1. GENERAL

1.1 Workstation Cable Installation

.1 Use 4-pair category 5 enhanced UTP for data wiring. Use the same cable type for voice wiring.

.2 When installing cabling in interior wall to outlets, EMT conduit should be used.

.3 Size boxes and housings to accommodate cable population and minimum bending radii.

2. PRODUCTS

2.1 Data and Voice Cabling - Horizontal Cabling to Workstation

.1 UTP: to CAN/CSA T529 and NEMA Level V or ETA/TIA 568A, Category 5 Enhanced, Bulletin PN-2841 or ETL Level 5E certification.

.1 Physical Characteristics:

.1 Conductors: four-pair, 24 AWG, thermoplastic insulated, solid copper wire.

.2 Twists: pairs variably twisted relative to one another. Minimum 29 twists/m per pair.

.1 Cable Size: maximum OD 6.4 mm.

.3 Breaking strength: 40.8 kg at temperature of -20°C ±1°C without jacket or insulation cracking.

.4 Colour coding of pairs: tracer coloured white paired with each of blue, orange, green and brown.

.5 Fire Rating: plenum-rated overall jacket, CSA FT-6 compliant.

.6 Maximum delay skew between Worse Pairs to be less than 35 ns per 100 metres.

.2 Transmission Characteristics:

.1 DC resistance: less than 94 _/km, with an unbalance between conductors in a pair of 5% maximum.

.2 Mutual Capacitance of any one pair: maximum of 46 pF/m @ 1 MHz.

.3 Maximum Attenuation values:

Frequency (MHz)	dB/k	dB/1000 ft

Frequency (MHz)	dB/k	dB/1000 ft
1	19.7	6.3
4	39.4	13.0
10	59.0	20.0
16	75.4	25.0
20	95.1	28.0
25	105.0	32.0
31.25	118.0	36.0
62.5	171.0	52.0
100	220.0	67.0

.4 Characteristic Impedance, 1-100 MHz: 100 ohms ±15%.

.5 NEXT coupling loss between pairs: equal to or greater than 131 dB/km at 12-20 MHz, 105 dB/Km @ 100 MHz.

3. EXECUTION

3.1 Installation

.1 Cable Installation:

.1 Install data cable and telephone cable in conduit.

.2 Wire and Cable:

.1 Swab raceway system before installing wiring.

.2 Do not exceed manufacturer's maximum pulling force specifications.

.3 Install cable along or at right angles to building lines unless impractical to do so. Verify specific cases of deviation in advance with consultant.

.4 Maintain open copper-conductor cable at minimum 150 mm distance from fluorescent ballasts and 300 mm from any conduits and wires under 120 Volts, 1.2 metres from motors and any transformers and 600 mm from power conduits and wires at or under 600 Volts.

.5 Ensure that cable is not flattened, squeezed, or crimped at any point along entire run. No splices or intermediate terminations in cable runs except by special permission in advance, with documentation detailing locations and nature of splices.

.6 Install cables in PVC raceway in equipment room and fan individual cables to applicable patch panels in neat, logical fashion.

.7 Tie wrap cables neatly into logical bundles.

.8 Minimum 3 m of slack cable per run.

.3 Patch Panels:

.1 Attach horizontal wiring in an ordered fashion following sequential numbering of outlets.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Provide a complete system of splitters boxes and cabinets for the installation of wiring and equipment.

1.2 Shop Drawings and Product Data

.1 Submit shop drawings and product data for cabinets in accordance with Section 16010 Electrical General Requirements.

2. PRODUCTS

2.1 Junction Boxes and Pull Boxes, Weatherproof

.1 Materials:

.1 Cast steel, Crouse Hinds, WBJ Series.

2.2 Junction Boxes and Pull Boxes, Indoor Dry Locations

.1 Materials:

.1 Code gauge sheet steel, welded construction, phosphatized and factory paint finish.

.2 Components:

.1 For flush mounting, covers to overlap box by 25 mm minimum all around with flush head cover retaining screws.

.2 Use rolled edges for surface boxes.

.3 Junction boxes mounted in exterior walls shall be complete with box vapour barriers.

2.3 Cabinets

.1 Materials:

.1 Cabinets: Code gauge sheet steel, welded construction, phosphatized and factory paint finish, suitable for field painting.

.2 Locks: to match panelboards.

.3 Backboards: 19 mm GIS fir plywood, one piece per cabinet, covering entire cabinet interior.

