PART 1 - INTRODUCTION - GENERAL

1.1 BACKGROUND

.1 This section outlines the technical and functional features related to the design, supply of materials, scope of installation work and work methods included in the contract. It shall serve as a guide for the configuration, programming, installation and connection of all automation components, as well as all control panels, even where supplied by third parties.

.2 The Contractor is to pay particular attention to personnel and equipment safety. As well as ease of operation and maintenance in designing the control systems and selecting the physical location of components.

.3 Each division works with their requirements, and are closely interrelated and are not necessarily executed sequentially. These requirements inevitably lead to downtime and changes to the sequences, originally scheduled for the conduct of business.

.4 These downtimes and changes in the sequencing of the work must be minimized. To do this it's the obligation of the contractor carrying out the work of the Division 29, to inquire into the nature and the sequencing of the work of other divisions to ensure cooperation and coordination, and continuously during the execution of its work and the work of other divisions.

.5 These downtimes and sequence changes must be taken into account in the conduct of business in order to predict the timing and costs accordingly.

.6 The subcontractor division 29 should ascertain from subcontractors in other divisions or the general contractor of any potential problems affecting the progress of its work and the progress of work of other divisions. These potential problems must be detected and resolved during the interdisciplinary coordination meetings. No additional costs can be charged to the Customer by lack of interdisciplinary coordination and the concealment of problems related to lack of coordination.

1.2 DOCUMENTS INCLUDED IN SPECIFICATIONS

.1 This section of the specifications should be read in conjunction with the following plans and documents to ensure a link between design and execution of the work:

.1 The section "Specific General Instructions – Division 44"

.2 The section "Process Automation – Scope of Work"

.3 The section "Process Automation – Functional Description"

.4 The section "Process Automation – Programming Methodology"

.5 The section "Process Automation – Manufacturing of Panels"

.6 The section "Process Automation – Electrical Requirements"

.7 The section "Process Automation – Control System"

.8 The section "Process Automation – Instrumentation"

1.3 RESPONSIBILITY

.1 These specifications are reliant on levels of performance to be achieved for the work described and set out the technical features and functional specifications required for the design, supply, installation and commissioning of a complete "turnkey" automation system. Contractor responsibility includes meeting or exceeding the requirements of these specifications and complying the operational requirements described or illustrated herein.

.2 It is the contractor's responsibility to include the design, supply, supervision of installation, integration and start-up of the automation system. Responsibility also includes calibration, programming and configuration of all components of the system supplied. These activities are to be performed in the presence of the Ministerial Representative.

1.4 WARRANTY

.1 The contractor must refer to the general clauses of the tender documents for information regarding warranty conditions. The warranty applies to both the hardware and software applications developed.

.2 All work, including all equipment and instruments, is to be guaranteed against:

.1 Inadequate or defective operational design

.2 Improper assembly

.3 Defective materials

.4 Inadequate calibration

.5 Inadequate or defective data or device programming or configuration

1.5 DEVIATION IN PERFORMANCE

.1 Following approval of the design documents supplied by the Contractor, no change or deviation in performance of the work will be permitted without the prior approval of the Ministerial Representative.

.2 In the course of performance of the work, variances may occur between the work indicated in the plans and the actual installation or between the plans of the various disciplines. Such variances shall be reported to the Ministerial Representative, who will indicate to the Contractor actions to take at that time.

.3 Any change shall be indicated in red on a copy of the plans and appropriate lists as work progresses to enable the Ministerial Representative to coordinate the documents.

PART 2 - STANDARDS, CODES AND REGULATIONS

2.1 LAWS AND REGULATIONS

.1 All work, materials, structures and work methods are to comply with local, municipal, provincial, national building and safety codes, along with the laws and regulations issued by the authorities with jurisdiction over the work. In the event of a conflict between regulations issued by competent authorities, the most stringent requirements shall prevail.

.2 The contractor must ensure that all of its personnel, including subcontractors and suppliers, are familiar with the various safety requirements and comply with occupational health and safety laws and regulations.

.3 Specifically, the equipment and work shall comply with the following laws and regulations:

.1 Bill C-21 Corporate Criminal Liability

.2 Regulation respecting the quality of the work environment, S-2.1, r.15.

.3 Regulation respecting industrial and commercial establishments, S-2.1, r.9.

2.2 CODES, STANDARDS AND NORMS

.1 Canadian Standards

.1 Specifically, the equipment and work shall comply with the most recent edition of the following codes, standards and norms:

.1 CSA C22.1 - Canadian Electrical Code (CSA C22.10 with Quebec amendments)

.2 C22.2 No. 14 - Industrial Control Equipment

.3 CSA Z432-04 - Safeguarding of Machinery

.4 NFC - National Fire Code

.5 NBC - National Building Code of Canada

.2 International Standards

.1 Specifically, the equipment and work shall comply with the most recent edition of the following codes, standards and norms:

.1 NFPA 79, Electrical Standard for Industrial Machinery.
.2 IEC 1131-3, Programmable Controllers Programming Languages.
.3 IEEE STD 100-xxxx, IEEE Standard Dictionary of Software Engineering Terminology.
.4 ASME B31.1 Power piping.
.5 ASME B31.3 Process piping.
.6 ISA Documentation Standards and User Resources for Industrial Automation and Control Systems, 2nd Edition.
.7 Profibus Standard.
.8 Modbus Standard.
.9 ANSI/TIA/EIA 942 Telecommunications Infrastructure Standard for Data Centers.
.10 ANSI/EIA/EIA- 607 Commercial Building Grounding and Bonding Requirements.
.11 TIA/EIA – 569-B (& addenda) Commercial Building Standard for Telecommunications Pathways and Spaces.
.12 TIA/EIA – 568-B (& addenda) Commercial Building Telecommunications Cabling Standard.
.13 TIA/EIA – 606A Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
.14 ANSI/TIA/EIA-526-14A Measurement of Optical Power Loss of Installed Multimode Fiber Cable Plant.
.15 ANSI/TIA/EIA-526-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant.
.16 TIA/EIA – 568 TSB-140 Additional Guidelines for Field Testing Length, Loss and Polarity of Optical Fiber Cabling Systems.
.17 ANSI/TIA/EIA-598 Optical Fiber Cable Color Coding.
.18 EIA RS-310 Racks, Panels and Associated Equipment.
.19 FCC Part-15 – Radiated Emission Limits.
.20 FCC Part-68 – Connection of Terminal Equipment to the Telephone Network.
.21 NFPA-70, National Electrical Code®, latest edition including all subsequent addendums.
.22 NFPA-75 Standard for the Protection of Information Technology Equipment (Latest Edition).
.23 IEEE 802.3 (et addenda, corrigendum) IEEE standard for information technology - Telecommunications and information exchange between systems – Local and metropolitan area networks Specific requirements – part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) access method and physical layer specifications.

.2 All equipment, materials and electrical or electronic instruments shall be CSA approved or, where CSA approved are not available, ULC approved.

.3 All materials that contact drinking water shall meet drinking water requirements set out in NSF/ANSI Standard 61.

.3 Contact information to obtain codes, standards and norms

.1 CSA (ACNOR) standards are available from:
Canadian Standards Association
865 Ellingham, Pointe-Claire
Quebec, CANADA H9R 5E8
(514) 428-2418
1-800-463-6727
www.csa.ca

.2 NFC and NBC standards are available from:
NRC
1-800-672-7990
613-993-2463
www.nationalcodes.ca

.3 Regulations governing quality of the workplace S-2.1, r.15 and governing industrial and
commercial establishments S-2.1, r.9 are available from:
PUBLICATIONS DU QUÉBEC
1000, Route de l'Église, 5th floor
Quebec, Quebec G1V 3V9
418-643-5150
1-800-463-2100
www.publicationsduquebec.gouv.qc.ca

.4 NFPA norms are available from:
National Fire Protection Association
1 Batterymarch Park
Quincy, Massachusetts
USA 02169-7471
1-617-770-3000
1-800-344-3555
www.nfpa.org

.5 IEC standards are available from:
American National Standards Institute
25 West 43rd Street, 4 floor
New York, NY 10036
1-212-642-4900
www.ansi.org

.6 IEEEE standards are available from:
Institute of Electrical and Electronic Engineers
1-800-422-4633
1-203-423-2130
www.ieee.org

.7 ASME standards are available from:
Information Central Orders/Inquiries
P.O. Box 2300
Fairfield, NJ 07007-2300
800-843-2763 (U.S/Canada)
www.asme.org

.8 ISA standards are available from:
Instrumentation, Systems and Automation Society
67 Alexander Drive
PO Box 12277
Research Triangle Park, NC 27709
919-549-8411
www.isa.org

.9 NSF standards are available from:
www.nsf.org

.10 Profibus standards are available from:
www.profibus.org

.11 Modbus standards are available from:
www.modbus.org

2.3 UNITS OF MEASUREMENT

.1 For the purposes of standardization, the following units of measurement shall be used, except where the numerical values do not fall within the measuring range 0.1 to 1000.

.1 Flow:
.1 Liquid: Cubic metres/second (m3/s) or litres/hour (l/h)

.2 Level:
.1 Liquid: Metres or percentage and coefficient

.3 Pressure:
.1 Sensing: Pascals (Pa, kPa or MPa)
.1 Absolute: Pascals (abs.)
.2 Vacuum: Pascals
.3 Differential: Kilopascals (kPa)

.4 Temperature: Degrees Celsius

.2 Unless otherwise indicated in the special sections, the unit may be changed with the approval of the Ministerial Representative.

.3 The scales and tables shall be direct read-off. Units of measurement shall be entered on grading scale plates and identification plates.

.4 In general, Contractor to retake existing units of measurement.

2.4 EQUIPMENT AND INSTRUMENT SYMBOLS

.1 The Ministerial Representative's equipment coding structure, where it exists, and ISA symbol system apply. Equipment shall bear the new numbering system suggested on the plans and be based on ISA coding or the Ministerial Representative's coding structure.

PART 3 - SCOPE OF WORK

.1 The contractor must supply a complete control system for all equipment in the treatment plant "D-29", generator "D-29A" and pump station "D-30", as described in the process sections of these specifications. The contractor is to include pre-purchased equipment supplied by third parties in the control system.

.2 In general, the contractor will supply the following, without limitation:

.1 Skilled labour for the design, programming, integration, testing, installation and complete start-up of the control system;

.2 Detailed engineering for all systems provided;

.3 Preparation and submission of shop drawings and assembly, installation and connection documents;

.4 Selection and supply of all equipment and materials;

.5 Delivery to site, offloading and storage of equipment and materials;

.6 Labour, tools, machinery and all related work required for testing, calibration and supervision of the complete and operational installation of all equipment and/or devices on the work site;

.7 Programming and complete configuration of all components of the proposed systems. Programming includes all normal and various emergency operation sequences;

.8 Performance of tests to demonstrate proper functioning of the systems;

.9 Documentation and personnel training;

.10 Quality control of all documents and work performed.

3.1 WORK INCLUDED

.1 The work included in these specifications covers the detailed engineering of all systems and includes, without limitation, survey to complement the plans and documents supplied, the final design of the new systems, description of all functions, programming methodology (programmable controller and HMI), development of temporary and transition logistics, where required, and the corresponding installation of equipment skids.

.2 Engineering services

.1 Detailed engineering of the control system, including all research, analysis and expert opinions, as well as production of all drawings and plans required.

.2 Preparation of all documents including, in particular, a document detailing the proposed programming methodology for the programmable controllers, human-machine interfaces (HMI) and supervision system (SCADA), and a document detailing all of the system functionalities tailored to the automation solution selected by the Contractor and complementing the functional description provided in the section "Process Automation – Functional Description".

.3 Management and coordination of all stakeholders working on the project.

.4 Close cooperation and coordination of work with other contractors at the work site and specifically supervision of the installation of the equipment on site by the Contractor.

.5 Programming, configuration, integration, calibration and commissioning of all control system components for the programmable controllers, communication networks, HMI and instruments. The programming details and description of system functionalities are provided in section "Process Automation – Functional Description".

.6 Programming, configuration and calibration of instruments and equipment.

.7 Performance of all tests as described in Part 7 – Quality Control of this document.

.3 Completion of Work.

.1 Installation and connection of all control system components, including all control panels (with or without programmable controllers), command and control panels for the metering pumps, pneumatic panels, control and field network components, instruments and all related systems.

.2 Installation of cables and conduits and connection of 120 VAC power supplies for the control and field networks, instruments, solenoid valves and control system components. Power supply for the equipment listed above to come from the programmable controller panels or remote input/output panels.

.3 Installation of cables and conduits and connection of all control points in the system to the various control panels.

.4 Installation of cables and conduits and connection of all control and power supply points for the metering pumps to the various control panels and pump command and control panels (where applicable).

.5 Drilling of holes in walls and concrete slabs for passage of cables, conduits and cable racks for the purposes of the control systems, including power supply for instruments and equipment under its responsibility.

.6 Repairs to all existing and other walls, floors and ceilings damaged by passage of cables or installation of equipment, in accordance with the existing finishing and adding flameproof insulation where required.

.7 Training of engineering, maintenance and operations personnel, as described in the applicable section of these specifications.

.8 In addition, Contractor responsibility includes providing and performing, at its cost, all minor work not specifically described in the specifications that is nevertheless required or needed to complete the work.

3.2 SUPPLY

.1 Contractor to supply and install all equipment for the membrane filtration control systems. The details of the equipment and components to be supplied and installed are described in the section "Process Automation – Control System" and in the plans, while the details for the instruments are described in the section "Process Automation – Instrumentation" and those for the cables are described in the section "Process Automation – Electrical Installation".

.2 Supply includes the following items, without limitation:

.1 All managing programmable controller, input/output and local panels for electrical distribution and connections as well as pneumatic control panels (where required). Panel details and contents are described in the section "Process Automation – Control System" of these specifications.

.2 All instruments including accessories, supports, tubing, isolating valves, connections and documentation, as described in the list of equipment for Division 44 as well as in the section "Process Automation – Instrumentation" of these specifications.

.3 All cables, connectors, pull boxes, conduits, cable racks, identification materials, supports to connect control system components to each other (panels, instruments, etc.). The types and details of the cables and connection components are described in the section "Process Automation – Electrical Installation".

.4 All software and licences for the operation, configuration, programming and diagnostics needed to perform the work and to enable the Ministerial Representative to operate and maintain the control system as a whole. The list of software to be provided is found in the section "Process Automation – Programming Methodology".

.5 Supply of all control and/or field network parts, specifically cables, connectors, pull boxes, conduits, identification materials, switches and concentrators, as shown in the plans. The details for the cables and accessories are described in section the section "Process Automation – Electrical Installation".

.6 Spare parts for the entire control system.

3.3 SPECIFIC CONSTRAINTS

.1 The work is conducted in a drinking water production environment continuously and constraints of producing drinking water must be taken into account during construction.

.2 The contractor of division 29 shall inquire into all the other constraints specified in the General section and in the specific sections of the estimate of each discipline.

.3 Quality control in the factory or on site also involves downtime longer or shorter depending on the nature and scope of this control. These downtimes are necessary and must be taken into account in the conduct of business in order to predict the timing and costs accordingly. Quality control must be done according to the requirements of the specifications and standards (these standards are listed or not in the tender documents) for the work involved.

.4 If there is doubt, by the representative of the City, with the quality of work performed or the quality of products and supplies delivered it may require additional quality control. The stops time for these additional checks are not subject to claims from the City.

.5 In no case does loss of time due to failure of coordination, changes the sequencing of work, and downtime cannot give claim to material from the Customer.

.6 The Ministerial Representative's staff may not be immediately available due to external constraints. Contractor to take this into account in performing its work and reassign personnel to other tasks while waiting.

.7 Where required, Contractor to provide consistent and even additional lighting sufficient to make performance and inspection of the work possible in lighting conditions that complies with the safety code. Inspection of work shall be possible without the use of additional lighting such as flashlights or utility lights.

.8 Contractor to take into account the fact that some of its work may take place in confined or tight spaces and that it shall supply safety equipment, scaffolding, lighting, communications and temporary electrical supply as required to perform the work safely.

.1 Workers shall have training in working in confined spaces and shall have a CSC permit to work in confined spaces.

PART 4 - IDENTIFICATION AND REFERENCES

.1 All instruments, panels, equipment, panel equipment, cables, wires, breakers, fuse holders, terminals and components, etc. included in the work, whether supplied, replaced, modified, relocated or corrected, to be identified. No two (2) instruments, pieces of equipment or cables may have the same reference number. All identification to be produced mechanically and not by hand.

PART 5 - DETAILED ENGINEERING OF CONTROL SYSTEMS

5.1 GENERAL

.1 Contractor to perform all of the detailed engineering, including work site data research, data analysis and detailed design of control systems.

.2 The following activities are included in the detailed engineering phases:

.1 Analysis of engineering documents (drawings, manuals, programming, etc.).

.2 Detailed design of new control systems.

.3 Plans and other engineering documents produced by the Contractor shall include, but are not limited to, the types of documents listed in section 1.13. Computer files to be submitted to the Ministerial Representative on CD-ROM, in a compatible format as requested in the general and special administrative conditions. For drawings and plans, computer files to be in the most recent version of AutoCAD supported by Autodesk, whereas the documents shall be in Word, Excel or PDF format.

.4 Shop drawings, installation, assembly and other engineering documents for instrumentation and control to be submitted by the Contractor, in accordance with the general and special administrative conditions.

.5 All of these documents to be reviewed by the Ministerial Representative before the Contractor may proceed with the work and purchases required, however approval does not release the Contractor from its contractual obligations.

.6 The documents that support the detailed engineering shall be submitted as shop drawings before performance of the work. Operation and maintenance manuals can be provided upon completion of the work. In addition, plans in these specifications to be reviewed and corrected in surveys versions by the Contractor and submitted to the Ministerial Representative.

5.2 PREPARATION OF PLANS AND DOCUMENTS

.1 Contractor to produce all plans and documents for the design and completion of the control system described. The required plans and documents include the following:

.1 Functional analysis following program and logic analysis;

.2 Programming methodology;

.3 Inspection and testing plans;

.4 System architecture and detailed communication networks;

.5 Panel plans (to scale) including arrangement, dimensions, electrical distribution(s) (120 VAC, 24 VDC, etc.), base details, input/output module details for the programmable controllers and list of materials;

.6 Cable diagram;

.7 Process and instrumentation diagrams (P&ID);

.8 Loop and connection diagram for all signals;

.9 Installation and mounting drawings (panels, instruments, etc.);

.10 Drawing for interconnecting the various panels, housings, equipment, instruments and components of the proposed system;

.11 Placement and location plans;

.12 List of cables, including cable specifications;

.13 List of instruments and equipment;

.14 Instrument product data;

.15 List of inputs and outputs;

.16 Calculation notes;

.17 Operations manual describing system functions;

.18 Technical manual describing system configurations and operation;

.19 Step-by-step procedures for configuration and starting up the equipment from as-purchased state;

.20 Maintenance manual, including data sheets and manuals for all equipment supplied.

.2 Complete plans shall specify, but are not limited to, loads, dimensions and connection points for each panel and component of the control systems.

.3 All cables and wires connected in the project shall be identified on the plans.

.4 Calculation notes shall support the system design. Calculation notes may be required by the Ministerial Representative's engineer.

.1 Calculation notes for heat dissipation of the control panels shall be submitted to the Ministerial Representative's engineer for approval.

.5 Technical data shall be prepared for each component.

.6 Calibration data shall be submitted for each instrument supplied.

.7 Complete operations manuals, technical details and maintenance instructions shall be supplied upon completion of the contract prior to final acceptance.

.8 The plans supplied with the specifications shall be reviewed, completed or completely revised by the Contractor to reflect the final design.

.9 Identification of plans and documents

.1 Unless otherwise indicated, all documents shall include the following:
- .1 Document title
- .2 Document number
- .3 Names of people who prepared and approved the document
- .4 Revision number of document
- .5 Follow-up on changes/revisions

.2 The document numbers shall be grouped according to a structure or logic that enables the Ministerial Representative to easily locate them by gallery, system, type of network, panel, etc.

5.3 FUNCTIONAL ANALYSIS

.1 The functional analysis describes all behaviours and functions of the control system, in terms of both physical and programming parts. The functional analysis shall also describe the auxiliary systems not necessarily including a programmable controller. The following topics shall be covered:

.1 Description of all modes of operation, control and functioning of the system overall and specific systems.

.2 Behaviours and lock-off of the system in all modes.

.3 Behaviours of system and subsystems for each loop, automatic sequence, equipment and instruments. The descriptions shall include all behaviours, both in normal operation and in the event of a fault, electrical outage or communication failure (during/after).

.4 Description of particular sequences (e.g.: metering, alternation, etc.).

.5 Description of alarms.

.6 Detailed description of functions of the various control panels and HMI, including distribution or simple relay panels. These descriptions should provide a clear understanding of all available functions in each control panel.

.7 Fallback actions for every fault and piece of equipment or sequence. Distinction should be made between sequences shutdown in normal or emergency mode and sequences paused. In all cases, the equipment shall be placed in failsafe position.

.8 Detailed process and instrumentation diagrams.

.9 Description of levels of operation of safety measures, particularly for the supervision system (SCADA) and control network.

.2 Functional analysis to be provided in text format and organized by system and subsystem. The analysis is a complement to the sections "Process Automation – Functional Description" and "Process Automation – Control System". Diagrams and tables may aid in comprehension of the text, but may not form the bulk of the document. This document shall be sufficiently detailed to permit validation of programming during testing (FAT and SAT), in order to reach an interim acceptance of the control system.

.3 The functional analysis shall be approved by the Ministerial Representative before any work on the control system may begin.

5.4 PROGRAMMING METHODOLOGY

.1 The contractor will demonstrate the programming methodology that it plans to use to complete the control system. The documents that support this methodology shall include the following:

.1 Programming architecture, including definition of program routines and sub-routines.

.2 Definition of standardized function blocks used (function and data blocks), including input/output signals used, data structure, programming, processing of modes, alarms, control and command interfaces (pop-up windows or other).

.3 Schedule, logic and identification structure for variables, function blocks, data blocks, tasks, programs and subprograms.

.4 Definition and structure of data flows including exchange tables among the various programmable controllers and HMI.

.5 Typical operation screens for the HMI and supervision system (SCADA), including an example of each type.

.2 Programming methodology to be approved by the Ministerial Representative before programming of the control system begins.

.3 All programming lines to be commented with an explanation of their purpose.

5.5 INSPECTION AND TESTING PLAN

.1 Contractor to submit a detailed inspection and testing plan for commissioning of the systems, as specified in the "Special Administrative Conditions". For the automation systems, the plan shall include the individual component tests as well as integrated systems tests, as described in Part 7 Quality Control of this document.

.2 Test log

.1 The contractor will prepare an on-site test log to be submitted to the Ministerial Representative for approval prior to the start of testing.

.2 On-site test log to include the following information:

.1 Details about the required configuration for the tests.

.2 Details and schedule of tests to be performed.

.3 Labour, equipment and materials required before and during the tests.

.3 All results of tests performed in compliance with on-site test log to be written up in a test report and submitted to the Ministerial Representative.

5.6 OTHER DOCUMENTS REQUIRED

.1 The following paragraphs list the minimum acceptable information to be included in each document. The Contractor may combine various plan types, but all of the information shall be included. The final version of drawings may not include external references to image files.

.2 Control system architecture

.1 The control system architecture is to be represented in the form of a block diagram showing the connections between each control system component, including communication networks for supervision and process control, main panels and remote panels, human-machine interfaces, printers, engineering stations and any other node connected to the network. The configuration of the network addressing and addressing of programmable controller bases shall be shown on the diagram.

.2 Plans will be in format A0.

.3 Communication network

.1 Plans for the communication networks shall show the architecture, interconnections, repeaters, couplers, terminals and identification of segments and addresses for the communication network. For the field networks, one (1) communication network shall be shown at the end of the same plan.

.2 Plans to be in A0 format.

.4 Control panel

.1 Plans shall show the exact arrangement of the components of a control panel, to scale, including pushbuttons, signal lamps, regulators, circuit breakers, terminal blocks, etc., that appear inside and outside the panels, cabinets, connection boxes or control desks. The identification plates for the panel and components shall also be shown. The interior and exterior dimensions of the panel shall be in metric. Each component shall be identified and a list of materials shall provide the description of the components.

.2 The plans shall also show the base details, input/output module details for the programmable controllers, the jumpers and DIP switches, as well as the electrical distribution diagrams for the panel (120 VAC, 24 VDC, etc.).

.3 Plans to be in 11x17 format and may be broken out onto several sheets with adequate referencing between sheets.

.5 Wiring diagram

.1 The wiring diagram is used to show the arrangement of the wiring for a piece of equipment.

.2 The diagram contains just the cable or conduit numbers and the junction box, LCP control panel and final element numbers.

.3 Where a cable passes through to another subsector, a reference to another wiring diagram is sufficient. The information on the wiring diagram shall be included in the list of cables and interconnection diagrams.

.4 Plans to be in 11x17 format and may be broken out onto several sheets with adequate referencing between sheets.

.6 Process and instrumentation diagrams (P&ID)

.1 Process and instrumentation diagrams (P&ID) to include the mechanical components, pipes and instrumentation for the entire process, including motors, sensors and final control elements, as well as their respective numbering. Also to include the control functions performed by the instruments.

.2 The following details shall be indicated:

.1 Detailed regulation loops, including loop numbers and details of the functional elements of the regulation loop.
.2 All interruptors and switches, whether analog or other.
.3 Command logic blocks without details. Details are provided in the functional description.
.4 Local motor control stations (HK), with loop numbers, and all other instruments (HSS, ZS, PSL, etc.) related to the same equipment.
.5 Default position of valves and actuators.
.6 Control equipment to which the inputs/outputs are connected.

.3 The existing process and instrumentation diagrams, attached to the specifications as references, are incomplete and shall be redrawn by the Supplier for the new control system with the same level of detail.

.4 Plans will be in A0 format and may be broken out onto several sheets with adequate referencing between sheets.

.7 Loop and connection diagram

.1 The loop diagrams show all elements of a control loop and how they are connected. The loop diagrams are not limited to analog signals; they shall also include all-or-nothing signals for the digital inputs/outputs. All equipment or equipment elements connected to the control system are considered to be one loop (e.g.: a single position detector, ZSL, is considered an open loop).

.2 Each loop diagram shall include all components of the loop, including primary elements, connections to various control equipment junction or connection boxes, converters, transducers, final loop elements, jumpers, DIP switches, etc. Each component is identified with a reference and its connection terminals, as they physically appear on the terminals. All cables, analog pairs or triads and pneumatic tubes shall be shown, and wires and tubes shall be identified. All terminal blocks, junction box terminals and relay panels shall be shown and identified.

.3 The diagram shall be divided into various sections representing the physical location of the components (panel, junction box, field element). The field elements shall be grouped on the left, the junction box connections in the centre and the control room, relay room or motor control centre connections on the right. The provisional diagrams shall be referenced by their location plan.

.4 A drawing may include just one loop, but a complex loop may be shown on several sheets of the same drawing. The drawings shall be in 11x17 format.

.8 Installation and mounting drawings

.1 Installation and mounting drawings are required for all new or retrofitted instruments to show details of installation or mounting. Drawings to contain appropriate references to the existing structures and equipment and a list of materials used. Submit drawings for Ministerial Representative approval.

.2 Drawings to be in 11x17 format.

.9 Interconnection diagram

.1 The interconnection diagram shall show all connections and wiring for the LCP relay panels, junction and instrument boxes. The interconnection diagram shall indicate instrument, cable, conductors and terminal reference numbers.

.2 An interconnection diagram shall be produced for each motor. The interconnections to the control loops shall be shown on the loop diagrams.

.3 Plans to be in 11x17 format and may be broken out onto several sheets with adequate referencing between sheets.

