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CONTROL OF WORK

1. GENERAL

1.1 Plant and Hours of Construction

.1 Normal construction activity shall take place only between the hours of 7:30 a.m. to 4:00 p.m., excluding Saturdays, Sundays, and legal holidays.

.1 Normal construction activity for electrical and process equipment tie-ins to existing non-active equipment (locked out and tagged out by the City) can occur based on the hours noted above.

.2 Normal work by the Contractor shall occur within these hours unless prior arrangements have been made with the Contract Administrator. If the altered normal construction activity hours request is declined by the Contract Administrator, the Contractor shall alter the Contractor's means and methods to not increase the cost nor schedule duration of the Work.

.3 Non-active existing infrastructure is defined as components or equipment deemed non-active by the City through the City's on-site safety protocols and the City's master lock-out, tag-out procedures.

.2 Notwithstanding the above clause, process and electrical equipment tie-ins to existing active infrastructure (temporary service interruption) shall occur during the following hours:

.1 MacLean RPS: 11:30 p.m. to 5:00 a.m. (maximum 5.5 hours in duration per outage) excluding Saturdays, Sundays, and legal holidays.

.2 McPhillips RPS: 11:30 p.m. to 5:00 a.m. (maximum 5.5 hours in duration per outage) excluding Saturdays, Sundays, and legal holidays.

.3 The Contract Administrator shall determine, based on interface with the City, if existing infrastructure is deemed active.

.3 Schedule and submit process, civil and electrical equipment tie-ins in writing to the Contract Administrator and submit Temporary Service Interruption Plan in accordance with this specification section.

1.2 Critical Work Sequence and Schedule Limitations

.1 McPhillips RPS is priority 1 with north side as starting point, followed by the south side;

.2 MacLean RPS is priority 2 with either the side as starting point, followed by the opposite side;

.3 Only one half of the potable water distribution process train header of a single RPS can be shut down at any time. Therefore, if one half of the potable water distribution process train header is shut down at location 1, then:

.1 The other half of location 1 potable water distribution shall stay fully operational.

.2 Both halves of location 2 potable water distribution systems shall stay fully operational.

.4 Potable water distribution process train headers will not be permitted to be taken out of service during the high water demand period between May 1 and September 30 in any given calendar year.

1.3 Care and Protection of Property and Premises

.1 Coordinate use of premises under the direction of the Contract Administrator.

.2 The Contractor shall be responsible for the preservation of all public and private property and shall use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the Work on the part of the Contractor, such property shall be restored by the Contractor, at their expense, to a condition equal or better to that existing before the damage was done, or they shall make good the damage in another manner acceptable to the Contract Administrator.

.1 Provide protection for existing building finishes and equipment during performance of Work.

.2 Provide necessary screens, covers, and hoardings.

.3 Protect property surrounding the Site from damage during performance of Work.

1.4 Interference with Existing Works

.1 Construction of the Work shall allow for continual operation of each RPS. Any interruptions in operation shall be coordinated with the Contract Administrator.

.2 Execute Work with the least possible interference or disturbance to facility operation, and normal use of premises. Coordinate with the Contract Administrator to facilitate the execution of Work to minimize disruption.

.1 City's operation staff will be working around the Site during the entire construction period for the execution of normal operations.

.2 Co-operate with the City's staff in scheduling operations and maintenance to minimize conflict.

.3 Coordinate all outages, including power to components, with the Contract Administrator a minimum of ten (10) Working Days in advance through the submission of an Interruption Plan in accordance with this specification section.

.3 Repair or replace portions of existing work which have been altered or damaged during construction operations to match existing or adjoining work, as directed by the Contract Administrator at no additional cost.

1.5 Lockout Tag Out of Existing Components and Equipment

.1 The City will Lockout Tag Out (LOTO) existing equipment and processes for the Contractor as required. Contractor to apply personal locks to LOTO. Contractor shall not operate, isolate or LOTO existing City equipment.

.2 The City will require single blocking:

.1 Contractor shall supply and install new gasket for the single blocking assembly.

.2 Contractor shall supply and install new single blocking plate, bolts and related appurtenances.

.3 At locations where only single valve blocking is practical, additional safety measures and monitoring will be required to provide a safe work environment for employees. Development of adequate safety plans in accordance with the Workplace Safety and Health Act and Regulation 217/06 are the responsibility of the Contractor, but as a minimum shall include:

.1 Provision of adequate egress from confined spaces including opening of manhole covers and blind flanges, and provision of ladders and other means of site exit.

.2 Use of body harnesses and safety hoisting equipment at all times when pressurized systems are disassembled and protected only by single block valves.

.3 Monitor and assess water leakage in closed system prior to disassembly of system. Monitor water leakage rate and advise City and Contract Administrator immediately of change in inflow rates. Evacuate confined space if necessary.

.1 Contractor shall manage nuisance water for any piping assembly and direct the nuisance water to an existing floor drain. Nuisance water drainage shall not impeded the safety of the Contractor nor City staff on-site.

.4 The City of Winnipeg Water and Waste Department will lock out all valves and necessary equipment closed in order to facilitate the Work. Where site access and lockout space on system valves are limited, the following lockout/tag out procedures will be implemented:

.1 Lockout locations for valves and equipment will be identified by the City.

.2 City will provide a single lock, chains and other devices to adequately secure valves within pits and chambers. The Contractor has the right to inspect the installation and satisfy that the lockout system is adequate. All locks utilized will be commonly keyed.

.3 Key(s) for single locked valves will be placed in a secure lock box at the site. All City staff and the Contractor will place personal/company locks complete with identification and tag out information on this lock box.

.4 Key(s) placed within the secure lock box will not be removed until all City staff, and Contractor locks have been removed from the lock box and verified that the work is completed.

.5 City staff will then unlock all valves and will commence with restoration of the systems to service.

1.6 Protection and Relocation of Existing Structures and Utilities

.1 Assume full responsibility for the protection of all buildings, structures, and utilities, public or private, including poles, signs, services to buildings, utilities in the street, gas pipes, water pipes, hydrants, sewers, drains, and electric and telephone cables, whether or not they are shown on the Drawings. Carefully support and protect all such structures and utilities from damage of any kind. Any damage resulting from the Contractor's operations shall be repaired by the Contractor at their expense.

.2 Protection and temporary removal and replacement of existing utilities and structures as described in this Section shall be a part of the Work under the Contract.

.3 Locate and protect utilities. Preserve active utilities traversing the Site in operating condition.

1.7 Access to Site

.1 Refer to General Conditions For Construction C8.

.2 Provide and maintain access roads, sidewalk crossings, ramps, and construction runways as may be required for access to Work.

.3 Maintain access to property including overhead clearances for use by emergency response vehicles.

.4 Provide full access to/from the Site for personnel and vehicular traffic.

.5 Workers shall display visible identification as Contractors or visitors.

.6 MacLean RPS: Contractor to access the building door via the west main person door. Contractor will be provided a key to access the building. Contractor's written sign-in of each individual employee is required for each entry or exit from the building's interior. Contractor sign-in shall be completed through the City's hardcopy visitor sign-in sheet at the Site.

.1 Person doors, and overhead door shall remain closed at all times for security purposes unless being used by the Contractor directly at that time.

.7 McPhillips RPS: Contractor to access the building door via the south person gate. Contractor will be provided a key to access the building. The City will provide the Contractor with an exterior person gate and vehicle gate access code number. Contractor's written sign-in of each individual employee is required for each individual entry or exit from the specific fenced exterior site or building interior. Contractor sign-in shall be completed through the City's hardcopy visitor sign-in sheet at the Site.

.1 Person doors, overhead door, person gates and vehicle gates shall remain closed at all times for security purposes unless being used by the Contractor directly at that time.

.8 Contract Administrator will holdback $10,000 on the Contractor's Progress Claim submission per individual RPS key which is distributed to the Contractor.

.1 The key holdback will be returned to the Contractor following City confirmation that the key(s) is returned. Key holdback release will occur in the following month's Progress Claim authorization as determined by the Contract Administrator.

1.8 City Site Safety Protocols

.1 The City will provide the Contractor with one Site Safety Orientation at each Site at no cost to the Contractor. The Contractor shall provide the Site safety orientation to any other Contractor personnel or sub-contractors who do not attend the Site Safety Orientation.

.2 Each person working on Site must complete the Site Safety Orientation. The Contractor shall provide the Contract Administrator with copies of completed orientations.

.1 The Contractor shall provide five (5) Working Days minimum notice to schedule the City provided Safety Orientations.

.3 Contractor shall adhere to all City's site safety protocols and procedures.

.4 Contractor shall post a hard copy of the Contractor's required personal protective equipment (PPE) specific to each Site at the entrance of each specific building.

.5 Contractor shall provide a full hard copy of the site-specific Contractor's safety plan, coordinate and designate a safety area where the safety plan will be stored at each site. Contractor to coordinate safety area with the City. The Contractor's safety plan shall be updated as construction progresses.

