Part 1 General

1.1 DESCRIPTION

.1 A brief but not necessarily all inclusive list of work to be performed under this contract is given herein.

.2 The Contractor shall supply all labour, material, equipment, transportation, services and facilities necessary to make, test and place into operation a complete electrical installation as shown on the drawings and/or as specified herein.

.3 Where the term "provide" is used herein, it shall mean "supply, install, adjust, test and place into operation".

.4 All systems shall be completely assembled, adjusted, tested and demonstrated to be ready for operation to the satisfaction of the Contract Administrator.

.5 The Contractor shall carefully examine the drawings and specifications and shall fully inform himself as to all existing conditions and limitations, including all laws, ordinances and regulations affecting the contract and the work and shall include in his tender all items implied or required to complete the work of this contract.

.6 The Contractor shall satisfy himself as to working space, storage space, access facilities and all other conditions pertaining to the site, relating to the conduct of his operations, by the inspection of the site and examination of the drawings.

.7 Refer to all other Divisions of the Specifications to determine their effect upon the work of this Section. All Sections of Divisions 01 to 46 inclusive form part of the Contract Documents.

1.2 EXTENT OF WORK

.1 This work shall consist of furnishing of all labour, material, equipment and all incidentals required for the upgraded Digester No.11.

.2 Work shall include, but not be limited to:

.1 Provision of new electrical system as required.

.2 Wire to and make connections to, all electrical power and control items required, including motors, controls, etc.

1.3 RELATED WORK

.1 Training – 01 79 00

.2 Commissioning - 01 98 13

.3 Close Out Submittals – 01 78 00

.4 Common Work Results – Integrated Automation – Section 25 05 00

.5 Field Equipment Panels - Section 25 14 23

.6 Process Controller – Section 25 30 01

.7 Instruments - Section 25 30 02

.8 Instrument Index – Section 25 31 03

.9 Asset List – Section 25 31 04

.10 DCS System – Section 25 90 01

.11 Local Area Network Definition (LANDef) – Section 25 90 02

.12 PLC Input/Output List - 25 90 03

1.4 EXAMINATION OF DRAWINGS

.1 The electrical drawings do not show all architectural, mechanical and structural details. All electrical schematics are shown diagrammatically unless otherwise noted. The Contractor shall review the mechanical and structural drawings to obtain building dimensions and details. Verify dimensions accurately by measurements.

.2 To change the location of electrical equipment, submit a request in writing to the Contract Administrator for approval. If approved, such changes are to be made at no additional cost to the City of Winnipeg.

.3 No extra will be allowed for any additional labour or materials required for relocation of equipment due to interference with equipment of other trades, beams, joists, walls, etc., unless the conflict has been submitted to the Contract Administrator in writing before closing of Bids.

1.5 APPROVED DESIGN AND INSTALLATION

.1 Equipment and material to be of approved design and manufactured in accordance with all governing regulations such as "Canadian Standards Association", "Canadian Electrical Code", "Provincial Department of Labour", "Underwriters Laboratory", etc. Equipment and material must bear applicable acceptance labels of all associations and governing bodies recognized by the municipal, provincial and federal authorities.

.2 Install equipment in strict accordance with manufacturer's recommendations and governing rules, regulations and codes.

.3 Where requirement conflict occurs, install all materials in accordance with the most severe requirements.

.4 All installation to ensure maximum headroom, minimum interference with free use of surrounding areas, and best access to equipment.

.5 To deviate major service runs from the location shown on the drawings, submit to the Contract Administrator suitable drawings showing such deviations together with reasons for deviations and obtain approval from the Contract Administrator before proceeding with the installation.

1.6 CODES AND STANDARDS

.1 Install all equipment in accordance with current editions of CSA 22.1 and 22.2, including all local amendments unless otherwise specified.

.2 Perform all work in accordance with drawings, specifications, applicable municipal and provincial regulations, and any pertinent inspection bulletins issued by the electrical inspection authority

having jurisdiction over the installation. In no instance shall the standard established by the drawings and specifications be reduced.

.3 Provide a copy of all standards referred to in this Section for use on site.

1.7 PERMITS, INSPECTIONS AND FEES

.1 Deliver to the Contract Administrator all necessary interim and final certificates of inspection and approval which may be required by all Inspection Authorities having jurisdiction over the work, as evidence that the work installed conforms with the laws and regulations of all governing authorities.

.2 Submit copies of all plans and specifications to the authority having jurisdiction for inspections as may be required prior to commencement of work to comply with the above.

.3 Notify the Inspection Authorities in sufficient time for them to arrange to inspect work.

.4 Pay all associated fees.

1.8 ABBREVIATIONS

.1 Abbreviations for electrical terms shall be to CSA Z85-1983.

.2 Names used throughout these specifications are:

EEMAC	Electrical & Electronic Manufacturers Association of Canada (formerly CEMA)
CSA	Canadian Standards Association
FM	Factory Mutual
NEMA	National Electrical Manufacturers Association (U.S.)
JIC	Joint Industry Conference
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
CEC	Canadian Electrical Code
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
NBC	National Building Code
ANSI	American National Standards Institute

1.9 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Division 01.

.2 Submit shop drawings for all equipment as indicated with the exception of conduit, standard conduit fittings and low voltage wiring.

.3 Indicate on shop drawings details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.

.4 Where applicable, include wiring, single line and schematic diagrams.

.5 Wiring drawings showing interconnection with work or other divisions are required.

.6 Indicate the number or letter used as an identification symbol on product data for panelboards, lighting fixtures and other equipment.

.7 All equipment on shop drawings to be clearly identified with specific device tagging as identified in the specifications and drawings.

1.10 OPERATION AND MAINTENANCE MANUALS

.1 O&M Manuals to conform to requirements in section 01 78 00 of this specification.

.2 Include in the manuals information based on following requirements:

.3 Operation and maintenance instructions to be sufficiently detailed with respect to design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.

.4 Technical data to be in form of approved shop drawings, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists.

.5 Advertising or sales literature is not acceptable.

.6 Provide wiring and schematic diagrams and performance curves.

.7 Include names and addresses of local suppliers for all items included in the operation and maintenance manuals.

.8 Submit six (6) complete copies of manuals and “as-built” drawings to the Contract Administrator for review. Revise initial manual as required by the Contract Administrator prior to final submission.

1.11 RECORD DRAWINGS

.1 Submit record drawings in accordance with Division 01.

.2 The Contractor shall record all changes made during construction and provide record drawings to the City of Winnipeg upon completion of the work.

.3 At the completion of the project, the Contractor shall submit one (1) set of record drawings on disk, accurately recording all changes, deviations and relocations necessitated by job conditions and equipment approved shop drawings all done on CADD using AutoCAD Release 2008 or later to the satisfaction of the Contract Administrator.

.4 Include with the record drawings a list for each motor indicating motor or equipment number and name, nameplate voltage, horsepower and current, the size and setting of overload and breaker or fuse protection provided.

1.12 DEFINITIONS

.1 The following are definitions of terms and expressions used in the specification:

.1 "Inspection Authority" means agent of any authority having jurisdiction over construction and safety standards associated with any part of electrical work on site.

.2 "Supply Authority" means electrical power company or commission responsible for delivery of electrical power to project.

.3 "Electrical Code" means Canadian Electrical Code C22.1-12 or code in force at project location.

.4 "Indicated" means as shown on contract drawings or noted in contract documents.

.2 Refer to CSA C22.2 No.0 for "Definitions and General Requirements".

1.13 COOPERATION AND COORDINATION

.1 Schedule expediting of all materials and execution of work with associated work specified in other Divisions.

Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete shall be schedule 40 galvanized steel pipe, sized for free passage of conduit, and protruding 50 mm (2").

.2 Cables, conduits and fittings to be embedded or plastered over neatly and close to building structure so furring can be kept to a minimum.

.3 Arrange for holes through exterior walls and roof to be flashed and made weatherproof.

1.14 SOURCE QUALITY CONTROL

.1 Arrange for a plant inspection by Contract Administrator where specified.

.2 Inform Contract Administrator of manufacturing progress and arrange inspections at appropriate times.

.3 Action required by factory inspection shall not be construed as final acceptance.

.4 Obtain a Certificate of Acceptance from the inspection authority on completion of work and provide to the Contract Administrator.

.5 The Contract Administrator may carry out inspections and prepare deficiency lists for action by the Contractor, during and on completion of project.

