FIRE ALARM SYSTEMS

1. GENERAL

1.1 Related Work

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

.2 Wires and Cables 0-1000 V: Section 16122

1.2 References

.1 CAN/ULC-S524, Installation of Fire Alarm Systems.

.2 ULC-S525, Audible Signal Appliances for Fire Alarm Systems.

.3 CAN/ULC-S526, Visual Signal Appliances, Fire Alarm.

.4 CAN/ULC-S527, Control Units, Fire Alarm.

.5 CAN/ULC-S528, Manual Pull Stations.

.6 CAN/ULC-S529, Smoke Detectors, Fire Alarm.

.7 CAN/ULC-S530, Heat Actuated Fire Detectors, Fire Alarm.

.8 CAN/ULC-S531, Smoke Alarms.

.9 CAN/ULC-S536, Inspection and Testing of Fire Alarm Systems.

.10 CAN/ULC-S537, Verification of Fire Alarm Systems.

.11 NBC, National Building Code of Canada.

.12 CSA C22.1 Section 32, Fire Alarm Systems and Fire Pumps.

.13 Local Building Code.

1.3 Description of System

.1 System includes:

.1 Control panel to carry out fire alarm and protection functions including receiving alarm signals, initiating general alarm, supervising system continuously, actuating zone annunciators, and initiating trouble signals.

.2 Trouble signal devices.

.3 Power supply facilities.

.4 Manual alarm stations.

.5 Automatic alarm initiating devices.

.6 Audible signal devices.

.7 End-of-line devices.

.8 Annunciators.

.9 Visual alarm signal devices.

.10 Ancillary devices.

1.4 Shop Drawings

.1 Submit shop drawings in accordance with Section 16010 – Electrical General Requirements.

.2 Include:

.1 Layout of equipment.

.2 Zoning.

.3 Complete wiring diagram, including schematics of modules.

1.5 Operation and Maintenance Data

.1 Provide operation and maintenance data for Fire Alarm System for incorporation into manual specified in Section 16010 – Electrical General Requirements.

.2 Include:

.1 Operation and maintenance instructions for complete fire alarm system to permit effective operation and maintenance.

.2 Technical data - illustrated parts lists with parts catalogue numbers.

.3 Copy of approved shop drawings.

.4 List of recommended spare parts for system.

1.6 Maintenance Materials

.1 Provide maintenance materials in accordance with Division 1 – Maintenance Materials, Special Tools and Spare Parts.

.2 Include:

.1 2 spare glass rods for manual pull box stations if applicable.

.2 rate of rise heat detector.

.3 pull station.

1.7 Training

.1 Arrange and pay for one on-site lectures and demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system. Seminars will use actual demonstration.

.2 A representative from the manufacturers shall attend the seminar.

2. PRODUCTS

2.1 Materials

.1 Equipment and devices: ULC listed and labeled and supplied by single manufacturer.

.2 Power supply: to CAN/ULC-S524.

.3 Audible signal devices: to ULC-S525.

.4 Visual signal devices: to CAN/ULC-S526.

.5 Control unit: to CAN/ULC-S527.

.6 Manual pull stations: to CAN/ULC-S528.

.7 Thermal detectors: to CAN/ULC-S530.

.8 Smoke detectors: to CAN/ULC-S529.

2.2 System Operation

.1 Single stage operation. Operation of any alarm initiating device to:

.1 Cause audible signal devices to sound throughout building.

.2 Transmit signal to fire department via auto dialer provided through Division 17.

.3 Cause zone of alarm device to be indicated on control panel.

.4 Cause air conditioning and ventilating fans to shut down or to function so as to provide required control of smoke movement.

2.3 Control Panel

.1 Class B.

.2 Single stage operation.

.3 Zoned. Minimum of 4 zones required.

.4 Non-coded.

.5 Enclosure: CSA Enclosure 1, c/w lockable concealed hinged door, full viewing window, flush lock and 2 keys. Enclosure to be suitable for surface wall mounting.

.6 Supervised, modular design with plug-in modules:

.1 Alarm receiver with trouble and alarm indications for class B initiating circuit.

.2 Spare zones: compatible with smoke detectors and open circuit devices.

.3 Space for future modules.

.4 Latching type supervisory receiver circuits. Discrete indication for both off-normal and trouble.

.7 Components:

.1 Coded alarm receiver panel with trouble and alarm indications for class B initiating circuit.

.2 Single stage alarm pulse rate panels:

.1 Single stroke control type for output to signal control panel continuously.