.10 Placement and location diagrams

.1 Placement and location diagrams shall indicate the approximate location where each instrument, panel, junction box or device will be mounted at the work site or on a piece of equipment. Every element installed out of reach or out of view of a person standing, at reference height, shall be indicated with its mounting height, aside from elements such as fire detectors or horns that are normally installed out of reach. The placement shall normally be shown in a plan format provided by the Ministerial Representative.

.2 Automation components shall be represented on the diagram with a rectangle containing the component identification.

.3 Plans to be in A0 format.

.11 List of cables

.1 The list of cables produced by the Supplier shall contain all information and relevant specifications for wiring, including cable number, source, destination, path, type, number of conductors, reference plan and any other relevant comments. The list shall include all cables in the control system, including power cables, network cables, instrumentation cables, etc.

.12 List of instruments and equipment

.1 The list of instruments and equipment identifies basic information related to the instruments and shall be produced and completed by the Supplier.

.2 List to include the following information at a minimum: instrument reference number and status (new, existing, modified, withdrawn, etc.), application (department), plan number or provisional diagram, equipment or line number shown, technical data sheet number, manufacturer, model, location plan number, installation detail number, electrical or ventilation requirements and identification of stakeholder supplying, installing and connecting the instrument.

.13 Technical data sheets

.1 The technical data sheets identify the criteria and features of the equipment and instruments in the system by process. A technical data sheet shall be prepared for each piece of equipment and instrument in the control system. Technical data sheets shall be written out and include the instrument features, including the following:

.1 Technical data sheet number.
.2 Identification of the process equipment.
.3 Identification.
.4 Description.
.5 Manufacturer.
.6 Supplier's model number.
.7 Features and options.
.8 A standardized technical data sheet in the case of instruments.
.9 Installation plan.
.10 Manufacturer's documentation.

.2 Every piece of equipment and every instrument shall be identified by its instrument or device number on a technical data sheet.

.3 When a piece of equipment or instrument is identical to another (make, model, materials and dimension) and used for a similar purpose (same process conditions, operating range, instructions, etc.), a single technical data sheet shall be prepared, but in that case, it shall also contain a table showing all equipment and instruments covered by the data sheet and including the following:

.1 The reference number for each piece of equipment or instrument.

.2 The diagram number showing the equipment or instrument (P&ID).

.14 List of inputs and outputs

.1 The list of input/output points for the system is used to show all relevant information regarding input and output signals for the input and output modules of the system and field networks. The list shall be used by programmers when programming the inputs/outputs (main, secondary and remote chassis and signals transmitted over the network). For each input/output point, the following information shall be included: name of input/output, name of panel, communication node number, slot number, channel number, type of input/output, type of signal, mnemonics, address, description and any other relevant comment.

.2 List of input/output points to be supplied by the Supplier in 11x17 paper format and electronic format (Excel file).

.15 Calculation notes

.1 At a minimum, load and heat dissipation calculation notes shall be prepared for the various control panels. The heat dissipation calculation notes for the panels shall be submitted to the Ministerial Representative's engineer for approval. For the other calculations, the Ministerial Representative's engineers may request a copy if deemed pertinent. This is no way releases the Supplier from its responsibility for assigning the task of designing the systems to a qualified engineer who shall have responsibility for them. Other calculation notes may be deemed relevant depending on the engineering detail.

.16 Operations manual

.1 The operations manual shall describe all functions and special procedures for the system, including, but not limited to, operation functions of the supervision system (SCADA), where applicable, the HMI, the programmable controllers and the communication networks. The operations manual shall also enable operators to understand how the process operation works, i.e. commands, menus and submenus, access levels. The operations manual may include information contained in the functional analysis.

.17 Technical manual

.1 The technical manual shall describe all the configurations (modules, communication, software, etc.), functions, logic and sequences of the control system, for the programmable controllers and for the instruments, controllers and supervision system.

.18 Maintenance manual

.1 The maintenance manual shall outline the regular maintenance schedules and include all documents (manuals, CDs, software, etc.) and accessories (spare parts, specialized tools, etc.), supplied by the manufacturer for all equipment. Technical data sheets, calibration data sheets and shop drawings for all equipment and instruments shall be included.

PART 6 - EXECUTION

6.1 MAINTENANCE OF WATER PRODUCTION

.1 All work shall be performed without disrupting drinking water production and distribution. Contractor responsibility therefore includes maintenance of adequate water production throughout the work.

6.2 SEQUENCE OF WORK

.1 The general sequence of instrumentation and control work is as follows:

.1 Detailed engineering of control system.

.2 Production of technical data sheets, shop drawings and construction drawings.

.3 Manufacture and supply of panels and system components.

.4 Programming and configuration of system components.

.5 Factory acceptance tests (FAT).

.6 Installation of programmable controller and instrumentation panels.

.7 Site acceptance tests (SAT) and calibration.

.8 Start-up of system.

6.3 MATERIALS SUPPLIED

.1 In addition to the provisions of the administrative conditions, Contractor to supply all materials indicated in these specifications and any additional materials required for the automation system to ensure complete, functional installation. In addition, Contractor to supply all materials required to complete the installation, including accessories, supports, conduits, racks, anchors, etc.

.2 Brand and manufacturer names indicated on the plans and/or specifications are provided as a guide for quality and type of materials, products and tools under this contract. No deviation from or substitution of the criteria set out may be considered, unless clearly identified and justified in the Contractor's bid, showing demonstrated technical and economic superiority over the specifications requirements. If the Contractor wishes to substitute a material or product, it shall:

.1 Submit request to Ministerial Representative for approval;

.2 Clearly identify and provide a detailed demonstration of the advantages of the switch;

.3 Provide a credit corresponding to the difference in cost of materials, products or labour supplied by Contractor compared to those specified in the plans and specifications;

.4 Produce a technical report from an independent laboratory showing evidence of equivalence. Cost of report to be borne by the Contractor and to include following:

.1 Features, technical specifications and other useful information described the materials proposed;

.2 All stress and behaviour test results required by the supervisor;

.3 All reports and analyses on existing or proposed systems affected by the requested substitution, including: system curve, analyses of transient conditions, electrical modifications, control modifications and any other analysis required.

.3 Analyses of substitutions to be in compliance with supervisor requirements. No equivalent accept unless requirements are met. Ministerial Representative not responsible for any delay caused directly or indirectly by the substitutions. Modifications to other parts of the structure necessary as a result of the substitutions to be performed at Contractor cost. Contractor also to take into account that delays may be incurred in approving equivalents and that no claim may be made as a result.

.4 All position switches, pushbutton, dry contact, analogue / discrete outputs, keypads, communication modules and other accessories required to interface with the starters (Full Voltage, progressive, variable frequency, etc. .) must be included in the design, supply and connections to allow the controllers to know all states starters and local control boxes (Fault, Overload, User Manual-Off-Auto, etc.). The Contractor must ensure this aspect of coordinating with other automation sections and the sections "Electric," the quote because no complaint should arise.

.5 The work also includes supply of conduits and wires for the control system and electrical distribution installations.

.6 All materials, devices and equipment supplied shall be new and in compliance with CSA standards and bear a stamp of approval.

.7 Contractor to indicate in its bid the type of technology it plans to supply, the name of the manufacturer selected to supply the control system and the name of the specific product supplied by the manufacturer.

.8 All bids based on specific manufacturers and products that are not named will be rejected.

.9 Materials supplied by the Contractor shall operate in temperature conditions varying from 0°C to 40°C and humidity varying from 10% to 95%.

.10 Any equipment that is damaged or does not perform adequately during construction, testing or the warranty period shall be replaced at the Contractor's cost. A 30 consecutive calendar-day commissioning period shall be completed after start-up of the equipment as a prerequisite for interim acceptance of the work.

6.4 INSTALLATION

.1 To install all new equipment or sets of equipment, Supplier to supervise Contractor in performing the following, without limitation:

.1 Unpackage, situate, mount and, as required, assemble the equipment.

.2 Centre the equipment on its base and fine-tune placement.

.3 Supply and install all anchors and supports required to mount the equipment.

.4 Install all accessories for the equipment as well as any other equipment, when delivered separately.

.5 Supply all hardware required to assemble and place the various components.

.2 Everything shall be in compliance with codes and standards, equipment manufacturer's technical specifications and instructions and appropriate plans.

.3 Installation of new equipment may require disassembly and reinstallation of some existing equipment. Contractor to ensure that components are all fully compatible with one another.

.4 Before beginning the work, Contractor to measure and verify on site all dimensions, ratings and levels. Also verify that the required space for new equipment is unobstructed by items not indicated on the plans.

PART 7 - QUALITY CONTROL

7.1 GENERAL

.1 To ensure quality control of the system, Contractor to include the following in its inspection and testing plan:

.1 Factory acceptance tests (FAT).

.2 Test bench tests (where explicitly required in the scope of work).

.3 Pre-operational verification.

.4 Site acceptance tests (SAT).

.2 Details for these tests are described in the following paragraphs and in other sections of the special technical conditions, in particular the sections "Process Automation – Electrical Installation", "Process Automation – Instrumentation" and "Process Automation – Control System".

7.2 FACTORY ACCEPTANCE TESTS (FAT)

.1 Factory acceptance tests (FAT) are tests performed at the manufacturer's site and are designed to ensure that the equipment complies with specifications and is functional before it arrives on site, making it possible to make any necessary corrections or replacements right at the manufacturer's site.

.2 Tests performed at the manufacturer's site shall be documented and include the following:

.1 Equipment and hardware tests (applicable to equipment such as instruments and actuators).

.2 Electrical tests on control panels (dielectric test, input/output tests, etc.), as specified in the section "Process Automation – Electrical Installation".

.3 Factory instrument calibration as specified in the section "Process Automation – Instrumentation".

.4 Configuration, communications, logic and simulation program tests at subcontractor sites for programmable controllers (API), HMI, etc. as specified in the section "Process Automation – Programming Methodology".

.3 Contractor responsibility includes supply and installation of instruments under a specific contract and performance of factory acceptance tests for all automation instruments and components included in the scope of the contract.

.4 Ministerial Representative to be present to witness a predetermined number of specific tests, as set out in the inspection and testing plan. Exact nature, test area and timing of factory acceptance tests to be determined by the Ministerial Representative and the Contractor. The Ministerial Representative may require the presence of the Contractor's subcontractors for the factory acceptance tests.

7.3 TEST BENCH TESTING

.1 The Contractor may manufacture a test fixture or test bench to demonstrate the proper operation of its equipment.

.2 Tests and simulations to be performed shall be documented and emulate actual design conditions as closely as possible, using hydraulic, electrical and pneumatic equipment wherever necessary.

7.4 PRE-OPERATIONAL VERIFICATION

.1 Pre-operational verification is designed to verify the installation, connection and calibration of the system equipment and instruments.

.2 Verification of instruments

.1 Verification (inspection) of instruments shall be performed to ensure that every instrument is free of defects and is calibrated, correctly installed and functional. Contractor to ensure that the identification plates for the instruments are in compliance with technical data sheets.

.2 Calibration and scaling of instruments and equipment shall match design conditions. Contractor to simulate actual design conditions as closely as possible using hydraulic, electrical and pneumatic equipment.

.3 Verification of inputs/outputs

.1 Verification of system inputs/outputs is designed to verify that all field signals (digital or analog) arriving at or leaving from the instruments are correctly connected to the input/output points for the programmable controllers, as well as confirm their polarity.

.2 Contractor to activate each instrument and verify the results. The list of inputs/outputs shall be used for the verification and failed tests shall be reported on a deficiency list.

7.5 SITE ACCEPTANCE TESTS (SAT)

.1 The site acceptance tests (SAT) are designed to verify all operating features specified in the functional description, step by step, in order to detect and correct logic and programming errors.

.2 The tests shall be performed on a control system that is as complete as possible with simulation tools that make it possible to easily activate inputs and view outputs. Contractor to specify the type of test simulation equipment that will be used.

.3 The tests to be performed on site shall be documented and shall include:

.1 Point-to-point tests on all system signals between all components of the control system (instrument to programmable controller to HMI and SCADA).

.2 Function tests on all components (manual and local modes).

.3 Tests on all communication networks (supervision, control and field).

.4 Function tests on control logic and programmable controller for the human-machine interfaces (HMI).

.5 Complete system performance tests (refresh rate, communication rate, sampling time, etc.) and performance tests during loss of certain systems and/or subsystems and/or communication networks.

7.6 TEST REQUIREMENTS AND PROCEDURES

.1 Materials and certificates required for tests

.1 Contractor to supply all materials and equipment required for the verifications, tests and calibration of all devices and instruments as specified in these specifications.

.2 Contractor to provide test equipment validation certificates. Up-to-date validation certificates issued by a specialized firm assigned by the Contractor to be maintained throughout the test period.

.2 Failed tests

.1 Contractor to inform the Ministerial Representative immediately of any defective equipment that cannot be repaired or instrument that cannot be calibrated.

.3 Powering up

.1 Contractor to obtain Ministerial Representative's approval prior to connecting any device or instrument to power (or instrument air). The powering up test shall demonstrate that the instrument works in compliance with the specifications. This activity shall be performed in the presence of the Ministerial Representative.

.2 After the powering up test, the source of electrical power (or instrument air) shall be disconnected and a test label affixed to the electrical power interruptor (or isolating valve).

.4 Test labels

.1 Upon completion of each test, Contractor to place a label on the device or instrument indicating its status. The test label shall contain, at a minimum, a description of the nature of the test(s) and the name(s) of those who performed them. The test label shall be placed on all components tested.

.5 Sealing openings after testing

.1 After the test, all openings and pneumatic connections shall be capped or supplied with a sealing device to prevent humidity and dust from entering. The cap or seals shall be clearly visible and easy to remove for final instrument installation.

PART 8 - TRAINING

.1 Contractor to include training of maintenance and operations staff training in its bid.

.2 Contractor to submit to the Engineer a training program described the topics covered at the sessions. At least 10 hours of classes shall be provided for in bid preparation. Training content shall include both process operation and control system elements, including the programmable controllers, instruments and the communication network.

.3 Contractor to submit its proposed training plan to the Engineer for approval and shall follow the Ministerial Representative's schedule.

PART 9 - PRODUCT

9.1 LEVEL GAUGES

.1 The measuring ranges of the level gauges shall be determined by the Contractor, with the help of the instrument manufacturer, on the basis of actual usage conditions.

.2 The level gauge housing shall be made of stainless steel, aluminum, or phenolic resin.

.3 The gauge shall be direct-read type.

.1 The graduations shall be black on a white background.

.4 The scale of the level gauge shall be graduated.

.1 The measuring accuracy shall be at least 0.1% of the maximum range.

.2 The scale shall show the level in metric units.

.5 Brands accepted:

.1 ABB;

.2 Endress & Hauser;

.3 Krohne.

.6 Equivalent models shall be approved.

PART 10 - EXECUTION

10.1 INSTALLATION OF INSTRUMENTS

.1 Level gauges

.1 Level gauges shall be installed in strict accordance with the manufacturer's recommendations.

.2 Orient the unit so as to prevent moisture from getting inside the housing.

.3 Level gauges shall be positioned so as to facilitate reading.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 These specifications set out the general requirements for the supply and scope of work for automation and instrumentation.

1.2 SCOPE

.1 This section describes the features, functionalities and requirements of equipment defined in the scope of work for the control system proposed in the "Process Automation - Specific General Instructions" section of these specifications.

.2 Part 1 describes in detail the supply of equipment involving several components. Part 2 describes the integration, installation and connection of equipment.

1.3 GENERAL DESCRIPTION

.1 The work includes, but is not limited to, the supply, manufacture, design, if necessary, set-up, internal wiring, installation, connections, inspections, painting, factory testing, labour, handling, storage, anchoring, levelling, transportation, delivery, assembly, disassembly, dismantling, site testing and warranty for all equipment and components.

.2 The term "panel" includes panel boards, enclosures and cabinets and is used throughout the text.

.3 Standards and specifications for panels are defined in the "Process Automation - Manufacturing of Panels" section.

.4 Where items are specified in both this Section and other sections of the "Process Automation" division, the provisions of this Section prevail.

1.4 SCOPE OF SUPPLY

.1 Supply includes, but is not limited to:

.2 Control panel for pumping station for both distribution pumps that are powered by two inverters (VFD).

.1 The Contractor shall provide, install and connect one PLC-001 to monitor and control equipment and instrumentation in pumping station D-30.

.2 Locate panel on ground floor of the station away from well access doors. Maintain 1 metre front clearance, from the floor to a minimum height of 2.2 meters.

.3 NEMA 4X panel.

.4 Connected to 120 V AC.

.3 The Contractor shall provide, install, connect and program the following components and equipment for the PLC-001:

.1 One chassis for the controller containing at least one power supply, one processor and all communication modules (Ethernet, Profibus, Modbus, etc.) and I/O required in the design developed during detailed engineering.

.2 Power supplies, line conditioners and filters.

.3 Power distribution system (120 V AC and 24 V DC)

.4 Modules or interfacing terminals for power cables and input/output (I/O) signals.

.5 Interface modules or in panel pre-wired terminal blocks and protection for each module input/output, including overload protection for each digital output.

.6 One operator interface (IPM-001) mounted on front of housing to include:

1. Ethernet communication port;

.7 One industrial type "Din Rail" mounted switch in the PLC-001, to include minimum:

2. Two Ethernet communication ports for copper connection.
3. One Ethernet communication port for fibre optic connection.

.4 The Contractor provides wires, cables and pipes; install and connect control and monitoring status signals for all starters for pumping station including, but not limited to, full voltage starters, variable speed starters and soft-starters.

.5 The Contractor shall provide the wires, cables and pipes, install and connect the control signals to the interlock between the fire panel and the control panel to reproduce the existing operation.

.6 All protection features for instrumentation and small equipment for process control including switches, circuit breakers, overload relays, fuses and other accessories.

.7 All instrumentation required for process control.

1.5 SCOPE OF WORK

.1 General

.1 The Contractor shall prepare the detailed engineering required for a complete and operational system.

.2 Perform detailed testing during commissioning of equipment to demonstrate that systems are operational.

.3 Set aside time and resources for commissioning systems.

.2 The Contractor shall supply, without limitation:

.1 Skilled labour for design, programming, integration, testing, implementation and complete commissioning of control systems, including comprehensive testing.

.2 A comprehensive functional analysis of the system.

.3 Programming and configuration and complete start-up of all components of the system proposed (PLC-001) to achieve safe operation in accordance with the requirements in the specifications, including all operating sequences in normal and emergency modes.

.4 Synchronize all controllers, operator interfaces (IPM), converters, communication modules, instrumentation and other components that are part of the control system as described in Section 29 00 70 - Control System, to ensure proper system performance in accordance with Section 29 00 10 - Functional Description.

.5 Provide wires, cables and conduits; install and connect control and monitoring status signals for the entire control system.

.6 Install, configure, program and perform a complete start-up for all starters for the pumping station (P-1, P-4) including, but not limited to, full voltage starters, variable speed starters and soft-starters.

.7 The Contractor shall install the wires, cables and conduits, and connect the control signals to the interlock between the fire panel and the control panel to reproduce the existing operation

1.6 DISMANTLING

.1 None.

.2

PART 2 - PRODUCTS

.1 Not used.

PART 3 - EXECUTION

.1 Not used.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This section of the specifications describes how the control system operates. It provides information on the control logics and functions to be incorporated into the control system.

.2 Control system functions shall allow the operation and supervision of all equipment.

.3 Contractor responsibility includes but is not limited to implementing all logics and functions described in this document and ensuring that they are all perfectly integrated.

.4 This document shall be read together with the process diagram drawings and control architecture drawings.

.5 In detailed engineering (P&ID), Contractor is responsible for revising and completing all the books related to this function description to ensure that it is entirely consistent with the final version of the control system.

.1 Revision of this document is included in the functional analysis required in the section "Process Automation - Specific General Instructions."

1.2 RELATED REQUIREMENTS

.1 Section 26 29 10 – Motor Starters to 600 V.

.2 Section 44 40 00 – Functional Description.

PART 2 - SYSTEM OPERATION

2.1 GENERAL

.1 Control system operation shall be effected using the SCADA supervisory system, local human-machine interfaces (HMI) (depending on the process), and local controls on the equipment itself.

.2 To efficiently control the process and process equipment, specific mode groupings were defined according to the tasks or functions concerned.

.3 These groupings are:

.1 Operating modes.

.2 Control modes.

2.2 OPERATING MODES

.1 Operating modes define how to operate process physical equipment or primary elements and control sequences. As required, the operating mode can be used in a grouping and include several sequences, items of equipment units or primary elements.

.2 The operating modes available are:

.1 MANUEL-LOCAL [English MANUAL-LOCAL] mode,

.2 MANUEL-DISTANCE [English MANUAL-REMOTE] mode,

.3 AUTO (automatic) mode.

.3 These operating modes are selected using a combination of a physical LOCAL/DISTANCE selector near the equipment and an AUTO/MANUEL selection via the operating interfaces (SCADA and HMI).

.4 For some equipment and primary elements, special devices are available to allow the equipment or element to be operated locally without electrical assist.

.1 These devices allow certain equipment operations, but since they are not uniformly available for all equipment items, it is not considered an operating mode for the purposes of this document.

.2 One example of this type of device is the wheel of certain valve actuators.

.3 The devices are required, on a case-by-case basis, in the equipment specifications.

.5 Operating mode MANUEL-LOCAL (maintenance):

.1 MANUEL-LOCAL operating mode is used when operating with visual contact.
.1 This operating mode is not recommended for controlling the process.
.2 This mode shall be used only for maintenance tasks or as a backup.
.3 This mode is defined as a manual mode with no PLC control.
.4 This mode is selected when the LOCAL/DISTANCE selector on the panel is set to LOCAL.

.2 Selecting MANUEL-LOCAL mode has no adverse effect on the process.

.1 The equipment stays in its last state.
.2 Returning from MANUEL-LOCAL mode (equipment LOCAL/DISTANCE selector set to DISTANCE) is also seamless, and the equipment goes back to the last state and operating mode it was in before MANUEL-LOCAL was selected.

.3 Ensure that local operation of equipment does not create a safety risk for persons or equipment.

.4 Push-buttons allow motors to be started and stopped locally.
- .1 All automatic valves with an air-driven actuator shall be fitted with a pilot solenoid valve with manual override.
- .2 Other equipment shall be controlled by push-button, selector, potentiometer or other mechanism that bypasses the PLC logic.
- .3 LOCAL operating mode always overrides DISTANCE mode.

.6 Operating mode MANUEL-DISTANCE.

.1 MANUEL-DISTANCE operating mode is mainly used for remote operation of the treatment system specified.

.2 This operating mode is selected when the LOCAL/DISTANCE selector on the panel is set to DISTANCE and the mode on the HMI is MANUEL.

.3 This operating mode is not recommended for controlling the process on a regular basis.

.4 This mode is used for remote operation.
- .1 Two examples are adjusting set points and step-by-step sequences.
- .2 Contractor is responsible for suggesting what is safe and functional.
- .3 This definition of the functions is included in the Contractor's functional analysis.

.5 In this operating mode, all safety interlocks, equipment interlocks and some process interlocks are in operation for the equipment or sequence concerned.

.6 Other details are provided in the paragraph on control modes.

.7 Operating mode AUTO:

.1 AUTO (automatic) operating mode applies to all items of equipment individually and to all sequences.

.2 For equipment, AUTO operating mode is selected when the equipment LOCAL/DISTANCE selector it set to DISTANCE and the operator has selected AUTO mode for that equipment.
- .1 When the LOCAL/DISTANCE selector for the equipment is set to DISTANCE, the equipment cannot be controlled using the local buttons on the equipment itself or close to it.

.3 For sequences, the operator selects AUTO mode from the menu for the sequence concerned when the operator sets the selector to AUTO.

.4 The system is normally operated in AUTO mode, and in this mode the process operates automatically with the logics, controls and sequences programmed in the control system.
- .1 Only certain process variables and parameters can be modified by the operator, as described below.
- .2 In this operating mode, all safety, equipment and process interlocks are in operation.

.5 Engaging AUTO mode has no adverse effect on the process.

.1 The equipment, controller or sequence uses the last state and set point as the starting point for the automatic operation concerned.

.6 The behaviour of AUTO operating mode shall be the same as the equipment, whether in LOCAL or DISTANCE mode.

.1 However, in AUTO-DISTANCE mode, the remote equipment shall have permissive from the corresponding PLC.

2.3 CONTROL MODES

.1 Control modes are used to select the source of control inputs or manual inputs by the operator so as to prevent contradictory control inputs coming from more than one source.

.1 Control inputs can come from the supervisory system (SCADA) or from a local control station (HMI) located near the different items of equipment.

.2 With control modes, the source of the control input can be identified, and using an interlock mechanism, it can be made unique.

.2 The control modes available are SCADA control mode and HMI control mode.

.1 Control modes can be associated either with several items of equipment as a group or with process functions.

.2 Control modes are never associated with an individual item of equipment, but this may be done in exceptional situations.

.3 The control mode selected is displayed at the central control station (SCADA) and at the local control stations (local HMIs), but the mode can only be selected from the local control stations, based on the principle that the closer the control station is to the equipment, the higher its priority.

.4 The hierarchy of HMI and SCADA control inputs shall be detailed in the functional analysis.

.5 SCADA control mode:

.1 When selected, SCADA control mode allows the operator at the central control station to control and operate the equipment or processes concerned.

.1 Control inputs from local control stations for those equipment items or processes shall be deactivated, but the states and alarms shall still be displayed there.

.2 Switching to SCADA mode shall no adverse effect on the process.

.1 The equipment, group or sequence stays in its last state.

.6 HMI control mode:

.1 When selected, HMI control mode allows the operator to control and operate the equipment items or processes concerned.

.1 Control inputs from the central control station (SCADA) to that equipment are deactivated, but the states and alarms are still displayed there.

.2 HMI mode shall be the default selection when the system is started up.

.3 Switching to HMI mode shall have no adverse effect on the process.
.1 The equipment, group or sequence stays in its last state.

2.4 TABLE OF INPUT/OUTPUT POINTS

.1 Contractor shall prepare a complete input/output table listing all inputs and outputs required to operate the chosen process.

2.5 RESPONSE TO POWER OUTAGE

.1 In automatic mode

.1 Starting up after a fault
.1 When an item of equipment not involved in a sequence is shut down due to a fault other than a power outage, manual confirmation by the operator (rearming or other) is required before restarting.
.2 When a sequence is stopped due to a fault other than a power outage, the equipment items already affected by the sequence revert to the state they were in before the sequence started, when it can be done safely.
.1 Manual confirmation by the operator (rearming) is required before the sequence can be restarted.
.2 This issue shall be covered in the functional analysis for each process and each item of equipment to ensure that the system as a whole operates safely.

.2 Starting after power outage
.1 After a power outage, equipment and sequences shall restart automatically (with backup or regular power) when it can be done safely.
.2 Generally, in the event of a power outage, the operating sequence of the system shall be functional under generator (backup) power.
.1 Data and set points shall not be lost in the transition to backup power.
.2 When regular power is restored, the system shall revert to regular electric power with no loss of data.
.3 In the event of a power outage or equipment signal failure, the last recorded value shall be used to continue the control sequence.
.4 The system shall resume operation precisely at the point where it was before the outage or failure, and this shall be done with no operator input, if it can be done safely.
.5 The Technology Supplier shall distinguish and define the types of

start-up that can be done automatically from those that require operator assistance.

.2 In manual mode

.1 Any equipment operating in manual mode (MANUEL-LOCAL or MANUEL-DISTANCE) that is shut down when a fault or power outage occurs shall stay shut down.

.2 Manual confirmation by the operator (rearming) shall be required before that equipment is restarted.

2.6 SYSTEM SECURITIES

.1 The supervisory system and the HMIs shall be password-protected so that only maintenance personnel have access.

.1 An operator password allows all inputs, but a maintenance password allows only control inputs, not changes to set points.

2.7 LOSS OF SUPPLY VOLTAGE

.1 If a loss of supply voltage occurs, equipment states shall generally be indicated for each process.

PART 3 - SYSTEMS FUNCTIONALITY

3.1 GENERAL

.1 Contractor's process specialists shall develop the basic functional description.