.6 Contractor shall allow for a minimum of 30 minutes of on-site time duration per individual personnel per individual site for the City prescribed safety debriefing.

.1 City safety debriefing is required for each Contractor personnel per individual Site location.

.7 The Contractor shall maintain an active day-to-day list of personnel who have received the City's safety debriefing on a Site-by-Site basis. This will be presented to the Contract Administrator in the monthly Site meetings by the Contractor.

1.9 City Prescribed Confined Spaces

.1 The City has prescribed the MacLean RPS lower-level distribution header area (entry accessed via existing steel access doors) as a confined space.

.2 Contractor personnel completing work in the above noted area must be properly trained in confined space entry in accordance with Manitoba legislation and the Contractor's specific safety policy.

.1 Contractor cannot derate the above area to not be a confined space.

.3 The City has prescribed all Site existing exterior concrete chambers, pits and below grade tanks deemed to remain as confined spaces.

.1 Contractor cannot derate the above areas as not being a confined space.

.4 The Contractor shall maintain an active day-to-day list of confined space trained personnel on a site-by-site basis. This will be presented to the Contract Administrator and City Representative in the monthly site meetings by the Contractor.

.5 Contractor is responsible for any and all equipment required for confined space entry work, as well as the completion and posting of confined space entry permits.

1.10 Cleanup and Disposal of Excess Material

.1 During the course of the Work, the Contractor shall keep the site of their operations in as clean and as neat a condition as possible.

.2 The Contractor shall dispose of all residues resulting from the construction Work and, at the conclusion of the Work, the Contractor shall remove and haul away any surplus excavation, broken concrete, soil, lumber, equipment, piping, temporary structures, and any other refuse

remaining from the construction operations, and shall leave the entire Site of the Work in a neat and orderly condition.

1.11 Protection and Usage of the Existing Fixed Overhead Bridge Cranes at the MacLean RPS and McPhillips RPS

.1 Contractor is allowed usage of the City's existing fixed bridge crane assembly at no cost to the Contractor based on the following:

.1 Contractor shall name a primary person and a secondary backup person (Contractor Crane Operator) who is a licensed crane operator in the Province of Manitoba. The Contractor's Crane Operator shall be the sole individual responsible for the operation of the City fixed bridge crane assembly.

.2 Operable load as listed on the City's existing fixed bridge crane assembly shall not be exceeded.

.1 MacLean RPS crane capacity: 9,070 kg.

.2 McPhillips RPS crane capacity: 9,070 kg.

.3 Contractor through the Contractor's Crane Operator shall supply and install all rigging, lifting plans, lifting beams, spreader bars and related appurtenances as required for the Work.

.4 Submit Contractor's Crane Operator, name, company, contact information and crane operator license including licence crane loading limitations in accordance with Section 01 33 00 - Submittal Procedures. Submit a minimum of four (4) weeks prior to the first required fixed bridge crane assembly scheduled usage.

.1 The Contractor must repair any damage caused by their Crane Operator to building surfaces, infrastructure, or components at the Contractor's expense. The Contract Administrator shall determine if the Contractor's repair is deemed satisfactory.

.5 The City will maintain and certify the fixed bridge crane assembly at no cost to the Contractor.

1.12 Usage of the Existing Main Floor MacLean RPS and McPhillips RPS Interior Building Loading Bay Area

.1 Contractor is allowed temporary usage of the City's main floor interior loading bay area based on the following:

.1 Temporary usage is limited to a duration of two (2) hours in any one Working Day unless authorized by the Contract Administrator.

.2 City guardrails or guardrail components in the area shall not be altered or removed.

.3 Storage of components for the Work at the main floor interior loading bay area is not allowed.

1.13 Building Non-Smoking Environment

.1 Smoking is not permitted on the Site.

1.14 Contractor Temporary Service Interruption Plan

.1 Notify the City, Contract Administrator, and utility companies of the intended interruption of services and obtain the required permission.

.2 Minimize the duration of interruptions.

.3 Where Work involves connecting or tie-in to existing active services (temporary interruption), provide the City and Contract Administrator ten (10) Working Days notice. Carry out work at times prescribed in this specification section.

.1 Submit a Temporary Interruption Plan in accordance with Section 01 33 00 – Submittal Procedures. The Temporary Interruption Plan shall include the following:

.1 Contractor anticipated City staff resources required;

.2 Date of the service interruption;

.3 Start and end time of the service interruption;

.4 Show the temporary services that will be provided by the Contractor if required to maintain the Site's operation;

.5 Indicate procedures and staging of the system interruptions/shutdowns and re-activation activities;

.6 Contractor anticipated impacts to services as a result of the service interruption;

.7 Contractor anticipated time required to bring systems back online;

.8 Contractor anticipated systems (including device piping and instrumentation diagram tag number) to be isolated and locked out, tagged out; and

.9 Contractor developed backout plan if work is not successful or will extend beyond the time anticipated time limits.

.2 The work associated with the Temporary Interruption Plan shall not commence until the Temporary Interruption Plan has been coordinated with the City and approved by the Contract Administrator.

.4 Establish the location and extent of service lines in the area of Work before starting the Work and in advance of developing the Contractor's Temporary Interruption Plan.

.1 Provide temporary services in accordance with the Temporary Interruption Plan when directed by the City to maintain critical building and City services.

.5 Where unknown services are encountered, immediately advise the City and Contract Administrator and confirm findings in writing.

.6 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in a manner approved by authorities having jurisdiction.

.7 Record locations of maintained, re-routed and abandoned service lines.

.8 Construct barriers, as required, in accordance with Section 01 52 00 - Construction Facilities.

.9 Include Contractor's scheduled Temporary Interruption Plan dates in the Contractor developed project schedule in accordance with Section 01 32 16 - Construction Progress Schedule.

1.15 Documents Required

.1 Maintain at each of the active Contractor construction sites, one (1) printed copy of each document as follows:

.1 Latest revisions of Construction Contract Drawings;

.2 Specifications;

.3 Addenda;

.4 Reviewed Shop Drawings;

.5 List of outstanding Shop Drawings;

.6 Proposed Change Notices (PCNs);

.7 Change of Work Orders (CWOs);

.8 Other modifications to the Construction Contract including RFIs and associated responses;

.9 Field Test Reports;

.10 Copy of approved Work Schedule;

.11 Health and Safety Plan and Other Safety Related Documents;

.12 Project meeting minutes; and

.13 Other documents as specified.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

MEASUREMENT AND PAYMENT

1. GENERAL

1.1 Description

.1 This Section includes administrative and procedural requirements necessary to prepare and process Applications for Progress Payment.

1.2 Schedule of Values

.1 Provide a Schedule of Values with the submission of monthly progress estimates.

.2 Schedule of Values to be supported by evidence as the Contract Administrator may reasonably direct and, when accepted by the Contract Administrator, to be used as the basis for progress estimates.

1.3 Measurement and Payment

.1 No payment(s) will be made prior to the completion of Contract execution by both parties and all requisite bonds and insurance have been submitted and approved.

.2 For each lump sum item in the Schedule of Values the Contractor will, in cooperation with the Contract Administrator, estimate the percentage of the item completed at the of the payment period. The Contractor will adjust the estimated percentage of the item as directed by the Contract Administrator.

1.4 Items Covered by Contract Prices

.1 In addition to covering the cost of various items of the Work, the contract lump sum price shall cover the cost of furnishing all materials, tools, equipment, labour, services transportation, hauling and incidentals necessary for executing the Work. Any item of Work not specifically listed under contract unit or lump sum prices shall be considered incidental to such other items as are listed. Payment for Work performed under the various Divisions of the Contract shall be made at the respective lump sum price breakdown for that item.

.2 All items not specifically included in the following measurement and payment clauses are incidental to the Work.

.3 Insurance and bonding shall be considered incidental to the Work. There shall be no separate payment for these items.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

CONSTRUCTION PROGRESS SCHEDULE

1. GENERAL

1.1 Definitions

.1 Activity: element of the Work performed during the course of the Project. Activity normally has an expected Duration, an expected cost, and expected resource requirements. Activities can be subdivided into tasks.

.2 Bar Chart (Gantt Chart) (in Microsoft Project and PDF): graphic display of schedule-related information. In a typical bar chart, activities or other Project elements are listed down the left side of the chart, dates are shown across the top, and Activity Durations are shown as date-placed horizontal bars. Generally, the Bar Chart should be derived from a commercially available computerized project management system.

.3 Baseline: original approved plan or schedule (for Project, work package, or Activity), plus or minus approved scope changes. This will be used to determine whether items are behind schedule.

.4 Duration: number of work periods (excluding holidays) required to complete Activity or other project elements. Usually expressed as Working Days or work weeks.

.5 Project Schedule or Schedule: planned dates for performing activities and the planned dates for meeting Substantial Performance. A dynamic, detailed record of tasks or activities alongside a critical path that must be accomplished to satisfy Project objectives. Project Schedule must be displayed using a Gantt Chart highlighting the critical tasks.