.3 Common control and power units:

.1 Control panel containing following indications and controls:

.1 "Power on" LED (green) to monitor primary source of power to system.
.2 "Power trouble" indication.
.3 "Ground trouble" indication.
.4 "Remote annunciator trouble" indication.
.5 "System trouble" indication.
.6 "System trouble" buzzer and silence switch c/w trouble resound feature.
.7 System reset switch.
.8 "LED test" switch if applicable.
.9 "Alarm silence" switch to silence signals manually. If new alarm occurs after signals have been silenced, signals to resound.
.10 "Signals silenced" indication.

.2 Master power supply panel to provide 24 V dc to system from 120 V ac, 60 Hz input.

.3 Fire department connections:

.1 Fire department bypass switch c/w indicator for trouble at panel.

.4 Auxiliary relays: plug-in type, dust cover, supervised against unauthorized removal by common trouble circuit and c/w bypass switch.

.1 Contacts: 2.0 A, 120 V ac, for initiation of fan shut down.

.2 Contact terminal size: capable of accepting 22-12 AWG wire.

2.4 Power Supply

.1 120 V, ac, 60 Hz input, 24 V dc output from rectifier to operate alarm and signal circuits. Power supply from 120 /208 V local emergency power panel. Include surge protection on incoming power wiring.

.2 Standby nickel cadmium battery unit with automatic battery charger to provide supervisory and trouble signal current for 24 hours, plus general alarm load for minimum of 5 minutes, complete with voltmeter and charging meter. Unit to be sized to carry the complete fire alarm system.

2.5 Manual Alarm Stations

.1 Manual alarm stations: pull lever, glass rod, wall mounted surface type, non-coded single pole normally open contact for single stage English signage.

2.6 Automatic Alarm Initiating Devices

.1 Heat detectors, fixed temperature, non-restorable, rated 88°C.

.2 Thermal fire detectors, combination fixed temperature and rate of rise, non-restorable fixed temperature element, self-restoring rate of rise, fixed temperature 57°C, rate of rise 8.3°C per minute.

.3 Smoke detector: ionization

.1 Twistlock Plug-in type with fixed base.

2.7 Audible Signal Devices

.1 Horns: 90 dB, surface mounting, 24 V dc c/w visual alarm device.

2.8 End-of-Line Devices

.1 End-of-line devices to control supervisory current in [alarm circuits] [and] [signaling circuits], sized to ensure correct supervisory current for each circuit. Open, [short] or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel [and remotely as indicated].

2.9 Visual Alarm Signal Devices

.1 Strobe type: flashing, white 24 V dc.

.2 Designed for surface mounting in combination with audible signal device as indicated.

2.10 As-Built Riser Diagram

.1 Fire alarm system riser diagram: in glazed frame, minimum size 600 x 600 mm.

2.11 Ancillary Devices

.1 Remote relay unit to initiate fan shutdown.

3. EXECUTION

3.1 Installation

.1 Install systems in accordance with CAN/ULC-S524 and TB OSH Chapter 3-4.

.2 Install main control panel and connect to ac power supply, dc standby power.

.3 Locate and install manual alarm stations and connect to alarm circuit wiring.

.4 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1 m of air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors.

.5 Connect alarm circuits to main control panel.

.6 Locate and install audible signal and visual signal devices and connect to signaling circuits.

.7 Connect signaling circuits to main control panel.

.8 Install end-of-line devices at end of alarm and signaling circuits, in a separate box not more than 1730 mm above finished floor.

.9 Locate and install remote relay units to control fan shut down.

3.2 Wiring

.1 Ensure conductors are routed in such a manner to provide required fire rating.

.2 Signal circuits to be wired with a minimum 2 - #14 R90 per zone. In no case shall the voltage drop to any signal exceed 10%.

.3 Alarm initiating devices to be wired with multi conductor #18 R90 cables as required in accordance with the Canadian Electrical Code. Circuit resistance shall not exceed 50 ohms.

.4 All wiring will be terminated into the terminal strips in the fire alarm cabinet with all wiring fully labeled. All cabling to be neat with cables bundled and wrapped inside the cabinets. No splicing will be allowed within the cabinets. A complete schedule of all wiring terminations will be mounted inside each control unit. A complete schematic with all devices, cable labeling information, destinations, etc. will be included with the shop drawings.

3.3 Field Quality Control

.1 Perform tests in accordance with Section 16980 – Testing, Adjusting and Balancing of Electrical Equipment and System and CAN/ULC-S537.