1.15 GUARANTEE

.1 Guarantee work described in this Section of the specification against all defects in labour and materials.

1.16 CARE, OPERATION AND START-UP

.1 Instruct the City of Winnipeg's operating personnel in the operation, care and maintenance of equipment.

.2 Arrange and pay for services of manufacturer's factory service representative to supervise start-up of installation, check, test, adjust, balance and calibrate components.

.3 Provide these services for such period, and for as many visits as necessary, to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.17 APPROVAL OF ALTERNATE MATERIALS

.1 Bids shall be based on the materials, products, and manufacturers specified.

.2 Alternates to materials, products, and manufacturers specified shall be in accordance with B7.

Part 2 Product

2.1 GENERAL

.1 All materials shall be fully approved by the Canadian Standards Association (CSA) for use as installed and meet the requirements of this specification in all respects.

.2 Where there is no alternative to supplying equipment which has CSA approval, submit such equipment to local inspection authority having jurisdiction for special inspection and obtain approval. Pay all associated fees.

.3 Materials and equipment shall be of Canadian manufacture except where specified otherwise or where Canadian made materials or equipment do not exist.

.4 Where two or more units of the same class or type of equipment are required, the units shall be the product of a single manufacturer, although components of equipment need not be products of the same manufacturer.

.5 Use material and equipment available from regular production of manufacturer.

.6 Control panels and component assemblies to be shop manufactured by CSA approved manufacturing facility.

.7 All field cables shall be Teck cable sized as appropriate and installed in cable tray. VFD and power cables shall be installed in separate cable tray from instrumentation and communication cables.

2.2 FINISH

.1 Finish metal enclosure surfaces by removing rust and scale, cleaning, and applying rust resistant primer inside and outside with at least two coats of finish enamel.

.2 Paint all outdoor electrical equipment "equipment green" finish to EEMAC-Y1.

.3 Paint all indoor switchgear and distribution enclosure "light grey" to ASA 61 grey.

.4 Clean, prime and paint exposed hangers, racks, fastenings, etc., to prevent rusting.

2.3 VOLTAGE RATINGS

.1 Operating voltages to be within those defined in CSA Standard C235-1969.

.2 All motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment must be able to operate in extreme operating conditions established in above standard without damage to equipment.

2.4 AMBIENT ENVIRONMENT

.1 Unless otherwise indicated, supply equipment enclosures, boxes, electrical materials and products suitable for ambient environment of the following areas. All these areas have been classified for compliance with the Canadian Electrical Code (CEC) 2012 version and NFPA 820.

Area	CEC (2012)	NFPA 820
Gallery No. 5	Category 2, Section 22	Ordinary
West Electrical Room	Ordinary	Ordinary
West Control Room	Ordinary	Ordinary
Digester Tank #11 - Interior -	Hazardous	Hazardous
Digester Tank #11 - Exterior -	Category 2, Section 22	Hazardous 1.5 m above top of tank and 1.5 m from any exterior tank wall; otherwise Category 2, Section 22

2.5 WIRING TERMINATIONS

.1 Lugs, terminals, screws used for termination of wiring must be suitable for copper conductors.

2.6 ENCLOSURES

.1 Minimum enclosure type to be used is EEMAC 12 for ordinary environments, EEMAC 4X for corrosive environments, EEMAC 7 for hazardous locations or EEMAC 3R for outdoor installations unless otherwise specified.

2.7 MANUFACTURERS AND CSA LABELS

.1 Manufacturers' nameplate and CSA labels are to be visible and legible after equipment is installed.

2.8 WARNING SIGNS

.1 Provide warning signs with suitable background colour and lettering as required to meet requirements of inspection authorities and Contract Administrator. Use decal signs, minimum size 178mm x 250mm.

2.9 PLYWOOD MOUNTING BOARDS

.1 Surface wall mounted panelboards and other electrical equipment shall be installed on plywood mounting boards. Boards shall be provided under this section of the specifications, sized to suit equipment indicated and/or implied.

.2 Plywood mounting boards shall consist of 20 mm fir plywood fastened securely to wall.

.3 Plywood mounting boards, strapping and trim shall be treated with wood preservative prior to installation and painted with one coat of primer and two coats of grey enamel ASA61. Painting shall be completed before any electrical equipment is mounted on the plywood.

.4 Service entrance equipment shall be spaced from the plywood mounting boards to the satisfaction of the inspection authorities.

Part 3 Execution

3.1 WORKMANSHIP

.1 Where sheet metal enclosures are not provided with knockouts, Greenlee punches shall be used in all cases. Cutting torches shall not be used for making holes.

3.2 INSTALLATION

.1 Determine manufacturers' recommendations regarding storage and installation of equipment and adhere to these recommendations.

.2 Check all factory joints and tighten where necessary to ensure continuity.

3.3 MOUNTING HEIGHTS

.1 Mounting height of equipment is given from finished floor to top of equipment.

.2 Exact mounting height of unnoted equipment must be verified with Contract Administrator before proceeding with installation.

.3 Install electrical equipment at heights listed below unless otherwise indicated. (All heights in millimetres from finished floor unless indicated):

.1	Local Switches:	1420
.2	Wall Receptacles:	450
.3	Lighting Panels:	1800
.4	Cabinets:	1800
.5	Emergency Lights:	2400 (minimum)

.4 All dimensions indicated are to the top above finished floor elevation.

3.4 SPECIAL PROTECTION

.1 Accept the responsibility to protect those working on the project from any physical danger due to exposed electrically energized equipment such as panel mains, outlet wiring, etc. Shield and mark all live parts "LIVE - 600 VOLTS" or with the appropriate voltage.

.2 Arrange for the installation of temporary doors, barriers, etc., for all electrical equipment. Keep these doors locked at all times except when under direct supervision.

3.5 FIREPROOFING

.1 Where sleeves or openings are installed in walls, floors, roof or partitions to accommodate raceways, cables or bus duct, provide all necessary seals, fittings, barriers and fire-resistant materials to restore the installation to its original fire rating to the satisfaction of the Contract Administrator and the City of Winnipeg's insurance underwriters.

3.6 EQUIPMENT IDENTIFICATION

.1 Supply and install identification nameplates on all equipment such as motor starters, safety switches, panelboards, pushbutton stations, etc. and any equipment not so supplied. All nameplates shall be securely fastened to equipment with stainless steel screws.

.2 All identification nameplates, except for motors, shall be laminated phenolic with minimum 6 mm (1/4 inch) black letters on white background, the wording of which shall be identical to that on the single line diagrams and the title of the equipment controlled. Motor nameplates to be of non-corroding metal stamped or engraved with black lettering on light background.

.3 Warning nameplates shall be laminated phenolic with minimum 6 mm (1/4 inch) white letters on red background, the wording to be reviewed by the Contract Administrator. All warning nameplates to be screwed to equipment.

.4 Warning nameplates required by Inspection Authorities shall be provided for all electrical switchgear and equipment and on access doors to electrical rooms, vaults, switchyards, etc. in accordance with the applicable Code regulations. Obtain all necessary details from the Inspection Authorities.

.5 Where wording not specified on the drawings, obtain exact wording from the Contract Administrator.

.6 Identify pull boxes, terminal cabinets and junction boxes enclosing cables or connections with nameplates indicating voltage, box number and circuit number.

.7 Provide junction boxes, relay panels and miscellaneous equipment energized from two or more sources with a warning nameplate prominently displayed, noting number and location of sources and their voltage.

.8 Provide a typewritten circuit directory with a clear plastic cover for each panelboard in a suitable holder on the inside of each panel door. Unless otherwise noted, the directory shall indicate breaker or switch circuit number, rating, load description and associated load data.

.9 Manufacturer's nameplates and CSA labels to be visible and legible after equipment is installed.

3.7 TOUCH-UP PAINTING

.1 Be responsible for field touch-up painting of all shop painted electrical equipment installed in this Contract.

.2 All surfaces to be painted shall be dry, clean, free from dust, dirt, grease, frost, rust, loose crystals or extraneous matter, tool and machine marks. Feather out edges of scratch marks to make patch inconspicuous.

.3 Apply one or more coats of paint until the damaged surface has been restored to original finish condition. Do not apply succeeding coats until preceding coat is dry and hard. Sand lightly between coats with No. 00 sandpaper.

.4 Be responsible for obtaining the necessary touch-up paint of the original type and quality from the equipment manufacturer.

.5 Supervise priming and finish painting of all electrical equipment and material not shop painted.