1.2 Requirements

.1 Provide the Contract Administrator with a Project Schedule on a monthly basis in the form of a Gantt chart showing time on the horizontal axis and tasks on the vertical axis.

.1 Monthly schedule updates will form a part of the Contractor's Progress Claim submission to the Contract Administrator.

.2 Indicate submission date of each anticipated Contractor Temporary Service Interruption Plan and indicate description of work in the schedule.

.3 Specify the date the Contractor must notify for release and the requested training date for the City's site-specific safety protocol orientation, as per the Working Day notice period in Section 01 14 14 - Control of Work.

.4 Specify the date by which the City/Contract Administrator must approve the Contractor's Temporary Service Interruption Plan, as per the Working Day notice period in Section 01 14 14 - Control of Work.

.5 Ensure start and end date details of site-specific component and equipment submissions of the following items:

.1 Primary flowmeter delivery at each Site.

.2 Secondary flowmeter delivery at each Site.

.3 Pipe spool delivery at each Site.

.4 Primary flowmeter installation start/end date at each Site.

.5 Secondary flowmeter installation start/end date at each Site.

.6 Pipe spool installation start/end date at each Site.

.6 Ensure the start and end date details of site-specific components and pre-commissioning activities.

.7 One overall Project Schedule inclusive of all the Sites is required. The overall Project Schedule shall clearly prescribe the individual Site's activities in the naming conventions below:

.1 MacLean RPS.

.2 McPhillips RPS.

.8 Ensure details of Project Schedule are practical and contribute to Substantial and Total Performance in accordance with specified dates.

.9 Ensure Project Schedule start, end dates and task duration in Working Days are prescribed. Alternations of any individual task or sub-task (s) start, end and task duration as the Work progresses will be shown on supplementary Contractor submitted schedules along with the pre-established Project Schedule start, end and task durations. The altered duration of the individual task or task(s) will be shown in different coloured fonts from the baseline duration.

.10 Ensure the Project Schedule lists all Manitoba Statutory Holidays as of the Contract award date.

1.3 Action and Informational Submittals

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.4 Progress Meetings

.1 Discuss the project schedule at the regular progress meetings with the Contract Administrator and City Representative.

.2 Identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than the Contract Administrator approved baseline project schedule.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

SUBMITTAL PROCEDURES

1. GENERAL

1.1 Description

.1 This Specification shall revise, amend, and supplement the requirements of CW 1110 of the City of Winnipeg's Standard Construction Specifications.

.2 Submit to the Contract Administrator the submittals required by individual Specification Sections for review. Submit promptly and in an orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.3 Do not proceed with Work affected by the submittal until reviewed by the Contract Administrator.

.4 Present Shop Drawings, product data, and samples in SI Metric units.

.1 Where items or information is not produced in SI Metric units, converted units are acceptable.

.5 Review submittals prior to submission to Contract Administrator. The Contractor review represents that necessary requirements have been determined and verified, for incorporation into Work.

.6 The review by the Contract Administrator is for the sole purpose of ascertaining general conformance with concept. It does not provide 'approval' of the detail design inherent in Shop Drawings (which remains with the Contractor), nor does it relieve the Contractor of responsibility for errors or omissions in Submittal or for meeting all requirements of the Work.

.7 Verify that field measurements and affected adjacent Work are coordinated in advance of the Submittal to the Contract Administrator.

.8 The Contractor shall make any corrections required by the Contract Administrator and shall resubmit corrections when the Contract Administrator's review so notes. The Contractor shall direct specific attention in writing on resubmitted submittals to revisions other than the corrections requested by the Contract Administrator on the previous submission.

.9 Keep one (1) reviewed hard copy of each submission on each active Site.

1.2 Submittal Procedures

.1 Direct submittals to the Contract Administrator via email. Use of proprietary document management software will not be permitted for submissions.

.1 Email transmittal shall contain:

.1 City Tender number.

.2 General project title.

.3 Submittal number in sequence and short submittal description.

.4 Confirmation of the submittal's specific application to each Site.

.1 Site naming conventions used by the Contractor shall be:

.1 MacLean RPS.

.2 McPhillips RPS.

.2 Electronic Submittals: Submittals made in electronic format shall be as follows:

.1 Each submittal shall be an electronic file in Adobe Acrobat Portable Document Format (PDF). Use the 2010 version or newer.

.2 Electronic files that contain more than ten (10) pages in PDF format shall contain internal book marking from index page to major sections of document.

.3 Add general information to each PDF file, including title, subject, author, and keywords.

.4 PDF files shall be set up to print legibly at 215.9 mm by 279.4 mm (8.5” by 11”), 279.4 mm by 431.8 mm (11” by 17”), or 559 mm by 864 mm (22” by 34”). No other paper sizes will be accepted.

.5 Submit new electronic files for each resubmittal.

.6 Include a copy of the transmittal in the Contractor’s submittal.

.7 Contract Administrator will reject submittals that are not accompanied by an electronic copy.

.3 Schedule of Submittals:

.1 Prepare a table listing all anticipated submittals required to complete the Work.

.2 For each Specification Section show, at a minimum, the following:

.1 Specification Section.

.2 Total number of submittals for each Specification Section.

.3 Identify each submittal by its submittal number in accordance with a numbering and tracking system.

.4 Identify each submittal by its name or title.

.5 Identify the application to each individual Site utilizing the Site naming conventions prescribed in this Specification Section.

.6 Identify the estimated date of submission to the Contract Administrator.

.7 State the revision number and status for each submittal.

.3 On a monthly basis, submit an updated schedule of submittals to the Contract Administrator if changes have occurred.

.4 Transmittal of Submittal:

.1 Stamp each submittal with a uniform Contractor's approval stamp before submitting to Contract Administrator.

.1 Stamp to include the Project name, submittal number, Specification number, Contractor's reviewer name, date of Contractor's approval, and a statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract. Stamp will be provided with the Contractor's signature.

.2 Contract Administrator will not review submittals that do not bear Contractor's approval stamp and signature and will return them without action.

.2 Identify each submittal with the following:

.1 Numbering and tracking system:

.1 Sequentially number each submittal.

.2 Resubmission of a submittal shall have the original number with a sequential alphabetic suffix.

.2 Specification Section and paragraph to which submittal applies.

.3 Project title and City Tender number (261-2025) as prescribed by the Contract Administrator.

.4 Date of transmittal.

.5 Name of Contractor.

.3 Identify and describe each deviation or variation from Contract.

.4 Include Contractor's written response to each of Contract Administrator's comments with resubmission of submittals.

.5 Format:

.1 Do not base Shop Drawings on reproductions of Contract Documents.

.2 Package submittal information by individual Specification Sections. Do not combine different Specification Sections in submittal package, unless otherwise directed in the Specification.

.3 Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract.

.6 Timeliness:

.1 Submit Shop Drawings and samples well in advance of scheduled delivery date for associated equipment or material and in an orderly sequence so as to cause no delay in the Work.

.7 Processing Time:

.1 Time for review shall commence on Contract Administrator's receipt of submittal.

.2 Contract Administrator will act upon Contractor's submittal and transmit response to Contractor not later than ten (10) Working Days after receipt unless otherwise specified.

.3 Resubmittals will be subject to the same review time.

.4 The review time required will not alleviate the Contractor of his responsibility to deliver the completed Work within the required time frame and schedule. Planning for submittal reviews and the risk to the construction schedule remains the Contractor's sole responsibility.

.8 Incomplete Submittals:

.1 The Contract Administrator will return the entire submittal for the Contractor's revision if preliminary review deems it incomplete.

.2 Incomplete Shop Drawing information will be considered as stipulated deductions for the purposes of progress payment certificates.

.3 When any of the following are missing, the submittal will be deemed incomplete:

.1 Contractor's review stamp, completed and signed.

.2 Transmittal of Contractor's Submittal form, completed and signed.

.3 Insufficient number of copies.

.4 All requested information is not provided.

.5 Submittals missing Professional Engineer's seal and signature, where it is required.

.9 Resubmittals:

.1 Clearly identify each correction or change made and include revision date.

.2 No adjustment of the schedule outlined in the Supplemental Conditions or Contract Price will be allowed due to delays in the progress of Work caused by rejection and subsequent resubmittals.

.3 The City may deduct the cost of additional reviews from the Contract Price.

1.3 Shop Drawings and Product Data

.1 The term "Shop Drawing" is defined in the City's General Conditions for Construction.

.2 Where specified within the specifications, Shop Drawings shall bear the seal of a Registered Professional Engineer in the Province of Manitoba.

.3 Additional submittal requirements for each component of Work may be listed within the relevant Specification Section.

.4 In general, all equipment to be installed at the Site will require Shop Drawings, which shall be submitted to the Contract Administrator.

.5 Sales bulletins or other general publications are not acceptable as submittals for review except where necessary to provide supplemental technical data.

.6 Submissions to include applicable standards, such as CSA or CGSB numbers.