.2 Fire alarm system:

.1 Test each device and alarm circuit to ensure manual stations, thermal and smoke detectors transmit alarm to control panel and actuate general alarm.

.2 Check annunciator panels to ensure zones are shown correctly.

.3 Simulate grounds and breaks on alarm and signaling circuits to ensure proper operation of system.

.4 Class B circuits.

1 Test each conductor on all circuits for capability of providing alarm signal on line side of single open-circuit fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

2 Test each conductor on all circuits for capability of providing alarm signal during ground-fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

3.4 Verification and Certification

.1 The manufacturer shall make an inspection of the fire alarm equipment, including those components necessary to the direct operation of the system such as detectors and controls, whether or not manufactured by the manufacturer added under this contract. The inspector shall comprise an examination of such equipment for the following.

.1 That the type of equipment installed is that designated by the specification.

.2 That the wiring connections to all equipment components show that the installer undertook to have observed ULC and CSA requirements.

.3 That equipment of the manufacturer's manufacture has been installed in accordance with the manufacturer's recommendations and that all signaling devices of whatever manufacture have been operated or tested to verify their operation.

.4 That the supervisory wiring of those items of equipment connected to a supervised circuit is operating and that the governmental regulations, if any, concerning such supervisory wiring have been met to the satisfaction of inspecting officials.

.5 To assist the contractor in preparing his bid the manufacturer shall indicate the number of hours necessary to complete this inspection prior to closing of tenders, and the number of hours necessary to provide a seminar on the system for the building Owner.

.2 The system shall be tested and verified according to requirements of CAN/ULC-S537 Standard for Verification of Fire Alarm System Installations. The complete verification procedure will be under the control and supervision of the Consultant. The services of the contractor and representatives of the fire alarm manufacturer are required for the verification. The following is a rough breakdown of the responsibilities of each part participating in the verification. The following is a rough breakdown of the responsibilities of each party participating in the verification. This list does not necessarily note all the required work. The contractor and fire alarm manufacturer shall provide equipment and manpower as necessary to complete the verification to the Consultant's requirements and approval.

.3 Contractor:

.1 Remove/reinstall devices

.2 Activate alarms

.3 Activate trouble alarms

.4 Provide 1 pair of radios

.5 All work to be 100% complete

.6 Provide necessary manpower

.7 Correct deficiencies

.8 Coordinate and schedule verification (all two weeks notice).

.4 Manufacturer:

.1 Ensure correct operation of all alarms, signals, auxiliary functions, trouble indication

.2 Record all data and issue report and certificate of verification

.3 Correct any deficiencies

.4 Check, calibrate, adjust and confirm correct operation of control panels, annunciator

.5 Generally assure that all aspects of system function properly

.6 Provide all test equipment, including sound pressure level meter, volt meter, aerosol test smoke.

.5 Consultant:

.1 Direct and supervise verification

.2 Check and ensure that system is applied and installed to all applicable codes

.3 Review test documentation, give to the owner and fire authorities.

.6 All costs involved in this inspection, including manufacturer's, electrical contractor's and the Consultant, shall be included in total price. Submit the cost for this verification to be applied to a cost allowance.

.7 Inspection Certification: On completion of the inspection and when all of the above conditions have been complied with, the manufacturer shall issue to the Interior Designer:

.8 A copy of the inspecting technician's report showing location of each device and certifying the test results of each device.

.1 A certificate of verification confirming that the inspection has been completed and showing the conditions upon which such inspection and certification have been rendered.

.2 Seal the certificate with the seal of a Professional Engineer registered in the Province of Alberta.

.3 Proof of liability insurance for the inspection.

END OF SECTION

SECURITY SYSTEM

1. GENERAL

1.1 RELATED WORK

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

.2 Wires and Cables 0-1000V — Section 16122

.3 Description of System

.1 Building Security Control system consisting of a central control panel with a minimum of 16 zones, door position switches, infra-red motion detectors of various range configurations, access/control keypads with LCD display. Security system to include a digital communicator for monitoring by others. System to accept input from fire alarm control panel and Process automation control system to transmit signal to local fire department and/or any other designated telephone number as directed by the owner.

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01300 – Submittals.

1.3 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for building entrance control system for incorporation into manual specified in Section 01300 – Submittals.

.2 Include description of system operation and all operating instructions. A written description of all functions of the system shall also be included. Description to be written using clear instructions avoiding unnecessary technical jargon.

.3 Include parts list, using component identification numbers standard to electronics industry.