.2 Components:

.1 With hinged door and return flange overlapping sides, with handle, lock and catch for surface mounting, size as indicated or to suit.

.2 Surface or flush with trim and hinged door, latch and lock and two keys, size as indicated or to suit. Keyed to match panelboard keys 19mm GIS Fir Plywood backboard.

2.4 Splitters

.1 Not used

3. EXECUTION

3.1 Installation

.1 Junction Boxes and Pull Boxes:

.1 Supply all pull boxes and junction boxes shown on the drawings or required for the installation.

.2 Boxes installed in party walls to be offset by a minimum of one stud space.

.3 Install in inconspicuous but accessible locations, above removable ceilings or in electrical rooms, utility rooms or storage areas.

.4 Identify with system name and circuit designation as applicable.

.5 Size in accordance with the Canadian Electrical Code, as a minimum.

.2 Cabinets:

.1 Mount cabinets with top not greater than 1980 mm above finished floor, coordinated with masonry, panelboards, fire hose cabinets and similar items. Securely fasten backboards to cabinet interiors.

.2 Install terminal block where indicated.

.3 Identification

.1 Provide equipment identification in accordance with Section 16010 - Electrical General Requirements.

END OF SECTION

OUTLET BOXES, CONDUIT BOXES AND FITTINGS

1. GENERAL

1.1 Work Included

.1 Provide a complete system of boxes for the installation of wiring and equipment.

1.2 References

.1 CSA C22.1-Canadian Electrical Codes, Part 1.

2. PRODUCTS

2.1 Outlet and Conduit Boxes General

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 Outlet Boxes for Metal Conduit

.1 Materials:

.1 Surface or recessed concealed type: Die formed steel, hot dip galvanized, 1.25 oz/sq. ft. minimum zinc coating.

.2 Surface mounting exposed: Cast ferrous for threaded conduit, with attached lugs, corrosion resistant two coats finish.

.2 Components:

.1 Ceiling outlets, surface mounting, concealed:

.1 101 mm square, depth 54 mm, Iberville 52171 series

.2 119 mm square, depth 54 mm, Iberville 72171 series

.2 Ceiling outlets, concealed mounting in concrete:

.1 101 mm octagonal concrete rings, depth from 38 mm to 152 mm Iberville 54521 series.

.2 Extension ring to change from recessed conduit to exposed conduit, 101 mm octagonal, 38 mm deep square Iberville 53151-1/2 or 38 mm deep octagonal Iberville 51151C or 54 mm deep, Iberville 55171C.

.3 Wall boxes, concealed in concrete or masonry: for one and two gang applications shall be 101 mm square, 54 mm deep, 52171 series complete with suitable 52-C-49 series square cornered raised tile wall cover for proper device and wall surface application. Masonry boxes may be used for line voltage switching.

.4 Wall outlets, concealed non-masonry construction, with plaster finish: For one or two gangs used with switches, receptacles, etc., use 54 mm deep Iberville 52171 series, with matching plaster covers, depth to suit. Alternately, use 119 mm square boxes, Iberville 72171 series and covers as required. (For more than two gangs use solid boxes Iberville GSB series with GBC series cover, or special boxes as required).

2.3 Masonry Boxes

.1 Electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

2.4 Concrete Boxes

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 Conduit Boxes

.1 Wall outlets, surface, exposed mounting or used for outdoor outlets: One or more gang, Crouse-Hinds FS series or FD series, or equal.

.2 Ceiling Outlets, surface, exposed mounting: Round with threaded hubs for conduit or teck cable connectors, gasketted covers. Crouse Hinds VXF series, or equal.

.3 Covers: Unless wiring devices and plates are mounted, provide blank, round canopy covers to match boxes.

2.6 Fittings - General

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

3. EXECUTION

3.1 Installation

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit, or armoured cable connections. Reducing washers are not allowed.

.5 Install all outlets flush and surface mounted as required for the installation.

.6 Surface mount conduit boxes in plant areas.

.7 Adjust position of recessed outlets in finished masonry walls to suit course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes.

.8 Do not distort boxes during installation. If boxes are distorted, replace with new boxes.

.9 Use plaster rings to correct depth. Use 30 mm on concrete block.

.10 Do not use sectional boxes.

.11 Provide boxes sized as required by the Canadian Electrical Code.

.12 Install vapour barrier material to surround and seal all outlet boxes located on exterior walls of building. Maintain wall insulation.