.2 Submit the detailed functional analysis as shop drawings according to the definition of functional analysis set out in the section Process Automation - Specific General Instructions, the design criteria for the divisions Process and Process Automation, the design criteria set out in this section and the section Process Automation - Programming Methodology of these specifications and the description of basic operation (mentioned above).

3.2 PROCESS

.1 Division 44 of the drawings and specifications provide a brief description of the processes for the two dispensing pumps which are powered by two variable frequency drives (VFD)

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 The purpose of this document is to describe the configuration and programming work required for automation equipment that makes up the control system.

.2 The system includes instruments, communications networks, programmable logical controllers (PLCs), human-machine interfaces (HMIs).

1.2 SCOPE OF SUPPLY

.1 The programming methodology applies to all the main components of the control system, including the instruments, programmable logical controllers (PLCs), controllers, human-machine interfaces (HMIs) and equipment requiring configuration, such as operators, dosing pumps, etc.

1.3 SUPPLY

.1 General

.1 Generally, the Contractor shall provide, but is not limited to providing, all the labour, expertise, materials and time required to implement the control system including complete programming of the process control system.

.1 The work includes, but is not limited to, the programming and configuration of programmable logical controllers (PLCs), controllers, human-machine interfaces (HMIs) to achieve all operational sequences in normal operation, specific operation and various emergency modes, as described in the Process Automation – Functional Description section of the specifications and indicated in the plans.

.2 Supply also includes factory testing, simulation, commissioning, all site trials for interim acceptance as well as corrections and improvements during the period of operation before final acceptance.

.3 Programs shall be tailored to the selected controllers and use the latest programming technologies available.

.4 Contractor to coordinate with the Ministerial Representative and all subcontractors (suppliers, integrators, etc.) associated with this contract to ensure complete, functional installation of all equipment, instruments, devices and processes.

.5 Contractor to provide a configuration management plan to ensure traceability of program versions. This plan shall be approved by the Ministerial Representative.

.2 Software and Licences

.1 Contractor to supply, install and configure all required communication drivers, all required operating, programming, configuration and programmable logic controller (PLC) diagnostics, human-machine interfaces (HMIs), automation engineering station, equipment and programmable component software.

.2 Software and licenses to include, at a minimum, the following:

.1 One (1) license/key or one (1) site license (unlimited), whichever is more beneficial, for the configuration and programming software for all PLC models provided.

.1 The final version supplied shall be coordinated with the Ministerial Representative to ensure compatibility with existing applications;

.2 For Siemens controllers, the software is SIMATIC STEP 7 Professional;

.3 For Allen-Bradley controllers by Rockwell, the software is RS Logix 5000.

.2 One (1) license/key or one (1) site license (unlimited), whichever is more beneficial, for the configuration and programming software for all human-machine interface models provided.

.1 The final version supplied shall be coordinated with the Ministerial Representative to ensure compatibility with existing applications;

.2 For Siemens interfaces, the software is SIMATIC WinCC

.3 For PanelView Plus interfaces by Rockwell, the software is FactoryTalk View.

.3 Contractor also to be equipped with all up-to-date software required to carry out the work.

.3 Engineering

.1 Contractor to do all the configurations and programming required for the control and supervision system to operate properly, referring to specifications and plans.

.1 This includes all controllers, human-machine interfaces, the supervision system, various pieces of equipment, instruments and other components comprising the control system as indicated in the Process Automation – Control System section, to ensure they are working properly and as prescribed in the Process Automation – Functional Description section.

.2 As the project evolves, the Contractor shall, in a timely manner, supply screen pages for the supervision system and human-machine interfaces for review by the Ministerial Representative.

.3 Contractor to include in controller programming exchange tables and commands and states segregation mechanisms based on their origin, namely, either human-machine interfaces (HMIs) or the supervision system.

.4 The Contractor shall supply at minimum the following structured exchange tables:
- .1 Tables of data exchange between managing controllers, PLCs, concentrator controllers and controllers;
- .2 Tables of data exchange between local controllers;
- .3 Tables of data exchange between HMIs and controllers;
- .4 Comprehensive exchange table showing all exchange blocks from PLCs to controllers via concentrator controllers.
  - .1 This table contains information on addressing and types of data exchanged.

.5 Contractor to program and configure all equipment that requires it such as actuators, starters (normal and soft), variable speed drives, motor control centres (MCC), dosing pumps and uninterruptible power systems (UPS).
- .1 The Contractor shall be responsible for ensuring that this equipment operates in harmony with the programmed operating modes in PLCs, the whole objective being to obtain a consistent, uniform system.

.6 Contractor to execute configurations and programs required to conduct all testing and simulations.
- .1 The Contractor shall also coordinate all tests with its subcontractors.

.7 The Contractor shall forward all passwords to the Ministerial Representative.
- .1 Similarly, all programs, subroutines, function blocks and programming elements shall be unlocked and accessible to the Ministerial Representative for modification or supervision purposes.
- .2 Should the Contractor wish to protect certain sections or function blocks in its programming, they shall demonstrate to the Ministerial Representative that these sections are subject to intellectual property specific to a process of the Contractor.

1.4 EXCLUDED SUPPLIES

.1 Not applicable.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Not applicable.

PART 3 - EXECUTION

3.1 GENERAL

.1 Automatic control sequences shall be integrated into controllers and PLCs in order to control equipment in the system.

.2 Generally, they consist in verifying a certain number of entry points, operating conditions, parameters configured by the operator and ordering of required equipment.

3.2 REGISTRATION OF SOFTWARE AND LICENSES

.1 All required software, licenses, drivers, connector components and programming cables shall be provided in sufficient quantity.

.1 They are to be registered in the name of the Ministerial Representative.

.2 Subject to validation by the Ministerial Representative, software shall be the most recent available on the market when the contract is awarded with the latest updates and/or corrections at the time of interim acceptance.

.1 Versions of software supplied to be validated by the Ministerial Representative before starting to develop applications to ensure compatibility with existing applications.

3.3 PROGRAMMING LOGIC

.1 General

.1 Control of sequences, equipment and alarms to be conducted by the PLC and/or the controller and not by the human-machine interface (HMI) or the supervision system (SCADA).

.1 For example, the supervision software sends a signal to the PLC to start functionality and the PLC activates and manages the start-up sequence and, where applicable, confirms execution of the sequence.

.2 Contractor to develop function blocks to standardise the programming.

.1 Similar sequences to be used for similar applications.

.2 For example, the start-up, shutdown and supervision logic for motors shall be the same for all motors in the same category.

.3 For identical equipment, the Contractor shall develop identical programs that are transferable from one piece of equipment to the other, where only the personalization settings are different.

.1 When certain customizations require it, conduct selection programming by equipment number.

.4 Contractor to use data structures to facilitate grouping of variables.

.5 Program structure to be divided into logical sections that are easily identifiable, to facilitate comprehension and troubleshooting.

.6 Contractor to present its function blocks, data structures and the intended program structure before programming commences.

.7 Local process equipment, operating without supervision, shall be analysed to determine whether automatic restart of functions is required after a shutdown or failure.

.8 System start-up confirmations to be based on process value readings and not only on starter contacts for electrical devices (contactors, overload relays, power relays, etc.).

.9 Waiting times, lags and settings shall be set and are subject to adjustments during the commissioning period.

.1 Adjustment limits shall be established in the functional description and presented in table form.

.2 Limits can be changed during commissioning by engineers or the operator.

.3 The system shall validate that the operator is not exceeding these limits during change requests.

.4 System thresholds and limits cannot be modified by the supervision systems, they can only be changed through programming by the engineering personnel.

.10 Programs shall be well documented and commented in French.

.1 This applies to the names of variable names, function blocks, data structures, names and titles of programs and subprograms as well as descriptions of program lines.

.2 Exceptionally, for variable names, an acronym in English is required for identification of instruments in accordance with the ISA standard (LSH, FIT, PAHH, etc.), but the description shall be in French only.

.3 Comments are the main program documentation.

.4 All text on screen pages shall be in French, both in the supervision system (SCADA) and in human-machine interfaces (HMIs).

.2 Transition states

.1 The programs developed shall be robust and cover behaviours during transition states.

.2 Contractor to ensure that all active systems remain in control during transitional states, that alarms are a true indication of the actual situation by prioritizing them and eliminating duplications and alarm showers.

.3 At a minimum, the following transition states are to be considered:

.1 PLC power-on;

.2 Start-up after download;

.3 Power failure and recovery;

.4 Communications failure and recovery;

.5 Equipment or instrument failure and recovery.

.3 Validation of control system inputs and outputs

.1 All incoming and outgoing signals from the control system shall be validated, whether they are communication signals or wired inputs and outputs.

.2 For communication signals, the state of the communication link shall be validated by a supervision strategy such as a watchdog, in both (2) directions.

.1 Then, the state of the communication module, and the state of the communication node, are to be validated.

.2 Finally, when the signal is a command, the validity of the command shall be confirmed especially when the command can come from several different sources.

.3 A communication error detected by a human-machine interface shall inform the operator of the nature of the loss of communication so that they can take appropriate action.

.4 Each PLC/controller to supervise and validate proper operation of all their communications with the other system components.

.1 The behaviour of the control system in the event of a communication breakdown with the supervision system, between PLCs or with field networks (a segment or multiple segments) shall be studied so that programmed automatisms are safe.

.2 This shall be presented in the functional description, as well as any actions taken whenever a communication failure is detected.

.3 Programming of these functionalities shall be done within a subprogram dedicated to the validation of communications and, therefore, to the validation of the incoming signals to the PLC.

.4 Exchange tables

.1 Exchange tables between PLCs to be presented in the form of tables of variables and data structures.

.1 To reduce the communication time, it is often desirable to consolidate the data into data structures.

.2 Contractor to investigate and propose an optimal solution.

.3 Exchange tables shall be an integral part of the functional description.

.4 The exchange tables are not simply a list of variables; they are to indicate the origin, destination, use and criticality of the variable.

.5 Variables to be communicated shall be placed in a table so that the PLC that needs it, comes and reads it.

.6 Obviously, where the communication is faulty, there needs to be a fallback value and subsequent actions for each variable in the exchange table.

.2 The comprehensive exchange table shall also be provided for the system (mapping).

.1 This table shows the size of all exchanges and the correspondence between the start addresses in the exchanged data blocks.
.2 This table enables configuration of exchanges in the supervision system (SCADA) and concentrators.

3.4 PLC PROGRAMMING

.1 General

.1 Although the PLCs selected can be programmed in Boolean language, in ladder diagram, functional blocks, in sequential logic ("Grafcet") and in structured text, a structured approach using functional blocks and sequential logic is required.
.1 The structured text is used for mathematical calculations.
.2 However, in specific instances and depending on the circumstances, the Contractor may, with the approval of the Ministerial Representative, choose another method more appropriate to the programming in question.

.2 Where Grafcet is not available for a PLC, Grafcets to be translated manually in ladder diagram format.
.1 The translation method shall be submitted to and approved by the Ministerial Representative prior to commencement of programming.
.2 In addition, visualization segments are to be programmed in ladder diagrams and accurately represent the different Grafcet steps.
.3 These visualization segments do not contribute anything from a logical point of view, every contact represents a Grafcet step and the arrangement of contacts accurately represents the Grafcet diagram.

.3 The programs developed shall be submitted during development for program compliance assessment.

.2 Description of PLC Programming

.1 As part of this mandate, it is expected that all PLC programming shall be done in such a way as to include all system functionalities described in the Process Automation – Functional Descriptions section of these specifications.

.2 During construction, Contractor to supply their own programming and configuration station, including all necessary licenses and software.

.3 As PLC programs are designed to be modified, downloaded, tested and diagnosed remotely, no local intervention is required.
.1 The source code, including all comments, is to be loaded into the PLC.

.3 Single program

.1 If a system includes four (4) or more PLCs with identical or virtually identical programming, a single program shall be used.

.1 The concept of a single program is described below, but will be explained in detail during work meetings.

.2 A single program is a program intended to be loaded into several PLCs without any modification required, despite minor differences between them.

.3 A single program shall have the following features:

.1 Ethernet addresses supplied to local PLCs, by the router, or an identical Ethernet address with personalization by the switch/router; this will be established during work meetings;

.2 Physical configuration of sub-bases and PLC cards, identical;

.3 The parameters or logic customized to each local PLC are all in the single program.

.1 The series of parameters used is determined by the identity of the local PLC.

.2 If there is a difference in part of the logic, execution of that logic will be activated or deactivated depending on the PLC identity that is transmitted by the concentrator;

.4 Creation of a data structure that contains a series of variables associated with each PLC and containing: an index table intended to customize the various input/output addresses, threshold values, settings specific to each PLC, different scaling and timer values.

.1 These variables associated with a particular PLC are not used directly by the program, they are recopied in a structure used by the program after the PLC ID number is transferred, for example.

.2 If the concentrator is not present or functional, the PLC number can be manually forced into the local PLC;

.3 This development method will be discussed at meetings;

.5 Use of same memory sections for exchanges with the concentrator: information is reassigned in the concentrator for transmission to a controller;

.6 Use of same memory sections for exchanges with the interfaces: interfaces manage the communication when an interface exchanges with several local PLCs;

.7 Where the local PLC has no ID number, the program sections not used for identification or data transfer are not executed.

.4 This program architecture is such that only one program needs to be modified to change a functionality for installation in all local PLCs.

.1 Although the physical configuration is to be similar, inputs/outputs can be at different addresses.

.4 PLC program structure.

.1 In its programming methodology, Contractor to present the program structure with tasks, programs and subprograms it intends to use.

.2 Programs shall be structured and modular.

.3 The structure shall be linked to systems based on a hierarchy of overall control down to the equipment level.

.4 The following program sections are a required minimum:
- .1 Initializations and constants;
- .2 Identification of PLC and customization of settings in the single program;
- .3 Validation and scaling of inputs and outputs;
- .4 Communication with supervision system (including watchdogs);
- .5 Communication with HMIs (including watchdogs);
- .6 Alarm handling;
- .7 Control loops;
- .8 Sequences and managers;
- .9 Equipment;
- .10 Simulations (for workshop testing only, FAT).

.5 Initialization of variables, assignment of constants for automatic timeout or meters, to be grouped together either in a program section or directly in the variable table.
- .1 The purpose being not to have to do a search to modify these values.

.6 The following figure illustrates a simplified example of a control system programming structure for an equipment grouping and represents an acceptable minimum of information expected of the Contractor.
- .1 This example to be adapted to this sector and the required functionalities.

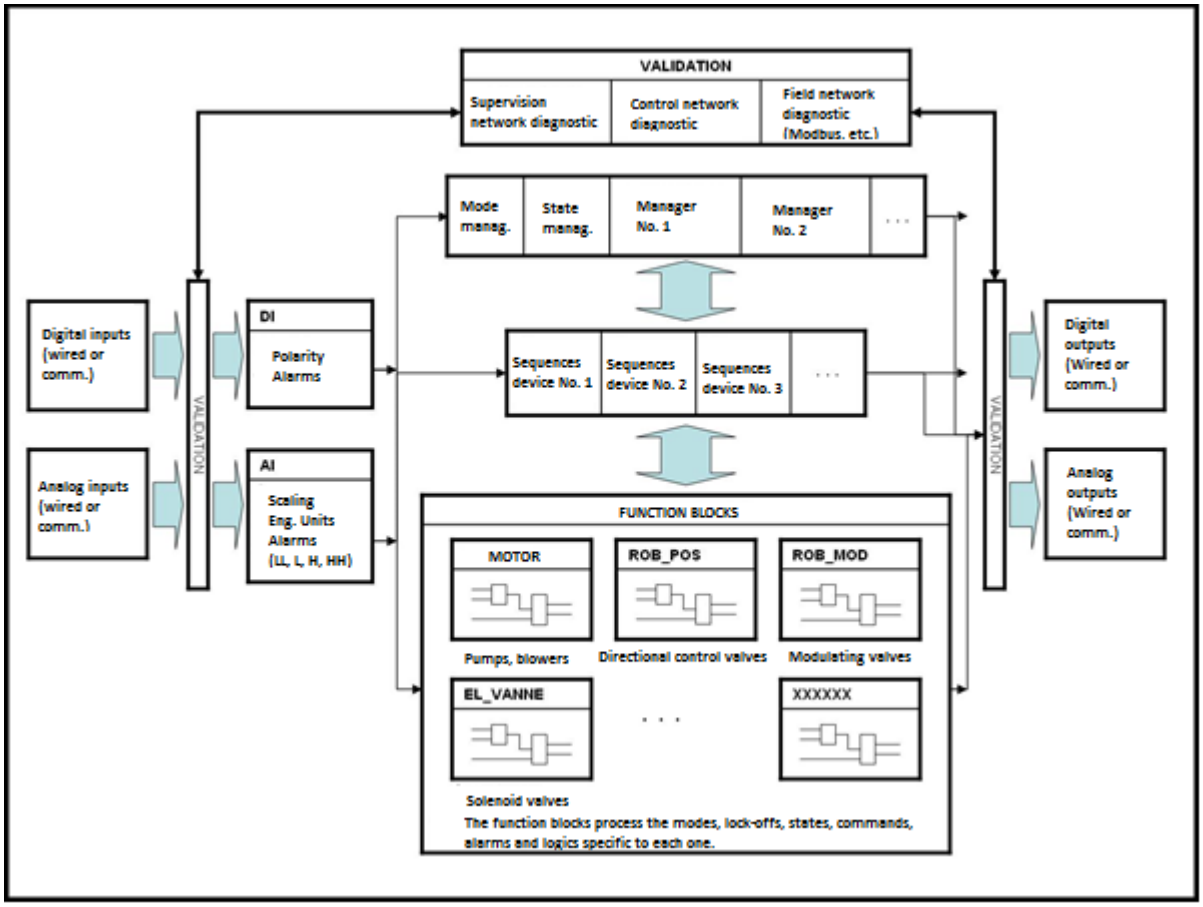

Figure 1 Proposed Programming Structure

.7 Management and diagnostics for the communication networks (Ethernet, Modbus Plus or Modbus, etc.) to be grouped together in the PLC, but separated according to each network.

.5 Function Blocks

.1 For PLCs, Contractor to develop standardized function blocks in order to standardize programming.

.2 Function blocks shall be defined for the following equipment at least:
.1 Modulating valve actuator;
.2 All-or-nothing valve actuator;
.3 Solenoid valve;
.4 Dosing pump;
.5 Full voltage starter motor;
.6 Reversible starter motor;
.7 Soft starter motor;
.8 Variable speed motor;
.9 Analog input (including scaling and alarms);
.10 Digital input (including alarm and polarity);
.11 Loop control (PID);
.12 Alarm.

.6 Identifiers Convention

.1 All signals, modules, blocks, structures, programs and logical components to be identified by a unique name that characterizes them and described briefly but clearly with a comment.

.2 The selected text shall correspond to the logic state "1", or the activation of a signal.

.3 All names, comments and variable identifiers can include both uppercase and lowercase to emphasize the primary meaning.

.4 Names of variables
.1 The name of the variable shall be bound to the name of the device.
.2 For purposes of programming, other "internal" variables shall also be defined.
.3 Refer to the ISA standard for the name of these variables and their associated suffixes.
.4 If there is no ISA description, use the correspondence with the acronym used by the signal function block or provide a list of suffixes.

.5 Mnemonics can be formed from the sector number, ISA code and loop number.
.1 Below are examples of variable names:
.1 Debit_FI0501 flowmeter display;
.2 Debit_FAH0501 high flow alarm;
.3 Debit_FAHH0501 high-high flow alarm;
.4 Debit_FIC0501_PC flow control loop setpoint value.

.6 The names of the variables shall represent the logical grouping of variables related to a device when they are sorted alphabetically.
.1 With PLCs, these names of variables can contain as many as 32 characters, so the name shall be significant.

.7 Similarly, descriptions of variables shall be structured in such a way that the name of the equipment, then the identification are indicated.

.8 Here are some prefixes to be used in naming variables:
- .1 Analog Input – prefix: AI_
- .2 Analog Output – prefix: AO_
- .3 Discrete Input – prefix: DI_
- .4 Analog Output – prefix: AO_
- .5 Threshold Value – prefix: Threshold_
- .6 Equipment – prefix: name equipment_

.9 Names of variables to be validated at work meetings.

.7 Name of PLCs

.1 The name of PLCs shall reflect what is presented in the specifications and plans.

.8 Name of programs and subprograms

.1 The name of programs and subprograms shall represent the logical grouping of equipment or the area determined by the program structure.

.9 Name of data structures and function blocks

.1 The names of the data structure and function block shall represent the functionality, consolidation or equipment to which it relates.

.2 Data structures shall be reviewed at work meetings because a distinction shall be made between the model structure and the name of the structure when in use.

.3 The following are examples of data structure names:
- .1 COMMUNIC_4011_4121 for data transferred from PLC_4011 to PLC_4121;
- .2 COMMUNIC_4121_4011 for data transferred from PLC_4121 to PLC_4011;
- .3 EA for an analog input;
- .4 Modulating_valve for a modulating valve actuator.
- .5 Solenoid valve for a solenoid valve;
- .6 MOTOR for a non-reversible motor;
- .7 MOTOR_REVERSIBLE for a reversible motor;
- .8 MOTOR_VFD for a motor with VFD;
- .9 MOTOR_SOFT for a motor with a soft starter.

.4 Example of mnemonics for analog values

ANALOG INPUTS		
Variable Name	**Type**	**Description**
EA_cnt	INTEGER	Unit value (count)
EA_PCT	REAL	Calibrated value (percentage)
EA_EU	REAL	Calibrated value (engineering units)
EA_In_max_EU	REAL	High engineering value
EA_In_min_EU	REAL	Low engineering value
EA_Seuil_TR_HAUT	REAL	High-high limit
EA_Seuil_HAUT	REAL	High limit
EA_Seuil_BAS	REAL	Low limit
EA_Seuil_TR_BAS	REAL	Low-low limit
EA_ALM_TR_HAUT	BOOL	High-high alarm
EA_ALM_HAUT	BOOL	High alarm
EA_ALM_BAS	BOOL	Low alarm
EA_ALM_TR_BAS	BOOL	Low-low alarm
ReserveB1	BOOL	Reserve (bit)
ReserveB2	BOOL	Reserve (bit)
ReserveR1	REAL	Reserve (value)
ReserveT1	TIMER	Reserve (timer)

.10 Program comments

.1 Generally, all mnemonics, program sections, routines, program lines, structures and client function blocks to be subject to comments.

.1 All comments shall be in French only, with no mistakes.

.2 Comments shall be such that they enable users to understand programs without having to interpret lines of code instruction by instruction.

.2 During program evaluation by the Ministerial Representative, specific attention is paid to program comments.

.1 They are subject to discussion and approval.

.3 Every routine or module shall have a heading and comments with the code.

.1 At minimum, the heading shall include the following elements:

.1 Name of the routine;
.2 Description of routine functionalities;
.3 Name of routines calling this routine;
.4 Routines called by this routine;
.5 Input parameters;
.6 Output parameters;
.7 Specifics;
.8 Revision information:

1. List of revisions
2. Revision number
3. Revision date
4. Reason for revision
5. Name of person making the revision

.4 Comments shall be inserted throughout the code describing progress or state.

.5 When programming calculations in structured text or another language, comments to be inserted to make the calculations easily understandable.
.1 Accordingly, comments shall include complete mathematical formulas, displayed as formulas.
.2 For example, the formula for the calculation of an average shall be expressed in the comments as follows:

$$\text{average} = \frac{\text{quantity 1} + \text{quantity 2} + \text{quantity 3}}{3}$$

.6 Programs to contain a comments section where all revisions are described.
.1 For each revision, explanation of changes, reason, program section affected by the revision, date of revision and name of person making it, as well all other relevant information.

.11 Interlocks

.1 Interlocks are intended to preserve integrity and prevent injury to personnel and damage to equipment. They fall into three (3) categories: security, equipment and process interlocks.
.1 Details of these interlocks are found in the Process Automation – Functional Description section of these specifications.

3.5 PROGRAMMING THE SUPERVISION SYSTEM

.1 The supervision system includes, when requested, the SCADA operating station and all human-machine interfaces provided.

.2 General

.1 Development of the SCADA application and human-machine interfaces (HMIs) to be standardized and mutually consistent.

.2 The following paragraphs serve as a guide to ensure that the operating station and human-machine interfaces provided are programmed and configured in accordance with the same standards.

.3 Contractor to program, at minimum, one screen page for each process flow diagram (P&ID) issued by detail engineering, as well as all the required process detail screen pages.

.1 Contractor also to program a detail screen page for each device.

.3 Display

.1 It is imperative that each part of the process be visible at all times, in order to monitor the condition of equipment, order new equipment and know the process variables in real time.

.1 To the extent possible, equipment to be shown with graphics related to the equipment in place.

.2 The arrangement of elements on the screen page shall follow the direction of the processing chain.

.3 Unless provided otherwise, the direction of the processing chain on screen pages shall be from left to right.

.4 A list view or representation using squares is not acceptable.

.2 Screen pages shall always comprise a main frame containing:

.1 Current display title, date, time, etc., as well as functionalities such as system access (logon), call buttons to the alarm summary page and the alarm history page;

.2 A buttons menu to navigate between the other screen pages;

.3 An alarm banner with acknowledgement buttons.

.3 Shall be operable in manual mode remotely, depending on the user.

.1 Manual mode to be defined for equipment, but also for control loops (takeover of final operating element).

.4 Sequences shall be manually operable in step-by-step mode and time setpoints for each of the sequence steps shall be modifiable.

.5 Trend curves for all process variables to be displayable.

.1 In the specific case of human-machine interfaces, process data shall be kept locally.

.2 This archiving is a temporary measure in the form of a FIFO type logical battery (the oldest data will automatically be destroyed).

.6 Analog variables from inputs/outputs that are either physical or internal to the control system can be displayed in analog (bar graph) or digital form.

.1 Engineering units to be present.

.7 Digital values to display as digits, with corresponding engineering units.

.1 The number of digits used for the numeric representation to be sufficient for a 0.1% reading of the maximum calibration value, including the decimal comma in French (as required).

.8 Typical screen pages for approval to be presented to the MinisterialRepresentative, before programming begins.

.1 They shall accompany the functional description.
.2 Validation of screen page functionality to be part of workshop testing (FAT).

.4 Access and Operation Level

.1 Various components of the supervision system to enable users and access levels as described in the Process Automation – Functional Description section.

.5 Colour and Presentation Standard

.1 Contractor to reproduce the colour and presentation standard of existing screen pages.

.2 Colour coding for process lines to be determined subsequently by the Ministerial Representative.

.6 Variable Nomenclature

.1 The name of the variable shall be bound to the name of the device.
.1 For purposes of programming, other "internal" variables shall also be defined.
.2 Refer to the ISA standard for the name of these variables and their associated suffixes.
.3 If there is no ISA description, use the correspondence with the acronym used by the signal function block or provide a list of suffixes.

.2 In the supervision system (SCADA), the mnemonic is made up of two (2) letters identifying the sector, followed by the ISA code and the loop number.
.1 Below are examples of variable names:
.1 PAFI0501 flow measurement display;
.2 PAFAH0501 high flow indicator alarm;
.3 PAFAHH0501 high-high flow indicator alarm;
.4 PAFIC0501 flow control loop setpoint value, this supervision system mnemonic (SCADA) can contain several values, namely, measurement, setpoint, controller output.

.3 Similarly, descriptions of variables shall be structured in such a way that the name of the equipment, then the identification are indicated.
.1 This description is limited to a maximum of 24 characters in the supervision system (SCADA).
.2 See a description example below:
.1 Water flow related descriptor NORMAL or HIGH

.4 Reminder: the description is intended for operators not programmers.

.5 Descriptions of displayable alarms, events or interlocks help the operator to understand and identify quickly (no ISA abbreviation in the description).
.1 Descriptions shall follow a display structure and be aligned:

DATE, TIME, LABEL, DESCRIPTION, STATE, CRITICALITY

.6 Example of alarm description on alarm banner:

2012-09-11	13:01	YV-430520,	Valve XYZ: Overtorque	ON	Normal
2012-09-11	11:56	LSHH-000001,	Equipment 123: High-high level	HH	Critical

.7 Pop up windows.