3.8 SLEEVES AND OPENINGS

.1 Provide sleeves and openings for exposed conduits, busways, and wireways, where they pass through walls or floors conforming to relevant fire codes where applicable.

.2 Sleeves for individual conduits shall be galvanized steel in ordinary areas or stainless steel in corrosive environments.

.3 Pack or fill sleeves and openings after the completed work is in place. Filling shall provide a waterproof seal to prevent leakage of water or other liquids through the sleeve or opening.

.4 Sleeves and openings shall not displace reinforcing steel, and shall receive approval of the Contract Administrator prior to placement.

3.9 CUTTING AND PATCHING

.1 Do all drilling, cutting, fitting and patching necessary for the running and securing of conduits, wireways, and other electrical equipment.

.2 Provide supports necessary for same.

.3 Provide bracing and anchorage of work subject to Contract Administrator's approval.

.4 No cutting of the structural members or of the fireproofing shall be done without the written consent of the Contract Administrator.

.5 Caulk and flash all conduits passing through walls, roofs or other surfaces exposed to weather or as indicated on the drawings to prevent the passage of water and/or sewer gases.

3.10 HANGERS AND SUPPORTS

.1 Provide hangers, angles, channels, and other supports necessitated by field conditions to install all items of electrical equipment. Design of supports and methods of fastening to building structures shall be subject to the Contract Administrator's approval.

.2 All local motor control devices are to be grouped and mounted on a free-standing frame of stainless steel construction easily accessible and as close to the motor as possible.

.3 Provide weight-distribution facilities, where required, so as not to exceed the load-bearing capacities of floors or walls that bear the weight of, or support, electrical items.

.4 Paint all exposed parts of hangers and supports with an anti-rust inhibiting primer.

.5 Equipment shall not be held in place by its own weight. Provide base anchor fasteners in each case.

3.11 PROTECTION OF EQUIPMENT

.1 Protect conduit and wireway openings against the entrance of foreign matter by means of plugs or caps.

.2 Fixtures, materials, equipment, or devices damaged prior to final acceptance of the work shall be restored to their original condition or replaced by the Contractor.

3.12 TESTING OF ELECTRICAL SYSTEMS

.1 General

.1 Prior to the Contract Administrator’s acceptance, all electrical equipment, materials and systems installed shall be subject to an inspection and applicable performance tests supervised by the Contract Administrator to ensure that the operation of the system and components satisfy the requirements of the Specifications.

.2 Ensure that the system and its components are ready prior to the inspection and test for acceptance.

.3 All testing shall be conducted by fully qualified personnel only. Tests requiring initial power energization of a system shall not be made without notification of the Contract Administrator. Tests, checks and the like carried out by or on behalf of the Contractor shall be documented and certified at no additional cost to the City of Winnipeg. Submit six copies of the test certificates to the Contract Administrator. Carefully check wiring for each system and/or part of a system to ensure that the system will function properly as indicated by wiring and schematic diagrams, description of operation, etc.

.4 Carefully check wiring for each system and/or part of a system to ensure that the system will function properly as indicated by wiring and schematic diagrams, description of operation, etc.

.5 Manually operate alarms and control devices to check whether their operation during normal and abnormal operating conditions causes the proper effect.

.6 In addition to tests on purely electrical systems, supply the necessary labour and equipment for operational tests required by other Divisions where electrical services are involved and make final adjustments to the electrical controls at no additional cost to the City of Winnipeg.

.7 Perform tests on auxiliary or specialized systems with the assistance of the manufacturer's representative. Upon successful conclusion of the tests, obtain a certificate from the manufacturer stating that the system has been installed to their satisfaction and that it is in good working order.

.8 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to values and settings as indicated.

.2 Supply all instruments, meters and personnel required for the tests.

3.13 CABLE AND WIRE 1000 VOLT AND BELOW

.1 Tests on cables in this voltage range shall be limited to insulation resistance measurements using a 500V megger for systems up to 350V and a 1000V megger for 351-600V systems.

.2 All testing to be completed prior to connection of equipment, with cable ends suitably isolated to prevent accidental contact with equipment. Under no circumstances shall testing be completed with wires/cables connected.

.3 Record all test results in a log book and submit to the Contract Administrator for reference. Replace or repair all circuits, which do not meet minimum requirements specified in the CEC, Table 24. Insulation resistance of the following circuits shall be measured:

.1 Power, lighting and motor feeders: phase-to- phase, phase-to-neutral and phase-to-ground.

.2 Control circuits: measure to ground only.

3.14 GROUNDING SYSTEM

.1 Test the grounding system efficacy for compliance with CSA Standard C22.1 and Supply Authority requirements. Verify that the ohmic resistance values specified therein are not exceeded.

.2 Notify Inspection and Supply Authorities that they may be present to witness Contractor testing and provide any assistance required by these Authorities for their own testing procedures.

3.15 TRAINING

.1 Provide for the training of the City of Winnipeg's representatives in the operation, maintenance and testing of all systems and equipment including the provision of qualified manufacturer's technical representatives for specialized systems.

.2 Provide these services for such period, and for as many visits as necessary to put installation in working order, and to ensure that operating personnel are conversant with all aspects of its care and operation.

3.16 DELIVERY AND STORAGE

.1 Ship and store equipment as per manufacturer’s recommendations.

.2 Ship channel bases and anchor stencils in advance of equipment.

.3 Keep equipment doors locked. Protect equipment from damage, dust and weather during shipping and storage.

.4 Block moving parts when necessary to prevent damage during movement and shipment of equipment. Instructions to remove blocking before putting equipment in service to be clearly and conspicuously displayed.

.5 Store all electrical equipment indoors. Temperature sensitive equipment to be stored in heated spaces.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

.1 All Sections of General Conditions form a part of this Specification. They shall be read and fully adhered to exactly as if repeated here in full.

.2 Refer to all other Divisions of the Specifications and these Documents to determine their effect upon the work of this Section.

.3 All Sections of all Divisions of the Specifications and these Documents inclusive form part of the Contract Documents.

1.2 SCOPE

.1 Refer to Section 25 05 00 for project electrical scope of work.

.2 Furnish all labour, materials, supervision, equipment and services specified herein, indicated or requested to install the complete wiring systems including, but not limited to:

.3 Low voltage wire and cable (1000 V and below)

1.3 CONTROL WIRING

.1 The wiring system shall include all wiring, terminations, wire markers, cable tags, cable ties, splice fittings, insulating tapes, connectors and miscellaneous materials necessary to complete the wiring system.

Part 2 Products

2.1 LOW VOLTAGE WIRE 1000 VOLT AND BELOW

.1 All wire shall have stranded, annealed copper or compact stranded 8000 Series aluminium alloy conductors, 600 volt rating, cross-linked polyethylene (XLPE) insulation, minus 40°C, 90°C maximum conductor temperature, limited flame spread.

.2 The wiring shall be suitable for installation in wet environment and rated RW-90.

.3 For direct buried installations or for installation in direct buried polyethylene pipe, the cable shall be cross linked polyethylene, rated RWU-90.

.4 Minimum conductor size shall be #12 AWG unless otherwise specified. #14 AWG may be used for control wiring, #6 for aluminium.

.5 Use GTF fixture wire, 600 volt, 125 C, flexible copper conductor for all connections between lighting fixtures and outlet boxes.

.6 Colour coding of insulated conductors shall conform to the following:

Single Phase Systems

Phase A Red

Phase B	Black
Neutral	White
Ground	Green

Three Phase Four Wire Systems

Phase A	Red
Phase B	Black
Phase C	Blue
Neutral	White
Ground	Green

.7 Insulated ground conductors forming part of a multi-conductor cable assembly shall have green colour coding.

.8 Cable and wire shall be as manufactured by Alcatel Canada Wire Inc., Phillips Cables Ltd., Pirelli Cables Inc., Alcan Cable Inc.

2.2 TECK CABLE / ACWU90

.1 Conductors:

.1 Grounding conductor: copper or 8000 series Aluminum

.2 Circuit conductors: copper or 8000 series Aluminum, size as indicated

.2 Insulation:

.1 Chemically cross-linked thermosetting polyethylene rated RW90, 600 volt

.3 Inner Jacket: polyvinyl chloride material (Teck cable)

.4 Armor: interlocking aluminum

.5 Overall covering PVC material, colour black, flame retardant, FT4 rated, AG14.