.13 Ceiling outlet boxes shall be provided for every surface mounted fixture or row of fixtures installed on suspended "hard" ceilings.

END OF SECTION

WIRING DEVICES

1. GENERAL

1.1 Work Included

.1 Provide and connect all wiring devices for the complete installation.

2. PRODUCTS

2.1 Manufacturer

.1 Wiring devices to be of one manufacture throughout project.

.2 Manufacturers shall be Hubbell, Leviton, Smith and Stone, Bryant or Pass & Seymour.

2.2 Devices

.1 The catalogue numbers shown below are for the particular manufacturer's series and all necessary suffixes shall be added for the requirements as stated. All devices shall be commercial specification grade minimum and wherever possible shall be of the same manufacture.

.2 Devices to be ivory with stainless steel coverplates in office or finished areas. Use galvanized steel coverplates in plant and mechanical areas and all surface mounted devices.

2.3 Switches

.1 120-277 volt, 20 amp, single and double pole, three and four-way: As Hubbell No. 1221, 1222, 1223 and 1224.

.2 For wet locations use the following switches: 20A, 120V single pole ivory ,side wired press-switch, as Hubbell #1281.

.3 Manually - operated general purpose AC switches shall have the following features:

.1 Terminal holes approved by AWG #10 wire.

.2 Silver alloy contacts.

.3 Urea or melamine molding for parts subject to carbon tracking.

.4 Suitable for back and/or side wiring.

2.4 Receptacles

.1 Duplex 15 ampere, 120 volt, 3 wire, ivory, U-ground, as Hubbell No. 5252, with the following features:

.1 Ivory urea molded housing.

.2 Suitable for #10 AWG for back and side wiring.

.3 Eight back wired entrances, four side wiring screws.

.4 Break-off links for use as split receptacles.

.5 Triple wipe contacts and rivetted grounding contacts.

.2 Duplex 15 ampere, 120 volt, 3 wire, ivory, U-ground ground fault receptacle, as Hubbell No. GF-5261. Refer to Section 16496 - Ground Fault Circuit Interrupters.

.3 Single 15 ampere, 120 volt, 3 wire housekeeping receptacle with stainless steel plate engraved with Housekeeping, as Hubbell No. 5262.

2.5 Coverplates

.1 Provide coverplates for all wiring devices, including but not limited to telephone, computer, television, P/A system and sound system.

.2 Use sheet steel utility box cover for wiring devices installed in surface mounted conduit boxes.

.3 Weatherproof double lift spring - loaded cast aluminum coverplates, complete with gaskets for single receptacles or switches.

.4 Weatherproof spring - loaded cast aluminum coverplates complete with gaskets for single receptacles or switches.

.5 Use gasketted DS cast covers on FS and FD type boxes.

3. EXECUTION

3.1 Installation

.1 Install single throw switches with handle in the "UP" position when switch closed.

.2 Install switches vertically in gang type outlet box when more than one switch is required in one location.

.3 Mount switches on the latch side of the doorway as close as possible to door frame unless otherwise indicated on drawings.

.4 Install receptacles vertically in gang type outlet box when more than one receptacle is required in one location.

.5 Where split receptacle has one portion switched, mount vertically and switch upper portion.

.6 Protect cover plate finish with paper or plastic film until all painting and other work is finished, then remove paper.

.7 Install suitable common coverplates where wiring devices are grouped. Do not distort plates by tightening screws excessively.

.8 Do not use coverplates meant for flush outlet boxes on surface mounted boxes.

.9 Wherever possible, mount equipment in a straight line at a uniform mounting height, coordinated with other equipment and materials.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Provide a complete system of wiring, making all connections necessary for the installation shown on drawings.

1.2 Special Codes

.1 Install and rate power cables in accordance with the Canadian Electrical Code requirements, or in accordance with IPCEA requirements where permissible.

1.3 References

.1 CSA C22.2 No. 65 Wire Connectors.

2. PRODUCTS

2.1 Materials

.1 Pressure type wire connectors: with current carrying parts same material as conductors sized to fit the conductors as required.

.2 Fixture type splicing connectors: with current carrying parts same material as conductors sized to fit the conductors 10 AWG or less.

2.2 Wire Connectors

.1 Use 3M "Scotchlock", self-insulated connectors for hand twist wire joints for lighting, small power, and control wiring.