.1 For each piece of equipment or instrument, the command or information pop-up window shall be standardized.

.1 It shall also include a reference to the equipment, working order, mode, setpoint, command buttons and all other necessary functionalities and diagnostics.

.2 Typical command pop-up windows for equipment shall be presented to the Ministerial Representative for review before programming begins.

.8 Command Validation

.1 Operator to be able to perform commands to control process equipment and visualize process status (data).

.2 Commands to include a minimum of two (2) operations: a command and a confirmation.

.1 This additional step limits the probability of starting or stopping equipment accidentally.

.2 This approach applies to starting a motor or a sequence.

.3 The operator to perform commands by selecting either menus, icons or displays of digital number of variables.

.1 Commands are the Stop/Start type.

.2 Do not use tilt switches.

.4 Commands to be in French, with description of blocks in French.

.9 Alarm Banner

.1 The alarm banner at the top of each screen page to display three (3) most recent alarms for operator, in order of priority.

.1 The alarm banner shall be a scrolldown menu enabling the operator to move around the list of alarms and to acknowledge the alarm of their choosing.

.2 The alarm banner to be present on all screen pages.

.10 Alarm Level

.1 Alarms to be classified by severity using the following levels and colours:

.1 RED for high alarms;

.2 YELLOW for medium alarms;

.3 CYAN for low alarms.

.2 Unacknowledged alarms to be represented by a flashing display.

.11 Audible Alarm Announcement

.1 Alarms to activate only the internal buzzer to the SCADA operating station.

.1 Human-machine interfaces to remain unresponsive to alarms.

.12 Independence of Human-Machine Interfaces

.1 In order to be independent, human-machine interfaces to read their data and transmit their commands directly to the appropriate PLCs.

.1 It is not permitted to consolidate data transfers in a PLC in order to read them in only one place.

3.6 PROGRAMMING OF ALARMS AND STATES

.1 This section is applicable to the programming of the PLC, the controller, the human-machine interface (HMI) or the supervision system (SCADA).

.2 The Contractor shall program all alarms necessary to allow operators to properly diagnose any problems affecting the normal operation of all systems supplied from the factory.

.1 The Contractor shall include a general alarm for each device and for the animation of the equipment in the supervision system.

.3 Trigger mechanisms, of acknowledgment and reset of alarms, vary slightly according to the systems and the source of the alarm.

.1 The Contractor shall investigate all alarms in order to be able to propose an integrated solution for all alarms considering that some do not have to be acknowledged while others do, and that some do not have to be reset while other do, etc.

.2 From this investigation, it should also be determined which alarms should be sent only to the supervision system, and which should be sent only to the human-machine interfaces as well as those which shall be transmitted to both.

.4 The Contractor shall establish the need to reset equipment depending on the risk level if equipment restarts following a simple acknowledgment.

.1 Similarly, the Contractor shall prioritize and consolidate alarms according to their criticality.

.5 The Contractor shall submit lists of alarms according to their criticality in the functional description.

.1 Contractor to ensure that these lists of alarms are to the satisfaction of Ministerial Representative.

.6 Alarm or event conditions shall be timed.

.1 The timeout value shall adapt to the process and may be different for each alarm.

.2 The timeout value shall be set and will be adjusted on site.

.7 Alarms shall be scheduled and/or prioritized and/or filtered to ensure that the origin of the problem, not its result, is stored in the PLC and displayed in local human-machine interfaces (HMIs) and the operating station.

.1 For example, failure due to motor overload causing a start fault will have more weight than an engine start fault.

.2 This order of priority shall be provided in the PLC.

.8 Alarm messages shall be standardized and include a reference to the faulty equipment with complete description (no abbreviations) of the equipment and label.

.9 The following is a list of alarms and statuses, not limitative, that the Contractor shall provide at a minimum (as applicable):

.1 For a pump, fan or pressure booster motor:

.1 Failure to run or stop: if a motor does not give confirmation of running after a run command or vice versa, if it gives a confirmation of running when there is no run command.

.1 When possible, the confirmation of running or stopping shall be based on process variables (see explanation below), in addition to the electrical confirmation.

.2 Motor overload failure;

.3 Failure of motor thermistor relay (if present);

.4 Feeder supply failure, making the equipment unavailable (when this information is available);

.5 Emergency stop failure;

.6 Selector status from starters (all selector positions);

.7 Status from local control stations;

.8 Operating status;

.9 Power status;

.10 Reference speed value status (for variable speed motors).

.2 Actuator:

.1 Inconsistency position: for example, if the PLC simultaneously receives confirmation of open and closed position of a valve, this will make the equipment unavailable;

.2 Attached instruments failure (positioner);

.3 Execution time exceeded ("timeout");

.1 For example, for an all-or-nothing valve, this alarm is set when the opening command has been activated yet the confirmation of opening is not received.

.3 For valves with actuators that are more recent, and for which the information is available, the following alarms shall be added:

.1 Overtorque;

.2 Communication failure;

.3 Other actuator defects;

.4 Failure regarding an emergency stop;

.5 State of selectors (all selectors' positions);

.6 State of local stations;

.7 Operating status;
.8 Power status;
.9 State of position value (for modulating actuators);
.10 State of open or closed position (for all-or-nothing actuators).

.4 Other alarms:
.1 Process Alarm: Process alarms are alarms that affect the smooth operation of the process and are not directly related to the equipment:
.1 Process variables exceeding the high-high, high, low and low-low limit;
.2 Wrong execution of a sequence (“Grafcet" or other);
.3 Too much time for the execution of a task, etc.
.2 Alarm comprising all the alarms for a device (for animation at operator station and human-machine interfaces);
.3 Alarms of auxiliary equipment to the process such as circuit breakers and heating and ventilation systems.

.10 Event

.1 Equipment not available for automatic control:
.1 In case the operator forgets equipment in "LOCAL" or "MANUAL" mode, it is wise to provide a reminder.

3.7 PLC ENGINEERING STATION

.1 The purpose of the engineering station is to:

.1 Program and configure PLCs online and offline;

.2 Program and configure human-machine interfaces;

.3 Configure and diagnose communication networks;

.4 Monitor instruments, actuators and other equipment for maintenance purposes.

.2 Contractor to install and configure all software and required communication drivers.

.1 Acceptable software is defined above in the Supply paragraph.

3.8 QUALITY CONTROL

.1 Verification of documents and programming

.1 All deliverables to be submitted for quality control and verification, including exchange tables, lists of inputs and outputs, program source codes, configuration of instruments, etc.

.2 Contractor shall also provide, but not be limited to providing, the following information during the various verification phases:

.1 Programming validated by the functional description, other sections of the specifications and other detail engineering documents produced by the Contractor;

.2 A system that reports no internal diagnostic errors, namely, all PLC modules, the various controllers, soft start controllers, variable speed controllers (VFD) and system components display no failures or errors.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This specification contains general directives for the fabrication of automation and instrumentation panels, cabinets, control boxes, junction boxes and enclosures.

1.2 GENERAL DESCRIPTION OF SUPPLY

.1 This specification is to be read in conjunction with the plans and estimates for the automation work in question.

.2 The term "panel", which encompasses panels, boxes, enclosures and cabinets, is used in the rest of the text.

.3 Refer to the section "Process Automation – Control System" to determine the type of panel required for each type of installation.

.4 Panels and components shall be assembled by a CSA-accredited firm. All components shall meet CSA or ULC standards.

1.3 STANDARDS FOR PANELS

.1 All panels and their elements shall be factory-assembled and bear a mark attesting that the assembly is CSA-certified, along with as a nameplate listing panel characteristics and fuse sizes.

.2 Panels shall be sized to house the required components with a minimum of 30% free space. Arrange components mounted inside panels to allow easy access for inspection, trouble-shooting and maintenance.

1.4 FIRE RESISTANCE

.1 Materials used in panels, cables, wires, cable trays, etc., shall be nonflammable, as per ASTM standard D635 and/or CSA standard 222-2-142.

.2 Materials used shall not give off toxic gases or dense smoke, or spread flames when heated or exposed to a naked flame.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Panels shall be completely enclosed and have a lockable exterior door with a minimum opening angle of 135°. Doors and access points shall have waterproof seals and comply with the following:

.1 NEMA 12 for dry environments.

.2 NEMA 4 for non-corrosive damp environments.

.3 NEMA 4X for corrosive damp environments.

2.2 MATERIALS

.1 Panel shall be industrial type and made of steel. The walls, top, chassis and bottom shall be the same thickness of steel.

.2 Brands accepted:

.1 Hammond

.2 Rittal

.3 Hoffmann

.3 The Departmental Representative shall approve equivalent brands.

2.3 PUSHBUTTONS

.1 The panel supplier shall install and wire panel-mounted pushbuttons. Pushbuttons shall be of same (NEMA) industrial type as the panels or boxes on which they are mounted.

.2 Pushbuttons shall be 30 mm in size. Connect input and output signals to the terminals.

.3 Use the following colour code for the pushbuttons:
.1 Red: Off / Close
.2 Noir: On / Open
.3 Yellow: Reset

.4 Models accepted:
.1 Allen-Bradley, series 800T
.2 Square D, series 9001
.3 Télémecanique, series XB5

.5 The Departmental Representative shall approve equivalent models.

2.4 INDICATOR LIGHTS

.1 The panel supplier shall install and wire panel-mounted indicator lights. Indicator lights shall be of the same (NEMA) industrial type as the panels or boxes on which they are mounted.

.2 Indicator lights shall be 30 mm in size. Connect input and output signals to the terminals.

.3 Use the following colour code for the indicator lights:
- .1 Red: Off / Closed
- .2 Green: On / Open
- .3 Yellow: Indication / Mode
- .4 White: Receiving power

.4 Models accepted:
- .1 Allen-Bradley, series 800T
- .2 Square D series 9001
- .3 Télémecanique, series XB5

.5 The Departmental Representative shall approve equivalent models.

2.5 TERMINALS, BREAKERS AND FUSEHOLDERS

.1 Panel-mounted terminals, breakers and fuseholders shall be cage type with clamp.

.2 All terminals and fuseholders shall be grey except ground terminals, which shall be green/yellow.

.3 Brands accepted:
- .1 Weidmuller
- .2 Wago

.4 The Departmental Representative shall approve equivalent brands.

2.6 STATIC UNINTERRUPTIBLE POWER SUPPLY

.1 Size SUPS to be able to supply all instrument and automatic control loads with a 30% reserve.

.2 Chose a model that will run for at least 30 minutes and provide a disturbance-free uninterruptible power supply.
- .1 Filters in dynamic derivation mode.

.3 Include with the uninterruptible power supply (UPS) working drawing the capacity and a brief load calculation, the latter signed by the Contractor's engineer.

2.7 ELECTRICAL FILTERS

.1 Filters for computers, printers and all equipment with prefabricated power receptacles shall be four (4) output "multi-socket" models designed to electrically protect computers and electronics and able to feed the various system power supplies.

.2 Filters for panel-mounted equipment shall be rail-mounted modular models with distribution via terminals and fuseholders or disconnect switches, also provided by the Contractor.

.3 Filters shall provide enough power to supply the equipment they serve with a minimum 20% reserve.

.4 Filters shall be protected against inverted polarities, open neutrals or defective grounds. They shall include a breaker and an indicator light.

.5 Models accepted:
- .1 Tycor, model Ulti-Mate

.6 The Departmental Representative shall approve equivalent models.

2.8 PRESSURE COMPENSATION SYSTEM

.1 Choose the pressure compensation system (vent cap) based on the panel NEMA class.

.2 Model accepted:
- .1 Hoffman APCDABS
- .2 OMEGA DA284
- .3 STEGO DA084

.3 The Departmental Representative shall approve equivalent models.

2.9 VENTILATION OR AIR CONDITIONING SYSTEM

.1 Choose the ventilation or air conditioning system based on the panel NEMA class.

.2 Models accepted:
- .1 Exair Cabinet Cooler
- .2 Rittal TopTherm Plus

.3 The Departmental Representative shall approve equivalent models.

PART 3 - LAYOUT, MOUNTING AND WIRING

3.1 PANELS

.1 Weld panels to resist normal transportation, lifting and operational stresses. Provide armatures to limit irregularities in the metal surface to ± 2 mm. The frame shall be rigid and independent.

.2 Divide large panels into bolted sections for ease of transportation.

.3 Make cutouts large enough to install and remove components. Maintain the watertight quality of the panel at the level specified for its type despite the presence of cutouts.

.4 Remove burrs and sharp edges and weld and mill joints to create a smooth surface. Similarly, make edges and corners straight and mill them to create a smooth surface and remove burrs.

3.2 PAINT

.1 Finish the surfaces of metal envelopes in the shop, that is, apply antirust primer to the inside and outside and at least two (2) coats of finish enamel paint, grey (RAL-7035) or similar in colour to the existing panels. Paint resistance shall comply with standard CSA C22.2 No 94.

.2 Fabricate in-panel mounting plates from cadmium-plated or galvanized steel.

.3 Clean and touch up in the shop any painted surfaces scratched or damaged during shipping and installation. Use paint that harmonizes with the original.

.4 Clean and prime hooks, supports, ties and other visible, non-galvanized attachment devices to protect them from rust.

3.3 INSTALLATION SUPPORT

.1 Install ground-mounted panels on a 100 mm ready-mix concrete base or provide and install them with a painted metal base made up of 100 mm U sections. The Supplier, in coordination with the Contractor, shall supervise drilling all the ground mounting holes. The Contractor shall supply and install all required anchors.

.2 Mount wall-mounted panels at least 20 inches above ground level, with external mounting flanges to locate them at least 1 inch out from the wall.

.3 Fabricate supports from cadmium-plated or galvanized steel.

3.4 ACCESSORIES

.1 Provide all panels with a document compartment on the inside of the door, of a size appropriate to the panel, along with all necessary accessories such as ground buses, gutters, access grommets, mounting rails, etc.

.2 Include the following accessories in all panels:

.1 One (1) cadmium-plated or galvanized steel mounting plate.

.2 One copper bus with screw terminals for the factory ground.

.3 One insulated copper bus with screw terminals for the instrumentation ground.

.4 Power supply connection terminals.

.5 Connection terminals for distribution of all power supplies (120 V AC, 24 V DC, etc.).

.6 Duplicate terminals for all input/output modules.

.7 Required power supplies, line conditioners and filters.

.3 Large panels, such as those for automatic controls and communication panels, shall include the following:

.1 A main disconnect for the panel power supply.

.2 A document compartment at least 270 mm wide, 250 mm high and 25 mm deep.

.3 Handles with lock and key.
.1 Each lock shall be delivered with two (2) keys.
.2 Panels of the same type shall use the same key.

.4 A fluorescent lighting system, including the fluorescent bulb, or an LED system, and a door switch.

.5 A duplex 120 V AC 2 A outlet to plug in electronics.

.6 A heating and/or air conditioning and/or ventilation system when required.

.7 A pressure compensation system (vent cap) meeting the NEMA standard applicable to the panel.

.8 An intrusion detection system.

.4 Static uninterruptible power supply

.1 Design control panels to accept two sources of supply: the SUPS and a normal 120 V AC source.

.2 Install a bypass switch at the SUPS input in order to be able to do maintenance on the SUPS without interrupting the power supply.

.3 At a minimum, connect automatic controls, control networks, operator interfaces and toxic gas analyzers to an uninterruptible power supply. Other equipment the function of which is to protect persons and equipment should also be on a SUPS.

.1 Determine the precise loads to be connected to an uninterruptible power supply and to a normal supply during the functional analysis.

.5 Electrical filters

.1 Supply all control system devices, computers and automatic controls with 120 V AC from a filtered power supply. A "filtered" power supply is free from any line disturbances such as voltage spikes and high-frequency RFI/EMI.

.2 Install supplementary filters when required, that is, when other equipment such as static uninterruptible power supplies (SUPS) are not sufficient to meet this objective.

3.5 WIRING

.1 Wiring inside panels shall be at least 18 AWG and meet the standards in the Electrical Code.

.2 Colour convention for wiring inside panels:

.1	Black	120 V AC supply (live)
.2	White	120 V AC supply (neutral)
.3	Red	120 V AC control wires
.4	Blue	24 V DC supply and control wires
.5	Blue and white	24 V DC supply wires (shared)
.6	Yellow	wires supplied from outside the panel
.7	Green	ground wires

.3 Group electrical wiring by voltage and separate with a physical barrier.

3.6 LABELING

.1 Use only mechanically produced identification labels. Handwritten ones are not allowed.

.2 Label panels on the front with screwed-on engraved Lamicoid plaques 3 mm thick. The Contractor shall make sure that the required NEMA classification is maintained.

.3 Also label all components inside the panels. Locate labels so as not to hinder the addition of future components and so as to be visible when the panel door is opened without having to move another component or wires.

.4 Identify every terminal, breaker, fuseholder and disconnect switch with a label appropriate to the type and manufacturer. Post information on replacing fuses near fuseholder terminals.

.5 Label each group of terminals. Mount the label in a labelholder that is separate from the terminals, of the same family as the terminals and located on the mounting rail immediately above or to the left of the group of terminals concerned, depending on whether mounting are vertical or horizontal.

.6 Label all wires AWG 12 and smaller permanently and indelibly at both ends using a heat shrink sleeve.

.7 Label all wires AWG 10 and larger permanently and indelibly at both ends using a self-stick water-, oil- and heat-resistant vinyl film.

3.7 MOUNTING AND LAYOUT

.1 The Contractor and Supplier shall provide the clearances recommended by the manufacturers around components. Gutters and access grommets shall not infringe on such clearances.

.2 The Contractor and Supplier shall orient components as recommended by the manufacturers.

.3 Provide equipment mounted in front of or inside panels with individual junction terminals.

.4 Install the factory copper ground bus below the panel (above the panel when the cables enter through the top), including a main terminal that accepts an AWG 6 wire to connect the copper bus to ground. Use an appropriate ground connector (thimble) and a copper AWG 16 (1.5 mm^2) cable to connect the ground bus to the panel frame and to all screwed-on or movable parts of the panel.

.5 Install the insulated copper ground bus for the instrumentation on insulators below the panel (above the panel when the cables enter through the top), including a main terminal that accepts an AWG 6 wire to connect the copper bus to ground. This insulated ground is for automation equipment such as automatic controllers, networks, instruments, analog signals, etc. Since it is insulated, this ground shall be made with green insulated copper cables and green insulated terminals

.6 Mount terminal, fuseholder, ground and equipment rails on spacers to maintain the attached components at an appropriate height for the component's operation and for connecting the wiring.

.7 Use, for all apparatus mounted on a mobile component (door, cover, etc.), ultra- flexible nineteen (19) strand cables and wires that are long enough to allow components to operate easily. Each strand passing through a joint shall contain at least fifteen (15) wires and be sheathed.

.8 Lay communication or instrumentation cables and electrical supply cables respecting the minimum distances required between each type of signal to eliminate any mutual influences, either using separate gutters or by grouping them within the gutters. The Supplier shall provide space in the gutters for the current components in the present system and an extra 20% for future additions.

.9 In panels containing components of different voltages (600 V AC, 120 V AC, 24 V DC and/or communication), separate groups of components with a physical barrier to prevent electromagnetic interference, mutual influence on heat dissipation, etc. Cover 600 V AC components with a protector to prevent accidental electrocution.

.1 Provide access to compartments containing components at voltages of 24 V or higher separate from that to compartments containing components at voltages below 24 V.

.10 Install conduits in panels in compliance with ANSI standard B 31.1.0 "Code for Pressure Piping", and using leading-edge technological methods to make them easily accessible. Size conduits appropriately. Also provide the needed supports, vents, stop valves and partition crossings.

3.8 TERMINALS, BREAKERS AND FUSEHOLDERS

.1 Locate all terminals, breakers and fuseholders near where the cables enter the panel, preferably at the bottom.

.2 Install all circuit protection devices, such as breakers, relays and fuses, and calibrate and set them as required for proper coordination.

.3 Provide at least two (2) reserve breakers in each panel.

.4 Provide a group of three (3) separate terminals to connect each main power supply to the panel (hydro, uninterruptible power supply, etc.). Group distribution terminals by type of supply (120 V AC, 24 V DC, etc.). Separate terminals for electronic components from power supply distribution terminals.

.5 Provide each multi-strand wire to be connected to a terminal via a spring-loaded connector with a ferrule appropriate to the type of terminal and wire. Each ferrule shall only take one wire and each terminal spring cage sall only take one ferrule. When required, the use of ferrules that take two (2) wires will be allowed.

.6 Single-strand wires may be connected directly to terminals with a spring-loaded connector without using a ferrule. Connect a maximum of (2) wires to the same side of one screw terminal.

.7 To distribute the same signal to two adjacent terminals (L1, N, 24V, C, GND, etc.), use screw buses or combs suitable for the terminals.

.8 Connect each wire exiting an external device to one terminal. Wiring done on site shall be accessible from the bottom, unless otherwise indicated.

.9 Provide three (3) terminals for each instrument operating at 4-20 mA, two (2) for the signal and one (1) terminal beside the two (2) others for shielding. Shield all analog input and output signals and ground them at the panel.

.10 Provide a reserve of at least 20% for terminals and fuseholders.

.11 See article 3.6 of this document for labeling terminals and fuseholders.

3.9 HEAT LOSSES

.1 The Supplier shall determine thermal losses for all apparatus installed in the panel and operating simultaneously at an ambient temperature of 40° C. The inside temperature shall be kept below the allowable ambient operating temperature of the most sensitive equipment. Should cooling by natural convection be impossible, use fans and aerators installed as high as possible with replaceable filters below the doors.

.2 Should ventilation be required, the Supplier shall allow for the fact that ambient air in corrosive environments (for example, if chlorine is present) cannot be used to ventilate panels.

.3 Dissipate heat from panels in corrosive environments using ventilation or air conditioning systems that maintain the integrity of the NEMA 4X classification.

.4 Present heat dissipation calculations for panels containing transformers, drives and/or EFV to the Departmental Representative for approval.

PART 4 - QUALITY CONTROL

4.1 GENERAL

.1 The tests described below add detail to and complete the tests required in section "Process Automation – Specific General Instructions".

4.2 PANEL INSPECTION

.1 The Supplier, in the Contractor's presence, shall verify the integrity of control panels before starting connection.

.2 The Supplier shall verify, in the presence of the Contractor and the Departmental Representative, that:

.1 All panels are brand new and free from faults.

.2 Technical requirements of standards, codes and regulations in effect are met.

.3 Specifications and technical requirements for fabrication and installation are met.

.4 Performances required in the estimates are met.

4.3 METHOD

.1 Submit the detailed verification procedure to the Departmental Representative for acceptance.

.2 The Supplier shall test the panels at its supplier's premises before they are installed on site. Testing shall meet the requirements of the most recent version of standard CAN/CSA-C22.2 No. 14 "Industrial Control Equipment" and include the following:

.1 Verify that devices mounted on and in the panel are solidly attached.

.2 Verify the layout of components and wiring for the various pieces of equipment as per the requirements in the different sections of these estimates.

.3 Measure the dielectric rigidity of the circuits and equipment with a megohmmeter.

.4 Verify the continuity of the ground.

.5 Verify the electrical continuity of all circuits as compared to the electrical diagrams.

.6 Perform operating tests on equipment and related devices installed at critical temperatures to ensure adequate heat dissipation according to the panel design chosen (with or without heating/cooling device).

4.4 PREPARATION FOR SHIPPING

.1 After necessary shop tests, inspections and connections, pack the panel solidly in a caisson-type box, well protected against shocks until delivery to the worksite.

.2 Ship devices not mechanically attached to the panel separately. Do not attach the panel with eyebolts for shipping.

END OF THE SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 These specifications apply to the requirements for electrical installations concerning controls, process instrumentation, telecommunications and related work in accordance with the drawings and the provisions herein.

.1 These specifications apply to prefabricated equipment mounted on a chassis and to equipment installed on-site.

.2 This document shall be read in conjunction with the other related specifications and documents.

.3 Specific restrictions and precautions apply in hazardous locations. Comply with the Canadian Electrical Code.

.4 All equipment, materials lists, etc. to be approved by the Ministerial Representative before installation.

.1 Any installation or purchase made prior to approval is at the Contractor's risk.

.2 Any departure from these specifications to be approved in advance in writing by the Ministerial Representative.

.5 The term "panel" includes panelboards, enclosures, cabinets and cupboards and is used throughout the text.

.6 Refer to "Process Automation - Control System" for details on panels required for each type of facility.

.7 Assembly of panel and components to be performed by a CSA-accredited firm. All components to meet CSA or ULC standards.

1.2 CODES, STANDARDS AND REGULATIONS

.1 All work, materials, structures and working methods shall conform to building codes, local municipal, provincial and national safety codes, and to the regulations of authorities having jurisdiction over the work. In the event of conflict between requirements, the more stringent applies.

.2 The work shall be governed by the latest edition of the relevant codes, standards and regulations:

.1 American National Standards Institute (ANSI);

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC);

.3 American Society for Testing and Materials (ASTM);

.4 International Electrotechnical Commission (IEC)

.5 Quebec Electrical Code (QEC) or Canadian Electrical Code (CEC);

.6 National Building Code (NBC);

.7 Canadian Standards Association (CSA);

.8 Factory Mutual Engineering Corporation (FM);

.9 Insulated Cable Engineers Association, Inc. (formerly IPCEA);

.10 Institute of Electrical and Electronics Engineers (IEEE);

.11 Instrumentation, Systems and Automation Society (ISA);

.12 National Electrical Manufacturers Association (NEMA);

.13 National Fire Protection Association (NFPA);

.14 Underwriters Laboratories of Canada (ULC).

.3 It is the Contractor's responsibility to ensure that staff are familiar with safety requirements

1.3 PREREQUISITES

.1 For telecommunications work, the Contractor shall be certified (Belden, Panduit, Tyco Network or others depending on the chosen solution) in order to certify that installation complies with good practice and the standards, regulations, laws and decisions of government agencies applicable in the cities and to the buildings where the equipment is to be installed.

PART 2 - PRODUCTS

2.1 GENERAL

.1 The Contractor shall supply all materials required to ensure that facilities for electric power distribution, controls, instrumentation and communications are complete and operational, with the exception of materials provided by equipment suppliers.

.2 Quality of measurement devices, equipment and components required for instrumentation, automation and process control that are not described in detail herein shall be comparable to that required for equipment that is described in detail, i.e., highest industrial quality.

.3 Use cadmium plated or galvanized steel for the manufacture of brackets and mounting plates.

2.2 IDENTIFICATION

.1 Cable identification to follow the requirements of Schedule A.

2.3 CABLES

.1 General

.1 Use stranded copper conductors, insulated with cross-linked polyethylene; cable design to comply with CSA C21.2 (latest edition).

.2 Outer cable sheath and cable construction to have high flame resistance and low emission of toxic or corrosive substances. Cables to meet minimum CSA standard C22.2 No. 0.3 for vertical burning test (FT-4) for gas emission.

.3 The Contractor shall provide evidence that cables have passed the required tests and submit certified test results.

.4 Cables are exposed to the following conditions:

.1 Maximum temperature:

.1 Normal: 40°C

.2 Special 60°C

.2 Minimum temperature: -40°C

.3 Average relative moisture: 15 to 99%

.4 Maximum altitude: 100 m

PART 3 - EXECUTION

3.1 GENERAL

.1 All electrical work to comply with the specifications in the applicable standards and meet the specific requirements set out herein.

.2 Cable conductors to be carefully laid and arranged in a compact group whether or not they are placed in cable racks, conduits or wireways.

.3 Cables entering or passing through junction boxes to comply with the relevant recommendations and requirements of the Canadian Electrical Code and take the surrounding environment into account.

.4 Conductors to be properly labelled and carefully arranged in junction boxes.