.6 Fastenings:

.1 One hole aluminum straps to secure surface cables 50 mm and smaller. Two hole straps for cables larger than 50 mm. All straps to have inert spacers between spacer and concrete.

.2 Channel type supports for two or more cables.

.3 3/8" diameter threaded rods to support suspended channels.

.7 Connectors:

.1 Watertight approved for Teck or ACWU90 cables.

.8 Lugs:

.1 Dual rated AL7CU or AL9CU and listed by CSA for use with Aluminum or Copper conductors and sized to accept aluminium conductors of the ampacity specified.

2.3 WIRING ACCESSORIES

.1 Wire markers, black letters on white background, shall be heat shrink type as manufactured by Critchley.

.2 Cable markers for cables or conductors greater than 13 mm (1/2 inch) diameter, shall be strap-on type, rigid PVC, black letters on white background, with PVC covered aluminum straps, as manufactured by Electrovert Cat. No. 510.

.3 Terminal blocks shall be minimum 600 volt rated, modular, sized to accommodate conductor size used, as manufactured by Weidmuller, Phoenix, Allen-Bradley.

.4 Where screw-type terminals are provided on equipment, field wiring shall be terminated with insulated fork tongue terminals, as manufactured by Thomas & Betts, Sta-Kon.

.5 Splice connectors for wire sizes #14-10 AWG inclusive, shall be of the compression spring type, as manufactured by Ideal Waterproof Type DP.

.6 Splice connectors for wire sizes #8 AWG and larger shall be split-bolt type, sized to suit number and size of conductors, as manufactured by Burndy Servit Type KS.

.7 Cable ties shall be nylon, one-piece, self-locking type, as manufactured by Thomas & Betts, Burndy, Electrovert.

.8 Electrical insulating tape as manufactured by 3M Scotch 88.

.9 Cable grips shall be provided for all vertical and catenary cable suspension installations to reduce cable tension at connectors or at cable bends. The cable grips shall be selected to accommodate the type and geometry of cable supported and shall be of the single weave, variable mesh design, as manufactured by Kellems, Arrow-Hart.

.10 Cable pulling lubricant shall be compatible with cable covering and shall not cause damage and corrosion to conduits or ducts.

2.4 VFD POWER CABLES

.1 1 kV rated cable to CSA C22.2 N° 123-96; CSA C22.2 N° 174-M1984 designed to reduce high frequency noise interference with data and control signals.

.2 Three bonding conductors – soft bare copper.

.3 Cross-linked polyethylene RW90 insulation on main conductors.

.4 Continuously corrugated, corrosion resistant aluminium sheath with matching connectors.

.5 Overall PVC jacket rated FT4.

.6 Acceptable manufacturer shall be Nexans DriveRx VFD Cable.

2.5 FIBRE OPTIC CABLE

.1 Multimode fibre cable.

.2 Construction:

.1 Central strength member: Dielectric epoxy glass rod.

.2 Fibres: 250μ m diameter buffer.

.3 Buffer tubes: Polymer loose tubes c/w super absorbent polymer.

.4 Cable core: components cabled around a central strength member.

.5 Core separator: super absorbent tape between cable core and outer strength member.

.6 Outer strength member: torque balanced contra helical aramid yarn.

.7 Cable jacket: black flame retardant, UV and moister resistant polymer c/w ripcord applied under jacket.

.8 Amour: aluminium interlocking armour.

.9 Armour jacket: flame retardant riser rated PVC.

.3 Fibre connectors to be ST type (twist style).

2.6 ETHERNET COMMUNICATION CABLE

.1 Ethernet communication cable shall be CAT6.

.2 Field cable shall be industrial CAT6 Ethernet cable with aluminium interlocked armour. Acceptable manufacturer shall be Belden 121872A or approved equal in accordance with B7

.3 Cable ends and terminations shall be completed and fully tested prior to connection to final device.

Part 3 Execution

3.1 INSTALLATION

.1 Install all wire according to the drawings with a minimum size of #12 AWG unless indicated otherwise.

.2 Pull wire into ducts and conduits in accordance with the manufacturer's recommendations, using patented wire grips suitable for the type of wire or using pulling eyes to be installed directly onto the conductors.

.3 Limit pulling tensions to those recommended by the manufacturer to avoid overstressing wire.

.4 Utilize adequate lubricant when pulling wires through ducts and conduits to minimize wear on cable jackets.

.5 Make connections to equipment "pig-tails" with mechanical, insulated, screw-on connectors for wire sizes #14-10 AWG. For wire sizes #8 AWG and larger utilize split-bolt connectors, taped with three layers minimum of insulating tape. For both copper and aluminium terminations, wire through the conductor, apply joint compound anti-oxidant, and torque to lug manufacturer’s recommended torque levels.

.6 No splices shall be permitted in cable or wiring runs without the written permission of the Contract Administrator, and shall only be permitted in junction boxes.

.7 Neutral conductors shall be identified. Paint or other means of colouring the insulation shall not be used.

.8 Unless otherwise specified, make all wiring taps, splices and terminations with identified compression screw type terminal blocks, securely fastened to avoid loosening under vibration or normal strain. Make connections for interior and exterior lighting circuits and 120 volt, 15 amp convenience receptacle circuits using screw-on or split-bolt connectors and insulating tape.

.9 Determine the exact length of cable required to avoid splices.

.10 Identify each conductor by specified markers at each termination indicating the circuit designation or wire number.

3.2 WIRING IDENTIFICATION

.1 Provide permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring. Maintain phase sequence and identification throughout system, i.e., panelboards, starters, terminal blocks, disconnect switches.

.2 All control system wiring to be labeled using permanent heat-shrink wire labels, labels to be installed at each termination point. Wire labels to match control system wiring diagrams produced by successful control panel manufacturer defined in Section 25 14 23.

.3 Maintain identification system at all junction boxes, splitters, cabinets and outlet boxes.

.4 Use colour coded wires in communication cables, matched throughout system. All colour coding must adhere to CSA C22.1.

3.3 CABLE IDENTIFICATION

.1 Identify each cable by attaching a suitable marker, stamped or indelibly marked with the cable number, at each end of the cable and in all junction boxes and pull boxes.

.2 Provide cable schedule for all cables installed to match cable identifications as installed on site.

.3 Cable Schedule template included in Section 26 05 33.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

.1 All Sections of General Conditions form a part of this Specification. They shall be read and fully adhered to exactly as if repeated here in full.

.2 Refer to all other Divisions of the Specifications and these Documents to determine their effect upon the work of this Section.

.3 All sections of all the Divisions of the Specification and all other documents included as part of this document form part of the Contract Documents.

1.2 SCOPE

.1 Refer to Section 26 05 00 for project electrical scope of work.

.2 Furnish all labour, materials, equipment and services specified, indicated or requested to install a complete grounding system. The grounding system shall include ground rods, all wiring, ground bus, thermit welds, mechanical fittings, connectors, links and miscellaneous materials necessary to complete a grounding system acceptable to the Inspection Authorities.

1.3 QUALITY ASSURANCE

.1 Grounding equipment to CSA C22.2 No. 41-M1987.

.2 Copper grounding conductors to ASA A7.1 1964.

Part 2 Products

2.1 GROUND CONDUCTORS

.1 Ground conductors shall be concentric stranded, soft drawn copper. Insulated conductors, where required by Inspection Authorities or specified, shall be type TW, 600 volt rating, green colour.

.2 Where direct buried bare ground conductor comes into contact with corrosive material, the conductor shall be tinned.

2.2 GROUND CLAMPS

.1 Ground clamps for connecting ground conductors to metal water piping not suitable for thermit weld connections shall be sized to accommodate the system ground conductor and the water pipe, as manufactured by T & B, Burndy.

2.3 COMPRESSION CONNECTIONS

.1 Compression devices shall be of pure wrought copper material, factory fitted with oxide inhibiting compound and shall meet latest IEEE 80 Standard, as manufactured by T & B, Burndy.

2.4 MECHANICAL CONNECTIONS

.1 Mechanical connectors shall be of bronze, copper or brass construction with stainless steel hardware selected and sized specifically for the particular application and shall meet latest IEEE standard.

2.5 GROUND RODS

.1 Ground rods shall be 19 mm (3/4") diameter, 3 m (10 feet) long, copper clad steel construction with the copper exterior coating permanently bonded to the steel core.

Part 3 Execution

3.1 INSTALLATION

.1 Make all conductor joints, splices and connections with permanent type thermit welds or mechanical compression connectors utilizing hydraulic tools.