2. PRODUCTS

2.1 SYSTEM OPERATION

.1 Each individual security device to be annunciated separately at the access control keypad. System to be zoned and programmed at the direction of consultant. All devices to be located to provide optimum detection and to have tamper contacts. Alarm activation to initiate local alarm signal via a paging speakers, (2) and cause the automatic telephone dialer line seizure module to dial a series of predetermined local and monitoring agency telephone numbers.

2.2 CONTROL PANEL

.1 DCS Power 832 PC5015 or approved equal, main control panel or approved equal.

.2 Addressable loop interface module.

.3 Individually programmable detection zones

.4 Internal supervised audible alarm output with siren output for exterior sirens.

.5 Digital communicator for event reporting.

2.3 SECURITY KEYPADS

.1 Power 832 LCD5500Z or approved equal, keypad, programmable messaging, 32 character display.

2.4 DETECTION DEVICES

.1 DSC AMP-700 series contact modules for door control.

2.5 COMMUNICATION CONDUCTORS

.1 Install addressable loop cabling from devices to panel location. All wire to be installed in conduit.

.2 Install type cable/wire as recommended by the system Manufacturer.

3. EXECUTION

3.1 INSTALLATION

.1 Install system in accordance with manufacturer's instructions.

.2 Locations shown on the drawings are for quantity only. The system supplier is to review and modify the locations/mounting of detectors if required to best suit architectural conditions and provide devices with appropriate range/view configurations.

.3 Each exterior door contact is to be on a separate zone. Program the remaining devices in zones as directed by the owner.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 16010 – Electrical General Requirements.

.2 Perform function tests to the satisfaction of the consultant that the system operates as intended.

END OF SECTION

INCOMING TELEPHONE SERVICE

1. GENERAL

1.1 Description

.1 Incoming telephone service facilities pole line to main terminal, aerial routing.

1.2 Related Work

.1 Plywood Backboard: Division 06

1.3 References

.1 CAN/CSA-C83, Communication and Power Line Hardware and latest NW Tel standards.

1.4 Co-ordination with Telephone and Telecommunication Authorities

.1 Co-ordinate with NW Tel to ensure availability of service.

2. PRODUCTS

2.1 Material

.1 Grounding-Secondary.

.2 Overhead service mast: to service provider requirements

.3 Communication line hardware to CAN/CSA-C83 and to latest EIA/TIA standards.

3. EXECUTION

3.1 Installation

.1 Install telephone service facilities.

.2 Install 19 mm thick plywood backboard for termination of equipment sized to NW Tel requirements and to suit placement of equipment.

.3 Install grounding facilities and make connections.

.4 Install 50 m rigid steel mast on building for overhead service where required.

END OF SECTION

DATA AND VOICE SYSTEMS

1. GENERAL

1.1 Related Work

.1 General Requirements: Section 16010

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

.3 Fastenings and Supports: Section 16191

1.2 Installer Qualifications

.1 Personnel installing communications cabling shall be trained and conversant with communications cabling practices required for this project.

1.3 General Requirements

.1 The workmanship and installation shall conform with the current guidelines contained in the following:

.1 Telephone system manual of the NW Tel.

.2 ANSI/EIA/TIA568A (or CSA T529-M), Commercial Building Telecommunications wiring standard.

.3 CSA C22.1 Canadian Electrical Code, Part 1 and BC Amendments.

.4 CSA C22.2 Canadian Electrical Code, Part 2.

.5 ANSI/EIA/TIA (or CSA T530-M), Commercial Building standard for Telecommunications pathways and spaces.

.6 ANSI/EIA/TI-606 (or CSA T528-M), Administration standard for Telecommunications infrastructure of commercial buildings.

.7 ANSI/EIA/TIA-607 (or CSA T527), Commercial Building Grounding and Bonding requirements for telecommunications.

.8 Building Industry Consulting International (BICSI) TDM Manual.

2. PRODUCTS

2.1 Communications Outlet Assemblies

.1 Communications Outlet - Boxes:

.1 One gang recessed box, 63 mm minimum depth comes with 19 mm deep One gang wallboard adapter ring, 1.6 mm 16 AWG thickness.

.2 25 mm EMT, from box to telephone termination backboard.

.2 Communication Outlet - Jacks:

.1 Data jacks to be Cat 5E complete with RJ45 jack, cabling, termination and testing.

.2 Voice jacks to be Cat 5E complete with RJ11 jack, cabling, terminations and testing.