.5 Use the proper tools to avoid damaging terminal blocks. The Contactor shall replace all damaged terminal blocks.

.6 Do not connect more than two wires on a single terminal

3.2 CABLE INSTALLATION

.1 Cable installation shall comply with the following requirements:

.1 Install in dedicated cables racks or in conduits so as not to impede access to other mechanical or electrical services. Shelves or dedicated cables racks and conduits reserved for cables shall not impede movement and shall be supported independently of other services. Spacing between cable rack supports to be no greater than 1.5 m (5 ft.).

.2 Prevent contact with hot surfaces, machinery or conduits for other services (steam pipes, hot water, lighting fixtures, motors, transformers, etc.).

.3 Use metal screens to separate control, communications and instrumentation cables.

.4 Use cable racks for cables with class A and B interference suppression shielding.

.5 Use metal screens to separate cables with class A and B interference suppression shielding sharing the same rack.

.6 Install armoured cables on CSA approved, open or covered ladder cables trays, inside or outside buildings.

.7 Do not exceed maximum bending radius before, during or after installation;

.8 To prevent damage to conductors, only pulling by hand is permitted for twisted or braided cable pairs.

.9 Where applicable, appropriately protect cables that may be exposed to lightning.

.2 During installation, the Contractor shall comply with the following:

.1 Ground inactive metal components.

.2 Shield equipment and cables.

.3 Appropriately arrange equipment and cables.

.4 Apply specific interference suppression measures.

3.3 CONDUIT INSTALLATION

.1 The Contractor shall comply with the following requirements:

.1 PVC when installed outside or in damp locations.

.2 PVC when installed inside.

.3 Prefabricated expansion joints on all conduits crossing an expansion joint.

.4 Only use liquid-tight flexible metal conduits to connect equipment to outlet boxes or to connect two devices over a short distance, maximum 0.5 m.

.5 Install surface conduits parallel or perpendicular to the building's structural lines.

.6 Fasten wireways with devices approved for the purpose at each elbow and at the end of each line before entering a junction or pull box; comply with minimum number of attachment points specified in the Quebec Electrical Code. Do not use perforated metal tape, adhesive tape, metal pins, wire or string.

.7 Use galvanized stainless steel Canstrut support profiles and mounting hardware with profiles, fasteners, bolts, nuts, washers, etc., used for installing conduits and enclosures.

.8 All connectors, adapters, bushings and other connection fittings used for the wiring system to be compatible with type of conduit and intended use.

.9 Use appropriate equipment to bend conduits; bend radius as follows:
- .1 Six times internal diameter for conduits up to 50 mm.
- .2 Ten times internal diameter for conduits of over 50 mm.

.10 Attach wireways to boxes and enclosures with two locknuts; use bushings at either end to prevent abrasion of cables and wires; do not impede continuity of ground.

.11 All conduits, used or not, to contain one functional nylon pull rope minimum 9.525 mm (3/8 inch) and able to withstand 880 N (200 lb) tensile strength. Attach pull rope to each end of the conduit.

.12 Size outlet boxes, pull boxes and equipment boxes in accordance with the requirements of the Quebec Electrical Code to suit number and size of wiring terminating in these boxes or in accordance with any other information provided during detailed engineering concerning cable pulling. Mount boxes and enclosures with anchoring devices intended for the purpose.

.13 Ground conduits, pullboxes, outlet boxes and junction boxes in accordance with prevailing standards.

3.4 CONNECTORS

.1 The Contractor shall install connectors in accordance with the following requirements:

.1 New panels: provide bottom entry connector for field cables; use connectors for cable entry from one panel to another.

.2 Cables routed to existing panels to be retained that do not have base plates, and to reused panels, do not require connectors.

.3 In accordance with the manufacturer's recommendations, attach cables with liquid-tight connectors to each enclosure entry so that the inner cable sheath can pass through the connector.

.4 Group separately in a sheath all communication, analogue and power cables.

.5 Twist into a single braid the metal strands of the armour when connecting them to an appropriate grounding device with a compression fitting or terminal board.

.6 Cable conductors to terminate on specific terminals.

3.5 OPENINGS AND SLEEVES

.1 The Contractor shall make all required openings in floors, ceilings and walls, and provide and install all required sleeves in concrete slabs.

.2 New or existing walls, floors and ceilings damaged by passage of wiring or installation of equipment to be sealed with resilient waterproof non-flammable sealant and repaired to match existing finishes.

.3 Obtain approval of the Ministerial Representative before creating openings.

3.6 FIREPROOFING

.1 Seal against fire and smoke conduit or cable openings passing through firestop walls and floors; use 3M products (CP25, 303, FS195, CS95) and 7902 and 7904 series seal kits.

.2 Install to CAN2-19.13-M82 and in accordance with manufacturer's recommendations. All disciplines to use the same manufacturer for firestopping products for the purpose of certification by the insurer.

3.7 GROUNDING

.1 For connections, use minimum AWG 6 and appropriate "H" fittings installed on main wire.

.2 Do not cut or reduce the main wire section in any way whatsoever.

.3 Insulate "H" connectors with at least three layers of Scotch tape 130C, followed by one layer of Scotch tape 70 and, finally, one layer of green Scotch tape 35.

.4 Grounding hardware to be tinned hard-drawn copper. Nuts and bolts for mechanical connections to be silicon bronze alloy. Before each connection on a grounding bar or grounding connection point on a cabinet, thoroughly clean contact surfaces with an abrasive pad such as Scotch Brite, and apply a conductive grease (Kopr-Shield for copper, PENETROX-13 for other metals).

.5 Connect new cable racks to the grounding network.

.6 In panels, connect the two grounding bars (non-isolated and isolated) with separate grounding cables Use minimum AWG 6 for connecting cables. The Contractor shall provide connecting cables.

.7 Isolated ground:

.1 Connect isolated ground busbars to grounding wire intended for the purpose in cable racks able to receive instrumentation cables.

.2 One set of isolated busbars in the panels connects the shielding and the common electrical equipment. These isolated ground bars are connected together, separately from the non-isolated electrical ground bars, and grounded in one location near the ground for the station.

.3 Connect the following equipment to the isolated ground:

.1 Components of instrumentation and communication panels.

.2 24 V DC power modules, use insulated wire.

.3 Drain wires for electrostatic shielding for instrumentation, transmitters, etc.

.4 All analogue signals. Keep cable shielding as close as possible to connection point. Ground electrostatic shielding drain wire on a dedicated terminal only at the point of origin of the cable, i.e., at the controller panel.

.4 Connect ground for telecommunication cables over a distance as short as possible to local ground by a copper conductor with a ≥ 6 mm² cross-section.

.5 Avoid accidental contact with the shielding of conductive elements. If necessary, wrap stripped shielding in insulation to prevent contact.

3.8 QUALITY CONTROL

.1 Perform tests in accordance with the Inspection and Testing Plan described in Process Automation - Specific General Instructions.

.2 Do not perform tests that may expose equipment to limits higher than those recommended by the manufacturer for field tests. The Contractor is responsible for any injury to personnel and damage to equipment due to improper testing procedures.

.3 The Contractor shall correct, at its own expense, all equipment defects and imperfections.

.4 The Ministerial Representative reserves the right to certify and accept all test results before commissioning equipment.

.5 Once installed, subject wiring to a dielectric test between each conductor and earth according to the requirements of the latest version of CAN/CSA-C22.2 No. 14 Industrial Control Equipment.

END OF SECTION

SCHEDULE A

IDENTIFICATION OF WIRING AND CIRCUIT COMPONENTS

PART 1 - GENERAL

.1 These specifications apply to the requirements for electric power distribution, controls, process instrumentation, installation and related work according to the drawings and the provisions of these specifications.

.2 Any departure from these specifications shall be approved in advance in writing by the Client Representative. This document shall be read in conjunction with the other related specifications and documents and with the drawings relating to these specifications.

PART 2 - PRODUCTS

2.1 GENERAL

.3 The Contractor shall supply all materials required to ensure that the installations for electric power distribution, controls, instrumentation and communications are identified.

.4 Identification

.1 All components and installations related to wiring shall be identified in a permanent, indelible and tamperproof manner.

.2 All identification lettering shall be produced mechanically; handwritten lettering is not acceptable.

.3 No accents shall be used in identification lettering.

.5 Substituting equivalent products or materials

.1 The Contractor is responsible for doing all analyses and tests to demonstrate equivalency and for supplying all documentation required, describing the differences between the product or material prescribed in the specifications and the substitute product or material.

3.2 IDENTIFYING CONDUCTORS

.1 All conductors shall be identified at both ends by a heat-shrinkable sleeve for conductors up to 25 mm in diameter or by a 38 mm self-adhesive vinyl film resistant to water, oil and heat for conductors over 25 mm in diameter. Identification lettering shall be printed in black on a yellow background. Lettering shall be printed in two lines; the supply in the 1st line and the termination point and the type in the 2nd line.

.2 Exposed or shielded conductors carrying over 750 volts, a communication system or a critical service (e.g., safety/security, fire, gas detection, etc.) shall be identified by a vinyl film as described above, according to the service carried. Identification lettering shall be repeated every 10 metres and at critical locations such as where the conductor runs through a wall or floor. Lettering shall be printed in black on a yellow background, except for the voltage, which shall be printed in blue on a black background.

.3 Electrical supply conductors shall be identified by a colour-coded self-adhesive vinyl film resistant to water, oil and heat every 15 metres and at critical locations such as where the conductor runs through a wall or floor. Identification shall consist of two coloured bands: the main band shall be 25 mm wide and the supplementary band 20 mm wide. Bands shall be colour-coded according to the table below.

SUPPLY TYPE	BASE COLOUR	SUPPLEMENTARY COLOUR
Up to 600 V, Emergency	Red	Red
Up to 250 V, Emergency	Red	Orange
Up to 250 V	Yellow	-
Up to 600 V	Yellow	Green
Up to 25 kV	Yellow	Red
Telephone	Green	-
Fire alarm	Red	-
Communications, Emergency	Red	Blue
Other safety/security systems	Red	Yellow
Other communication systems	Green	Blue

.4 Heat-shrinkable sleeves

.1 Model accepted:

.1 Permasleeve from Brady

.5 Vinyl films

.1 Model accepted:

.1 HandiMark from Brady

.6 Equivalent brands or models shall be approved.

3.3 IDENTIFYING CABLE TRAYS

.1 Every cable tray shall be identified every 10 metres and on both sides of critical locations such as where it runs through a wall or floor by a 38 mm self-adhesive vinyl film resistant to water, oil and heat. Identification lettering shall be printed in black on a yellow background.

.2 Model accepted:

.1 HandiMark from Brady

.3 Equivalent brands or models shall be approved.

3.4 IDENTIFYING CONDUITS

.1 Only conduits carrying over 750 volts, a communication system or a critical service (e.g., safety/security, fire, gas detection, etc.) shall be identified according to the service carried every 10 metres and on both sides of critical locations such as where the conduit runs through a wall or floor. Identification shall be in the form of a 38 mm self-adhesive vinyl film resistant to water, oil and heat, and the lettering shall be printed in black on a yellow background, except for the voltage, which shall be printed in blue on a black background.

.2 Electrical supply conduits shall be identified by a colour-coded self-adhesive vinyl film resistant to water, oil and heat every 15 metres and at critical locations such as where the conduit runs through a wall or floor. Identification shall consist of two coloured bands: the main band shall be 25 mm wide and the supplementary band 20 mm wide. Bands shall be colour-coded according to the table below.

SUPPLY TYPE	BASE COLOUR	SUPPLEMENTARY COLOUR
Up to 600 V, Emergency	Red	Red
Up to 250 V, Emergency	Red	Orange
Up to 250 V	Yellow	-
Up to 600 V	Yellow	Green
Up to 25 kV	Yellow	Red
Telephone	Green	-
Fire alarm	Red	-
Communications, Emergency	Red	Blue
Other safety/security systems	Red	Yellow
Other communication systems	Green	Blue

.1 Model accepted:

.1 HandiMark from Brady

.2 Equivalent brands or models shall be approved.

2.5 IDENTIFYING JUNCTION BOXES AND PULL BOXES

.3 Every junction box associated with process control (controls or electric power) shall be identified by a lamicoid nameplate 2 mm thick. The nameplate shall be mechanically fastened to the box with screws. The size and colour of the nameplates shall be as indicated in the two tables below.

NAMEPLATE SIZE			
Size	**Dimensions (mm)**	**Number of lines**	**Height of lettering (mm)**
1	10 x 50	2	3
2	12 x 70	2	5
3	12 x 70	3	3

NAMEPLATE SIZE			
4	20 x 90	2	8
5	20 x 90	3	5
6	25 x 100	2	10
7	25 x 100	3	6

NAMEPLATE COLOUR		
Type	Back-ground	Lettering
Normal power	White	Black
Uninterruptible power supply (UPS)	Green	White
Emergency power	Red	White

.4 Other junction boxes shall be identified by a 25 mm self-adhesive vinyl film resistant to water, oil and heat. Lettering shall be printed in black on a yellow background.

.5 Every pull box having more than 2 conduits and each pull box carrying over 750 volts, a communication system or a critical service (e.g., safety/security, fire, gas detection, etc.) shall be identified according to the service carried by a 25 mm self-adhesive vinyl film resistant to water, oil and heat. Lettering shall be printed in black on a yellow background, except for the voltage, which shall be printed in blue on a black background.

.6 Pull boxes and other wiring accessories providing access to conductors shall be painted (maximum surface area 20 cm x 20 cm):

.1 Red for fire services;

.2 Green for telephone;

.3 Yellow for other critical systems (e.g., emergency evacuation, gas detection, etc.)

.7 Model accepted:

.1 HandiMark from Brady

.8 Equivalent brands or models shall be approved.

3.6 IDENTIFYING WIRING

.1 Every conductor shall be identified at both ends by a heat-shrinkable sleeve. Lettering shall be printed in black on a white background.

.2 Where it is not possible to install a sleeve, and subject to approval by the Client Representative, an adhesive vinyl label wrapped around the wire can be used.

.3 Heat-shrinkable sleeves

.1 Model accepted:

.1 Permasleeve from Brady

.4 Vinyl films

.1 Model accepted:

.1 HandiMark from Brady

.5 Equivalent brands or models shall be approved.

3.7 IDENTIFYING TERMINALS

.1 Every terminal shall be identified by a nameplate supplied for that purpose by the terminal manufacturer. Lettering shall be printed in black on a white background.

.2 Every terminal block shall be identified by a nameplate mounted on a support supplied for that purpose by the terminal manufacturer. Lettering shall be printed in black on a white background.

3.8 IDENTIFYING WALL-MOUNTED DISCONNECT DEVICES

.1 Every wall-mounted disconnect device shall be identified by a lamicoid nameplate 2 mm thick. The size and colour of the nameplates shall be as indicated in the two tables in the paragraph above under the heading "IDENTIFYING JUNCTION BOXES AND PULL BOXES."

.2 The connected supply and load shall be identified on the disconnect device by a 12 mm self-adhesive vinyl film resistant toA water, oil and heat. Lettering shall be printed in italic type according to the same colour code as the nameplates.

.3 Model accepted:

.1 HandiMark from Brady

.4 Equivalent brands or models shall be approved.

3.9 IDENTIFYING PANELS

.1 Control and distribution centre panels and electrical distribution panels

.1 Every panel shall be identified by a lamicoid nameplate 2 mm thick. The size and colour of the nameplates shall be as indicated in the two tables in the paragraph above under the heading "Identifying junction boxes and pull boxes."

.2 The connected supply and load shall be identified on the panel by a 12 mm self-adhesive vinyl film resistant to water, oil and heat.
.1 Lettering shall be printed in italic type according to the same colour code as the nameplates.

.3 Vinyl films
.1 Model accepted:
.1 HandiMark from Brady
.2 Equivalent brands or models shall be approved.

.2 Control panels

.1 Every control panel shall be identified by a lamicoid nameplate with the following characteristics:
.1 Dimensions: 50 x 200 x 2 mm (height x length x thickness);
.2 Background colour: White;
.3 Lettering colour: Black;
.4 Edge colour: Black;
.5 Number of lines: 3 lines;
.6 Font: Arial;

.7 Height of lettering: 102 mm (1st line) and 7 mm (2nd and 3rd lines).

3.10 IDENTIFYING COMPONENTS IN CONTROL PANELS

.1 Every component in a control panel shall be identified by a lamicoid nameplate or by a P-Touch self-adhesive label.

.1 Lettering shall be printed in black on a white background.

.2 For fuse holder terminals, information concerning fuse replacement shall be provided near the fuse holder terminal.

.2 Every network component shall be identified by its network address with a P-Touch self-adhesive label.

.1 Lettering shall be printed in black on a white background.

.3 Breaker panelboards

.1 For breaker panelboards, nameplates shall indicate the supply, equipment identification and voltage.

.2 Circuit breaker identification shall be a list of all circuits connected to the breaker panel.

.1 The list of circuits shall include the complete circuit nomenclature, including a typewritten legend, indicating the location and load of each circuit.

.2 The list of circuits shall be supplied in 2 copies, one of which shall be plastic-laminated and inserted in the inner door of the panel.

3.11 IDENTIFYING EQUIPMENT

.1 Every item of equipment in the system shall be identified by a lamicoid nameplate with the following characteristics:

.1 Dimensions: 40 x 121 x 3 mm (height x length x thickness);

.2 Background colour: Medium blue;

.3 Lettering colour: White;

.4 Edge colour: White (3 mm thickness);

.5 Corners: Rounded (all 4 corners);

.6 Lettering: Arial font, upper case, centred and proportionally sized (letters like "i" and apostrophes shall be narrower than other letters [like "E"]);

.7 Number of lines (on front): 2 lines (maximum 20 characters including spaces);

.8 Height of lettering (on front): 8 mm;

.9 Number of lines (on back): 1 line (maximum 11 characters);

.10 Height of lettering (on back): 17 mm;

.11 Hole for chain: At right end as seen from front, at mid-height.

.2 Example (front):

Hole for chain

.3 Example (back):

Hole for chain

.4 The chain for the instrument nameplate shall have the following characteristics:

.1 Length: As required for ease of operation (maximum 20 cm);

.2 Material: Chrome-plated (rustproof).

3.12 IDENTIFYING INSTRUMENTS

.1 Every instrument in the system shall be identified by a lamicoid nameplate with the following characteristics:

.1 Dimensions: 25 x 75 x 3 mm (height x length x thickness);

.2 Background colour: Yellow;

.3 Lettering colour: Black;

.4 Edge colour: Black (3 mm thickness);

.5 Corners: Rounded (all 4 corners);

.6 Lettering: Arial font;

.7 Number of lines: 3 lines;

.8 Height of lettering: 56 mm (1st line) and 4 mm (2nd and 3rd lines);

.9 Hole for chain:Mid-height at both ends.

PART 3 - EXECUTION

3.1 GENERAL

.1 All panels shall be identified and markings shall be such that no two components or wires have the same identifier.

.2 All lettering shall be mechanically produced; handwritten lettering is not acceptable.

.3 The lettering on nameplates shall be in French and shall be approved by the Client Representative before they are produced.

3.2 EXISTING CIRCUIT COMPONENTS AND WIRING

.1 In general, where the Contractor shall execute the work with existing circuit components and wiring (cables, cable trays, conduits, wire, etc.), the identifiers shall remain the same, but the Contractor shall replace all damaged or missing identifiers and labels.

3.3 DOCUMENTATION

.1 The Contractor shall supply all schematics showing the routing, type and utilization of conduits, shielded cables and cable trays, as well as the following lists:

.1 List of conductors (starting point, terminating point, approximate length, utilization, etc.);

.2 List of cable trays (identification, routing, type, approximate length, utilization, etc.);

.3 List of identified junction boxes and pull boxes (identification, utilization, etc.).

.2 The above lists shall be prepared with the latest version of Excel software.

.3 Every list shall include a cover page listing all revisions.

.1 The revisions table shall include the revision, date, persons responsible (drafted by, verified by, and approved by), and a brief description of the revision.

.2 The items in the lists shall be arranged according to the numerical sequence of items.

.4 Lists of conductors

.1 Items in the lists of conductors shall be arranged by category, for example:

.1 Distribution cables, 12 kV;
.2 Distribution cables, 4.16 kV;
.3 Distribution cables, 600 V for CCD-1;
.4 Motor control cables for CCD-1;
.5 Uninterruptible distribution cables, 600 V for CCD-4;
.6 Control cables by plant sector (building).

.2 The lists shall contain the following information:

.1 Cable number;
.2 Cable specifications (type and size);
.3 Approximate length (in metres);
.4 Identification of "Source" [starting point];
.5 Identification of "Destination" [terminating point];
.6 Routing (numbers of cable trays or conduits);
.7 Identification of sector or system;
.8 Description of function (e.g., "supply", "digital input or output 120 Vac", "digital input or output 24 Vdc", "analog input or output", "Ethernet communication", "Modbus communication", "Profibus communication", etc.);
.9 Revision.

.5 Lists of cable trays

.1 The lists of cable trays shall contain the following information:

.1 Cable tray number;
.2 Type (ladder, ventilated);
.3 Width (in metres);
.4 Approximate length (in metres);
.5 Location (room name and number);
.6 Description of function (distribution, service, control);
.7 Revision.

3.4 IDENTIFYING CONDUCTORS

.1 The identification number on each conductor shall be unique for the plant and shall be indicated on the Contractor's detail drawings.

.2 The same conductor identification system shall be used for all conductors (electrical distribution, controls, etc.).

.3 The identifier on each conductor shall be unique and shall include the identification of the starting point, termination point and the type of signal carried by the conductor according to the following format:

.1 "Source" [starting point] / "Destination" [terminating point] - "Signal" [signal] "Séquence" [sequence]

.2 "Source" is the starting point of the conductor (its supply connection), omitting the hyphen ("-") between the prefix and number;

.3 "Destination" is where the conductor terminates, omitting the hyphen ("-") between the prefix and number;

.4 "Signal" is all the voltages and types of signal carried by the conductor:

.1 "A.vvvV" for supply conductors, where vvv represents the voltage of the signal in the conductor. If the conductor carries direct current, the capital "V" at the end shall be changed to "V c.c." [Vdc];

.2 "C.vvvV" for control conductors, where vvv represents the voltage of the signal in the conductor. If the conductor carries direct current, the capital "V" at the end shall be changed to "V c.c." [Vdc];

.3 "T." for remote measurement conductors, such as 4-20 mA signals, resistive signals, 0-5 Vdc signals, etc.;

.4 "R.xxx" for network conductors, where xxx represents the acronym identifying the type of network:

.1 ETH for Ethernet;

.2 MB for Modbus

.3 DP for Profibus DP;

.4 PA for Profibus PA.

.5 "Sequence" is the sequential number, in cases where there is more than one conductor with the same conductor identifier.

.4 The definition of equipment considered as a "Source" [supply] or a "Destination" [terminating point] includes panels, junction boxes, instruments, etc.

.5 Examples:

.1 "PLC410021/LT410220-R.DP", for the Profibus conductor from control panel PLC-410021 to level transmitter LT-410220;

.2 "PLC410021/LT410220-A.120V", for the 120 Vac uninterruptible supply conductor for level transmitter LT-410220 from control panel PLC-410021;

.3 "PLC430022/ZSC431401-C.120V", for the conductor carrying the control signal for position detector ZSC-431401;

.4 "CCD4605/PPN4601-A.600V", for the 600 V supply conductor to distribution panel PPN-4601 from control and distribution centre CCD-4605.

3.5 IDENTIFYING CABLE TRAYS

.1 The identifier on each cable tray shall be unique for the plant and shall be indicated on the Contractor's detail drawings.

.2 The identification number shall be in the following format:

.1 "Secteur" [sector] – ETA – "Séquence" [sequence]

.2 "Secteur" is the number of the plant sector and sub-sector;

.3 "Sequence" is the sequential number of the cable tray according to the plant cable tray list.

.3 Examples:

.1 "20-ETA-23", for cable tray No. 23 in building 20.

.4 The Contractor shall in all cases refer to the existing list of cable trays in the plant to determine which sequential numbers are available, and then reserve them for its work.

3.6 IDENTIFYING CONDUITS AND PULL BOXES

.1 The identifier on conduits and pull boxes (voltage over 750 V, communication systems and critical services) shall indicate the voltage or the type of network or service and shall be indicated on the Contractor's detail drawings.

.2 Examples:

.1 "12KV", for 12 kV supply;

.2 "TÉLÉPHONIE", for telephone circuits;

.3 "INCENDIE", for fire detection and fire protection;

.4 "RESEAU ETH. BUREAUTIQUE", for Ethernet information technology network;

.5 "RESEAU ETH. CONTRÔLE", for Ethernet control network;

.6 "RESEAU BAC. CVAC", for BacNet building mechanicals control network.

.3 The suffix "/F.O." shall be added for fibre optic network items.

3.7 IDENTIFYING JUNCTION BOXES

.1 Junction boxes associated with process control

.1 Identifiers on junction boxes for electrical services related to process equipment shall be in the following format:
.1 "Sector" – BJ – "Sequence"
.2 "Sector" is the number of the plant sector and sub-sector;
.3 "Sequence" is the sequential number (minimum 4 digits) of the junction box or pull box according to the plant list.

.2 Example:
.1 "43-BJ-0105", for junction box No. 0105 of gallery No. 3.

.3 The Contractor shall in all cases refer to the existing list of junction boxes and pull boxes in the plant to determine which sequential numbers are available, and then reserve them for its work.

.2 Other junction boxes (electrical)

.1 The identifiers on other electrical service junction boxes shall include the identification of the supply panel and circuit(s).

.2 Example:
.1 "PPU4301-CCT1", for the junction box on circuit 1 from panel PPU-4301 of gallery No. 3.

3.8 IDENTIFYING WIRING

.1 The identifier on each conductor shall be unique for the plant and shall be indicated on the Contractor's detail drawings.

.2 Conductors shall be identified according to one of two systems, depending on whether it belongs to a cable used for electric power distribution in the plant or a cable used for plant control systems.

.3 By definition:

.1 Electric power distribution cables are those cables supplied from the plant electric utility entrance (Hydro-Québec) or from a control and distribution centre (CCD) or a distribution panel.

.2 Control cables are those cables supplied from a control panel or communications panel.

.4 Examples:

FORMAT	
Cable supplying 600 V to valves	Electrical
Profibus network cable for valves	Control
Cable supplying heating equipment	Electrical
Cable supplying a wall receptacle (if from a distribution panel)	Electrical
Cable supplying a light fixture	Electrical
Cable supplying an instrument such as a flowmeter or turbidimeter (if from an electrical panel)	Electrical
Cable supplying an instrument such as a flowmeter or turbidimeter (if from a control panel)	Control
Control cable for an instrument	Control
Cable supplying a control panel	Electrical
Network cable	Control

.5 Conductors of electrical distribution cables

.1 The identifiers on conductors belonging to distribution cables shall include the identification of the supply of the corresponding signal (i.e., number of the circuit on the distribution panel or the control and distribution centre [CCD] panel) or the nearest upstream disconnect device (where a disconnect device is installed), and shall be in the following format:

.1 "Panel or CCD" - "Circuit or cell" / "Sequence"

.2 "Panel or CCD" is the identification and/or the number of the distribution panel or control and distribution centre (CCD) panel, omitting the hyphen ("-") between the prefix and number;

.3 "Circuit or cell" is the number or identification of the circuit on

the distribution panel or the cell of the control and distribution centre (CCD);

.4 "Sequence" is the sequential number according to te number of conductors in the cable or a suffix as indicated in paragraph 3.8.7 below.

.2 Examples:

.1 "CCD4601-3A/L1", for the phase 1 conductor for cell 3A of control and distribution centre CCD-4601;

.2 "PPN8013-6/L", for the 120 Vac live supply conductor of circuit No. 6 on distribution panel PPN-8013;

.3 "SEC430120/T1", for the conductor from terminal T1 of disconnect device SEC-430120.