.2 Make ground connections to building steel or flat metallic surfaces with thermit welds. Locate connections where they will not be subject to mechanical damage and, where possible, be accessible for inspection.

.3 Protect grounding conductors or bus subject to mechanical damage by rigid steel conduit or steel guards which shall be effectively grounded at both ends to the ground conductor they are protecting, regardless of their length.

.4 Make connections to ground bus using mechanical clamp type connectors.

.5 Securely bond metal enclosures, motor frames, steel supports for starters, panels, switches, etc., which are not rigidly secured to and in contact with grounded structural steel of a building or conduit system, or which are subject to excessive vibration, to building steel or conduit system with stranded copper conductors.

.6 Install ground conductors passing through masonry walls, floors, foundations, etc. in 25 mm (1") rigid PVC conduit sleeves. Where sleeves are installed in walls or floors below grade, seal the sleeves watertight after installation of ground conductor.

3.2 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to the following list: service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steelwork, distribution panels, outdoor lighting, telephone backboard.

3.3 TESTS

.1 Perform tests in accordance with Section 26 05 00.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of the Contract Administrator and inspection authority having jurisdiction.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

.5 Perform tests in presence of the Contract Administrator.

.6 Submit written test results to the Contract Administrator.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

.1 All Sections of General Conditions form a part of this Specification. They shall be read and fully adhered to exactly as if repeated here in full.

.2 Refer to all other Divisions of the Specifications and these Documents to determine their effect upon the work of this Section.

.3 All sections of all the Divisions of the Specification and all other documents included as part of this document form part of the Contract Documents.

1.2 SCOPE

.1 Refer to Section 26 05 00 for project electrical scope of work.

.2 This section covers the supply and installation of all fastenings and supports for equipment mounted under the electrical contract.

Part 2 Products

2.1 MATERIALS

.1 Expansive screw anchors, shields, or other fastening items containing lead or other material that might loosen or melt under fire conditions shall not be used. All fastenings located in the corrosive plant environment shall be corrosion resistant stainless steel.

.2 Power-actuated fasteners and devices shall not be used.

.3 Support channels, length as required, U shaped, size as required, of stainless steel.

.4 Support equipment, conduit or cable clips, spring loaded bolts, cable clamps etc., to be purpose-built accessories to basic channel members.

.5 Two-hole PVC straps to secure surface conduits 50 mm and smaller.

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

.7 Support individual cable or conduit runs with 6.0 mm diameter stainless steel threaded rods and spring clips.

.8 Support two or more cables or conduits on channels supported by 6.0 mm diameter stainless steel threaded rod hangers where direct fastening to building construction is impractical.

Part 3 Execution

3.1 INSTALLATION

.1 Install fastenings and supports as required for each type of equipment, cables and conduit to manufacturer's installation recommendations.

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

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

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

.5 Do not use supports of other equipment installed for conduit or cable support except with permission and approval of the Contract Administrator.

.6 Any aluminum support bracket or channel that is in direct contact with concrete is required to have inert spacers to reduce chemical reaction between support and concrete.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

.1 All Sections of General Conditions form a part of this Specification. They shall be read and fully adhered to exactly as if repeated here in full.

.2 Refer to all other Divisions of the Specifications and these Documents to determine their effect upon the work of this Section.

.3 All sections of all the Divisions of the Specification and all other documents included as part of this document form part of the Contract Documents.

1.2 SCOPE

.1 Refer to Section 26 05 00 for project electrical scope of work.

.2 Furnish all labour, materials, equipment and services specified, indicated or requested to install the electrical boxes specified herein and on the drawings.

Part 2 Products

2.1 OUTLET BOXES

.1 Size boxes in accordance with CSA C22.1-1986.

.2 100 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 Outlet boxes to be PVC.

.6 All outlet boxes shall be supplied with ground stud.

.7 Outlet boxes to be Series FS or FD as manufactured by Ipex.

.8 Surface mounted outlet boxes shall be EEMAC 4X, EEMAC 7 unless otherwise indicated.

.9 All outlet boxes to CSA C22.2 No. 18-M1987.

Part 3 Execution

3.1 INSTALLATION

.1 Install boxes to clear all building and mechanical services equipment. Where two or more devices are shown at one location, utilize multi-gang boxes. Supply all outlet boxes with covers as required.

.2 Size all boxes to accommodate the number of conduits, conductors and terminal blocks. Provide junction boxes with 20% spare terminal blocks.

.3 Securely fasten surface-mounted boxes to the building or mounting structure and support independently of the conduits entering the box.

.4 Install junction and pull boxes mounted on brick, concrete or block walls with 3 mm (1/8 inch) thick lead or nylon washers between box and wall face.

.5 Provide pull boxes sized to CEC requirements, in all conduit raceway systems to limit length of straight conduit runs to 30 m (100 ft). Reduce this length by 7.5 m (25 ft) for each 90 degrees bend or 4 m (12 ft) for each 45 degree bend or offset.

.6 Mark location and size of all pull boxes on the record drawings.

3.2 APPLICATION

.1 Location of outlets indicated may be changed by the Contract Administrator at no extra cost or credit, providing distance moved does not exceed 3000 mm, and notice is given before installation is completed.

3.3 MOUNTING HEIGHTS

.1 Refer to Section 26 05 00.

.2 Exact mounting height of unnoted equipment must be verified with the Contract Administrator before proceeding with installation.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

.1 All Sections of General Conditions form a part of this Specification. They shall be read and fully adhered to exactly as if repeated here in full.

.2 Refer to all other Divisions of the Specifications and these Documents to determine their effect upon the work of this Section.

.3 All sections of all the Divisions of the Specification and all other documents included as part of this document form part of the Contract Documents.

1.2 SCOPE

.1 Refer to Section 26 05 00 for project electrical scope of work.

.2 This section covers the supply and installation of all wire and box connectors.

1.3 QUALITY ASSURANCE

.1 Solder lugs to CSA C22.2 No. 19-1935 (R1981).

.2 Wire connectors to CSA C22.2 No. 65-M1988.

.3 Connectors shall be copper or copper alloy.

.4 Bushing stud connectors to EEMAC 1Y-2-1961 and shall be suited for conductor type.

.5 Clamps or connectors for cable to CSA-C22.2 No. 18, 1972.

Part 2 Products

2.1 MATERIALS

.1 All lugs, terminals and screws used for termination of wiring must be suitable for copper conductors.

.2 Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.

.3 Fixture type splicing connectors: with current carrying parts of copper sized to fit copper 10 AWG or less.

.4 Clamps or connectors for flexible conduit, as required.

.5 All cable terminations shall be with compression type connectors.

Part 3 Execution

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors.

.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-M1988.

.3 Install fixture type connectors and tighten. Replace insulating cap.

.4 Install crimp type connectors to the satisfaction of the Contract Administrator.

.5 Install box connectors to CSA requirements.

END OF SECTION

CABLE TAG	CABLE SOURCE	CABLE DESTINATION	CABLE TYPE	# CONDUCTORS	WIRE GAUGE

Part 1 General

1.1 GENERAL CONDITIONS

.1 All Sections of General Conditions form a part of this Specification. They shall be read and fully adhered to exactly as if repeated here in full.

.2 Refer to all other Divisions of the Specifications and these Documents to determine their effect upon the work of this Section.

.3 All sections of all the Divisions of the Specification and all other documents included as part of this document form part of the Contract Documents.

1.2 SCOPE

.1 Refer to Section 26 05 00 for project electrical scope of work.

.2 Furnish all labour, materials, supervision, equipment and services specified, indicated or requested to install a complete conduit raceway system. The raceway systems shall be comprised of the supply and installation of all conduits, fittings, supports, hangers and miscellaneous support materials and hardware required.

1.3 QUALITY ASSURANCE

.1 Rigid PVC (Unplasticized) conduit to CSA C22.2 No. 211.2-M1984. Liquid-tight flexible metal conduit to CSA C22.2 No. 56-1977. Rigid metal and epoxy coated conduit is based on CSA C22.2 No. 45.

1.4 LOCATION OF CONDUIT

.1 The drawings do not show specific conduit runs. All conduit shall be surface or as run in the floor slab unless otherwise indicated in the specifications and/or shown on the drawings. All devices shall be surface mounted type except as shown.

Part 2 Products

2.1 CONDUITS

.1 Conduit in ordinary areas and humid corrosive environments shall be Rigid P.V.C. Minimum size to be 21 mm.

