indicated on the drawings. PPD's will be provided by CSC.
- . 4 Contractor to integrate the new PPA with the existing system. This will include media converters at both ends of the new fiber connection.

PART 2 - PRODUCTS

2.1 COMPONENTS

- . 1 Personal Protection Transmitter.
- . 2 Wireless RF Receivers

2.2 PPD (Supplied by CSC)

- . 1 Personal Protective Device to be battery powered with non-rechargeable commercially available batteries.
- . 2 Push button to activate an alarm transmission.
- . 3 User programmable features: tilt angle, audible warning of pending alarm, silent mode, time delay of pending alarm, warning duration, retransmission of man down alarm at user intervals.
- . 4 Capable of system administrator to report any desired identification code without returning to the factory.
- . 5 Capable of operating for one week after low battery warning.
- . 6 Automatically report a low battery.
- . 7 Capable of being configured by system administrator to transmit repeatedly after duress call is initiated.

2.3 RF RECEIVERS

- . 1 120VAC input from UPS.
- . 2 To communicate to existing central system. Provide all necessary labour, material, and software to integrate new RF receiver to existing system
- . 3 Non-locatable (FLASH) system.

PART 3- EXECUTION

3.1 INSTALLATION

- . 1 Provide quantity of PPD's as indicated on drawings.
- . 2 Install RF receiver in accessible ceiling where indicated on drawings.
- . 3 Feed power to RF receiver from LAN room UPS power.
- . 4 Provide the services of a Senstar certified company to provide upgrades to the annunciator in building F-58 to include the new kitchen facility.
- . 5 Supply all components necessary to constitute a complete system.

3.2 WIRING

- . 1 Wire and connect all devices and equipment.
- . 2 Install all wire in conduit to Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

3.3 TESTS

- . 1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- . 2 Test all system functions.
- . 3 Provide written test results in Operation and Maintenance Manuals.

3.4 SETUP AND PROGRAMMING

- . 1 Include in the tender price for the manufacturer's factory representative to verify the system operation and setup the system to meet the Departmental Representative's requirements. At the end of the project, provide a letter to the Departmental Representative confirming that the system has been checked out and set up as per the Departmental Representative's requirements.

3.5 COMMISSIONING

- . 1 Provide manufacturer's representative and one electrician (wiring/cabling alterations, installations, allocation of equipment, etc.) as required for commissioning as per Section 01 91 01 - Commissioning.

END OF SECTION