.3 For electrical distribution cables, where cables with coloured conductors are used, conductor colours shall conform to the colour code prescribed in clause 4.036 of the Electrical Code:

.1 1 phase, Black (L) and White (N);

.2 3 phases, Red (phase A), Black (phase B) and Blue (phase C);

.3 Green (ground).

.6 Conductors for equipment control cables

.1 Identifiers on conductors for control and instrumentation shall include the identification of the signal terminating point (i.e., identification of the instrument) followed by a sequential number in the following format:

.1 "Identification of instrument" / "Sequence"

.2 "Identification of instrument" is the identification of the instrument including its ISA identification letters and the instrument number, omitting the hyphen ("-") between the prefix and number;

.3 "Sequence" is the sequential number according to the number of conductors in the instrument cable or a suffix as indicated in paragraph 3.8.7 below.

.2 Examples:

.1 "LT410220/L", for the live conductor supplying 120 Vac to level transmitter LT-410220;

.2 "LT410220/N", for the neutral conductor of the 120 Vac supply to level transmitter LT-410220;

.3 "LT410220/1", for the first signal conductor of level transmitter LT-410220;

.4 "LT410220/2", for the second signal conductor of level transmitter LT-410220.

.7 Prefixes and suffixes

.1 Certain letters are designated for specific uses when used as a line prefix or suffix:

.1 L1Phase 1 or A of a 3-phase supply;
.2 L2 Phase 2 or B of a 3-phase supply;
.3 L3 Phase 3 or C of a 3-phase supply;
.4 L 120 Vac supply;
.5 N Neutral;
.6 V Positive of a direct current supply (Vdc);
.7 C Negative (common) of a direct current supply (Vdc);
.8 GRN Ground.

.2 The letters I, O and U shall never be used as a line prefix or suffix, to avoid confusion with digits or other letters.

.3 On drawings only, where required, a code indicating the pair number and/or the colour of the conductor insulation shall be added in parentheses after the identifier.

.4 Colour code:

.1 B: White;
.2 N:Black;
.3 R: Red;
.4 V:Green;
.5 BL:Blue;
.6 JA:Yellow.

3.9 IDENTIFYING TERMINALS

.1 Every terminal, fuse holder, circuit breaker and terminal block shall be identified individually by a unique identifier, according to the context and association hierarchy (terminals, terminal blocks, panels, etc.).

.2 Two terminal blocks are identified:

.1 Supply terminal blocks

.1 Supply terminal blocks used as the main connection of a panel and those of the different electrical distributions (120 Vac, 24 Vdc, etc.).
.2 These terminal blocks shall be identified as follows:
.1 TBA – "Terminal block number"
.2 "Terminal block number" shall consist of 3 digits and shall follow an identification logic based on the type of distribution.
.3 For example:

.1 TBA-001, TBA-002, ... for the main supply terminal block of the panel (normal 120 Vac, uninterruptible 120 Vac, etc.);
.2 TBA-101, TBA-102, ... for 120 Vac distribution terminal blocks;
.3 TBA-201, TBA-202, ... for 24 Vdc distribution terminal blocks.

.2 Other terminal blocks
.1 The other terminal blocks include all terminals other than supply terminals, including in-panel pre-wired terminal blocks for input/outputs, bus terminal blocks, etc.
.2 These terminal blocks shall be identified as follows:
.1 TB – "Terminal block number"
.2 "Terminal block number" shall consist of at least 4 digits and shall follow an identification logic based on the type of signals carried by the terminal or the panel layout.
.3 For example:
.1 The numbers of the input/output in-panel pre-wired terminal blocks shall contain the number of the control housing and the number of the slot in the corresponding input/output module (TB-410021-03 for the terminal block of the input/output module located in slot 3 of control API-410021).

.3 Terminals

.1 Every terminal shall be identified by a sequential number (minimum 2 digits) or, where applicable, by the corresponding numbers and identification of the module concerned (e.g., for input/output modules).

.2 Examples:
.1 01, 02, 03, 04, etc.;
.2 101, 102, 103, 104, etc.

.4 Fuse holder terminal

.1 Every fuse holder terminal shall be identified as follows:
.1 FU "Sequence"
.2 "Sequence" is a sequential number (minimum 2 digits) according to the number of fuse holder terminals or the line number on the distribution schematic.

.2 Examples:
.1 FU01, FU02, FU154.

.5 Circuit breaker terminal

.1 Every circuit breaker terminal (inside a control panel) shall be identified as follows:
  .1 D "Sequence"
  .2 "Sequence" is a sequential number (minimum 2 digits) according to the number of circuit breaker terminals or the line number on the distribution schematic.

.2 Examples:
  .1 D01, D02, D154.

3.10 IDENTIFYING WALL-MOUNTED DISCONNECT DEVICES

.1 The identifier on each wall-mounted disconnect device shall be unique and shall be indicated on the Contractor's detail drawings.

.2 Examples:

  .1 SEC-400120, SEC-089230.

.3 A vinyl film shall be fastened with adhesive near the input and output points of the disconnect device to identify the source of supply and the load.

  .1 Examples:
    .1 PPU4301/CCT1,2,3.

3.11 IDENTIFYING PANELS

.1 The identifier on each panel shall be unique and shall be indicated on the Contractor's detail drawings.

.2 Panels shall be identified according to one of two systems, depending on whether they are used for electric power distribution in the plant or for control (see paragraph 3.8 "IDENTIFYING WIRING" for details and definitions).

.3 Control and distribution centre panels

  .1 Identifiers on control and distribution centre (CCD) panels shall consist of only 4 digits in the following format:
    .1 CCD – "Sector" "Sequence"
    .2 "Sector" is the number of the plant sector and sub-sector;
    .3 "Sequence" is a sequential number (minimum 2 digits).

  .2 Examples:
    .1 "CCD-2003", for CCD number 3 of the raw water pumping

sector;

.2 "CCD-4605", for CCD number 5 of filter gallery No. 6.

.4 Electrical distribution panels

.1 Identifiers on distribution panels shall consist of only 4 digits in the following format:

.1 P "Voltage" "Type" – "Sector" "Sequence"

.2 "Voltage" is the panel voltage:

.1 P 600 V;

.2 S 120 V.

.3 "Type" is the type of panel:

.1 N Normal supply panel;

.2 U Emergency supply panel;

.3 S Uninterruptible supply panel.

.4 "Sector" is the number of the plant sector and sub-sector;

.5 "Sequence" is a sequential number (minimum 2 digits).

.2 Examples:

.1 "PPN-2011", for 600 V distribution panel number 11 of the raw water pumping sector (normal supply);

.2 "PSS-4605", for 120 V distribution panel number 5 of filter gallery 6 (uninterruptible supply).

.5 Control panels

.1 Identifiers on control panels shall conform to these examples:

.1 "PCL-410021" for the secondary control panel of filter gallery No. 1;

.2 "PCL-000011" for communications panel No. 11 of the telecommunications room.

.2 The nameplates on control panels shall contain, besides the identifier, 2 additional lines indicating the type and utilization of the panel.

.1 No accents shall be used in identification lettering.

.2 Examples:

PLC-400011 **PANNEAU D'AUTOMATE GERANT** **SECTEUR FILTRATION**

Nameplate of manager control panel for filtration sector.

PLC-430022

Nameplate of secondary control panel

PANNEAU D'AUTOMATE SECONDAIRE **GALERIE No.3 - FILTRES 505 à 508 et 509 à 512**

for filters on west side of gallery No. 3.

3.12 IDENTIFYING COMPONENTS IN CONTROL PANELS

.1 The identifiers on all components in control panels shall identify the component followed by a sequential number in the following format:

.1 "Component" "Sequence"

.2 "Component" is an acronym or abbreviation denoting the component:

.1 BA Power supply;
.2 RECPT Duplex receptacle, 120 Vac;
.3 SW Network switch;
.4 TR Transformer;
.5 SEC Disconnect device;
.6 D Circuit breaker;
.7 etc.

.3 "Sequence" is a six-digit number representing the component or a sequential number (minimum 2 digits) based on the number of components or the line number on the distribution schematic.

.2 Example:

.1 BA01, SW410101.

3.13 IDENTIFYING INSTRUMENTS

.1 The nameplates on instruments shall contain, besides the identifier (3rd line), two additional lines indicating the function or measured value (1st line) and the process or equipment concerned (2nd line).

.1 No accents shall be used in identification lettering.

.2 Examples:

PDIT-471002
O PERTE DE CHARGE O
FILTRE #10

Nameplate of pressure drop sensor for filter No. 10 in gallery No. 7.

	FIT-430103	
O	**DEBITMETRE**	**O**
	EAU FILTREE, FILTRE #01	

Nameplate of filtered water flowmeter for filter No. 1 in gallery No. 3.

	LIT-403212	
O	**NIVEAUMETRE**	**O**
	RESERVE D'EAU FILTREE No.2 OUEST	

Nameplate of filtered water level meter for tank No. 2 West.

3.14 IDENTIFYING NETWORK COMPONENTS

.1 Identifiers for network components shall consist of the complete component identification according to the type of network.

.1 For Ethernet networks, the identifier shall be the IP address;

.2 For terrestrial networks, the identifier shall be the network number followed by the node number.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This document shall be read together with the other specifications in the "Process Automation – Electrical Requirements" section.

PART 2 - PRODUCTS

2.1 INSTRUMENTATION AND CONTROL CABLES

.1 Instrumentation and control cables are used to transmit the following signals:

.1 4-20 mA current (DC) and other similar analog signals;

.2 Electric resistors at a range of 0 to 250 Ω;

.3 Digital control signals at 24 V (AC or DC);

.4 Other signals according to the requirements in the drawings and specifications.

.2 Instrumentation and control cables shall have the following specifications:

.1 Conductor type: single pair or triad, multiple pairs or triads and multiple triads for thermocouples;

.2 Conductors: 1.5 mm^2 (16 AWG) 7-stranded copper for each pair or triad and single-stranded conductor for thermocouples;

.3 Insulation: minimum 300 V, 105°C, PVC;

.4 Shielding: ribbon of Mylar-aluminum tape at least 25 mils thick, 7-stranded copper wire (18 AWG) for grounding of each pair or triad, and ribbon around the bundle of pairs or triads;

.5 Conductor colour:
.1 Pair: black and white;
.2 Triad: black, white and red;

.6 Inner sheath: PVC (-40°C to +90°C);

.7 Outer sheath: gray colour, FRPVC (-40°C to +90°C);

.8 Armour: interlocking aluminum;

.9 Number of pairs or triads: 4, 8 and 12.

.3 The high temperature cables (OLFLEX) shall, unless otherwise indicated, be aluminum sheathed for temperatures up to 200°C.

PART 3 - EXECUTION

.1 Not used.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This document shall be read together with the other specifications in the "Process Automation – Electrical Requirements-" section.

PART 2 - PRODUCTS

2.1 CONTROL CABLES (120 VAC)

.1 Control cables are used to carry control signals to some field devices, to supply some instruments and electronic components, and for other control signals at 120 VAC.

.2 Control cables shall have the following specifications:

.1 Conductors: 2.5 mm^2 (14 AWG) 7-stranded copper;

.2 Type: TECK 90;

.3 Insulation: 600 V, 90°C, XLPE;

.4 Inner sheath: black, PVC (-40°C to +90°C);

.5 Outer sheath: black, FRPVC (-40°C to +90°C);

.6 Armour: interlocking aluminum;

.7 Number of conductors: 2, 3, 7, 12 and 30.

PART 3 - EXECUTION

.3 Not used.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This document shall be read together with the other specifications in the "Process Automation – Electrical Requirements" section.

PART 2 - PRODUCTS

2.1 RS-232 COMMUNICATION CABLES (EIA RS232)

.1 The RS-232 serial cables (EIA RS232) shall have the following specifications:

- .1 4 pairs of 0.25 mm2 (24 AWG) 7-stranded copper cable, shielded twisted pairs;
- .2 Type: standard cable (Belden 8164 or equivalent);
- .3 Insulation: 600 V;
- .4 Maximum capacitance: 2,500 pF;
- .5 Resistance: between 3,000 and 7,000 Ω;
- .6 Outer sheath: grey, PVC (-40°C to +80°C).

2.2 RS-422 COMMUNICATION CABLES (EIA RS422)

.1 The RS-422 serial cables (EIA RS422) shall have the following specifications:

- .1 4 pairs of 0.25 mm2 (24 AWG) 7-stranded copper cable, shielded twisted pairs;
- .2 Type: standard cable (Belden 8164 or equivalent);
- .3 Insulation: 600 V;
- .4 Maximum capacitance: 2,500 pF;
- .5 Resistance: between 3,000 and 7,000 Ω;
- .6 Outer sheath: grey, PVC (-40°C to +80°C).

2.3 RS-485 COMMUNICATION CABLES (EIA RS485)

.1 The RS-485 serial cables (EIA RS485) shall have the following specifications:

- .1 4 pairs of 0.25 mm2 (24 AWG) 7-stranded copper cable, twisted pairs;
- .2 Shielding: aluminium / polyester, coverage 100%, with 0.25 mm2 (24 AWG) stranded tinned copper drain wire;
- .3 Type: standard cable (Belden 9844 or equivalent);
- .4 Insulation: 600 V, polyethylene;
- .5 Rated capacitance: 13 pF/foot;
- .6 Rated impedance: 120 Ω;
- .7 Inner sheath: grey, PVC (-40°C to +80°C);
- .8 Outer sheath: yellow, PVC (-40°C to +80°C);
- .9 Armour: interlocking aluminum.

PART 3 - EXECUTION

.1 Not used.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This document shall be read together with the other specifications in the "Process Automation – Electrical Requirements" section.

PART 2 - PRODUCTS

2.1 COPPER COMMUNICATION CABLES

.1 The copper Ethernet communication cables shall have the following specifications:

.1 4 pairs of 0.25 mm^2 (24 AWG) single-stranded copper conductor, twisted pairs;

.2 Type: standard industrial Ethernet cable (IE), Cat. 6;

.3 Insulation resistance: ≥ 500 mΩ/km;

.4 Characteristic impedance: 100 Ω ± 15 Ω at 1-100 mHz;

.5 Outer sheath: PVC (-40°C to +80°C).

2.2 FIBRE OPTIC COMMUNICATION CABLES

.1 The bidder shall accurately describe types and features of proposed cables and supplier.

.2 The submitted fibre optic cables shall have the following properties:

.1 Dielectric loose tube cable;

.2 At least 12 fibres;

.3 Waterproof without gel;

.4 Each cable shall be protected against rodents by a conduit made of the specified material;

.5 Draw temperature: -10 to 60°C;

.6 Operating temperature: -40 to 70°C;

.7 Any cable type used shall comply with the bend radius specified in the spec sheets (static and dynamic bend radius);

.8 The fibre optic Ethernet communication cables shall have the following specifications:

.1 Fibre optic cables for indoor installation;
.2 OM3 50/125 m fibre with 900 µm coating, FT4;
.3 Attenuation of 3.5 db/km at 850 nm;
.4 Bandwidth 160 mHz/km at 850 nm;
.5 Number of fibres: 12;
.6 Colour: aqua;
.7 Rated OFNR / FT4;
.8 Model accepted:
.9 Panduit, model FODRX6Y
.10 Equivalent brands or models shall be approved.

.3 Bidders have full latitude to suggest cable types that meet the minimum size requirements, based on available stock or optimized manufacturing costs.

PART 3 - EXECUTION

3.1 TELECOMMUNICATIONS CABLE INSTALLATION

.1 Install telecommunications cables in accordance with legal requirements and industry standards for safety and immunity. The Contractor shall meet the following requirements:

.1 Cable duct networks, conduits, sleeves and related telecommunications materials shall be used only for telecommunications wiring and shall not be shared with other utilities, such as electrical wiring;

.2 Install telecommunications cables in PVC conduits or Teck for cable trays. Contractor to supply and install conduits for telecommunications cables wherever they do not exist;

.3 Use cable clamps to connect cable shielding. In addition, use additional fastening for each network cable and place as close as possible to the connection box to absorb the traction exerted on the cable;

.4 In areas with mechanical stress, install cables in steel-armoured – or failing that, aluminum-armoured – tubes;

.5 Lay all cable untwisted in order not to reduce useful life;

.6 Install all telecommunications cables as far as possible from electrical and electromagnetic sources such as electrical wiring, ballasts, fluorescent lamps, motors, transformers, etc.;

.7 All indoor telecommunications cables shall be installed and fastened in dry locations, in accordance with the tractive force limit, the minimum bending radius and all other installation constraints specified by the manufacturer or stipulated in applicable installation standards.

.8 Provide 10 m of extra cable at terminations to allow for relocation and future changes.

.9 Provide at least 100% additional fibre for expansion.

.10 Use LC connectors.

.11 For fibre terminations, use fiber patch panels in LIU panels with fused pigtails.

.2 Contractor to provide prefabricated connections between the patch panels and active telecommunications equipment.

3.2 EXECUTION OF ARCHITECTURE

.1 Submit a document to the Ministerial Representative for each box detailing connection points and the strand identification system (strand numbering, colour identification, etc.) to facilitate future work.

.2 Lay fibre optic cables end to end between the two connection points (pump station and treatment plant). No fusions without justification accepted by the Ministerial Representative.

3.3 LOOP INSIDE BUILDINGS

.1 To allow future indoor rearrangements, the supplier shall leave a minimum 5 m loop of optical cable as close as possible to the equipment in each building.

3.4 CABLE PULLING

.1 The supplier shall determine cable unrolling location(s) and direction, and set up pulleys and cable protectors in each access shaft before pulling fibre optic cable.

.2 For protection, the cable shall always remain on its reel during pulling. If cable shall be unrolled on the ground before pulling, secure the area with a barrier and appropriate signage to eliminate risk of damage to cable.

.3 When a section of cable shall pass through several pulling chambers, a person shall be assigned to each of the chambers.

.4 The assigned persons shall install cable by pulling it from each pulling chamber. An appropriate communication system will enable them to communicate with each other and stop pulling at any time if necessary.

.5 Do not exceed the maximum pulling tension stipulated by the cable manufacturer. Connect a tensionmeter equipped with an alarm or an automatic release mechanism to the pulling equipment for immediate alert when maximum tension is reached.

.6 If maximum pulling tension is reached, supplier shall stop unrolling and determine the location and cause of the excessive tension.

.7 Before resuming installation, check for damage to the cable sheath.

.8 If Contractor uses the jetting method, it shall provide all required expertise and equipment, such as air compressors.

3.5 CABLE HANDLING AND STORAGE

.1 The supplier shall take all necessary precautions in cable handling and storage to avoid damaging the optical fibre and cable sheath during handling and installation.

3.6 CABLE LUBRICATION

.1 Supplier shall use a lubricant for polyethylene-sheathed cable to make it easier to pull fibre optic cable through the conduits.

.2 At locations where pulling tension is likely to reach high levels because of bends, coat cable sheath with lubricant at conduit entrance for adequate lubrication.

3.7 MAXIMUM TRACTIVE FORCE

.1 Supplier shall consult cable manufacturer's technical specifications for maximum tractive force that can be applied to cables, generally 2,700 N (600 lbs) for conventional optical cables.

3.8 BENDING RADIUS

.1 Supplier shall respect manufacturer's recommended minimum bending radius when installing cable (usually 15x diameter).

3.9 CONDUIT CLEANING

.1 Before laying new fibre optic cable, supplier shall clean conduits and insert a pull rope.

3.10 CLEANING AND CAPPING

.1 All new conduits shall be cleaned and capped after installation.

3.11 PULL ROPE

.1 To facilitate optic cable installation, place a 6 mm-diameter braided polypropylene pull rope in all new conduits and replace with a new one after use. Pull the new rope simultaneously with the cable.

3.12 GROUNDING OF FIBRE OPTIC CABLES

.1 Supplier shall ground the sheath of all metal-sheathed fibre optic cables. For cables with a double metal sheath, connect only the outer sheath to the ground. Ground cable to existing grounding network (underground or indoor).

.2 If fusion boxes have just been installed in the pulling chambers, the Contractor shall be responsible for installing grounding bars and rods in the chambers.

.3 In underground networks, the metal sheath of the fibre optic cable shall be grounded at all fusion points (if applicable). Ground cable to the inside of the grounded fusion box.

.4 Indoors, ground the metal sheath of the cable no more than 3 m from building entry using 6 AWG copper wire. The metal sheath shall also be grounded at cable termination point.

.5 Metal-sheathed fibre optic cables shall also be grounded at the building entry point and the connection panel.

3.13 LABELLING

.1 Supplier shall label fibre optic cable at the following locations:

.1 Inside and outside building entry point;

.2 Conduit entry and exit points;

.3 Buried protective housing;

.4 Front panel of connection cabinets;

.5 Outdoor fusion boxes.

3.14 CLIMATIC CONDITIONS

.1 The supplier shall check the cable manufacturer's recommendations prior to installation and comply with stipulated temperature limits to avoid damaging cable structure and components.

.2 Handle fibre optic cables carefully when installing at low temperatures. During the cold season, it is recommended that cables be stored in heated premises for at least 12 hours before installation.

3.15 MOUNTING INSPECTION

.1 Perform technical control after all cable guides are in place to make sure installation and labelling are correct. Perform a control after all wiring is in place to make sure the guides are the correct size, that all holes have been closed, etc.

3.16 CABLE TESTING

.1 The Contractor is responsible for providing all equipment, tools and labour required for acceptance testing of fibre optic cables. Tests are to include loss measurement of splices and fibres using optical time domain reflectometer (OTDR) and the insertion method (measure power, laser source, optical detector). Perform two-way tests using both methods.

.2 After completion of testing, the Contractor shall issue a report on the results of the two-way OTDR and insertion tests.

.3 The test report shall include the names and addresses of the origin and destination sites, the name of the employee who performed the tests, test date, and testing equipment brand, model, serial number and calibration certificate.

.4 The Contractor shall correct, at its own expense, all defects found during testing and replace, at its own expense, the defective materials or redo the work. It shall then repeat all checks and tests and provide the Ministerial Representative with all test results until these are satisfactory to the Ministerial Representative.

.5 Cost of all required testing equipment to be borne by the Contractor.

3.17 VERIFICATION OF FUSIONS

.1 When installing cable, the Contractor shall conduct tests on each fibre as fusions are performed to check the quality of the fusions before closing the fusion box. Optical loss (one-way) in fusions to be below 0.22 dB.

.2 Report on two-way OTDR tests.

.3 Actual value of optical loss from each fusion (average two-way optical loss in both directions), number of fusions identified, average optical loss of fusions, length and optical loss in dB/Km.

3.18 REPORT ON TWO-WAY INSERTION TESTS

.1 Report on two-way insertion tests shall include:

.1 Theoretical calculation of optical loss (quantities and losses associated with connectors, fusions, fibre);

.2 Maximum theoretical optical loss;

.3 Optical loss in both directions, in dB;

.4 Average two-way optical loss and length.

.2 To calculate theoretical loss, the supplier shall use, at a minimum, the following losses:

.1 Average two-way optical loss not to exceed maximum theoretical optical loss.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This document shall be read together with the other specifications in the "Process Automation – Electrical Requirements" section.

PART 2 - PRODUCTS

1.1 PROFIBUS-DP COMMUNICATION CABLES

.1 The Profibus-DP communication cables shall have the following specifications:

.1 Two 0.34 mm^2 (22 AWG) single-stranded copper conductors, twisted and shielded;

.2 Type: standard Profibus FC GP cable (Belden 3079a or equivalent);

.3 Insulation: 600 V;

.4 Characteristic rated impedance: 150 Ω;

.5 Outer sheath: purple, PVC (-40°C to +80°C).

1.2 PROFIBUS-PA COMMUNICATION CABLES

.1 The Profibus-PA communication cables shall have the following specifications:

.1 Two 0.8 mm^2 (18 AWG) seven-stranded copper conductors, twisted and shielded;

.2 Type: FC process cable (Belden 3076F or equivalent);

.3 Insulation: 600 V;

.4 Characteristic rated impedance: 100 Ω;

.5 Outer sheath: blue or black, PVC (-40°C to +80°C).

PART 3 - EXECUTION

.2 Not used.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This section describes the features, functionalities and particularities of the equipment defined in the scope of supply for the control system proposed in the "Process Automation - Scope of Supply" section of these specifications.

.1 The Contractor shall also refer to the projected plans to absorb the desired control philosophy as well as the scope of supply.

.2 More specifically, the first part of this document describes in detail the supply of equipment comprising several components, the second part describes the features of the system components, and the third part describes the scope of the work of setting up, installing and connecting the equipment for the planned control system, testing its various components, and commissioning them.

1.2 SCOPE OF SUPPLY

.1 In this specification, the description of the items to be supplied is not exhaustive in terms of quantities or types.

.1 The Contractor shall supply any other equipment, devices and accessories necessary for the implementation of the solution and technology that it is proposing.

.2 The Contractor shall define the complete list of equipment and software to be supplied in accordance with the present specifications in order to obtain a complete, functional solution.

.3 Hence the Contractor shall refer to the technical and functional requirements defined in the present specifications to determine the nature and the exact number of the pieces of equipment and accessories to be supplied.

.4 The Contractor shall ensure the compatibility of all programmable logic controllers (PLCs) supplied for the various areas and needs of the plant.

.5 The Contractor shall supply the networking equipment necessary for the system to work properly.

.6 The Contractor shall supply the wall panels for the connections to the various field networks, as required, and for the distribution of power to the instruments and other pieces of equipment.

.1 These panels shall be of a type appropriate to the environment in which they will be installed and shall conform to the detailed engineering design of the control system.

.2 These panels shall contain the components necessary for their functionality, including the following (according to the panel):

.1 Network components and switches (according to the panel);
.2 Required power supplies, line conditioners and filters;
.3 Power distribution systems (120 V AC and/or 24 V DC);
.4 Interfacing terminals and modules for the various power cables and input/output signals.

.7 The Contractor shall supply, install and connect all of the cables needed to connect all of the components of the control system to one another, as well as supply all necessary accessories, such as connectors, pull boxes, conduits, cable racks, supports, etc.

.1 The cables to be supplied include but are not limited to the following:

.1 Power and control cables between the instruments and the PLC and input/output (I/O) panels;
.2 Power and control cables for the metering pumps;
.3 Control cables between the actuators and the PLC and I/O panels;
.4 Communication cables between the various PLCs and between the various remote I/O modules;
.5 Communication cables between the various PLCs and the CCMs;

.8 The Contractor shall supply all of the replacement parts needed for the control system to work properly.

.1 The following set of replacement parts constitutes the minimum to be supplied, but once the detailed engineering and the selection of components have been completed, the Contractor shall submit a complete list guaranteeing secure availability of the planned control system.

.2 This list shall take into account the life cycle (MTBF) for every component placed in service, as well as how critical each component is for the control system.

.3 Other replacement parts:

.1 One (1) set of fuses (minimum 3) for each model used.

PART 2 - PRODUCTS

.1 Not used.

PART 3 - EXECUTION

3.1 GENERAL

.1 The Contractor shall perform all of the work of setting up and installing the various components of the planned control system, as well as testing and commissioning them.

.1 The Contractor shall ensure that all necessary precautions are taken (for the analyses, assembly work and testing) so that the project can be completed in accordance with best practices and in conformity with the present specifications and the requirements established by the various manufacturers.

.2 The work shall at all times be governed by the factor of risk to the personnel working on the project and to all of the facilities.

.3 The Contractor shall assign to the site qualified personnel in sufficient numbers to supervise the performance of the work and ensure that the tasks of installation, testing and commissioning are carried out in accordance with the plan established jointly by the Client and the Contractor.

.4 Particular attention shall be paid to the ergonomics (height, dimensions, distances, etc.) of all operating equipment, such as operator workstations and human-machine interfaces.

3.2 INSTALLATION AND CONNECTION OF CONTROL PANELS

.1 The Contractor shall install, connect and commission the necessary PLC panels and I/O panels and all of the connection and distribution panels.

.2 The Contractor shall supply and install all of the power, command and control cables necessary to obtain a complete, functional system.