3. EXECUTION

3.1 Installation

.1 Boxes and Fittings:

.1 Ensure in advance that outlet box/data outlet installation methods yield vertically-mounted outlets.

.2 Cabinets, Enclosures, Racks, Backboards:

.1 Install at locations and heights indicated on drawings.

.2 Use green insulated 6 AWG ground conductors for grounding.

.3 Protect ground conductors from mechanical injury.

.3 Connectors:

.1 Use tooling specific to connector types in use.

.2 Use connectors suitable for nature of conductor in cable, e.g., stranded vs. solid copper.

.3 Ensure that connectors' strain relief provisions are used. Strip jackets only amount required.

.4 Maintain pair twists as close to connector as possible.

.5 Provide and install necessary strain reliefs and cable support brackets, and install cables

3.2 Testing

.1 Test all runs upon completion of permanent terminations as per EIA/TIA standards, using instrumentation acceptable to Engineer. Before commencing testing, submit sample test data sheets and information with respect to test instrumentation to be used.

3.3 Fire Stop

.1 After installation of the cable, all penetrations for conduits, sleeves, etc. shall be sealed using material and methods that meet the requirements of ULC standards CAN4.2115 and installed according to manufacturer's specifications.

END OF SECTION

MOTOR STARTERS TO 600 V & VARIABLE FREQUENCY DRIVES

1. GENERAL

1.1 Related Work

.1 Electrical General Requirements — Section 16010

.2 Connections to Mechanical Equipment: — Section 16950

1.2 Starter Requirements

.1 In general, there are categories of starting equipment for three phase motors.

.1 Integral Mounted Starters: Some items of mechanical equipment such as boilers, have the starter mounted as part of the equipment. For this equipment, supply disconnects and wire to the terminals of the equipment.

.2 Separately Mounted Starters: For motors without integral mounted starters, supply separately mounted starters as indicated on the Drawings and wire the equipment.

.3 Starters in Motor Control Centres: For motors fed from motor control centres, wire from the equipment to the motor control centres.

.2 Provide manual starters for all single phase motors unless otherwise indicated on the motor schedule.

.3 Provide interlocking between starters where required.

.4 All starter accessories such as pilot lights, Hand-Off-Auto, Start-Stop, etc. whether integrally or remote mounted shall be heavy duty oil tight, unless otherwise specified.

1.3 Shop Drawings and Product Data

.1 Submit shop drawings in accordance with Section 16010 – Electrical General Requirements.

.2 Indicate:

.1 Mounting method and dimensions
.2 Starter size and type
.3 Layout of identified internal and front panel components
.4 Enclosure types
.5 Wiring diagram for each type of starter
.6 Interconnection diagrams.

1.4 Operation and Maintenance Data

.1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 16010 – Electrical General requirements.

.2 Include operation and maintenance data for each type and style of starter.

2. PRODUCTS

2.1 Materials

.1 Starters: Nema rated.

2.2 Enclosure

.1 All individually mounted motor starters shall be enclosed in a general purpose sheet steel enclosure unless in wet areas where they shall be watertight EEMAC 4.

2.3 Manual Motor Starters

.1 Manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:

.1 Switching mechanism, quick make and break
.2 Overload heaters, manual reset, trip indicating handle
.3 Rated volts and poles to suit application.

.2 Accessories:

.1 Toggle switch: standard labelled as indicated.

.2 Indicating lights: standard heavy duty type and colour as indicated.

.3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.4 Full Voltage Non Reversing (FVNR) Magnetic Starters

.1 Provide motor starters of the electro-mechanical type with the coil controlled by an application specific microprocessor.

.2 Provide one (1) current sensor accurate to 2% for each phase to provide motor running overload protection that yields a time current curve closely paralleling that of the respective motor heating damage boundary. Running overload protection shall be DIP switch selectable for the specific motor full load amperes.

.3 Provide DIP switch selectable overload trip class of 10, 20 and 30.

.4 Provide phase loss protection and phase unbalance protection. If the phase unbalance on any of two phases is greater than 30% of the DIP switch selected trip rating, a phase loss/unbalance trip occurs.

.5 Provide ground fault protection set at 20% of maximum continuous ampere rating with a start delay of 17 seconds, and a run delay of 0.4 seconds to prevent nuisance tripping on startup.

.6 Provide each motor starter with a snap-in window which allows clear visibility of overload DIP switch settings and prevents unwanted tampering of DIP switch settings once installed.