.2 Use T & B non-insulated ring type compression lugs for terminating #10 AWG and smaller motor connections. Tape with rubber and scotchtape. Lugs to accept ten - 32 x 3/8" machine bolts.

.3 Terminate conductors #8 AWG and larger with Thomas & Betts Colour-Keyed compression connectors Series 54000, or on lugs provided with equipment. Wrap with ductseal, tape with rubber tape and scotchtape.

.4 Thomas & Betts "KOPR-SHIELD" compound Series CP8 on all terminations for compression connectors.

3. EXECUTION

3.1 Installation

.1 Remove insulation carefully from ends of conductors and:

.1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.

.2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No. 65.

3.2 Wire Connectors

.1 Select hand twist connectors for wire size and install tightly on conductors.

.2 Brush "KOPR-SHIELD" compound on terminations for compression connectors as recommended by the manufacturer.

.3 Install compression connectors using methods and tools recommended by manufacturer.

.4 Do not install stranded conductors under screw terminals unless compression lugs are installed.

END OF SECTION

GROUNDING

1. GENERAL

1.1 Description

.1 Supply and install a complete grounding system. Securely and adequately ground all components of the electrical system in accordance with the requirements of all related sections in the latest Electrical Protection Act and the local Electrical Inspection Branch.

.2 The system to consist of cables, ground rods, supports, and all necessary materials and inter-connections to provide a complete system. Measured resistance to ground of the AC system shall not exceed 5 ohms.

.3 All ground conductors shall be run in conduit.

2. PRODUCTS

.1 Cables 3/0 and smaller to be connected to ground bars via Burndy Quiklug Type QA-2B connectors. Connections for cables larger than 3/0 shall be brazed.

.2 All ground wires to be stranded copper TWH complete with a green jacket unless otherwise shown.

.3 Ground rods shall be 20 mm x 3000 mm copper flashed or galvanized for first 400 mm.

.4 Cable to pipe connectors to be made with Burndy GAR connectors.

.5 In the main electrical room, provide a copper ground bar complete with lugs suitable to terminate all ground cables as detailed on drawings.

3. EXECUTION

3.1 Grounding - General

.1 All frames and metallic enclosures of all electrical equipment and electrically operated equipment shall be grounded through the conduit/cable system or via a ground wire.

.2 All transformers, switchgear, motor control centres, panelboards fed from the main distribution centre shall be grounded by grounding conductors sized in accordance with the Canadian Electrical Code. The ground wire shall be terminated at each end with an appropriate grounding lug which shall be connected to the equipment ground bus. Ground wire to be green TWH.

.3 All sub panels such as lighting panels, local distribution panels, etc., shall be grounded with a green ground wire run back to the panel from which it is fed. The ground conductor shall be sized according to the Canadian Electrical Code.

.4 Connect using #3/0 bare copper conductors from the main electrical room ground bus to the water line at the water meter by means of an approved type fitting and to a minimum of 4 ground rods located adjacent to the main distribution centre. Test the system for ground resistance before connecting the utility ground and install additional ground rods as necessary to meet the minimum requirements.

.5 All main distribution centres, motor control centres, switchgear, and all panels requiring equipment grounds shall contain a ground bus of adequate size, and tapped for lugs for the ground wire required.

.6 All bolted connections must be accessible.

.7 All motors shall be grounded by means of an adequately sized green ground wire contained within the feeder conduit.

.8 Include a separate green ground wire in all power conduits including branch circuit wiring sized to Table 16, Canadian Electrical Code.

.9 Expansion joints and telescoping sections of raceways shall be bonded using jumper cables as per Canadian Electrical Code.

.10 Use Burndy compression connectors or approved equal for all grounding splices and terminations unless otherwise shown on the Drawings. For bolted ground connections use Burndy Engineering Company's "Durium" or approved equal hardware.

.11 Connect all transformer neutrals to the main building ground wire, using compression terminations.

.12 Install rigid conduit sleeves where ground wires pass through concrete slabs.

.13 Install ground conductor in all cabletrays.

.14 Conduit installed buried in earth or installed in or under grade floor slabs shall have separate ground wire installed, whether the conduits are metal or not.

.15 Ground all utility services to the electrical system ground.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Supply and install all hangers, supports and inserts for the installation shown on the drawings and specified herein, as necessary to fasten electrical equipment securely to the building structure.