.1 More specifically, the Contractor shall run and connect the cables and conduits:

.1 Between the control panel and the instruments – control and power
.2 Between the control panel and small pieces of equipment such as metering pumps and valves – control and power (various voltages as required);
.3 Between the control panel and the motors – control and power (600 V AC or other)
.4 Between the distribution panel and the control panel – power (600 V AC or other).

.3 The Contractor shall ensure that the following requirements are met with respect to installation of the panels:

.1 The panels shall be installed at the locations indicated on the specification drawings and specified by the operator.

.2 The Contractor shall take the necessary measurements on site to select the dimensions of the proposed panels.

.3 The final height at which a human-machine interface is installed shall be such that the upper edge of the screen (excluding the frame) corresponds to eye level for a person who is standing (about 1.62 m). Parallax shall be minimized, especially for human-machine interfaces equipped with touchscreens.

.4 All cables for communication, instrumentation and electrical power shall be routed through the bottom of the panel; holes shall be drilled in the lower wall of the corresponding panel and in the floor slab supporting it.

.5 All I/O cables shall be connected to remote terminal blocks of the corresponding modules.

.6 A thermal-magnetic circuit breaker for protection against overloads and short circuits shall be installed for each control panel.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This document shall be read together with the other specifications in the section "Process Automation – Control System".

PART 2 - PRODUCTS

2.1 INDUSTRIAL PROGRAMMABLE LOGIC CONTROLLERS

.1 The industrial programmable logic controllers (PLCs) shall be from one of the following manufacturers:

- .1 PLCs:
  - .1 Siemens, S7-200 or S7-300 series
  - .2 Allen Bradley, CompactLogix or ControlLogix series
- .2 Redundant PLCs:
  - .1 Siemens, S7-400 series
  - .2 Allen Bradley, ControlLogix series

.2 To ensure computability, only the brands identified above will be accepted.

- .1 Equivalent brands will have to be approved.

.3 Product characteristics shall be as follows.

- .1 All materials, devices and equipment shall be new, with no faults or defects.
- .2 All of the PLCs supplied shall be modular.
  - .1 Input/output modules integrated into the same housing as the central processing unit (CPU) will not be accepted.
  - .2 The various modules can be mounted on DIN rails, except for the master PLC, which shall be mounted in a chassis with a backplane.
- .3 All of the PLC components shall be identical and come from the same version.
  - .1 The Contractor shall guarantee interchangeability between modules of the same type with no need to modify the installation or update the programming and configuration software.

.4 All of the devices shall be designed so that they can be assembled, replaced and maintained as quickly and inexpensively as possible.
- .1 All of the PLCs shall be interfaceable with a TCP/IP Ethernet connection.
- .2 All similar parts shall come from the same manufacturer, be interchangeable and be designed so that they can be replaced as quickly as possible.

.4 PLCs

.1 Every CPU shall meet the following technical specifications:
- .1 Each CPU shall have not only enough processing capacity for the signals to be processed now, but also a percentage of space set aside for programming future hardware.
- .2 Enough built-in working memory shall be installed so that the programs and data used by the CPU always occupy less than 50% of the available memory.
- .3 The CPUs shall support all of the required communication interfaces with their various protocols, all on the same chassis.
- .4 The complete real-time processing cycle for the I/O memory tables (read, process, and write) shall be less than 50 ms.

.2 Every CPU shall have:
- .1 Indicators on the front for module diagnostics.
- .2 Indicators on the front for operating mode.
- .3 A slot for a memory card in order to expand working memory or load the user program.
- .4 Self-diagnosing capability for modules and programs.
- .5 Synchronization of the processor clock speed to within 1 ms through the communication network.
- .6 Parameterizable monitoring functions to ensure safety and a predefined reaction in case of processor error.

.3 The PLC power supply shall be redundant.
- .1 The switchover from primary power to secondary power shall be automatic, transparent and reported by the triggering of an alarm.

.5 Remote input/output chassis

.1 Remote input/output chassis shall be used if the Contractor considers it necessary.

.2 The power supply for the remote input/output chassis shall be redundant.
- .1 The switchover from primary power to secondary power shall be automatic, transparent and reported by the triggering of an alarm.

.3 The chassis, power modules, and communication modules shall meet the technical requirements of the lines of PLCs concerned.

.1 The input/output modules shall meet the technical requirements described in the following paragraphs.

.4 The input/output modules shall be from the same product line as the main chassis with the CPU.

.6 Communication modules

.1 Communication modules are used to establish the communication networks of the control system.

.2 These networks are the supervision network, the field networks and the remote input/output chassis networks.

.3 If the processor does not come with an Ethernet link, the Contractor shall supply an Ethernet communication module.

.1 The Ethernet communication module shall be equipped with copper ports required by the 100Base-TX standard, supporting a theoretical transmission rate of 100 Mbit/s for a distance of 100 m.

.4 If remote inputs/outputs are required, the Contractor shall supply a dedicated communication module for remote inputs/outputs.

.5 Each communication module shall be the same brand and family as the CPU that supports it.

.6 The communication modules shall meet the following technical requirements at a minimum:

.1 A built-in error checker.
.2 Ability to be removed and taken out of service with the power on.
.3 An indicator on the front of the module, showing its overall status.
.4 An indicator on the front of the module, showing the data transmission status.
.5 An indicator on the front of the module, showing the status of the network.
.6 An indicator on the front of the module, showing when there is a communication alarm.

.7 Digital input modules

.1 The digital input modules are used to monitor external input contacts and detect any change in their state. The types of inputs can be summarized as follows:

.1 Alarms.
.2 Equipment statuses.
.3 Relay operation.
.4 Digital inputs.
.5 Position detectors.

.2 The digital input modules shall be of the same brand and family as the CPU and shall meet the following technical requirements at a minimum:

.1 An indicator on the front of the module, showing its overall status.
.2 An indicator on the front of the module showing the status of each input.
.3 Sixteen (16) isolated input points at 120 V AC or thirty-two (32) isolated input points at 24 V DC.
.4 An optocoupler for each input.
.5 Error-free detection of external contacts when the power is greater than or equal to 80% of the nominal value.
.6 A diagnostic for input points in resting and working modes.
.7 The ability to detect the absence of a charging voltage.

.8 Digital output modules

.1 The function of the digital output modules is to control the equipment with maximum safety. The digital output modules shall be of the same brand and family as the CPU and shall meet the following technical requirements at a minimum:

.1 An indicator on the front of the module, showing its overall status.
.2 An indicator on the front of the module, showing the status of each output.
.3 Sixteen (16) relay output points.
.4 Individually isolated normally open (NO) contacts.
.5 Every point shall be controlled independently in two (2) ways (open or closed state) and shall remain in that state until an opposite state command is issued.
.6 When a digital output module is at rest or in a failure condition, all output contacts shall be in the state corresponding to the type used (open state for normally open contact relays and closed state for normally closed contact relays).

.2 Output contacts shall have the following characteristics:

.1 Ability to operate contacts with a resistive load of 1 A at 24 V DC.
.2 Impedance seen at the connection terminals below 1 ohm when the contact is closed.

.9 Analog input modules

.1 The analog input modules are used to monitor various process values of the system, such as levels, flows and turbidity.

.2 The analog signals are as follows:

.1 Resistances from several potentiometers indicating valve positions.
1. These potentiometers are mounted, for example, on the valve actuators.
.2 Current of 4 to 20 mA from several current transmitters.

.3 Resistances from eighteen (18) Pt100 platinum resistance thermometers.

.3 Signals shall be connected to the panels by a twisted pair in a shielded cable (detailed technical specifications for wiring are provided in the section of these specifications entitled "Process Automation - Measuring and Control Cables").

.4 The analog signals are available as current between 4 and 20 mA, resistance between 0 and 250 ohms and resistances from Pt100 platinum resistance thermometers.

.5 Every analog input module shall have:
- .1 An indicator on the front of the module, showing its overall status.
- .2 An indicator on the front showing the status of each channel.
- .3 A maximum of eight (8) inputs.
- .4 Galvanic isolation for each channel.
- .5 Insensitivity to common mode noise.
- .6 An alarm for exceeding the threshold for each channel.
- .7 An alarm for module status.
- .8 An alarm for signal loss for each channel.

.6 The analog input modules shall be of the same brand and family as the CPU and shall meet the following technical requirements at a minimum:
- .1 Accept voltage or current signals.
- .2 Accept resistance inputs ranging from 0 to 250 ohms.
- .3 Accept resistance inputs for temperatures from 0° to 50°C, at a minimum.
- .4 Ability to configure a dead band for each signal.
- .5 Overall accuracy of 0.2% over the full scale.
- .6 Linear accuracy of 0.1% over the full scale.
- .7 Sample all input channels in 500 ms.
- .8 Conversion time per channel shall not exceed 5 ms.
- .9 Ability to apply a different current range to the same module.
- .10 Software-controlled configurable features.
- .11 A minimum resolution of 13 bits plus sign.

.10 Analog Output Modules

.1 If various voltage and amperage ranges are required, the analog output modules shall support them.

.2 The analog output modules can be used to control equipment with variable process control.

.3 The analog output modules shall have:
- .1 An indicator on the front of the module, showing its overall status.
- .2 An indicator on the front showing the status of each channel.
- .3 A maximum of eight (8) outputs.

.4 Galvanic isolation for each channel.
.5 Protection against short circuits.
.6 An alarm for module status.
.7 An alarm for signal loss on each channel.

.4 The analog output modules shall be of the same brand and family as the CPU and shall meet the following technical requirements at a minimum:
.1 Each output shall be configurable independently.
.2 Output current 0 to 20 mA with an accuracy of ±1%.
.3 Conversion time per channel shall not exceed 1.5 ms.
.4 Stabilization time for a capacitative load shall not exceed 4 ms.
.5 Software-controlled configurable features.
.6 A minimum resolution of 11 bits plus sign.

.11 Replacement parts for PLCs:

.1 One (1) power supply;

.2 One (1) central processing unit (CPU) including all modules and accessories (memory, communication, battery, etc.).

.3 One (1) replacement module for of each type of communication module installed.

.4 One (1) replacement module for each type of analog and digital input/output module installed.

PART 3 - EXECUTION

.1 Not used.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This document shall be read together with the other specifications in the section "Process Automation – Control System".

PART 2 - PRODUCTS

2.1 HUMAN-MACHINE INTERFACES

.1 The human-machine interfaces (HMIs) shall be supplied by one of the following manufacturers:

.1 Siemens, SIMATIC HMI Panels

.2 Allen Bradley, PanelView Plus

.2 The human-machine interfaces shall meet the following technical requirements at a minimum:

.1 Colour TFT touch screens, minimum 8 inches (diagonal), for programmable logic controllers;

.2 A module for communicating with the Ethernet TCP/IP network;

.3 Local backup capability using a Compact Flash card;

.4 User data shall at all times occupy no more than 50% of the HMI's memory capacity.

.5 Capability of displaying trend curves.

.6 Capability for remote access.

.7 All other required accessories.

.3 Every interface shall display all equipment statuses and instrument readings for the corresponding system.

.1 It shall also be possible to use the HMI to control the system equipment, adjust the set points, and manage the alarms.

PART 3 - EXECUTION

3.1 INSTALLATION OF HUMAN-MACHINE INTERFACES

.1 The final height at which a human-machine interface is installed shall be such that the upper edge of the screen (excluding the frame) corresponds to eye level for a person about 1.62 m tall, when standing.

.2 The parallax shall be minimized, especially for human-machine interfaces equipped with a touch screen.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This document shall be read together with the other specifications in the section "Process Automation – Control System".

PART 2 - PRODUCTS

2.1 SWITCHES

.1 The Ethernet switches shall be supplied by one of the following manufacturers:

- .1 Siemens, Scalance or Ruggedcom
- .2 Allen Bradley
- .3 Cisco, Series IE
- .4 N-Tron, Series 700

.2 Equivalent manufacturers will have to be approved.

.3 The Ethernet switches chosen for the various networks shall allow implementation of the proposed network topologies.

- .1 The networks will be composed chiefly of programmable logic controllers, supervisory control and data acquisition (SCADA) system workstations and stationary human-machine interfaces.

.4 Every switch shall be equipped with a sufficient number of Ethernet RJ45 connectors (taking at least two (2) spare copper ports into account) and fibre-optic connectors if required.

.5 The switches shall be uniform and of industrial quality.

.6 The acceptable technical requirements for each switch are as follows:

- .1 Brackets for mounting on DIN rails and brackets for mounting on walls.
- .2 Every switch shall be "Plug and Play" and require no configuration before being placed in service.
  - .1 Every switch shall also have communication self-management functions to optimize connections and communication response times (i.e., be a "managed switch").
  - .2 Every switch shall have all fibre optic ports, if required, in compliance

with the 100Base-FX standard, using a full duplex multimode fibre optic medium, supporting a transmission speed of 100 Mbits/s over a distance of 2000 m.

.3 All required copper ports shall comply with the 100Base-TX standard, supporting a theoretical transmission speed of 100 Mbits/s over a distance of 100 m.

.4 A self-diagnostic function in the form of a row of LEDs indicating the following information:

.1 Electrical power status;

.2 Data transmission status;

.3 Connection status for each port.

2.2 ROUTERS

.1 The Ethernet routers shall meet the specifications listed in paragraph 2.1 – Switches.

.2 The Ethernet routers shall be supplied by one of the following manufacturers:

.1 Siemens, Scalance or Ruggedcom;

.2 Allen Bradley;

.3 Cisco, Series IE;

.4 N-Tron, Series 700.

.3 Equivalent manufacturers will have to be approved.

.4 When required, the Ethernet routers shall support virtual private network (VPN) functionalities.

PART 3 - EXECUTION

3.1 INSTALLATION OF THE CONTROL NETWORK

.1 The Contractor shall supply and install all of the accessories required to complete the installation of the networks described, including conduits, cable trays, supports, and accessories.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This document shall be read together with the other specifications in the section "Process Automation – Control System".

.2 Every field network shall comprise a sufficient quantity of repeaters, gateways and line terminators to connect the various segments of the network and keep the data transmission speed at the minimum threshold required in the present specification.

PART 2 - PRODUCTS

2.1 PROFIBUS DP/PA COMMUNICATION GATEWAYS

.1 The Profibus DP/PA communication gateways shall meet the following technical requirements:

.1 Separation of potential between the master Profibus DP and the Profibus PA;

.2 Diagnostic indicator lights;

.3 A power supply integrated into the Profibus PA;

.4 Isolation of at least 500 V DC;

.5 A transmission speed of at least 45.45 kbits/s on the DP and 31.25 kbits/s on the PA;

.6 Equipped with a bracket for mounting on a DIN rail.

.2 Self-diagnostic functions allowing monitoring of:

.1 The Profibus DP network;

.2 The Profibus PA network;

.3 The electrical power.

2.2 MODBUS REPEATERS

.1 The RS485 repeaters used for the Modbus networks shall meet the following specifications:

.1 Transmission speed configurable from 9.6 kbits/s to 12 Mbits/s;

.2 Galvanic separation of connected bus segments;

.3 Service temperature from -5°C to 45°C with a maximum condensation of at least 90%;

.4 Equipped with a bracket for mounting on a DIN rail.

.2 Every repeater shall have indicator lights on its face showing:

.1 Electrical power status;

.2 Communication status;

.3 Communication alarms.

2.3 PROFIBUS REPEATERS

.1 The RS485 repeaters used in the Profibus field networks shall meet the following specifications:

.1 Transmission speed configurable from 9.6 kbits/s to 12 Mbits/s;

.2 Galvanic separation of connected network segments;

.3 Service temperature from -5°C to 45°C with a maximum condensation of at least 90%;

.4 Equipped with a bracket for mounting on a DIN rail;

.2 Every repeater shall have indicator lights on its face showing:

.1 Electrical power status;

.2 Communication status;

.3 Communication alarms.

PART 3 - EXECUTION

3.1 INSTALLATION OF THE CONTROL NETWORK

.1 The Contractor shall supply and install all of the accessories required to complete the installation of the networks described, including conduits, cable trays, supports and accessories.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This section describes the technical requirements for the instruments defined in the scope of the contract for the control system proposed in the "Process Automation" division of the present specification and as shown in the standard process diagrams.

.2 More specifically, the first part of this document describes in detail the supply of the instruments, the second part describes the features of the instruments, and the third part describes the scope of the work of integrating the instruments into the system, installing them on chassis, and connecting them up.

1.2 SCOPE OF SUPPLY

.1 The instruments supplied shall take certain measurements and indicate certain states of the facilities and the process described in this specification.

.2 All of the instruments supplied shall be installed, calibrated, commissioned and integrated into the planned control system.

.1 Integration includes programming the programmable logic controllers, the human/machine interfaces, the concentrators, the controllers and the SCADA supervision system.

.2 The planned control system is described in more detail in the specification "Process Automation – Control System".

.3 Materials supplied

.1 The Contractor shall supply all of the instruments required to build a functional, safe, high-performance system that meets the requirements of this specification, as shown in the standard process diagrams and required for operations.

.2 The Contractor shall also supply a set of replacement instruments to ensure that the system provides satisfactory performance throughout the warranty period. The Contractor shall also ensure that replacement parts continue to be available after the warranty has expired.

.1 For the procedures for supplying replacement parts for instruments, see the administrative clauses and the technical specification (process specification).

.3 All instruments that may be used to measure parameters in process gas or be used for water or gas shall be cleaned for service with oxygen by the Manufacturer and sealed before delivery to prevent contamination when stored in accordance with CGA recommendations.

.4 Work included

.1 The Contractor shall install, connect and calibrate all instruments mounted on chassis. The Contractor shall:

.1 Provide and install at the Contractor's shop all pipes and tubes for connecting the instruments to the process;
.2 Also supply rotameters to adjust the instrument flows;
.3 Supply and install all necessary power wiring and conduits, control wiring, communication wiring and junction boxes.

.1 Refer to the specification "Process Automation - Electrical Requirements";

.4 Supply and install all accessories (shut-off valves, mounting supports, etc.) and all necessary hardware;
.5 Supply instruments cleaned for service with oygen and ozone, when required;
.6 Make all connections for the instruments;
.7 Connect and integrate the instruments into the new control system (when mounted on the same chassis).

.2 For all instruments to be mounted other than on chassis, the Contractor shall:
.1 Provide the instruments necessary for its solution;
.2 Also supply rotameters to adjust the instrument flows;
.3 Supply connection diagrams for the power wiring, control wiring and communication wiring and the necessary junction boxes.
.1 Refer to the specification "Process Automation - Electrical Requirements";
.4 Specify all accessories (shut-off valves, mounting supports, etc.) required for a complete installation;
.5 Make all connections for the instruments when they are installed;
.6 Integrate the instruments into the control system and the SCADA system.

.3 The Contractor shall commission all the instruments and supply all documentation, in French, including completed data sheets for all components supplied, calibration reports or certificates and manufacturer's manuals.

.4 The Contractor shall be responsible for:
.1 Checking/validating the quantities shown on the P&IDs;
.2 Supply, at a minimum, the instruments indicated on the standard P&IDs and list of instruments given to the Contractor, as well as any other instruments necessary for the system to work properly;

.3 Supply all documentation, including completed data sheets for all components supplied, calibration reports or certificates and manufacturer's manuals.

.1 Work excluded

.1 Not used.

1.3 EQUIVALENTS

.1 Any request for equivalents shall be made in accordance with the provisions of the administrative clauses.

1.4 CODES AND REGULATIONS

.1 All work, materials, structures and working methods shall conform to the building codes, the local, municipal, provincial and national safety codes, and the regulations of the authorities having jurisdiction over the work.

.1 In case of conflict between the regulations of the competent authorities, the most stringent requirements will take precedence.

.2 All equipment, materials, electrical and electronic instruments shall be CSA-approved.

.3 The work shall be governed by the latest edition of the following codes, standards and regulations:

.1 ANSI American National Standards Institute;

.2 CEQ Code électrique du Québec or the Canadian Electrical Code;

.3 NBC National Building Code;

.4 CSA Canadian Standards Association;

.5 EEMAC Electrical Equipment Manufacturers Association of Canada;

.6 FM Factory Mutual Engineering Corporation;

.7 IEEE Institute of Electrical and Electronic Engineers;

.8 ISA Instrumentation, Systems and Automation society;

.9 NEMA National Electrical Manufacturers Association;

.10 NFPA National Fire Protection Association;

.11 OSHA Occupational Safety and Health Administration;

.12 ULC Underwriters' Laboratories of Canada;

.13 CGA Compressed Gas Association.

PART 2 - PRODUCTS

2.1 GENERAL

.1 The Contractor's choice of manufacturer and instrument models shall remain uniform for all systems and subsystems in the contract.

.2 When a manufacturer is specified, the Contractor shall submit its price according to this requirement.

.3 When required, instrument measuring elements shall have been cleaned in advance at the Contractor's shop by the Contractor, for service with oxygen, and delivered sealed to the site.

.1 This cleaning is required for any instrument that comes in contact with an oxygen-enriched gas, regardless of whether ozone is present.

.4 The characteristic specifications for the instruments below apply to all instruments supplied, regardless of whether they are mounted on chassis.

.1 If the required specifications cannot be met because they are not relevant to the desired application, then the Contractor shall request an exemption and demonstrate the justification for its choice.

.5 If instruments that would be useful for the process are not described below, then their accessory features and quality shall be similar to what is described below.

.1 Also comply with all notes on the drawings.

.6 The details for each section shall be validated in the shop drawing phase.

PART 3 - EXECUTION

3.1 GENERAL

.1 The Contractor shall prepare and use instrument data sheets for the selection of instruments suitable to each process application under this contract.

.1 A single data sheet may be associated with multiple equipment identification numbers, provided that the technical characteristics and process application of each device are identical.

.2 The Contractor shall indicate on an additional sheet all of the equipment numbers associated with the data sheet in question.

.2 For a single type of device, only one manufacturer shall be chosen, regardless of the original equipment supplier, and this applies to all systems and subsystems.

3.2 INSTALLATION OF INSTRUMENTS

.1 Instruments shall be supplied, installed and connected by the Contractor on all equipment mounted on panels or chassis.

.1 The manufacturers' specific recommendations, detailed assembly drawings and locations shall be shown in the shop drawings.

.2 All instruments shall be installed in strict accordance with the manufacturer's recommendations.

.3 For each instrument, the Contractor shall:

.1 Provide all devices with appropriate supports according to the constraints encountered on the installation site, and make them independent of process equipment such as motors, pumps, conduits, etc., so that they are not subjected to any mechanical vibrations;

.2 Provide a sufficient length of cable to allow equipment and sensors to be disassembled and/or removed;

.3 Position and mount instruments with a display or indicator so that they can be read easily.

.1 When a measuring sensor's position is such that it cannot be read easily at eye level and is not readily accessible, supply, install and connect an independent display/transmitter with all required wiring and mounting brackets for remote installation.

3.3 QUALITY CONTROL AND TESTING

.1 General

.1 The specification requirements shall be met before equipment can be accepted by the Ministerial Representative.

.2 Any defective equipment shall be repaired or replaced by the Contractor. Any system deficiency shall be corrected to the satisfaction of the Ministerial Representative.

.3 For some devices, the Contractor shall provide assistance from the manufacturer for the start-up of the equipment.

.2 Tests at installation

.1 The Supplier shall perform, in the shop, all inspections and tests required to demonstrate the that the instruments installed and integrated into the control system are working properly.

.2 These tests shall include:

.1 Dielectric tests on all instruments and associated electrical components;

.2 Systematic verification of every calibrated instrument. The Supplier shall demonstrate the reliability of the measured values of all variables available, and shall also demonstrate the reliability of the calibration performed.

.3 Integration into the control system.

.3 The Contractor shall demonstrate that each instrument has been integrated into the control system in accordance with the requirements stated in the present specification and in the specification "Process Automation - Control System".

.4 Pressure tests on process connection piping

.1 After installing each instrument, the Contractor shall conduct an exhaustive inspection of the system by which it is connected to the process.

.2 The Contractor shall ensure that existing insulation is sealed and, if any leaks are found in the process-connection systems, shall eliminate them by replacing the shut-off valves, gaskets, or other accessories responsible for these leaks.

.3 During the pressure tests, the pressure indicated on the gauges for the cleaning air shall remain the same for at least 10 minutes; otherwise, the defects shall be corrected.

3.4 CALIBRATION

.1 Calibrations, settings and adjustments shall be made in accordance with the manufacturer's instructions.

.2 The instruments used shall be calibrated in both directions (upper and lower) from the set point and, if necessary, adjusted until their accuracy is consistent with the limits set by the manufacturer.

.3 For devices that do not have calibration certificates issued by the manufacturer, the Contractor shall perform the calibration.

.1 A calibration sheet shall be completed for each calibration performed.

.4 The calibration sheets shall be sent to the Ministerial Representative.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This document shall be read together with the other specifications in the section "Process Automation – Instrumentation".

PART 2 - PRODUCT

2.1 FLOWMETER

.1 The flowmeter shall be composed of one (1) conical glass tube, graduated, oriented vertically with the larger end upward, as well as one (1) stainless steel regulating float that can move freely within the tube.

.1 A needle valve shall be present to allow the flow to be adjusted.

.2 The flowmeter shall be equipped with a low-flow switch.

.2 The scale shall be graduated in appropriate flow units and calibrated for the appropriate fluid.

.1 The measuring accuracy shall be industrial-type, from 1 to 3% of the maximum range.

.3 Brands accepted:

.1 ABB,

.2 Endress & Hauser;

.3 Kobold.

.4 Equivalent models shall be approved.

PART 3 - EXECUTION

3.1 INSTALLATION OF INSTRUMENTS

.1 Flowmeter

.1 The installation shall be in strict accordance with the manufacturer's recommendations.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This document shall be read together with the other specifications in the section "Process Automation – Instrumentation".

PART 2 - PRODUCT

2.1 LEVEL GAUGES

.1 The measuring ranges of the level gauges shall be determined by the Contractor, with the help of the instrument manufacturer, on the basis of actual usage conditions.

.2 The level gauge housing shall be made of stainless steel, aluminum, or phenolic resin.

.3 The gauge shall be direct-read type.

.1 The graduations shall be black on a white background.

.4 The scale of the level gauge shall be graduated.

.1 The measuring accuracy shall be at least 0.1% of the maximum range.

.2 The scale shall show the level in metric units.

.5 Brands accepted:

.1 ABB;

.2 Endress & Hauser;

.3 Krohne.

.6 Equivalent models shall be approved.

PART 3 - EXECUTION

3.1 INSTALLATION OF INSTRUMENTS

.1 Level gauges

.1 Level gauges shall be installed in strict accordance with the manufacturer's recommendations.

.2 Orient the unit so as to prevent moisture from getting inside the housing.

.3 Level gauges shall be positioned so as to facilitate reading.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This document shall be read together with the other specifications in the section "Process Automation – Instrumentation".

PART 2 - PRODUCT

2.1 PRESSURE GAUGES

.1 The measuring ranges of the pressure gauges shall be determined by the Contractor, with the help of the instrument manufacturer, on the basis of actual usage conditions (level, temperature, flow, etc.).

.2 The pressure gauge shall be Bourdon type and made of bronze.

.1 Every indicator shall have a one-piece molded casing with the viewing glass on the front and the assembly screws or clamps on the back, to avoid any injuries if a pressure burst occurs when someone is standing in front of the instrument.

.2 The gauge shall be filled with glycerin.

.3 The gauge shall be protected by a gauge protector and an isolating valve.

.4 It shall also be equipped with a diaphragm preventing fine particles from clogging the pipe.

.1 When used for raw wastewater, sludge or other water containing particles, the gauge shall be equipped with a diaphragm filled with oil to prevent fine particles from clogging the pipe.

.3 The pressure gauge housing shall be made of stainless steel, aluminum, or phenolic resin.

.1 The tube shall be made of stainless steel and have a diameter suitable to the existing pipes.

.2 The pressure gauge shall be installed with a Grade 316 stainless steel isolation valve supplied and installed upstream.

.4 The dial shall be direct-read type.

.1 The diameter of the dial shall be at least 100 mm.

.2 The graduations shall be black on a white background.