.7 Adjustments made on Shop Drawings by the Contract Administrator are not intended to change the Contract Price. If adjustments affect the value of the Work state such as in writing to the Contract Administrator prior to proceeding with the Work.

.8 Only two (2) reviews of Shop Drawings will be made by the Contract Administrator at no cost. Each additional review will be charged to the Contractor at the Contract Administrator's scheduled rates. The Contract Administrator's charges for the additional Work will be deducted from the payment to the Contractor.

.9 All final reviewed Shop Drawings with red lines shall be drafted as original documents (CAD) with no red lines. These shall then be incorporated into the Operations and Maintenance Manuals.

1.4 Samples

.1 As required in the Contract Documents the Contractor shall submit samples of items or components to be incorporated in the Work which shall be submitted to the Contract Administrator. Coordinate location of samples to be delivered to the Contract Administrator's office at the cost of the Contractor. If the Contract Administration determines that the sample is to be kept on the project Site, provide a heated, secured space for the samples to be located in and readily accessible by the Contract Administrator for the duration of the on-Site Works.

.2 Adjustments made on samples by the Contract Administrator are not intended to change the Contract Price. If adjustments affect the value of the Work state such as in writing to the Contract Administrator prior to proceeding with the Work.

1.5 Requests for Information

.1 In the event that the Contractor or any Subcontractor involved in the Work determines that some portion of the Drawings, Specifications, or other Contract Documents requires clarification or interpretation by the Contract Administrator, the Contractor shall submit a Request for Information (RFI) Form in writing to the Contract Administrator.

.2 Submission Procedure:

.1 Submit RFI's to the Contract Administrator on the "Request for Information" in accordance with the link to the City's RFI form provided below. The Contract Administrator shall not respond to a RFI except as submitted on this form.

https://www.winnipeg.ca/infrastructure/templates/ExecutionControl/Request_for_Information_(RFI)_v2.0.docx

.2 Number RFI's consecutively in one sequence in the order submitted, in a numbering system established by the Contract Administrator.

.3 Submit one (1) distinct subject per RFI request. Do not combine unrelated items on one (1) form.

.4 Where RFI form does not have sufficient space, attach additional sheets as required.

.5 Submit with RFI form all necessary supporting documentation.

.3 In the RFI, the Contractor shall clearly and concisely set forth:

.1 The issue for which clarification or interpretation is sought and why a response is needed from the Contract Administrator;

.2 An interpretation or understanding of the requirement along with reasons why such an understanding was reached; and

.3 The specific Site in which the RFI occurs at, utilizing the Site naming conventions established in this specification section.

.4 The Contract Administrator will review all RFIs to determine whether they are valid RFIs. If it is determined that the document is not a valid RFI, it will be returned to the Contractor not having been reviewed with an explanation of why it was deemed not valid.

.5 An RFI response shall be issued within ten (10) Working Days of receipt of the request from the Contractor unless the Contract Administrator determines that a longer time is necessary to provide an adequate response. When the RFI submission is received by the Contract Administrator before noon, the review period commences on that Working Day. When the RFI submission is received by the Contract Administrator afternoon, the review period commences on the subsequent Working Day.

.6 If, at any time, the Contractor submits a large number of RFI's or the Contract Administrator considers the RFI to be of such complexity that the Contract Administrator cannot process the RFI's within ten (10) Working Days, the Contract Administrator shall confer with the Contractor within five (5) Working Days of receipt of such RFI's and the Contract Administrator and the Contractor will jointly prepare an estimate of the time necessary for processing same as well as an order of priority among the RFI's submitted. The Contractor shall accommodate such necessary time at no impact to the schedule and at no additional cost to the Contract.

.7 If the Contractor submits a RFI on an activity with ten (10) Working Days or less of available time to the impacted activity on the current project schedule, the Contractor shall not be entitled to any time extension due to the time it takes the Contractor Administrator to respond to the request provided that the Contract Administrator responds within the ten (10) Working Days set forth above.

.8 An RFI response from the Contract Administrator will not change any requirement of the Contract. In the event the Contractor believes that the RFI response from the Contract Administrator will cause a change to the requirements of the Contract, the Contractor shall within ten (10) Working Days give written notice to the Contract Administrator stating that the Contractor believes the RFI response will result in the Contract and the Contractor intends to submit a change request. Failure to give such written notice of ten (10) Working Days shall waive the Contractor's right to seek additional time or cost under the requirements of the Contract.

1.6 Closeout Submittals

.1 Refer to Section 01 78 00 - Closeout Submittals for closeout submittal requirements.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

SAFETY PROCEDURES

1. GENERAL

1.1 References

.1 The Workplace Safety and Health Act, C.C.S.M. c. W210, Province of Manitoba.

1.2 Requirements

.1 Appoint a suitably qualified employee who has sole responsibility with regard to safety on Site on behalf of the Contractor. Advise the Contract Administrator in writing as to the identity of this individual.

.2 Establish and maintain Safety and Health procedures for construction of the Works.

.3 Comply with additional safety requirements as specified in the General Conditions.

1.3 Safety and Health Regulations

.1 Contractor shall follow City safety and health standards, policies and procedures for Contractors as referenced in Section 01 14 14 - Control of the Work.

.2 Not withstanding D12, the Contractor shall provide a Safe Work Plan (SWP). Contractor shall reference Section 01 14 14 - Control of the Work for supplementary information including the posting of site-specific personal protection equipment (PPE) requirements at each Site and site-specific SWP hardcopy and coordinated safety area at each Site. Contractor shall include a SWP for the usage of City-owned fixed overhead bridge crane usage.

.3 Keep a hard copy of the relevant construction occupational safety and health regulations on Site at all times. Post the policies and notices for the information of workers.

.4 Ensure that workers are instructed and trained in safe and healthy working practices; take immediate action to correct any unsafe conditions and hold regular weekly safety (toolbox) meetings with all workers.

.5 Establish Job Safety and Health Procedures and submit copies for the Contract Administrator’s information.

.6 Provide Safety Orientation for all Contractor Personnel:

.1 All Contractor personnel must attend the Contractor’s Safety Orientation before access to the Site is granted.

.2 Coordinate and maintain records of Contractor personnel who have received the City prescribed Site Safety Orientation. Contractor record shall be based on a Site-by-Site basis.

1.4 First Aid Facilities and Services

.1 The Contractor shall provide first aid services at each Site, including their Subcontractors, until Total Performance.

.2 Provide first aid coverage for each Site at all times, including periods outside of normal work hours (evenings, weekends, and holidays) as required to support the work of Subcontractors.

.3 Make all provisions and pay all installation, manpower, equipment, medical supplies, restocking, and other costs for the first aid facilities in order to provide ongoing service for the Site in accordance with the requirements of this Specification.

.4 Locate the first aid facility in a convenient location within each Site. The Contractor shall provide and maintain unobstructed emergency vehicle access to the main door of the first aid facility, including appropriate signage as required.

.5 Arrange and supply transportation for injured workers both on and off Site.

.6 The Contract Administrator may review the Contractor's first aid facility, personnel, procedures, and safety and health program. The Contract Administrator is to have full access to the Work and the Contractor's first aid facilities and records at all times.

1.5 General Site Rules

.1 Ensure that all workers comply with "NO SMOKING" regulations on the Site.

.2 Wear hard hats and safety footwear on the Site at all times. Wear reflective vests as required by Site policy.

.3 Wear eye protection where there is a risk of eye injury; this includes chipping, grinding, welding, drilling, sawing, concrete placing, etc.

.4 Wear a hearing protection device where required and ensure all workers have a valid hearing test.

.5 Use scaffolding that complies with the Workplace Safety and Health Act and Regulation 217/06.

.6 Obtain a valid certificate of inspection for all cranes and boom trucks before coming on Site.

.7 Immediately report all hazardous situations to the Contract Administrator.

.8 Reference Section 01 14 14 - Control of Work, for City prescribed Confined Spaces for the individual Sites.

1.6 Submittals

.1 Submit in writing to the Contract Administrator the identity of the Contractor representative responsible for safety on Site as described in 1.2.1.

.2 Submit, by presentation to the Contract Administrator, the safety orientation for all Contractor’s Personnel. This presentation must be made before commencement of the Work.

.3 Make available on the Site to the Contract Administrator minutes of safety meetings, accident investigations, safety inspections, safety and health programs, safety orientation records, hearing test records, copies of safe work procedures, and copies of training records as appropriate.

.4 Present to the Contract Administrator and City any safety deviations, remediations and lessons learned at each bi-weekly job meeting.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

QUALITY CONTROL

1. GENERAL

1.1 Description

.1 Ensure Quality of Work is of the highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify the Contract Administrator if required Work is such as to make it impractical to produce required results.

.2 Do not employ anyone unskilled in their required duties. The Contract Administrator reserves the right to require dismissal from Site, for the workers deemed incompetent or careless.

.3 Decisions as to the standard or fitness of Quality of Work in cases of dispute rest solely with the Contract Administrator, whose decision is final.