.2 Conduit in hazardous areas shall be threaded rigid aluminium epoxy coated conduit with zinc coating and corrosion resistant epoxy finish inside and outside. Minimum size to be 21 mm.

.3 Liquid-tight flexible metal conduit for motor and equipment connections.

.4 EMT conduit shall not be utilized anywhere in the installation.

2.2 STRUT CHANNEL AND ACCESSORIES

.1 Strut Channel shall be galvanized in non-corrosive areas or stainless in corrosive areas

.2 Strut clamps shall be one piece heavy-duty construction with parallel hook design.

2.3 CONDUIT FASTENINGS

.1 Two hole PVC straps to secure surface conduits.

.2 Beam clamps to secure conduits to exposed steel work.

2.4 CONDUIT FITTINGS

.1 Fittings shall be manufactured for use with conduit specified. Coating shall be same as conduit.

.2 Factory “ells” where 90° bends are required for 25mm and larger conduits.

2.5 EXPANSION FITTINGS FOR PVC CONDUIT

.1 All conduits entering outlet boxes and devices that are located in walls subject to movement shall be terminated by means of liquid-tight flexible conduit, approximately 450 mm in length between the PVC conduit and the outlet box or device which is being supplied. All conduits, bus duct, wireways, etc., passing through or across expansion joints of the building shall be installed with the use of approved expansion fittings.

2.6 FISH CORD

.1 Polypropylene.

Part 3 Execution

3.1 GENERAL INSTALLATION REQUIREMENTS

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass. All conduits shall be surface mounted unless otherwise indicated.

.2 Cut conduit ends square and ream to remove burrs and sharp edges. Ensure that conduits butt in couplings and other fittings.

.3 Bends and offsets shall have a minimum radius of curvature not less than the minimum bending radius of the cable to be installed.

.4 Temporarily plug all conduits terminating in cabinets and boxes where moisture and foreign matter may enter.

.5 Blow all conduits through with clean compressed air to clear all foreign matter and moisture prior to the installation of wires or cables.

.6 Install fish cord in all conduits.

.7 Group exposed conduits together wherever possible and run parallel to building lines, supported from structural members and protected by the flanges of the structural member where practical.

.8 All conduit fastened to the surfaces of the structure shall be mounted on strut channel. Strut channel to be suitably spaced to meet manufacturer and code requirements. Direct mounting of conduit to surface of structure will not be permitted.

.9 Use manufacturer recommended mounting clips to secure conduit to strut channel.

.10 Support strut channel to structure with suitable fasteners or beam clamps for attaching to structure. Make no holes in building structural members for supporting conduits without the permission of the Contract Administrator.

.11 Provide additional strut channel supports at each elbow and terminations at a box or cabinet.

.12 Perforated metal straps used to support conduits are unacceptable.

.13 Install conduits at least 150 mm (6") clear of all steam pipes and flues, and 1 m (39") clear of heaters. Do not bend over sharp objects or improperly form.

.14 The maximum length of straight conduit run shall be 30 m (100 feet) between pull boxes or other terminations. This length shall be reduced by 10 m (32 feet) for each 90 degree bend or 5 m (12.5 feet) for each 45 degree bend or offset. Conduit runs shall not include more than the equivalent of two 90 degree bends between pull boxes except where indicated otherwise on the drawings.

.15 Where conduits pass through roof, seal with flashing and make weatherproof. For conduits passing through exterior walls, above or below grade, seal with waterproof sealing compound.

.16 All conduits originating or passing through an area containing corrosive or explosive gases and entering control panels, junction boxes, MCC's or any other equipment shall be suitably sealed at each point of entry to prevent any ingress of corrosive or explosive gases.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

.1 All Sections of General Conditions form a part of this Specification. They shall be read and fully adhered to exactly as if repeated here in full.

.2 Refer to all other Divisions of the Specifications and these Documents to determine their effect upon the work of this Section.

.3 All sections of all the Divisions of the Specification and all other documents included as part of this document form part of the Contract Documents.

1.2 SCOPE

.1 Refer to Section 26 05 00 for project electrical scope of work.

.2 This section covers the supply and installation of all wiring, conduit, and control devices related to all mechanical equipment specified in Divisions 40 and 46.

.3 Provide all labour and materials as necessary to install, wire, connect and put into satisfactory operation the following control panels and mechanical equipment supplied under Divisions 40 and 46:

- .1 Electric motors and actuated valves
- .2 Motor starters, contactors, and interlocks where specified as components of "packaged" equipment including, but not limited to:
  - .1 Foam Suppression/Mixing System
- .3 Miscellaneous plumbing and HVAC equipment including fans, hot water tank, air handing units, etc.

1.3 SUBMITTALS

.1 Submit shop drawings in accordance with Section 26 05 00.

Part 2 Products

2.1 MATERIALS

.1 Supply and install all motor power wiring and conduit, all control wiring and conduit, all local and remote control devices, and all motor starters and contactors except where specified as components of "packaged" equipment.

Part 3 Execution

3.1 INSTALLATION

.1 Coordinate the work of this Section with the installation of the equipment specified in the relevant Sections of Divisions 40 and 46 and shown on the Mechanical and Electrical drawings.

.2 Perform all work in compliance with the relevant sections of this Division.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

.1 All Sections of General Conditions form a part of this Specification. They shall be read and fully adhered to exactly as if repeated here in full.

.2 Refer to all other Divisions of the Specifications and these Documents to determine their effect upon the work of this Section.

.3 All sections of all the Divisions of the Specification and all other documents included as part of this document form part of the Contract Documents.

1.2 SCOPE

.1 Refer to Section 26 05 00 for project electrical scope of work.

.2 This section covers the supply and installation of all motor and equipment disconnect switches.

1.3 SUBMITTALS

.1 Submit shop drawings in accordance with Section 26 05 00 including the following information:

.2 Scale drawing of switch and enclosure.

.3 Switch voltage rating.

Part 2 Products

2.1 UNFUSED DISCONNECT SWITCHES

.1 Provide unfused disconnect switches, voltage and amperage rated to suit loads.

.2 Disconnect shall be front-operational, heavy duty, industrial grade, quick-make, quick-break type.

.3 Make provision for padlocking in the "OFF" position.

.4 Mechanically interlocked door to prevent opening when handle in "ON" position.

.5 "ON/OFF" switch position indication on switch enclosure cover.

.6 Disconnect enclosures shall be EEMAC 7 in hazardous locations, EEMAC 4X in corrosive environments and EEMAC 12 in ordinary areas, unless otherwise indicated.

.7 Provide early break auxiliary contact for connection to motor enable circuit for all motors.

2.2 FUSED DISCONNECT SWITCHES

.1 Provide fused disconnect switches, voltage and amperage rated to suit loads.

.2 Disconnect shall be front-operational, heavy duty, industrial grade, quick-make, quick-break type.

.3 Make provision for padlocking in the "OFF" position.

.4 Mechanically interlocked door to prevent opening when handle in "ON" position.

.5 "ON/OFF" switch position indication on switch enclosure cover.

.6 Disconnect enclosures shall be EEMAC 7 in hazardous locations, EEMAC 4X in corrosive environments and EEMAC12 in ordinary areas, unless otherwise indicated.

.7 Provide early break auxiliary contact for connection to motor enable circuit for all motors.

2.3 MANUFACTURERS

.1 Disconnects for all equipment specified shall be as manufactured by Cooper Crouse-Hinds GHG series, Arrow Hart AH series, Cutler-Hammer HD series, Schneider Canada Square ”D” CHU series.

Part 3 Execution

3.1 INSTALLATION

.1 Install disconnect switches as per manufacturer's recommendations.

.2 Mount switches at 1400 mm above finished floor to the underside of the switch enclosure.

3.2 IDENTIFICATION

.1 .1 Provide lamacoid nameplate on front face of switch identifying equipment.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

.1 All Sections of General Conditions form a part of this Specification. They shall be read and fully adhered to exactly as if repeated here in full.

.2 Refer to all other Divisions of the Specifications and these Documents to determine their effect upon the work of this Section.

.3 All sections of all the Divisions of the Specification and all other documents included as part of this document form part of the Contract Documents.

1.2 SCOPE

.1 Refer to Section 26 05 00 for project electrical scope of work.

.2 This section covers the supply and installation of all magnetic and thermal magnetic circuit breakers.