2. PRODUCT

2.1 Framing and Support System

.1 Materials:

.1 Intermediate duty supporting structures shall employ P1000 Unistrut or equal together with the manufactures connecting components and fasteners for a complete system.

.2 Heavy duty supporting structures to be fabricated and welded from steel structural members and prime painted before installation.

.2 Finishes:

.1 Outdoors and or wet locations: Hot dipped galvanized.

.2 Indoors in damp or dry locations: Galvanized when available, prime painted if not available.

.3 Nuts, bolts, machine screws: Cadmium plated.

.3 Unistrut:

.1 Section P1000 or as required for load and span, with mounting screws, or approved. P1000 or equal is a minimum standard for supporting conduits 50 mm and larger.

2.2 Concrete and Masonry Anchors

.1 Materials: Hardened steel inserts, zinc plated for corrosion resistance. All anchor bolts must be galvanized.

.2 Components: non-drilling anchors for use in predrilled holes, sized to safely support the applied load with a minimum safety factor of four.

.3 Manufacturer: Hilti (Canada) Limited or approved equal.

2.3 Non-Metallic Anchors

.1 Material: Plastic anchors for sheet metal screws.

.2 Manufacturer: Fischer.

2.4 Conduit Supports

.1 General: Malleable iron one-hole conduit straps where exposed to weather. Stamped steel two-hole straps indoors.

.2 Structural Steel: Crouse-Hinds "Wedgetite" supports or equivalent manufactured by Appleton.

.3 Masonry, concrete, stone, etc.: Anchors.

.4 Title: Toggle bolts.

.5 Metal studs, ceiling hangers, etc.: "Caddy-Clips"

.6 Unistrut: Unistrut conduit clamps.

2.5 Cable Supports and Clamps

.1 General: As per conduit supports, except that for single conductor cables, suitable non-ferrous, or approved stainless steel or aluminum clamps shall be used.

3. EXECUTION

3.1 General

.1 Do not cut or drill beams, joists or structural steel unless written permission of the Consultants is obtained.

.2 Distance between conduit or cable supports not to exceed code requirements.

.3 Supports to be suitable for the real loads imposed by equipment.

.4 Supports to be securely fastened, free from vibration and excessive deflection or rotation. Maximum deflections are 4 mm over a 1 meter span and 8 mm over a 2 meter span.

.5 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

.6 Provide conduit rack with 25% spare capacity for multiple runs.

.7 Provide channel support with fittings for vertical runs of conduit and cables.

3.2 Installation

.1 Secure equipment to poured concrete with expandable inserts.

.2 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.4 Fasten exposed conduit or cables to building construction or support system using straps.

.1 One-hole malleable iron or steel straps to secure surface conduits and cables 50 mm and smaller.

.2 Two-hole steel straps for conduits and cables larger than 50 mm.

.3 Beam clamps to secure conduit to exposed steel work.

.5 Suspended support systems.

.1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.

.2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.

.6 Use plastic anchors for light loads only. Use metal anchors for all other loads.

.7 Shot driven pins may only be used with written approval of the structural engineer.

.8 Use round or pan head screws for fastening straps, boxes, etc.

.9 Do not support heavy loads from the bottom chord of open web steel joists.

.10 Support outlet boxes, junction boxes, panel tubs, etc., independent of conduits running to them. Support conduits within 600 mm of outlet boxes. Support surface mounted panel tubs with a minimum of four 6 mm fasteners.

.11 For surface mounting of two or more conduits use channels at 1.5 m oc spacing.

.12 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.13 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.14 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.15 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Consultant.

END OF SECTION

1. GENERAL

1.1 Related Requirements

.1 Electrical General Requirements: Section 16010

1.2 Coordination with Power Supply Authority

.1 Coordinate and meet requirements of power supply authority. Ensure availability of power when required.

1.3 Related Work

.1 Conduits, Conduit Fastenings and Conduit Fittings: Section 16111

2. PRODUCTS

2.1 Components

.1 Underground Ducts: rigid type DB2, size as indicated.

.2 Rigid Steel Galvanized Conduit and Fittings: To Section 16111 - Conduits, Conduit Fastenings and Conduit Fittings.

.3 Conductors: Copper, type RW-90, to Section 16010, size and number of conductors as indicated.

.4 Concrete: 20 MPa with additive to give permanent red colour - 20 mm maximum aggregate size.

.5 Cable Lugs: Suitable for the application and use as required by the Canadian Electrical Code, approved by the electrical inspection authority and acceptable to the local supply authority.