1.2 References

.1 Within the text of the Specifications, reference may be made to the following standards and statutes:

.1	AISI	American National Standards Institute
.2	ANSI	American National Standards Institute
.3	ASME	American Society of Mechanical Engineers
.4	ASTM	American Society for Testing and Materials
.5	AWWA	American Water Works Association
.6	AWS	American Welding Society
.7	CAN	National Standard of Canada
.8	CEC	Canadian Electric Code
.9	CGSB	Canadian Government Specification Board
.10	CSA	Canadian Standards Association
.11	IEEE	Institute of Electrical and Electronics Engineers
.12	ISA	International Society of Automation
.13	ISO	International Organization for Standardization
.14	MEC	Manitoba Electric Code
.15	NACE	National Association of Corrosion Engineers

.16	NBC	National Building Code
.17	NEMA	National Electrical Manufacturer's Association
.18	NFPA	National Fire Protection Association
.19	NSF	NSF International
.20	ULC or cUL	Underwriters Laboratories of Canada
.21	SSPC	Society for Protective Coatings

.2 Conform to the latest version of such standards available at the time of tendering, in whole or in part, as specified.

.3 If there are questions as to whether any product or system is in conformance with applicable standards, the Contract Administrator reserves the right to have such products or systems tested to prove or disprove conformance with Contract Documents, or by the Contractor in the event of non-conformance.

1.3 Independent Inspection Agencies

.1 Independent inspection/testing agencies may be engaged by the City to inspect and/or test portions of the Work. The cost of such services will be borne by the City. Costs of additional tests required due to defective Work shall be paid by the Contractor.

.2 All equipment required for executing inspection and testing will be provided by the respective agencies.

.3 Employment of inspection/testing agencies does not relieve or relax the Contractor’s responsibility to perform the Work in accordance with the Contract Documents.

.4 If defects are revealed during inspection and/or testing, the appointed agency will request additional inspection and/or testing to ascertain the full degree of defect. Correct the defect and irregularities as advised by the Contract Administrator at no cost to the City. The Contractor shall be responsible for the costs of the subsequent testing and inspection of the corrected Work. The City shall deduct such costs from the Contract, amount of which will be determined by the Contract Administrator.

1.4 Access to Work

.1 Allow the Contract Administrator access to the Work. If part of the Work is in preparation at locations other than the Site, allow access to such Work whenever it is in progress.

.2 The City, the Contract Administrator, and other authorities having jurisdiction shall have access to the Work, off-site manufacturing, and fabrication plants. Do not cover or enclose systems prior to inspection.

1.5 Procedures

.1 Notify appropriate agency and the Contract Administrator a minimum of seventy-two (72) hours in advance of requirement for tests, so that attendance arrangements can be made.

1.6 Rejected Work

.1 Remove defective Work, whether the result of poor workmanship, use of defective products, or damage and whether incorporated in Work or not, which has been rejected by the Contract Administrator as failing to conform to the Contract Documents. Replace or re-execute in accordance with the Contract Documents.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

TEMPORARY UTILITIES

1. GENERAL

1.1 Installation and Removal

.1 Provide temporary utility controls in order to execute Work expeditiously.

.2 Remove from Site all such work after use.

1.2 Water Supply for Personnel Usage

.1 City will provide continuous supply of potable water for Contractor general usage. Water supply is restricted to the capacity of the interior wall hydrant's potable water system at each Site or exterior wall hydrant's at each Site.

.2 Arrange for connection, and pay costs for conveyance items, maintenance and removal of the Contractor related appurtenances.

.1 The Contractor's water connection shall include a back-flow preventer device, supplied and installed by the Contractor, before connecting to the City's wall hydrant.

.3 Potable water will be provided by the City at each Site at no cost to the Contractor.

1.3 Water Supply for Commissioning and Disinfection of Equipment to Remain

.1 City will provide continuous supply of potable water for commissioning and disinfection of equipment to remain as a part of the Work at each Site. Water supply is restricted to the capacity of the interior wall hydrant's potable water system at each Site.

.2 Arrange for connection, and pay costs for conveyance items, maintenance and removal of the Contractor related appurtenances.

.1 The Contractor's water connection shall include a back-flow preventer device, supplied and installed by the Contractor, before connecting to the City's wall hydrant.

.3 Potable water will be provided by the City at each Site at no cost to the Contractor.

1.4 Confined Space Ventilation for the Interior Specific Building Areas and Exterior Areas

.1 Reference Section 01 14 14 - Control of Work: Contractor to supply all necessary confined space ventilation requirements in accordance with Manitoba legislation and the Contractor's specific safety policy.

1.5 Temporary Power and Light for Each Site

.1 Temporary power during construction for temporary construction trailer, closed trailer storage, temporary lighting and operating of hand power tools (excluding welding equipment):

.1 The City will supply power to the Contractor at no cost to the individual safe normal operating capacity of a fixed outlet and fixed circuit breaker.

.2 Contractor shall be responsible for confirming, coordinating and establishing the on-Site limitations and any conveyance of power, including commissioning and decommissioning activities.

1.6 Temporary Communication Facilities and Internet/Email

.1 Provide a cellular telephone to the Contractor's on-site Superintendent. Cellular communication is required twenty-four (24) hours a day from the Contract Administrator.

.2 Provide internet access to the Contractor's on-site Superintendent. Email communication is required twenty-four (24) hours a day from the Contract Administrator.

1.7 Fire Protection

.1 Provide and maintain temporary fire protection equipment during performance of Work.

.2 Burning rubbish and construction waste materials are not permitted on-site.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

CONSTRUCTION FACILITIES

1. GENERAL

1.1 Reference Standards

.1 Canadian Standards Association (CSA International):

.1 CAN/CSA-S269.2, Access Scaffolding for Construction Purposes.

1.2 Shop Drawings

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

1.3 Installation and Removal

.1 Prepare site plan (Shop Drawing) indicating proposed location and dimensions of area to be used by Contractor, number of trailers to be used, avenues of ingress/egress to any temporary construction fenced area and details of any temporary construction fence installation. Indicate the location of existing buildings and structures, existing fencing to remain in the area, and existing roadways.

.2 Identify how construction traffic will be directed through (both in and out traffic) the Site.

.3 Identify any temporary construction roads and how the roads will interface with the City areas.

.4 Identify any temporary construction roads and how the roads will interface with City roadways at the Site.

.5 Identify areas which have to be gravelled to prevent tracking of mud.

.6 Indicate use of supplemental or other staging areas.

.7 Provide construction facilities in order to execute Work expeditiously.

.8 Remove from Site all such Work after use.

.9 Contractor laydown areas are acceptable on-site as prescribed by Tender Documents.

1.4 Scaffolding

.1 Scaffolding shall be conducted in accordance with CAN/CSA-S269.2.

.2 Provide and maintain scaffolding and protective barriers during the Work.

1.5 Dust Tight Screens

.1 Provide dust tight screens or partitions to localize dust-generating activities, and for protection of workers, existing systems and buildings, and the public.

.2 Maintain and relocate protection until such Work is complete.

1.6 Hoisting

.1 Provide, operate and maintain temporary cranes required for moving of materials and equipment.

.2 Temporary hoists and cranes to be operated by a qualified operator.

1.7 Site Storage/Loading

.1 Do not load or permit to load any part of Work with weight or force that will endanger Work.

1.8 Construction Parking

.1 Parking will be permitted on each Site but shall be within the Contractor laydown area or as specifically prescribed in the Tender Documents provided it does not disrupt performance of the City work at each Site.

.2 Provide and maintain adequate access to each Site.

.3 Where mud has been deposited on roadways by the Contractor's equipment, clean roadways free of mud.

.4 Keep Construction Parking and related temporary roadways, and work areas free of snow build-up.

1.9 Security

.1 Do not allow unauthorized access to the Site.

1.10 Equipment, Tool and Materials Storage

.1 Provide and maintain, in clean and orderly condition, lockable weatherproof temporary sheds for storage of tools, equipment and materials.

.2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.

1.11 Sanitary Facilities

.1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.

.2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.

.3 City water closet facilities at each Site shall not be utilized by the Contractor.

1.12 Construction Signage

.1 No other signs or advertisements, other than construction warning signs, are permitted on Site.

1.13 Protection and Maintenance of Traffic

.1 Maintain and protect traffic on affected roads during construction period.

.2 Protect travelling public from damage to person and property.

.3 Construct temporary access roads and crane support pads if necessary.

.4 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.

.5 Dust control: adequate to ensure safe operation at all times.

.6 Provide snow removal during period of Work.

.7 Remove, upon completion of Work all temporary access roads and crane supporting pads.

1.14 Clean-Up

.1 Clean dirt or mud tracked onto paved or surfaced roadways, parking lots and sidewalks.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 Examination

.1 Locate and protect utilities. Preserve active utilities traversing each Site in operating condition.