.3 Specific circuit breaker voltage, phase, ampacity, pole numbers, interrupting capacity, breaker type and setting are indicated elsewhere in the specifications or on the drawings.

1.3 QUALITY ASSURANCE

.1 All equipment to CSA Standard 22.2, No. 5-M1986.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section 26 05 00, including:

.1 Component function, make and model no.
.2 Breaker voltage and amperage.
.3 Breaker phase, number of poles & number of wires.
.4 Indication of solid neutral if required.

.2 Submit time-current characteristic curves for breakers with ampacity of 15 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

Part 2 Products

2.1 BREAKERS - GENERAL

.1 Bolt-on moulded case circuit breakers, quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.

.2 Common-trip breakers with single handle for multi-pole applications.

.3 Magnetic instantaneous trip elements in circuit breakers, to operate only when the value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-10 times current rating.

.4 Circuit breakers with interchangeable trips as indicated.

2.2 THERMAL MAGNETIC BREAKERS

.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping.

2.3 MAGNETIC BREAKERS

.1 Magnetic circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection (motor starters).

2.4 ENCLOSURES

.1 All breakers shall be housed in an EEMAC 12 rated panelboards, motor panels or MCC. Wall mounted breakers to be housed in EEMAC 4X rated enclosures.

2.5 MANUFACTURERS

.1 For circuit breakers protecting fans, heating elements, transformers and panelboards, acceptable manufacturer is Schneider Canada Federal Pioneer FHL, Cutler-Hammer Series C, Moeller NZM Series.

.2 For circuit breakers protecting electric motors, acceptable manufacturer is Schneider Canada Square “D” Mag-Guard MCP, Culter-Hammer Series C HMCP, Moeller NZM Series.

Part 3 Execution

3.1 INSTALLATION

.1 Install circuit breakers in MCC as indicated.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

.1 All Sections of General Conditions form a part of this Specification. They shall be read and fully adhered to exactly as if repeated here in full.

.2 Refer to all other Divisions of the Specifications and these Documents to determine their effect upon the work of this Section.

.3 All sections of all the Divisions of the Specification and all other documents included as part of this document form part of the Contract Documents.

1.2 SCOPE OF WORK

.1 This section provides specification requirements for adjustable frequency drives, variable speed drives or herein identified as AC Drives for use with NEMA B design AC motors.

.2 Any exceptions/deviations to this specification shall be indicated in writing and submitted with the quotation.

1.3 REFERENCES

.1 CSA C22.2 No. 14-M91—Industrial Control Equipment

.2 IEC 529—Degrees of Protection Provided by Enclosure

.3 NEMA ICS7—Industrial Control and Systems Adjustable Speed Drives

.4 NEMA ICS 7.1—Safety Standards for Construction and Guide for Selection Installation and Operation of Adjustable Speed Drives

.5 UL 508—UL Standard for Safety Industrial Control Equipment

.6 UL 508C—UL Standard for Safety Power Conversion Equipment

1.4 RELATED WORK

.1 Training – 01 79 00

.2 Commissioning - 01 98 13

.3 Close Out Submittals – 01 78 00

.4

1.5 SUBMITTALS

.1 Submit shop drawings in accordance with Section 26 05 00. submittal to include standard catalogue sheets showing voltage, horsepower, maximum current ratings and recommended replacement parts with part numbers shall be furnished for each different Horsepower rated AC Drive provided.

1.6 WARRANTY

.1 1-year parts warranty shall be provided on materials and workmanship form the date of start-up or 18 months from the date of shipment.

1.7 QUALITY ASSURANCE

.1 The AC Drive and all associated optional equipment shall be CSA certified. As verification, a CSA label shall be attached on the side of the drive controller.

.2 The AC Drive shall be designed, constructed and tested in accordance with NEMA, NEC, IEC standards and CSA certified.

Part 2 Products

2.1 MANUFACTURERS

.1 The AC Drive shall be provided by ABB, ACS800 series.

.2 Alternate control techniques other than sine wave by pulse width modulated (PWM) are not acceptable.

2.2 GENERAL DESCRIPTION

.1 Provide programming software for VFD on CD as well as any cables required to connect to the VFD, without the need for disconnection of the Ethernet cable connected to the automation system.

.2 Provide printout, and soft copy on USB stick, of VFD parameters at completion of commissioning in O&M manual.

.3 VFD shall be provided in standalone NEMA 12 panel, gasketted complete with all drip shields necessary to prevent the ingress of liquids that may drip from ceiling in electrical room.

.4 The AC Drive shall convert the input AC mains power to an adjustable frequency and voltage as defined in the following sections.

.5 Provide a line reactor with a minimum of 5% impedance based on the drive operating at its continuous output current rating.

.6 The input power section shall utilize a full wave bridge design incorporating diode rectifiers. The diode rectifiers shall convert fixed voltage and frequency, AC line power to fixed DC voltage. This power section shall be insensitive to phase rotation of the AC line. The DC voltage shall be filtered.

.7 The output power section shall change fixed DC voltage to adjustable frequency AC voltage. This section shall utilize insulated gate bipolar transistors (IGBTs) or intelligent power modules (IPMs) as required by the current rating of the motor.

.8 The AC Drive's output shall be connected to output load reactor for distances shorter than 30 m and combination load reactor and dv/dt filter for distances longer than 30 m. Load reactors to be Transcoil KDR series. Long lead filters (dv/dt) to be Transcoil V1k series, or approved equal.

2.3 MOTOR DATA

.1 The AC Drive shall be sized to operate the following AC motor:

.1 Motor Horsepower: as indicated on drawings.

.2 Motor RPM: 1800; 60Hz)

.3 Motor voltage: 575 Vac

.4 Motor service factor: 1.15

2.4 APPLICATION DATA

.1 The AC Drive shall be sized to operate a constant torque load.

.2 The motor speed range shall be from a minimum speed of 1.0 Hertz to a maximum speed of 60 Hertz.

.3 The AC drive shall have, as a minimum, a 5:1 turndown ratio.

2.5 ENVIRONMENTAL RATINGS

.1 The AC Drive shall be of construction that allows operation in a pollution Degree 2 environment.

.2 The AC Drive shall be designed to operate in an ambient temperature from –100 to + 400C.

.3 The storage temperature range shall be –40 to + 70 C.

.4 The maximum relative humidity shall be 95% at 400C, non-condensing.

.5 The AC Drive shall be rated to operate at altitudes less than or equal to 3,300 ft. (1000m). For altitudes above 3,300 ft., de-rate the AC Drive by 1% for every 300 ft. (100 m).

2.6 RATINGS

.1 The AC Drive shall be designed to operate from an input voltage of 525 to 690 Vac +/- 10%.

.2 The AC Drive shall operate from an input voltage frequency range from 45 to 66 Hertz.

.3 The displacement power factor shall not be less than .96 lagging under any speed or load condition.

.4 The efficiency of the AC Drive at 100% speed and load shall not be less than 97%.

.5 The constant torque rated AC Drive overcurrent capacity shall be not less than 150% for 1 minute.

.6 The output carrier frequency of the AC Drive shall be selectable from 1.0 to 6 KHZ depending on Drive rating. For low noise operation, derating may be required.

.7 The output frequency shall be from 0.1 to 320 Hertz.

.8 The AC drive will incorporate Sensorless Flux Vector control technology for increased starting torque and better dynamic speed control performance.

2.7 PROTECTION

.1 Upon power-up the AC Drive shall automatically test for valid operation of memory, dynamic brake failure, power and the pre-charge circuit.

.2 The Power Converter shall be protected against short circuits between, output phases, output phases and ground. The AC Drive shall safely shut down without damaging any power circuit devices.

.3 For a fault condition other than a ground fault, short circuit or internal fault, an auto restart function should provide up to 10 programmable restart attempts with Lock-out after the last attempt. The programmable time delay before restart attempts will range from 1 to 60 seconds. This feature can be defeated if not required.

.4 The rotating motor auto start on power-up function could be enabled/disabled if required.

.5 The AC Drive shall be capable of running without a motor connected for setup and testing.

.6 The deceleration mode of the AC drive shall be programmable for normal and fault conditions. The stop modes shall include free-wheel stop, emergency stop and DC injection braking.

.7 Upon a loss of the analog process follower reference signal, the AC drive shall fault and/or operate at a user defined speed set between software programmed low speed and high speed settings.