.5 The pressure gauge scale shall be graduated over an arc of 270°.

.1 The measuring accuracy shall be at least 0.5% of the maximum pressure.

.2 The measuring range shall be equivalent to two (2) times the operating pressure of the equipment placed under pressure.

.3 The scale shall show the pressure in metric units and Imperial units (kPa/Psi) on a double scale.

.1 The scale shall allow a pressure gradient of 20 kPa to be read easily.

.6 Brands accepted:

.1 Ashcroft;

.2 Marsh;

.3 Wika.

.7 Equivalent models shall be approved.

PART 3 - EXECUTION

3.1 INSTALLATION OF INSTRUMENTS

.1 Pressure gauges

.1 The Contractor shall drill the pipes and install the threaded fittings required to install the pressure gauges.

.2 The Contractor shall install an isolation valve with purge for each pressure gauge.

.1 The gauges shall not be installed on the pipes directly (without fittings).

.3 The Contractor shall install the pressure gauges at a convenient height where they can be readily seen by users.

.1 The gauges shall be positioned so as to facilitate reading.

.4 The Contractor shall ensure that the seals are tight on all the pressure gauges.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This document shall be read together with the other specifications in the section "Process Automation – Instrumentation".

PART 2 - PRODUCT

2.1 THERMOMETERS

.1 The measuring ranges of the thermometers shall be determined by the Contractor, with the help of the instrument manufacturer, on the basis of actual usage conditions (level, pressure, flow, etc.).

.2 The thermometer housing shall be made of stainless steel, aluminum, or phenolic resin.

.3 The dial shall be direct-read type.

.1 The dial shall be at least 100 mm in diameter.

.2 The graduations shall be black on a white background.

.4 The thermometer scale shall be graduated over an arc of 270°.

.1 The measuring accuracy shall be at least 0.1% of the maximum range.

.2 The scale shall show the temperature in metric units (°C).

.5 Brands accepted:

.1 Ashcroft, Series EI.

.6 Equivalent models shall be approved.

PART 3 - EXECUTION

3.1 INSTALLATION OF INSTRUMENTS

.1 Thermometers

.1 The thermometers shall be installed in strict accordance with the manufacturer's recommendations.

.2 Orient the unit so as to prevent moisture from getting inside the housing.

.3 The thermometers shall be positioned so as to facilitate reading.

.4 No bimetal thermometer shall be exposed continuously to a process temperature exceeding 425°C.

.5 Inside the isolation well, expose the two (2) lowest inches of the stem to the temperature to be measured.

.1 The two (2) lowest inches of the stem constitute the sensitive portion of the thermometer.

.6 For calibration adjustments, immerse the sensitive portion of the thermometer stem in a source of calibrated temperature and stabilize the unit.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This document shall be read together with the other specifications in the section "Process Automation – Instrumentation".

PART 2 - PRODUCT

2.1 FLOW SWITCHES

.1 The measuring ranges of the flow switches shall be determined by the Contractor, with the help of the instrument manufacturer, on the basis of actual usage conditions (level, pressure, temperature, etc.)

.2 The power supply for the instrument signal shall be 24 V DC.

.3 The switch shall provide a PNP output.

.4 A digital display in engineering units shall be included.

.5 Brands accepted:

.1 ABB;

.2 Endress & Hauser;

.3 Kobold.

.6 Equivalent models shall be approved.

PART 3 - EXECUTION

3.1 INSTALLATION OF INSTRUMENTS

.1 Flow switches

.1 The installation shall be in strict accordance with the manufacturer's recommendations.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This document shall be read together with the other specifications in the section "Process Automation – Instrumentation".

PART 2 - PRODUCT

2.1 LEVEL SWITCHES WITH VIBRATING BLADES

.1 Level switches with fork-type vibrating blades shall be selected so that the sensor is integrated with the transmitter.

.2 The transmitter housing shall be of sturdy construction (NEMA Type 4X).

.3 The sensor and transmitter shall be protected against damage by the chemicals whose presence they detect.

.4 The power supply for the transmitter shall be 120 V AC.

.5 The transmitter shall contain light-emitting diodes (LEDs) to indicate the following states:

.1 Power on;

.2 Fork submerged;

.3 Fault.

.6 The transmitter shall provide a normally closed relay-type output so that the alarm condition (presence of liquid) corresponds to the opening of a contact ("fail safe").

.7 Brands accepted:

.1 Endress & Hauser; Liquiphant FTL;

.2 Siemens, SITRANS LVL200;

.3 Vega, Vegaswing.

.8 Equivalent models shall be approved.

2.2 LEVEL SWITCHES WITH CONDUCTIVE PROBES

.1 Level switches with conductive probes shall be selected so that the sensor is integrated with the transmitter.

.2 The housing shall be of sturdy construction (NEMA Type 4X).

.3 The probes and transmitter shall be protected against damage by the chemicals whose presence they detect.

.4 The power supply for the transmitter shall be 120 V AC.

.5 The transmitter shall contain light-emitting diodes (LEDs) to indicate the following states:

.1 Power on;

.2 Fork submerged;

.3 Fault.

.6 The transmitter shall provide a normally closed relay-type output so that the alarm condition (presence of liquid) corresponds to the opening of a contact ("fail safe").

.7 Brands accepted:

.1 Endress & Hauser; Liquiphant FTL;

.2 Gems, Warwick.

.8 Equivalent models shall be approved.

2.3 MECHANICAL LEVEL (FLOAT) SWITCHES

.1 Each mechanical level switch shall be in a plastic housing and freely suspended with its cable adjusted to the desired height.

.1 When the liquid reaches the level switch, the housing tilts and the mechanical switch closes or opens the circuit, thereby starting or stopping a pump or activating an alarm circuit.

.2 The cable sheath and the level switch casing shall be made of materials that can withstand the fluids in which they will be immersed.

.1 The switch housing shall not be damaged by corrosive chemicals or by hydrocarbons such as oils and greases.

.2 The Contractor shall supply, along with the shop drawings, proof of the chemical resistance of the materials used.

.3 The cable of each mechanical level switch shall be long enough to connect it to a junction box located near the tank.

.1 The cables shall be supplied by the same manufacturer.

.2 The length of cable required for each probe shall be determined by the Contractor.

.3 All brackets and fasteners required to hold the cables of the level switches in place shall be provided by the Contractor.

.4 The switch shall provide a relay output.

.5 Brands accepted:

.1 Endress & Hauser;

.2 Flygt;

.3 Kobold.

.6 Equivalent models shall be approved.

PART 3 - EXECUTION

3.1 INSTALLATION OF INSTRUMENTS

.1 General

.1 All brackets and fasteners required to hold the level switches in place shall be made of stainless steel.

.2 The devices shall be protected against shocks and inclement weather and, if possible, mounted in locations that are not directly exposed to solar radiation.

.2 Level switches with vibrating blades

.1 The Contractor shall install level switches with vibrating blades in a vertical position, near the lowest point of the tank (near the drain, for example).

.1 An added tube shall protect the probe against splashing.

.1 The length of the tube shall be identical to that of the forks.

.2 The tube shall be held in place by means of an L-bracket, such that the end of the forks leaves a clearance of ½ inch above the floor and a distance of 4 inches from the wall of the

containment basin.

.2 The switch housing shall be installed outside the containment tank, at a height of at least 6 inches above the wall of the tank.

.1 The Contractor shall provide the necessary extensions or control the switches specifying the length of the probe accordingly.

.3 Level switches with conductive probes

.1 The Contractor shall install level switches with conductive probes in a vertical position, near the lowest point of the tank (near the drain, for example).

.1 Compact probes (less than about 300 mm long) can be installed in any orientation.

.2 A support is required for probes that will be exposed to high lateral loads.

.2 For liquids that tend to deposit a layer of conductive material on the probe's insulation, the last spacer shall be moved to at least 100 mm from the end to provide a high resistance when the probe is exposed to these liquids.

.3 The housing for the probes shall be installed outside the containment tank, at a height of at least 6 inches above the wall of the tank.

.1 Leave at least 50 mm of space between two devices.

.2 The Contractor shall provide the necessary extensions or control the switches specifying the length of the probe accordingly.

.4 Mechanical level switches

.1 To comply with local regulations, level switches shall normally be connected to a low-voltage circuit, through a transformer.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This document shall be read together with the other specifications in the section "Process Automation – Instrumentation".

PART 2 - PRODUCT

2.1 ABSOLUTE/DIFFERENTIAL/RELATIVE PRESSURE SWITCHES

.1 The measuring ranges of the pressure switches shall be determined by the Contractor, with the help of the instrument manufacturer, on the basis of actual usage conditions (level, pressure, temperature, flow, etc.).

.2 The switch's set point shall be adjustable from 15 to 100 % of the maximum range.

.1 Each indicator should have a solid front arrangement for a release of excess pressure from behind.

.2 The indicator should be filled with glycerin.

.3 The indicator must be protected by a pressure gauge guard and isolation valves.

.4 The indicator should be provided with a diaphragm to prevent fine particles from clogging the pipe.

.1 When used for the raw water, sludge or any other charged water particles, the pressure gauge must be equipped with a diaphragm filled with oil to prevent fine particles from clogging the conduit.

.3 The dead band shall be adjustable.

.1 The tube should be of stainless steel and have a diameter adapted to the existing pipelines.

.2 The indicator must be installed with an isolation valve 316 stainless steel supplied and installed upstream.

.4 The switch shall provide a relay output.

.1 The dial diameter should be at least 100 mm.

.2 The markings shall be black on a white background.

.5 A digital display in engineering units shall be included.

.1 The measurement accuracy must be at least 0.5% of the maximum pressure.

.2 The measuring range must be equivalent to two (2) times the operating pressure of the pressurizing equipment.

.3 The scale should indicate the pressure in metric and imperial units (kPa / psi) on a double scale.

.1 The scale should allow easy reading of a pressure gradient of 20 kPa.

.6 Brands accepted:

.1 Ashcroft.

.2 Marsh;

.3 Wika.

.7 Equivalent models shall be approved.

PART 3 - EXECUTION

3.1 INSTALLATION OF INSTRUMENTS

.1 Absolute/differential/relative pressure switches

.1 Every switch shall be installed in a location where it will not be damaged by and its operation will not be affected by shocks, vibrations or temperature fluctuations.

.2 The switch shall be installed so as to prevent moisture from entering the housing through the electrical connection.

.1 The indicators should not be installed directly on the pipes (without connections).

.3 A 1/2", Grade 316 stainless steel isolation valve, with a line for purging the pipe, shall also be supplied.

.1 Indicators should be positioned to facilitate reading.

.4 The pressure switch shall be mounted, with its pressure connections, in a horizontal position.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This document shall be read together with the other specifications in the section "Process Automation – Instrumentation".

PART 2 - PRODUCT

2.1 TEMPERATURE SWITCHES

.1 The measuring ranges of the temperature switches shall be determined by the Contractor, with the help of the instrument manufacturer, on the basis of actual usage conditions (level, pressure, flow, etc.).

.2 The temperature measurements shall be made using thermal sensors composed of resistance temperature detectors (RTDs) insulated with heat sinks and covered with a sheath.

.3 The RTD response time shall be selected appropriately.

.4 The acceptable error measured by the RTD shall be minimal.

.1 The long-term stability of the switch shall be less than 0.1°C per year or less than 0.05% of the temperature range per year.

.2 Warming of the RTD shall not affect the accuracy of the temperature measurements.

.5 Brands accepted:

.1 Achcroft, série EI.

.6 Equivalent models shall be approved.

PART 3 - EXECUTION

3.1 INSTALLATION OF INSTRUMENTS

.1 Temperature switches

.1 There shall be no restrictions on how the sensor is installed (upright or on an angle).

.2 The parts of the heat sink that come in contact with a liquid shall be made of materials compatible with that liquid.

.3 Temperature indicators must be placed so as to facilitate reading.

.4 No bimetal type temperature indicator should not be continuously exposed to a higher process temperature to 425 ° C.

.5 Exhibit, within the isolation well, the two (2) inches below the rod to the temperature measured.

.1 Two inches below the rod is the sensitive part of the indicator.

.6 For calibration adjustments, immerse the sensitive portion of the indicator rod in a calibrated temperature source and stabilize the unit

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This document shall be read together with the other specifications in the section "Process Automation – Instrumentation".

PART 2 - PRODUCTS

2.1 GENERAL

.1 The measuring ranges of the flow transmitters shall be determined by the Contractor, with the help of the instrument manufacturer, on the basis of actual usage conditions (level, pressure, temperature, etc.)

.2 When the transmitter is separate from the flow sensor, all of the electronic circuits shall be located in the transmitter.

.1 In case of an installation with a remote transmitter, the wiring between the measuring element and the transmitter shall be included.

2.2 ELECTROMAGNETIC FLOW TRANSMITTERS

.1 The body of the flowmeter shall be of sturdy construction.

.1 The inner lining shall be made of polyurethane or ebonite.

.2 Mechanical connections shall be flanged.

.2 The electrodes for measuring flow shall be made of Grade 316L stainless steel or Hastelloy C4 alloy.

.3 The transmitter housing shall be of sturdy construction (NEMA Type 4X).

.1 The transmitter shall be equipped with a local display.

.4 The flow shall be graduated in L/h, L/s and m^3/s.

.1 The minimum accuracy shall be at least 0.2% of the flow rate measured between 0.3 m/s and 9 m/s for a distance without restrictions (elbows, valves, or reactors) and 5 times the diameter upstream from the flowmeter and 1 time the diameter downstream, both measured from the centre of the flowmeter.

.5 The zero of the device shall be stable and never require adjustment.

.6 The power supply for the transmitter shall be 24 V DC.

.7 The transmitter shall provide an output signal of 4-20 mA including HART communication.

.8 Brands accepted:

.1 Endress & Hauser;

.2 Rosemount.

.9 Equivalent models shall be approved.

2.3 MASS FLOW TRANSMITTERS

.1 Mass flowmeters shall be able to measure thermal mass flows of gas with no need for pressure or temperature compensation.

.2 The power supply for the transmitter shall be 24 V DC.

.3 The transmitter shall provide an output signal of 4-20 mA including HART communication.

.4 Each flowmeter shall consist of:

.1 One (1) flow-rate sensor suited to the existing conditions;

.2 One (1) electronic processing card for measuring and providing all of the required states and variables (flow, temperature, viscosity, alarm, etc.);

.3 One (1) illuminated liquid crystal display equipped with a touch keyboard for viewing the quantities measured and the alarms trasnmitted, as well as for configuring, programming and calibrating the instrument in local mode.

.4 Each of the mass flowmeters shall be of modular design.

.1 It shall be possible to replace the sensor, the electronic processing card, the display or the communication card without having to replace the entire system.

.5 Each mass flowmeter shall meet the following requirements:

.1 The sensor shall be either direct-insertion type or flanged, according to the application;

.2 The pressure drop shall be ≤ 10 mbar across the entire measuring scale;

.3 The accuracy of the values measured shall in no case exceed 0.5% across the entire scale, with respect to the entire range of acceptable temperatures;

.4 Each of the flowmeters shall be able to measure and provide at least two (2) variables: the gas temperature and flow rate;

.5 Have dry-contact outputs for the alarm signals;

.6 The acceptable power voltage is 24 V DC ± 10 %.

.7 It shall be possible to program the flowmeter in local mode with a touch keyboard.

.8 The sensor and the transmitter housing shall be made of aluminum or stainless steel. The transmitter housing shall be of sturdy construction (NEMA Type 4X).

.9 A digital display in engineering units shall be included.

.10 Brands accepted:

.1 Endress & Hauser;

.2 Rosemount.

.11 Equivalent models shall be approved.

PART 3 - EXECUTION

3.1 GENERAL

.1 The flow transmitters shall be installed in strict accordance with the manufacturer's recommendations.

3.2 ELECTROMAGNETIC FLOW TRANSMITTERS

.1 For nominal diameters greater than or equal to 350 mm, the sensor shall be mounted on a sufficiently strong and stable base.

.2 The wall-mounted housing shall be installed so that the cable inputs are facing downward.

.3 The installer shall make sure to connect the measurement system correctly, in accordance with the wiring diagrams.

.1 In addition, the transmitter shall be grounded, except in the case of a galvanic isolated auxiliary power supply.

.4 The two (2) flanges shall be connected to the corresponding flange of the pipe by means of a grounding cable, to avoid interference with the measurement; the grounding cable shall be mounted directly on the metal transport support.

.5 Grounding disks shall be used for potential equalization, in particular with fibreglass or PVC pipes.

.6 The straight segment of pipe at the intake shall be greater than or equal to five (5) times the nominal diameter.

.7 The straight segment of pipe at the outlet shall be greater than or equal to one (1) time the nominal diameter.

.8 It shall be possible to configure all device parameters important for a standard measurement quickly and easily through the "Quick Setup" feature.

3.3 MASS FLOW TRANSMITTERS

.1 The flowmeter can be mounted vertically or horizontally.

.1 If the meter will be used to measure gases containing moisture or contaminants, it is recommended that it be mounted vertically, and that a separate version be used.

.2 The direction of the arrow corresponds to the direction of flow in the pipe.

.3 For a horizontal pipe, the transmitter shall be positioned toward the top.

.2 If the gas contains moisture or is saturated with water vapour, the Contractor shall provide adequate insulation for the pipe and the sensor housing and/or add back-up heating for the pipe and/or the housing.

.3 The thermal sensor shall be positioned as far as possible from any element that might disrupt the flow.

.1 If the sensor shall be installed near sources of flow disruption, then the Contractor shall take suitable steps to minimize fluctuations in measurements.

.2 As a general rule, upstream of the meter, a straight length of pipe 15 times its nominal diameter is required for a flanged version and 20 times for a direction-insertion version.

.3 Downstream, a length 2 to 5 times the nominal diameter is required, depending on the model.

.4 Any tap for pressure, temperature or analyzer shall be located downstream from the sensor.

.1 For flange installations only, if the recommended straight length for the intake pipe cannot be provided, then a perforated-plate flow tranquilizer shall be used.

.2 If the sensor is insertion-type, then the use of a tranquilizer requires a custom calibration and a special installation.

.1 The Contractor shall submit the details of this type of installation for validation by the Client's representative.

.5 The pipes on which the flow sensors are mounted shall be welded seamlessly; the joints shall be of the right dimensions and correctly aligned.

.1 The pipe immediately at the flowmeter intake shall be weld-free, and its inner diameter shall match the flowmeter's.

.2 Avoid any change in diameter greater than 1 mm at the intake or outlet.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This document shall be read together with the other specifications in the section "Process Automation – Instrumentation".

PART 2 - PRODUCT

2.1 HYDROSTATIC LEVEL TRANSMITTER

.1 The hydrostatic level transmitter shall be composed of a piezoelectric sensor.

.1 The sensor will include the carrying cable with PE coating, without protection of the measuring element.

.2 The measuring ranges of the transmitter shall be determined by the Contractor, with the help of the instrument manufacturer, on the basis of actual usage conditions.

.3 The accuracy of the transmitter shall be 0.1%.

.4 The power supply for the instrument shall be 24 V DC.

.5 The transmitter shall provide an output signal of 4-20 mA including HART communication.

.6 The electrical connection section shall be separate from the electronic module, and the housing shall be made of aluminum or of NEMA Type 4X stainless steel.

.7 The instrument shall include a digital display with four (4) decimal digits, in engineering units, and a bar-type display below it.

.8 It shall be possible to configure the various parameters using a keyboard in local mode.

.9 Brands accepted:

.1 Endress & Hauser;

.2 Rosemount;

.3 Vega.

.10 Equivalent models shall be approved.

2.2 ULTRASONIC LEVEL TRANSMITTER

.1 Ultrasonic technology shall be used to make and deliver measurements of level without contact.

.1 The transmitter's continuous measurement of level produces a signal that is proportional to the level and that can be used for process control or for analog or digital display.

.2 The measuring ranges of the transmitter shall be determined by the Contractor, with the help of the instrument manufacturer, on the basis of actual usage conditions.

.3 The accuracy of the transmitter shall be 0.2% of the measured distance to the bottom of the tank, when empty.

.4 The power supply for the instrument shall be 24 V DC.

.5 The transmitter shall provide an output signal of 4-20 mA including HART communication.

.6 The electrical connection section shall be separate from the electronic module, and the housing shall be made of aluminum or of NEMA Type 4X stainless steel.

.7 The instrument shall include a digital display with four (4) decimal digits, in engineering units, and a bar-type display below it.

.8 It shall be possible to configure the various parameters using a keyboard in local mode.

.9 Brands accepted:

.1 Endress & Hauser;

.2 Rosemount;

.3 Siemens;

.4 Vega.

.10 Equivalent models shall be approved.

PART 3 - EXECUTION

3.1 INSTALLATION OF INSTRUMENTS

.1 General

.1 Leave enough space around the instrument so that maintenance personnel can access it freely and can open the cover of the transmitter module.

.2 Install displays/transmitters at standard height (146 cm).

.2 Ultrasonic level transmitters

.1 Install the level transmitter in a location that is free of vibrations.

.2 The level transmitter shall be installed far away from devices that use high voltage or DC voltage, as well as from variable-frequency drive units.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This document shall be read together with the other specifications in the section "Process Automation – Instrumentation".

PART 2 - PRODUCT

2.1 ABSOLUTE PRESSURE TRANSMITTERS

.1 The measuring ranges of the pressure transmitters shall be determined by the Contractor, with the help of the instrument manufacturer, on the basis of actual usage conditions (level, pressure, temperature, flow, etc.).

.2 The measuring diaphragm may be either ceramic or metal (316L stainless steel), according to the application.

.1 The Contractor shall justify, in shop drawings, its choice of measuring diaphragm.

.3 The accuracy of the transmitter shall be 0.1%.

.4 The power supply for the instrument signal shall be 24 V DC.

.5 The transmitter shall provide an output signal of 4-20 mA including HART communication.

.6 The electrical connection section shall be separate from the electronic module, and the housing shall be made of aluminum or of NEMA Type 4X stainless steel.

.7 The instrument shall include a digital display with four (4) decimal digits, in engineering units, and a bar-type display below it.

.8 It shall be possible to configure the various parameters using a keyboard in local mode.

.9 The process connection shall be ½-inch female NPT, stainless steel.

.10 The pressure transmitter shall be equipped with an isolation block with two (2) valves made of grade 316 stainless steel, including all required purges.

.11 Brands accepted:

.1 Endress & Hauser;

.2 Rosemount.

.12 Equivalent models shall be approved.

2.2 DIFFERENTIAL PRESSURE TRANSMITTERS

.1 The measuring ranges of the pressure transmitters shall be determined by the Contractor, with the help of the instrument manufacturer, on the basis of actual usage conditions (level, pressure, temperature, flow, etc.).

.2 Differential pressure transmitters can be used to measure pressure loss, flow or level.

.1 When a transmitter is used to measure pressure loss, it shall be able to measure the differential pressure in both directions (for example, -20 kPa @ +20 kPa).

.3 The measuring diaphragm may be either ceramic or metal (316L stainless steel), according to the application.

.1 The Contractor shall justify, in shop drawings, its choice of measuring diaphragm.

.4 The transmitter shall be analog, proportional to the inlet pressure.

.5 The accuracy of the transmitter shall be 0.1%, with an operational measuring range of 20:1.

.6 The power supply for the instrument signal shall be 24 V DC.

.7 The transmitter shall provide an output signal of 4-20 mA including HART communication.

.8 The electrical connection section shall be separate from the electronic module, and the housing shall be made of aluminum or of NEMA Type 4X stainless steel.

.9 The instrument shall include a digital display with four (4) decimal digits, in engineering units, and a bar-type display below it.

.10 It shall be possible to configure the various parameters using a keyboard in local mode.

.11 The process connection shall be ½-inch female NPT, stainless steel.

.12 The pressure transmitter shall be equipped with an isolation block with three (3) valves made of grade 316 stainless steel, including all required purges.

.13 Brands accepted:

.1 Endress & Hauser;

.2 Rosemount;

.3 Siemens.

.14 Equivalent models shall be approved.

2.3 RELATIVE PRESSURE TRANSMITTERS

.1 The measuring ranges of the pressure transmitters shall be determined by the Contractor, with the help of the instrument manufacturer, on the basis of actual usage conditions (level, pressure, temperature, flow, etc.).

.2 The measuring diaphragm may be either ceramic or metal (316L stainless steel), according to the application.

.1 The Contractor shall justify, in shop drawings, its choice of measuring diaphragm.

.3 The accuracy of the transmitter shall be 0.1%.

.4 The power supply for the instrument signal shall be 24 V DC.

.5 The transmitter shall provide an output signal of 4-20 mA including HART communication.

.6 The electrical connection section shall be separate from the electronic module, and the housing shall be made of aluminum or of NEMA Type 4X stainless steel.

.7 The instrument shall include a digital display with four (4) decimal digits, in engineering units, and a bar-type display below it.

.8 It shall be possible to configure the various parameters using a keyboard in local mode.

.9 The process connection shall be ½-inch female NPT, stainless steel.

.10 The pressure transmitter shall be equipped with an isolation block with two (2) valves made of grade 316 stainless steel, including all required purges.

.11 Brands accepted:

.1 Endress & Hauser;

.2 Rosemount.

.12 Equivalent models shall be approved.

PART 3 - EXECUTION

3.1 INSTALLATION OF INSTRUMENTS

.1 Absolute, differential and relative pressure transmitters

.1 An isolation block with three (3) valves made of grade 316 stainless steel shall be installed on any differential pressure transmitter that will be used to measure flow or pressure loss.

.1 An isolation block with two (2) valves shall be installed for measuring level.

.2 Any new transmitter shall be mounted on a post two (2) inches in diameter and made of grade 316 stainless steel.

.1 Two (2) or three (3) transmitters may be mounted on the same support.

.2 An existing support may be reused after modification to support up to three (3) transmitters.

.3 The support shall be long enough to allow access to the transmitters' purge valves and to leave enough space between them for maintenance.

.3 Choose a location that will not interfere with traffic and that will avoid the risk of splashing (gutters).

.4 Install the transmitter so as to leave enough room to calibrate it and to access the electronic circuits and the connections.

.5 The head of the transmitter can be turned 90° so that the connection box faces the maintenance technician.

.6 When capillaries (measuring tubes) are used to connect each transmitter to the measuring probes, these tubes shall all be of the same material and have the same diameter.

.1 The contractor shall determine the necessary length.

.2 The radii of curvature of the capillaries shall never be less than 100 mm or three (3) times the diameter of the capillary.

END OF SECTION

PART 1 - GENERAL

1.1 BACKGROUND

.1 This document shall be read together with the other specifications in the section "Process Automation – Instrumentation".

PART 2 - PRODUCT

2.1 TEMPERATURE TRANSMITTERS

.1 The measuring ranges of the temperature transmitters shall be determined by the Contractor, with the help of the instrument manufacturer, on the basis of actual usage conditions (level, pressure, flow, etc.).

.2 The temperature measurements shall be made using thermal sensors composed of resistance temperature detectors (RTD) insulated with heat sinks and covered with a sheath.

.3 The RTD response time shall be selected appropriately.

.4 The acceptable error measured by the RTD shall be minimal.

.1 The long-term stability of the transmitter shall be less than 0.1°C per year or less than 0.05 % of the temperature range per year.

.2 Warming of the RTD shall not affect the accuracy of the temperature measurements.

.5 The power supply for the instrument signal shall be 24 V DC.

.6 The transmitter shall provide an output signal of 4-20 mA including HART communication.

.7 A digital display in engineering units shall be included.

.8 Brands accepted:

.1 Endress & Hauser;

.2 Rosemount.

.9 Equivalent models shall be approved.

PART 3 - EXECUTION

3.1 INSTALLATION OF INSTRUMENTS

.1 Temperature transmitters

.1 There shall be no restrictions on how the sensor is installed (upright or on an angle).

.2 The parts of the heat sink that come in contact with a liquid shall be made of materials compatible with that liquid.

.1 The minimum immersion of the sensor shall comply with ASTM E644 standards.

END OF SECTION