END OF SECTION

MATERIAL AND EQUIPMENT

1. GENERAL

1.1 Intent

.1 Use new material and equipment unless otherwise specified.

.2 Provide material and equipment of specified design and quality, performing to published ratings and for which replacement parts are readily available.

.3 Use products of one manufacturer for equipment or material of the same type or classification unless otherwise specified.

1.2 Manufacturer’s Instructions

.1 Unless otherwise specified, comply with the manufacturer's latest printed instructions for materials and installation methods.

.2 Notify Contract Administrator in writing of any conflict between these Specifications and manufacturer's instructions. Contract Administrator will designate which document is to be followed.

1.3 Fasteners

.1 Provide metal fastenings and accessories in same texture, colour and finish as base metal in which they occur. Prevent electrolytic action between dissimilar metals. Use non-corrosive fastenings, anchors and spacers for securing exterior Work.

.2 Space anchors within limits of load bearing or shear capacity and ensure that they provide positive permanent anchorage.

.3 Keep exposed fastenings to minimum, space evenly and lay out neatly.

.4 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

.5 Obtain Contract Administrator's approval before using explosive actuated fastening devices. If approval is obtained comply with CSA Z166-1975.

1.4 Fastenings Materials

.1 Use fastenings materials as prescribed in the Tender Documents.

1.5 Storage, Handling and Protection of Products

.1 Handle and store products in a manner to prevent damage, contamination, deterioration, and soiling, and in accordance with manufacturer's recommendations when applicable.

.2 Store packaged or bundled products in original and undamaged condition with manufacturer's seals and labels intact. Do not remove from packaging or bundling until required in Work.

.3 Products subject to damage from weather are to be stored in weatherproof enclosures, heated if required.

.4 Store sheet material and lumber on flat, solid supports and keep clear of ground. Cover during storage.

.5 Store and mix paints in a room assigned for this purpose. Keep room under lock and key at all times. Remove oily rags and other combustible debris from Site daily. Take every precaution necessary to prevent spontaneous combustion.

.6 Remove and replace damaged products at own expense and to the satisfaction of the Contract Administrator.

1.6 Quality of Material and Workmanship

.1 All materials which are described in these Specifications, and on the Drawings shall be new and the best of their respective kinds.

.2 All Work and materials shall be at all times open to inspection, acceptance or rejection by the Contract Administrator, but any failure or omission on the part of the Contract Administrator to disapprove or reject any Work or materials shall not be construed to be an acceptance of any defective Work or material.

.3 The Contractor shall remove at own his expense, any Work or material condemned by the Contract Administrator and re-build or replace the same to the satisfaction of the Contract Administrator without additional charge.

.4 The performance of this Work shall be in accordance with the best practices and the finished Work shall be neat in appearance.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

FACILITY START-UP/COMMISSIONING

1. GENERAL

1.1 Quality Assurance

.1 Test equipment and material where required by Specification to demonstrate its proper and safe operation.

.2 Test procedures in accordance with applicable portions of AWWA, ASME, ASHRAE and other recognized test codes as far as field conditions permit.

.3 Performance of the tests on Site must be witnessed by the Contract Administrator.

1.2 Commissioning Plan

.1 Submit detailed Start-up (Pre-Commissioning) and Commissioning Plans to the Contract Administrator for review within four (4) weeks of the scheduled start of commissioning at each specific Site address. The Plans shall include:

.1 Detailed schedule of events.

.2 Identify Commissioning Leader and Coordinator on the Contractor's Team.

.1 The Contractor leads all commissioning activities.

.2 The Contract Administrator is the Prime Witness of the commissioning activities to ensure that the Contractor's Work is in compliance with the contract documents.

.3 The City shall provide Operational, Electrical, and Automation support, oversight, and input as the City deems required. As a further clarification, the Contractor shall provide sufficient personnel to complete all commissioning activities as required. The City may request or require that City staff witness or perform certain activities on City Infrastructure.

.4 The City will determine which activities they wish to perform or have support staff from Operations, Electrical, or Automation present at during the review of the Contractor's detailed commissioning plan.

.3 Provide plans for offline testing and tie-ins.

.1 All commissioning and demonstrations shall follow the requirements and operational limitations described and referenced in the implementation plan.

.2 The Contractor is responsible for developing a commissioning plan to demonstrate full compliance with the contract requirements and coordination of the trades and disciplines.

.3 The Contract Administrator will review the commissioning plan against the contract requirements and will provide comments identifying scope not covered by the supplied commissioning plan. The Contractor shall revise the commissioning plan until the entire contract scope is covered and no comments are returned by the Contract Administrator.

.4 The Commissioning plan shall include demonstration of full functionality at a minimum of:

.1 All replaced and added flowmeters;

.2 All modified valves;

.3 All heaters;

.4 All sump pumps;

.5 All new equipment and devices;

.6 All modified equipment and devices;

.7 All equipment with modified supporting infrastructure;

.8 All impacted control loops.

.5 The Detailed Commissioning Plan shall include a detailed checklist of pre-commissioning requirements that shall be completed, signed, and submitted to the Contract Administrator prior to the commencement of commissioning. The pre-commissioning requirements shall include at a minimum:

.1 Required completed works by each discipline;

.2 Required completed isolation, lockout, and pump/valve state according to the implementation plan;

.3 Energization of all circuits demonstrated to the Contract Administrator;

.4 Loop Checks for all control loops being commissioned;

.5 Process Control System (SCADA) and HMI programming submitted and reviewed by the Contract Administrator;

.6 Factory Acceptance Reports;

.7 Motor polarization tests reports;

.8 Meggering tests reports;

.9 Tagging and Identification;

.10 Supplier installation certificates and sign offs.

.6 Drawings and sketches as required to illustrate the planned sequence of events.

.7 List and details for all temporary equipment (pumps, piping, etc.) required for commissioning.

.8 Process control and equipment testing.

.9 Planned attendance schedule for supplier's representatives.

.10 Identify any risks to schedule, shutdown durations, equipment operation, associated processes or other factors which could negatively influence commissioning and provide risk mitigation strategies.

.11 Contingency plans in the event of a process malfunction.

.12 Identify and coordinate required disciplines from the Contract Administrator and City required for witnessing and supporting commissioning activities with at least two weeks notice. Providing less than two (2) weeks notice may result in delays due to coordinating and scheduling required personnel. Delays due to insufficient notice shall not be considered for Change Work Orders and will be deemed to be the responsibility if the Contractor.

1.3 Submittals

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 The Contractor shall submit a Commissioning Plan which shall be approved by the Contract Administrator in advance. The Commissioning Plan shall be in accordance with Clause 1.2.

.3 Submit completed and signed Form 101. Commissioning shall not proceed until all Form 101 are submitted to the satisfaction of the Contract Administrator.

.4 Provide inspection/start-up reports from all manufacturer's representatives for all major equipment.

.5 Perform tests as specified and upon completion of mechanical certification of tests with detailed data as required. Itemize each test as to time performed and personnel responsibility.

.6 Submit completed and signed Form 102.

1.4 Liability

.1 Take charge of facility during tests, assume responsibility for damages in event of injury to personnel, building or equipment and bear costs for liability, repairs and restoration in this connection.

1.5 Coordination

.1 Coordinate start-up and commissioning schedule with the City and Contract Administrator.

1.6 Definitions

.1 Major Equipment: for the purposes of this Section, major equipment shall include:

.1 Primary flow meter(s).

.2 Secondary flow meter(s).

.3 Power supplied to Primary flow meter(s) and Secondary flow meter(s).

.4 Electronic controls to and from Primary flow meter(s) and Secondary flow meter(s).

.5 Interface with existing City Supervisory Control and Data Acquisition (SCADA) System and programable logic control system (PLC).

2. PRODUCTS

2.1 General

.1 The Contractor shall provide all materials to complete start-up and commissioning.

.2 The Contractor shall arrange for any temporary piping as required for facility start-up/ commissioning activities. Include details for temporary pipe material, supports/anchors, and connection locations in the Commissioning Plan.

3. EXECUTION

3.1 Scope

.1 Start-up and commissioning shall include all equipment installed under this Contract.

3.2 General

.1 Start-up and commissioning shall be performed when the facilities are sufficiently complete to operate for their intended use.

.2 Start-up and commissioning must be completed to the satisfaction of the Contract Administrator before the Certificate of Substantial Performance will be issued in accordance with D22.

.3 Prior to commissioning, all equipment installed under this Contract shall be operated by the Contractor for the purposes of flushing out and testing to determine that the equipment operates in a satisfactory manner and that it meets the performance requirements set out in these Specifications.

.4 In all cases, the labour, material, power, water, etc., necessary to do the draining, filling, cleaning and testing shall be provided by the Contractor.

.5 The Contractor shall develop a lock out/tag out procedure for equipment to prevent unsafe operation. The Contractor shall manage the procedure and communicate the requirements to all personnel involved in commissioning.

3.3 Lubricants

.1 For designated equipment, furnish all lubricants required for testing and prior to acceptance. In addition, furnish an estimated six (6) months' supply of grease and oil necessary for proper lubrication of the equipment.