.7 Provide an application specific microprocessor with the following features:

.1 Microprocessor shall measure control circuit voltage and prevent closing of the coil on voltages below 78 volts AC and/or voltages above 135 volts AC.

.2 Microprocessor shall apply voltage to the coil such that a guaranteed maximum of two (2) milliseconds of main contact bounce occurs on contactor closure.

.3 Microprocessor shall continuously measure coil circuit voltage and current so as to maintain constant coil power at a level to maintain main contact closure and minimize coil power consumption.

.4 Provide electronic circuitry that isolates the coil and is isolated from surges.

.5 Microprocessor shall wait for three (3) half-cycles of control start signal prior to activating a close to prevent starts resulting from momentary voltage spikes, switching transients, fluttering contacts, and shorted programmable logic control outputs. The phase angle of the power in the control circuit is to be compared with the phase angle of the input start signal to prevent starts resulting from capacitively coupled or inductively coupled signals.

.8 Motor starters shall have replaceable fixed and movable contacts.

.9 Accessories

.1 Motor starter shall be designed to accommodate two (2) auxiliary contact blocks, each capable of a combination of up to four (4) normally closed or four (4) normally open auxiliary contacts. Contacts to be color-coded; black designating NC and silver designating NO. Contacts to be rated ten (10) amperes continuous, 7200 VA make, 720 VA break for 120 through 600 volts AC, and 69 VA make and break for 125 through 300 volts DC. Provide a minimum of one (1) spare NO contact and one (1) spare NC contact in addition to any auxiliary contacts required.

.2 Provide control modules to perform the indicated input/output control functions as shown on the contract drawings. Module to incorporate faceplates having membrane-type pushbuttons and LEDs. All pushbutton and LED functions shall be furnished with clearly written identification. Control modules shall be provided with 6-foot connection cord and single plug-in wiring to accommodate jack provided in the contactor. Provide as required, modules available to cover applications ranging from full-voltage non-reversing, reversing, multi-speed, and reduced voltage. Modules to be provided with the ability to replace conventional "start", "stop", "hand", and "auto", control functions, and when utilized in starter applications. Modules to be provided with the ability to replace conventional indicating light status of "run", "off", "overload alarm", and "overload trip" when utilized in starter applications.

.10 Microprocessor-based motor control shall be Cutler-Hammer IT Series or approved equal.

2.5 Variable Frequency Drives

.1 This section establishes the requirements for the design, fabrication, inspection, testing, delivery and installation of variable frequency drive (VFD) controllers and ancillary equipment packaged into a motor control centre as indicated on drawings or standard enclosure for wall or free standing arrangements where so indicated on drawings.

.2 Shop assemble and pre-wire the equipment.

.3 All drives and ancillary components to be supplied by one manufacturer to assure a properly coordinated system.

.4 Use standard "off the shelf" designs. No field modified or custom designed system will be allowed.

.5 Design all equipment using modularized solid state equipment to allow easy maintenance and replacement.

.6 Submit shop drawings in accordance with Sections 16010.

.1 Provide:

.1 Catalog and technical data.

.2 Outline dimensions, shipping section dimensions, weight, and foundation requirements for all assemblies.

.2 Control schematics.

.1 External connection diagram showing function and identification of all terminals requiring field connections.

.2 Line harmonic distortion calculations. The total system's harmonics to be addressed as a complete system study as to what is required in the way of harmonic filters to attenuate THD (total harmonics distortion). The single line and/or impedance diagram of the electrical site system to be provided by the Engineer.

.3 Component fabrication drawings consisting of detailed circuit schematics, printed circuit board drawings, and chassis layouts for all electrical and electronic components.

.4 Manufacturer's certification that VFD can withstand applicable short circuit fault conditions.

.5 Manufacturer's certification that VFD can withstand environmental conditions.

2.5.1 Submittals For Information Only

.1 Provide operation and maintenance data for variable frequency drive controllers for incorporation into manual.

.2 To include, but not be limited to:

.1 All shop drawings information listed above. Troubleshooting flowcharts for all device fault.

.2 An instruction manual for programming and hardware provided with the equipment at time of shipment.

.3 Setting sheets to record all VFD configuration options/selections for drive setup.

2.5.2 Reference Standards

.1 Confirm to the following reference standards in accordance with Section 01090:

.1 ANSI C-343.
.2 CSA
.3 EEMAC.
.4 IEEE STD 444, IEC 146A standards.
.5 NEMA MG1.

.2 All units to be UL listed, CSA approved.