.8 The AC drive shall have solid state I2t protection that is UL listed and meets UL 508 as a Class 10 overload protection and meets IEC 947. The minimum adjustment range shall be from 50 to 110% of the current output of the AC Drive.

.9 There shall be a minimum of 2 skip frequency ranges that can each be programmed with a programmable bandwidth from 0 to 10Hz. The skip frequencies shall be programmed independently, back to back or overlapping.

.10 The AC Drive shall have an internal over temperature protection.

2.8 ADJUSTMENTS AND CONFIGURATIONS

.1 If required, a password should be available to allow the terminal keypad to be locked out from unauthorized personnel.

.2 The acceleration and deceleration ramp times shall be adjustable from [0.1 to 3000.0 seconds].

.3 The memory shall retain and record run status, operating time, fault type of the past 10 faults.

.4 Slip compensation shall be a software enabled function.

.5 The AC drive shall offer programmable DC injection braking that will brake the AC motor by injecting DC current and creating a stationary magnetic pole in the stator continuously, at start and/or at stop. The level of current will be adjustable between 15-150% of rated current.

.6 As a minimum, the following parameters shall be accessible:

.1 Maximum speed

.2 Minimum speed

.3 Current limit

.4 Thermal overload

.5 Restart limit

.6 Skip frequency and bandwidth

.7 Preset speed

2.9 OPERATOR INTERFACE

.1 The operator interface terminal should feature and alphanumeric display with seven indicators for speed controller status (Run, direction, ready stop, alarm, fault) and three indicators for control (I/O terminal, keypad, bus/communication). There are also three LEDs indicators green/green/red for Ready, Run, Fault. The terminal should allow the modification of AC drive adjustments via a keypad. All electrical values, configuration parameters, application and activity function access, faults, local control, adjustment storage will be in plain English.

.2 The display will be a high resolution, LCD backlighted screen capable of displaying two lines of alphanumeric characters. The use of coded or abbreviated displays shall not be acceptable.

.3 The following monitoring values shall be accessible and available when in the operating mode:

.1 Frequency (Hz) and/or motor speed (RPM)

.2 Motor current (A), motor voltage (V), motor torque (%), motor power (%)

.3 Drive temperature (oC)

.4 Motor temperature (%)

.5 Values or status of analog I/O, digital I/O

.4 The operator terminal shall allow the user to display up to three user selectable monitoring values on the same screen at a time.

.5 The operator terminal shall offer a general menu consisting of parameter setting, fault history, and drive configuration. A software lock with password will limit access to the main menu or parameters.

.6 There will be function keys that allowing the ability to scroll through menus and screens, select or activate functions or increase the value of a selected parameter.

.7 A data entry key will allow the user to confirm a selected menu or numeric value.

.8 The following control functions shall be available on the keypad:

.1 Start

.2 Stop

.3 Select

.4 Reset

.9 A RESET key will allow a parameter to return the existing value if adjustment is not required and the value is displayed.

.10 The AC drive shall have a LED on the keypad to indicate RUN status of the drive.

2.10 CONTROL

.1 Provide door mounted Human Interface Module (HIM).

.2 Provide door mounted Hand-Off-Auto Switch. VFD to monitor Auto switch status, and transmit status to PLC control system via Ethernet. In auto mode, local controls to be in-active. In hand mode, the start/stop and speed control shall be via door mounted HIM.

.3 External pilot devices shall be able to be connected to a terminal strip for starting/stopping the AC Drive, speed control and displaying operating status. All outputs will be software assignable.

.4 The control power for the digital inputs and outputs shall be 24 VDC.

.5 There will be two (2) analog inputs. The analog inputs will be hardware selectable and consist of the following configurations: 0(4)–20 mA, 0-10V, or +/-10V.

.6 There will be six (6) digital inputs that shall be individually user assignable to perform the various control functions available.

.7 There will be one (1) software assignable analog output that can be selected and assigned in the software. The analog output assignments shall be programmable 0(4)-20 mA or 0-10V.

.8 Two form "C" configurable relay output contacts and an open collector output (24 VDC) to power a relay or pilot light, shall be provided. Each shall be programmable to indicate one of the following:

.1 Run
.2 Fault
.3 Ready
.4 At speed
.5 Current limit
.6 Follower present
.7 Auto speed mode
.8 Reverse indicator
.9 PID control active
.10 Over-temperature alarm

.9 There shall be available additional hardware input / output cards for incorporating alternate control signals including AC voltage logic inputs, PTC thermistor inputs and encoder feedback inputs.

2.11 COMMUNICATIONS

.1 The AC Drive shall be equipped with Modbus TCP Ethernet communication card and shall be capable of communicating directly with the Modicon M340 PLC without the need for an external protocol converter.

Part 3 Execution

3.1 INSPECTION

.1 Verify that the location is ready to receive work and the dimensions are as indicated.

.2 Do not install AC Drive until the building environment can be maintained with the service conditions required by the manufacturer.

3.2 PROTECTION

.1 Before and during the installation, the AC Drive equipment shall be protected from site contaminants.

3.3 INSTALLATION

.1 AC drives shall be installed in the control panels as indicated. Installation shall be in compliance with manufacturer's instructions, drawings and recommendations.

3.4 TRAINING

.1 An on-site training course of 1 day shall be provided by a representative of the AC Drive supplier to plant and / or maintenance personnel.

3.5 INSPECTION

.1 The supplier of AC Drive shall have a factory trained service representative in domestic residence within 1000 km (average) of the job site. The factory representative shall be trained in the maintenance and troubleshooting of the equipment as specified herein.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

.1 All Sections of General Conditions form a part of this Specification. They shall be read and fully adhered to exactly as if repeated here in full.

.2 Refer to all other Divisions of the Specifications and these Documents to determine their effect upon the work of this Section.

.3 All sections of all the Divisions of the Specification and all other documents included as part of this document form part of the Contract Documents.

1.2 SCOPE

.1 Refer to Section 26 05 00 for project electrical scope of work.

.2 This section covers the following:

.3 Electrical work pertaining to installation of equipment, which is specified under other divisions.

.4 Automatic control devices specified in other divisions, supplied and installed under that division, and wired and connected under this division.

.5 Wiring associated with control wiring schematics on electrical drawings under this division.

1.3 QUALITY ASSURANCE

.1 Coordinate with mechanical shop drawings for electrical requirements. Where mechanical shop drawings differ in control or power requirements this shall be reported to the Contract Administrator.

Part 2 Products

2.1 MATERIALS

.1 Refer to other sections for equipment specifications.

.2 Circuit breaker and feeder sizes as indicated on the electrical drawings for all motors, fans, HVAC equipment, etc., as supplied under the Mechanical Division are based on design data only. Contractor responsible for coordinating with the Mechanical Division to determine exact voltage and amperage of all equipment on site and ensure starters, breakers, feeder wiring, conduit sizes, etc., are correctly sized for the equipment being fed in addition to informing the Contract Administrator of all required changes. No extras will be allowed for costs incurred resulting from failure to properly execute this coordination.

Part 3 Execution

3.1 INSTALLATION

.1 Refer to individual sections for execution.

.2 Coordinate overcurrent and overload protective devices with the nameplate ratings of the motors.

.3 Fill out a “MOTOR DATA SHEET” for each single phase and 3 phase motor.

END OF SECTION

MOTOR DATA SHEET

EQUIPMENT NAME AND NUMBER_____

NAMEPLATE INFORMATION

MANUFACTURER_____

KW(HP)_____ **MAX AMBIENT**_____ ^{0}C

R.P.M._____ **SERVICE FACTOR**_____

VOLTS_____ **INSULATION CLASS**_____

AMPS_____ **EEMAC DESIGN**_____

PHASE_____ **SERIAL NUMBER**_____

FRAME_____ **MODEL NUMBER**_____

OPERATION CONDITIONS

FULL LOAD AMPS_____ **A**_____ **B**_____ **C**

FULL LOAD OPERATING VOLTAGE AT MOTOR_____ **A-B**_____ **B-C**_____ **C-A**

OVERLOAD RELAY INSTALLED_____ **ADJUSTABLE SETTING AT**_____

M.C.P. AMPS_____ **ADJUSTABLE SETTING AT**_____

ACCELERATING TIME (IF OVER 5 SECONDS)_____

REDUCED VOLTAGE STARTER TRANSITION TIME SETTING_____

SPECIAL CONTROLS AND REMARKS (THERMISTOR AND RELAY TYPE, CAPACITORS AND WHERE CONNECTED, ETC.)

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