.2 Furnish lubricants in the original sealed containers, correctly identified as to brand, grade and with reference to the particular piece of equipment for which it is intended.

.3 Provide all lubricants of Canadian manufacture and which are readily available in Canada.

.4 Provide a complete listing of recommended lubricants with designated application as an integral part of the instruction and maintenance manuals.

3.4 Trial Testing of Equipment

.1 Conduct the following trial testing of equipment at each individual Site address:

.1 Seven (7) day trial test for each process train header for the Primary flow meter(s) and Secondary flow meter(s).

.2 Equipment shall be inspected by the Contractor and the equipment shall be ready to run in all respects.

.3 Prior to operating any equipment by the process equipment suppliers, provide the Contract Administrator with two (2) weeks notice to arrange for a pre-start-up inspection.

.4 At the completion of the seven-day trial test for each process train header for each RPS complete and submit Form 101 for the following components:

.1 Primary flow meter(s).

.2 Secondary flow meter(s).

3.5 Performance Testing

.1 The Work required under the Performance Testing shall be the operation and testing of all Major Equipment in a simulated systems operation.

.2 Complete the additional start-up and commissioning requirements for the systems as described in the Division 26, and 40 Specifications.

.3 At the completion of the seven-day trial test for each process train header for each RPS, complete and submit Form 102 for the following components:

.1 Primary flow meter(s).

.2 Secondary flow meter(s).

.4 Facility operating personnel will normally be present during the testing procedures for training purposes, but they will not in any way participate in operating the equipment.

.5 The Contractor shall be responsible for the safe discharge of the test flows.

.6 Conduct performance tests to demonstrate equipment and systems meet specified requirements after installations are completed.

.7 Conduct final operating tests in presence of the Contract Administrator representative(s). Illustrate start-up and shutdown, sequence and simulate emergency conditions for safety shutdowns, with automatic and manual reset. Test all alarms. Repair and test defects until satisfactory. Make final adjustments to suit actual conditions.

.8 All equipment shall be operated in “manual” and “automatic” modes through entire range of equipment capacities.

3.6 Procedure for Handing over to Operating Personnel

.1 When the commissioning has been completed to the satisfaction of the Contract Administrator it shall be handed over for operation by the City’s operating personnel, or upon request of Contract Administrator.

CERTIFICATE OF SATISFACTORY EQUIPMENT TRIAL TESTING
FORM 101

We certify that the equipment listed below has been continuously operated for specified time frame and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: _____

ITEM OF EQUIPMENT: _____

_____

TAG NO: _____

REFERENCE SPECIFICATION: _____

_____ _____
(Authorized Signing Representative of the Supplier) Date

_____ _____
(Authorized Signing Representative of the Contractor) Date

_____ _____
(Authorized Signing Representative of the Contract Administrator) Date

CERTIFICATE OF SATISFACTORY SYSTEM PERFORMANCE TESTING
FORM 102

We certify that the System listed below has been operated and tested as per the Specifications and that the System meets its Performance Testing Criteria, including fully automatic controls. The System is therefore classed as "conforming".

PROJECT: _____

SYSTEM: _____

_____

TAG NO: _____

REFERENCE SPECIFICATION: _____

_____ _____
(Authorized Signing Representative of the Supplier) Date

_____ _____
(Authorized Signing Representative of the Contractor) Date

_____ _____
(Authorized Signing Representative of the Contract Administrator) Date

END OF SECTION

DELIVERY, STORAGE AND HANDLING

1. GENERAL

1.1 General Requirements

.1 This Section specifies the general requirements for the delivery, storage, handling, and protection of all items required in the construction of the Work. Specific requirements, if any, are specified with the related item.

.2 Contractor shall maintain signed records at each site for all deliveries.

.1 The Contract Administrator reserves the right to request readable PDF images of any Contractor deliverable to the Site at any point.

1.2 Transportation and Delivery

.1 Pay costs of transportation of products required in performance of the Work.

.2 Transport and handle items in accordance with manufacturer's printed instructions.

.3 Schedule delivery to reduce long-term on-site storage prior to installation and/or operation. Under no circumstances shall equipment be delivered to the Site more than two (2) months prior to installation without written authorization from the Contract Administrator.

.4 Ship equipment, material, and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.5 The Contractor shall ensure that they are fully informed of precautions to be taken in the unloading of the equipment and subsequent storage including any required maintenance.

.6 The Contractor shall be responsible for all equipment at the Site or any alternative storage location.

.1 Temporary fence and lock equipment and materials stored on the interior building laydown area. Temporary fence support footing bases shall not protrude beyond the dimensioned interior building laydown areas.

.7 If off-site storage of equipment is required, then the second move of the equipment to the Site will be at the Contractor’s cost.

.8 Carefully pack and crate equipment for shipment. Protect polished and machined metal surfaces from corrosion and damage during shipment and installation.

.9 Deliver products to the Site in manufacturer's original sealed containers or other packing systems, complete with instructions for handling, storing, unpacking, protecting, and installing.

.10 Assume responsibility for equipment material and spare parts just before unloading from carrier at the Site.

.11 All items delivered to the Site shall be unloaded and placed in a manner which:

.1 It shall not hamper the Contractor's normal construction operation or those of subcontractors, other contractors, or the City;

.2 It shall not interfere with the flow of necessary traffic or impede access to the City's active equipment or areas required for use by City operators.

.12 Provide equipment and personnel to unload all items delivered to the Site.

1.3 Traffic Management on City Streets

.1 Further to Section 3.7 of CW 1130 of the General Requirements, the Contractor shall be responsible to redirect and maintain traffic with appropriate signing in accordance with The City of Winnipeg, "Manual of Temporary Traffic Control in Work Areas on City Streets" at all times during construction.

.2 Maintain access for approaches, driveways, public lanes and crossing streets for all locations.

.3 The Contractor shall maintain access to all businesses during business hours, except where written authorization has been provided by the business.

.4 The Contractor shall not park company or private vehicles inside the barricaded work zone in a manner that will block sightlines for vehicles and pedestrians approaching and crossing intersections.

.5 The Contractor is responsible for maintaining safe vehicular and pedestrian traffic. The Contractor shall rectify any unsafe conditions immediately upon notification. This could include but is not limited to, providing flag persons, clearing debris and snow from Sites, temporary infilling of pot holes or site grade deviations that can cause tripping hazards, moving equipment, and erecting additional signage.

.6 Local Streets:

.1 Erect Road Closure signage in accordance with The City of Winnipeg, "Manual of Temporary Traffic Control in Work Areas on City Streets".

.7 Measurement and Payment:

.1 Traffic management as outlined here will be considered incidental to the Work. No separate payment will be made.

1.4 Storage and Protection

.1 Handle and store products and equipment to prevent damage, adulteration, deterioration, and soiling in accordance with the manufacturer's instructions, with seals and labels intact and legible. Storage instruction shall be studied by the Contractor. Instructions shall be carefully followed and a written record of this kept by the Contractor for each product and piece of equipment.

.1 Remove and replace damaged products at own expense and to the satisfaction of the Contract Administrator.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

We certify that the equipment listed below has been received and delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: _____

ITEM OF EQUIPMENT: _____

_____

TAG NO: _____

REFERENCE SPECIFICATION: _____

_____ _____
(Authorized Signing Representative of the Contractor) Date

_____ _____
(Authorized Signing Representative of the Manufacturer) Date

_____ _____
(Authorized Signing Representative of the Contract Administrator) Date

CLEANING

1. GENERAL

1.1 Project Cleanliness

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by the City or other Contractors.

.2 Remove waste materials from the Site at weekly regularly scheduled times or dispose of them as directed by the Contract Administrator.

.3 Conduct cleaning and disposal operations to comply with local codes, ordinances, regulations, and anti-pollution laws. Do not burn or bury rubbish or waste materials on the Site. Do not dispose of volatile wastes, such as mineral spirits, oil, or paint thinner, in storm or sanitary drains. Do not dispose of wastes into streams or waterways.

.4 Provide on-site containers for collection of waste materials and debris.

.5 Provide and use marked separate bins for recycling.

.6 Dispose of waste materials and debris at designated dumping areas off-site.

.7 Clean interior areas prior to start of finishing work and maintain areas free of dust and other contaminants during finishing operations.

.8 Store volatile waste in covered metal containers and remove from premises at the end of each Working Day.

.9 Provide adequate ventilation during use of volatile or noxious substances.

.10 Schedule cleaning operations so that resulting dust, debris, and other contaminants shall not fall on wet, newly painted surfaces nor contaminate building systems.

2. PRODUCTS

2.1 Materials

.1 Use only those cleaning materials which will not create hazards to property and persons or damage surfaces of material to be cleaned.

.2 Use only cleaning materials recommended by the manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

3. EXECUTION

3.1 Cleaning During Construction

.1 At all times maintain areas covered by the Contract and adjacent properties and public access roads free from accumulations of waste, debris, and rubbish caused by construction operations.