2.5.3 Unit Responsibility

.1 The VFD's specified in this section to be product of a single manufacturer.

.2 The driven equipment supplier assumes total system responsibility for the motor to be VFD compatible as per NEMA MGI Part 31, 1993, Rev.1.

2.5.4 Vendor Qualifications

.1 General

The acceptable drive vendor to provide a factory trained sales force in the North West Territories or in the province of Alberta, available for consultation to answer any application and maintenance questions.

.2 Vendor Service

The acceptable vendor to have a distributor organization which stocks standard drives, modification kits and spare parts in the North West Territories or in the province of Alberta.

.3 Vendor Organization

The acceptable vendor to be factory trained service representatives on staff. The factory representative to be trained in the maintenance and troubleshooting of the equipment as specified herein.

2.5.5 Quality Assurance

.1 The following terms are used for the purpose of describing quality assurance and testing requirements:

.1 Factory Tests: testing of components and systems at the manufacturing level.

.2 Shop Tests: testing of assembled system prior to shipping to site. Field Tests: testing of installed system prior to or as part of the start-up phase; refer to part 3 of this specification.

2.5.6 Acceptable Manufacturers

.1 Cutler Hammer, Schneider Electric, ABB, Hitachi, or approved equal.

2.5.7 Ambient

.1 The VFD to be suitable for use in normal indoor non-hazardous industrial environments subject to the following conditions.

.2 For enclosed units, an ambient temperature range of 0 to 40C.

.3 For open units, an ambient temperature of 0 to 50C.

.4 For all units, a humidity range from 5 to 95%, non-condensing.

.5 For all units, an altitude range up to 1,000 meters without derating the VFD's output power capability.

.6 To ensure adequate heat dissipation the VFD unit is to include fan assisted cooling such that it would not degrade the enclosure rating. When forced cooling is used, provide alarm status and shutdown of VFD on fan loss.

2.5.8 Construction

.1 Design the VFD to provide for ease of maintenance.

.2 The VFD shall consist of the following major components:

.1 Input rectifier section to supply fixed DC bus voltage.
.2 DC bus capacitors.
.3 Open loop Vector Control generating inverter section.
.4 Suitable snubber circuitry to control output voltage spikes and to control rise times of the output pulses.
.5 Built in ground fault protection.
.6 Input line reactors with a minimum of 5% per unit impedance.
.7 The VFD vendor to provide a minimum of a 5% output reactor, harmonic compensated filter network to limit dv/dt rise to motors on 575 volt systems only.

.3 In each VFD include, as standard, a fully digital display which will display programming, operation, and fault code diagnostic information. This display to be mounted on the MCC enclosure door.

.4 Separate the VFD power terminal blocks physically from control signal terminal blocks.

.5 The VFD shall be modularly constructed. Provide printed circuit boards with plug-in connections and easily removable from the drive. Provide power components readily accessible with screw terminal connections for easy removal.

2.5.9 Equipment Enclosure

.1 The VFD are to be mounted EEMAC 1 enclosure.

.2 Shop Assemble and pre-wire the equipment. Include in each VFD unit:

.1 Fused disconnect switch or circuit breaker as main isolation disconnect.
.2 Variable frequency drive controller complete with accessories.
.3 Bypass solid state reduced voltage starter.
.4 Mechanically interlocked magnetic motor contactors, for VFD output and Bypass operation.
.5 Input 5% iron core line reactor as a minimum.
.6 Output line reactor filters for 575 volt inverter duty motors only.

.7 Fused primary (2) and Secondary (1) 120 Vac control transformer with 50VA surplus capacity.

.8 Thermal overload for motor protection for each motor in bypass operation.

2.5.10 System Requirements

.1 Motor Operation

.1 The nominal VFD rating is based on a EEMAC Type B, inverter duty, AC induction motor with Standard or High efficiency construction having a 1.15 service factor. Determine final VFD selection by load type, full load motor current and special requirements (if any) listed in Equipment List.

.2 Unless otherwise noted elsewhere the EEMAC Type B Premium Efficiency inverter duty AC induction motor to be used to operate a variable or constant torque load over a 30 to 110% speed range reaching rated nameplate horsepower (hp) at 60Hz.

2.5.11 Electrical Design Characteristics

.1 Input Power

.1 Unless otherwise specified, the VFD to accept nominal supply voltage 575V +15% 3-phase 60 Hz, grounded power supply.

.2 Permit variations of up to +2 Hz of line frequency without the VFD shutting down on a fault.