.6 Drainage Assembly: Provide drain holes not less than 12 mm diameter in each conduit and provide a fabricated 50 mm drain assembly with saddle cutouts for each conduit fitting over the drain line. Tape drain assembly to each conduit to prevent entrance of concrete. Band drain assembly with 12 mm stainless steel strips to conduit assembly to prevent mechanical displacement.

.7 Duct Spaces: Fabricated plastic, S.C.A. approved for use.

3. EXECUTION

3.1 Installation

.1 Install cables in trenches and in ducts.

.2 Allow adequate conductor length for connection to supply by power supply authority.

.3 Allow adequate conductor length for connection to service equipment.

.4 Service conduit shall terminate in main panel with an approved grounding bushing. From the grounding bushing a #3/0 ground connection shall be made to the distribution centre ground bus.

3.2 Ductbank Installation

.1 Provide reinforcing rods and band ties over entire length as detailed.

.2 Ensure that concrete fills all voids around ducts.

.3 Lay PVC ducts with configuration and reinforcing as indicated with preformed interlocking, rigid plastic intermediate spacers to maintain spacing between ducts at not less than 40 mm horizontally and vertically. Stagger joints in adjacent layers at least 150 mm and make joints watertight. Encase duct bank with minimum 75 mm thick concrete cover on all sides.

.4 Slope ductbanks 150 mm per 30 m minimum to drainage point. Adjust final slopes on-site to coordinate with existing utilities.

.5 Provide drain holes not less than 12 mm in diameter in each conduit and provide a fabricated 50 mm drain assembly with saddle cutouts for each conduit fitting over the drain line. Tape drain assembly to each conduit to prevent entrance of concrete. Band drain assembly with 12 mm stainless steel straps to conduit assembly to prevent mechanical displacement.

.6 Install on undisturbed soil where possible. Backfill required to be compacted pit run gravel and sand, 200 mm lifts maximum.

.7 Clean and swab all ducts. Install galvanized iron pillories in spare ducts. Cap spare ducts.

3.3 Service Installation

.1 General routing to follow that indicated on drawings.

.2 Provide ductbank from service point to building or as indicated on drawings. At building, adapt to rigid steel conduit encased in concrete.

END OF SECTION

COORDINATION AND SHORT CIRCUIT STUDY

1. GENERAL

1.1 Description

.1 Provide a coordination/protective study and short circuit study of all equipment specified herein and submit for review.

.2 Include the following:

.1 13.8 kV cable thermal damage curves

.2 Utility overcurrent protection and 600V moulded case circuit breaker overcurrent, overload, and ground fault devices.

.3 347/600 and 120/208V panelboards, MCCs, emergency generator and switchgear, connecting feeder cables and bus duct.

.4 13.8 kV and 600V transformer damage curves, magnetizing currents for all transformers 150 kVA and larger.

.5 Locked rotor currents, acceleration times and damage curves for motors 75 kW and larger.

.6 Generator overcurrent device, generator short circuit curves.

.7 Any additional data necessary for successful completion of the coordination and short circuit study.

.3 Data shall clearly state the operating time in cycles of each breaker and indicate whether the time current curves for relays are inclusive of breaker trippings time or otherwise.

.4 Prepare a summation chart showing all ratings and settings with easy reference to the appropriate curve.

.5 Symmetrical and asymmetrical fault current calculations shall be submitted to verify the correct choice of the protective elements of the system.

.6 Prepare a systems single line diagram on which the resultant short circuit values, device numbers and equipment ratings are shown.

.7 Include a list of recommended settings for each relay.

1.2 Related Work

.1 Service Entrance Board: Section 16421

1.3 Qualifications

.1 This study shall be provided by the supplier of the main switchboard.

.2 This study shall be performed by and bear the stamp of a Professional Engineer registered in the Northwest Territories..

1.4 Submittals

.1 Submit the complete study for review prior to carrying out calibration and verification.

.2 Submit typed results of coordination and short circuit study in maintenance manuals.

2. PRODUCTS

2.1 Tripping Devices

.1 Relay style, CT ratios and fuse sizes have been selected on a preliminary basis for design purposes. Final selection shall be based on the results of this study and shall be included at no extra cost.

3. EXECUTION

3.1 Data

.1 Provide the main switchboard supplier with all relevant data for equipment not provided by that supplier.

END OF SECTION