.3 Permit power line interruptions of up to 2.0 seconds without the VFD shutting down on a fault providing an extended power loss ride-through. If the drive trips on under voltage, the drive will activate the Automatic Restart/Reset for under voltage trips and the rotating start function to allow the drive to restart immediately when the power returns, and match the motor rotating speed and take control.

.4 The VFD not to exceed the notch depth of 20%, the total harmonic distortion factor (THD) of 5%, total demand distortion of 10% and the notch area of the line-to-line voltage to be maximum 28,500 volt-microseconds at rated voltage an current, as specified in IEEE 519, latest edition.

.5 The VFD shall present a displacement power factor of 0.98 or better to the AC line at any speed or load. True full load power factor shall be 90% or better.

.6 Efficiency of VFD controller shall be not less than 98% at 60 hertz output when driving the specified maximum load.

.7 The variable frequency control to operate satisfactorily when connected to a bus supplying other solid state power conversion equipment which may be causing up to 5% total harmonic voltage distortion and communication notches up to 36,500 volt microseconds.

.8 The VFD to include transient voltage suppression to allow reliable operation encountered in an industrial/commercial power distribution system for transients up to 3000V, 50 JOULES.

.2 Output Power

.1 The VFD to produce a three phase output for the load.
.2 The VFD to be of the Open Loop Vector Control Modulated type and to consist of a full wave diode bridge converter to convert incoming fixed voltage/frequency to a fixed DC voltage. The Vector Control strategy shall incorporate a microprocessor to handle all Logic functions as well as the complex, pulse generating algorithms that control output stage switching. Generate the inverter output by IGBT power transistors only.
.3 Unless otherwise specified, the standard VFD output frequency to be adjustable from 0 to 90 Hz.

2.5.12 Protective Features

.1 Incorporate the following protective features with each VFD:

.1 Disconnect switch with fuses.
.2 Short Circuit Protection: Instantaneous overcurrent protection, including short circuit phase-phase or phase-ground by high speed fuses with 100,000 ampere fault capacity rating.
.3 Fully protect the VFD against load faults. Bolted faults, phase to phase or phase to ground, shall not damage the unit. Design VFD to withstand the short circuit currents.

.2 Adjustable current limit from 50 - 150% (50 - 135% for variable torque loads) rated current of unit. The VFD to avoid nuisance current trips caused by short acceleration or deceleration settings by temporarily increasing the acceleration or deceleration times.

.3 Phase Protection

.1 Each output phase to be monitored. If a short circuit condition occurs, a circuit shall guard against further damage by turning off the entire output section experiencing the shorted condition.
.2 The VFD to shut down and annunciate the fault and display the appropriate fault code on the digital display panel.

.4 Over voltage Sensing

.1 Should either the input line rise above 15% of rated input voltage, or the internal DC bus rise above allowable levels due to load regeneration, the VFD to sense an over voltage condition and annunciate it on the digital display panel and alarm contact.
.2 The VFD to trip if the DC voltage exceeds 125% of rated voltage. The VFD to compensate for over voltages caused by short deceleration settings by automatically increasing the decelerating time in order to avoid nuisance over voltage trips.

.5 Under Voltage Sensing

.1 Should the input line fall below 85% of rated input voltage, the VFD to sense an under voltage condition and annunciate it on the digital display panel.

.6 Motor Overload Protection

.1 Provide the VFD with a separate motor overload protection for each motor connected to the drive.

.2 The overload protection to be adjustable from 80 to 115% of the full load current rating.

.7 Motor Over Temperature Protection

.1 Provide the VFD with a positive temperature coefficient thermistor (PTC) over-temperature device installed in motor to shut down system if the motor becomes overheated. Provide status indication for motor over temperature.

.8 Heat Sink Temperature

.1 The VFD to monitor the temperature of the heat sink. If the heat sink temperature exceeds design/limits the VFD shall shut down and annunciate the condition on the digital display panel.

.9 Ground Fault Detection

.1 Should an output phase short to earth ground occur, the VFD to have circuits to guard against excessive currents. This condition to be monitored and annunciated on the digital display panel.

2.5.13 Control Features

.1 General

.1 Provide two galvanically isolated analog inputs which are both capable of operating from 4-20 mA.

.2 A linear and tapered curve suitable for drives requiring controlled acceleration/deceleration.

.3 Provide offset and gain programmable functions to set operating range.

.4 Provide two (2) 4-20 mA galvanically isolated analog outputs which can be programmed to be proportional to:

.1 Output motor current
.2 Motor speed.