.2 During execution of Work, clean Site and dispose of produced waste materials, debris, and rubbish to assure that buildings, grounds, and public properties are maintained free from accumulations of waste materials and rubbish. Unneeded construction equipment shall be

removed, and all damage repaired, so that the public and property owners will be inconvenienced as little as possible.

.3 Wet down dry materials and rubbish to lay dust and prevent blowing dust as applicable.

.4 Where material or debris has washed or flowed into or been placed in existing potable water piping and aqueducts, watercourses, ditches, gutters, drains, pipes structures, work done under this Contract, or elsewhere during the course of the Contractor's operations, such material or debris shall be entirely removed and satisfactorily disposed of during the progress of the Work, and the areas shall, upon completion of the Work, be left in a clean and neat condition.

.5 On or before the completion of the Work, the Contractor shall, unless otherwise especially directed or permitted in writing, return the Site to acceptable condition.

.1 The Contractor shall tear down and remove all temporary buildings and structures built by them.

.2 The Contractor shall remove all temporary works, tools, and machinery or other construction equipment furnished by them.

.3 The Contractor shall remove all rubbish from any grounds which they have occupied and shall leave the roads and all parts of the premises and adjacent property affected by their operations in a neat and satisfactory condition.

.6 When Substantial Performance has been achieved, remove surplus products, tools, construction machinery, and equipment not required for performance of the remaining Work.

3.2 Final Cleaning

.1 Final cleaning shall be completed prior to issuance of Total Performance.

.2 Remove waste products and debris other than that caused by others and leave Work Site clean and suitable for occupancy.

.3 Prior to final review remove surplus products, tools, construction machinery, and equipment.

.4 Remove waste products and debris other than that caused by the City or other Contractors.

.5 Remove stains, spots, marks, and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.

.6 Clean any Contractor installed interior items free of dust.

.7 Inspect finishes, fitments, and equipment and ensure specified workmanship and operation.

.8 Exterior Work:

.1 Broom clean and wash exterior walks, steps, and surfaces (if disturbed) as applicable.

.2 Remove dirt and other disfiguration from exterior surfaces.

.3 Repair landscaping (if disturbed).

.9 Restore and clean the existing equipment and building, if damaged as a result of this Work.

.10 Sweep and wash clean paved areas.

.11 Remove debris and surplus materials from accessible concealed spaces as applicable.

END OF SECTION

CLOSEOUT SUBMITTALS

1. GENERAL

1.1 Work Included

.1 Furnish complete information as specified in this Section for Closeout Submittals.

.2 Provide on Site, Hands-On Training as specified in this Section for Closeout Submittals.

1.2 Submittals

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Provide signed attendance list for all providers and attendees of the On-site, Hands-On Training.

.3 Substantial Performance shall not be granted until review and acceptance of all Closeout Submittals is achieved.

1.3 Closeout Submittals

.1 Operating and Maintenance Manuals in accordance with Section 01 91 51 - Operating and Maintenance Manual.

.2 As-Built Drawings:

.1 Within public right of ways, buried sewer and water utilities and surface works as-builts are the responsibility of the Contract Administrator. The Contractor is responsible for As-Built Drawings of the remaining Works to the requirements below:

.1 Possess a complete set of Drawings for the purpose of maintaining project As-Built Drawings. Accurately mark up deviations from the Contract caused by the Site conditions and changes ordered by the Contract Administrator. Update daily.

.2 The Contractor shall keep one (1) complete set of white prints at the Site during the Work, including all addenda, change orders, Site instructions, clarifications, and revisions for the purpose of the as-built and Record Drawings. As the Work proceeds, the Contractor shall clearly mark up the white prints in red pen all the Work which deviated from the original Contract. The marked-up information is to include locations of all devices and locations of all equipment.

.3 Identify Drawings as "Project Record Copy". Maintain in good condition and make available for review on-site by the Contract Administrator at all times.

.4 On completion of the Work, submit as-built Drawings to the Contract Administrator for review.

.3 On Site, Hands-On Training per individual site address:

.1 Coordinate with Contract Administrator a minimum of ten (10) Working days prior to the Contractor designated training date.

.2 Allow for up to eight (8) City staff as attendees.

.3 Contractor training staff shall be educated in the systems in which they are providing training on.

.4 Hands-on equipment training for City operations personnel will include:

.1 Identifying instrumentation: location of primary element; location of instrument readout; discuss purpose, basic operation, and information interpretation.

.2 Discussing, demonstrating, and performing standard operating procedures and daily visual inspection of system operation.

.3 Discussing preventive maintenance activities.

.4 Discussing start-up and shutdown procedures.

.5 Discuss naming conventions and equipment tagging.

.6 Discuss electrical and mechanical fuse locations.

.7 Discuss overall primary electrical panel disconnect location and any equipment panel naming conventions within the primary electrical panel.

.8 Performing the required equipment exercise procedures.

.9 Performing routine disassembly and assembly of equipment if applicable.

.10 Identifying and reviewing safety items and performing general safety procedures.

.11 Reviewing normal repair procedures.

.12 Discussing preventive maintenance activities.

.13 Performing routine start-up and shutdown procedures.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

OPERATION AND MAINTENANCE MANUAL

1. GENERAL

1.1 Manual

.1 An organized compilation of operating and maintenance data including detailed technical information, documents and records describing operation and maintenance of individual products or systems.

1.2 General

.1 Assemble, coordinate, bind and index required data into Operation and Maintenance Manuals for the:

.1 Equipment specified in Division 26.

.2 Equipment specified in Division 40.

.2 Submit one (1) copy of draft operation and maintenance manuals to Contract Administrator fifteen (15) Working Days prior to application of Substantial Performance of the Project.

.3 Submit one electronic (PDF) copy of the Contract Administrator reviewed Operation and Maintenance Manual for each Site address via USB (flash drive) drive. All Operation and Maintenance Manual data shall be in English for each Site. Only one USB drive per individual site will be accepted.

.4 Material: label each section with tabs protected with celluloid covers fastened to hard paper dividing sheets.

.5 Type lists and notes.

.6 Drawings, diagrams and Manufacturer's literature must be legible.

.7 A draft copy of the manuals is required prior to applying for Substantial Performance.

1.3 Binders

.1 Prepare sets of manuals for various divisions using identical bindings, and the same indexing system and format for all manuals.

.2 Provide 215 x 280 mm hard covered, three-hole extension type catalogue binders with a 75 mm spine bound with heavy weight fabricord, hot stamped in silver lettering front and spine. Acceptable Material: Universal Bindery, ACCO or approved equal. The Contractor shall be responsible for determining the required number and thickness of the binder(s) for each set.

.3 Wording shall be prepared by the Contractor and submitted for approval to the Contract Administrator prior to embossing.

.4 The number of binders shall be determined by the Contractor based on the amount of material submitted. To determine the required number of binders, the contents of each binder shall not be more than 75 mm thick. Where more than one (1) binder is required, label lower section as Volume I, and the second one as Volume II.

1.4 Contents

.1 The manuals, including manuals prepared by subcontractors, shall be prepared as one (1) manual with consistent numbering and tabs.

.2 The information to be included in the binder is as follows:

.1 Title sheet, labelled "Operations and Maintenance Instructions", containing project name and date.

.2 Table of contents.

.3 List with names, addresses, telephone numbers of Contractor, Subcontractors, Manufacturers, Suppliers and Agents, Service Companies. Only one list shall be provided and shall include the suppliers of all subcontractors.

.4 A master checklist with operations, maintenance and lubrication tasks for all equipment in the facility organized into daily, weekly, monthly, bi-monthly, and bi-yearly categories.

.5 Copies of all final Shop Drawings (review stamped).

.6 Manufacturer's data sheets (operating and maintenance brochure) on all equipment. Locate this information with the shop drawings for the same piece of equipment.

.7 Installation and performance test data on all equipment including start-up and commissioning sheets from Section 01 60 00 - Material and Equipment and Section 01 65 00 - Facility Start-up/Commissioning.

.8 Reports and certificates of inspection including Electrical Inspection certificates.

.9 Operations, maintenance and lubrication instructions, for each section, including daily, weekly, monthly, semi-annual and annual checks for equipment and systems, including a complete list of equipment and tools.

.10 Each valve directory listing serial number, manufacturer name, manufacturer primary factory office location and contact information, purpose, location, size, make, tag numbers as marked on the project record drawings and other pertinent information of each valve.

.11 Each primary flow meter directory listing serial number, manufacturer name, manufacturer primary factory office location and contact information, purpose, location, size, make, tag numbers as marked on the project record drawings and other pertinent information.

.12 Each secondary flow meter directory listing serial number, manufacturer name, manufacturer primary factory office location and contact information, purpose, location, size, make, tag numbers as marked on the project record drawings and other pertinent information.

.13 Operational information on all mechanical components.

.14 Parts list for all equipment.

.15 Recommended spare parts list for each piece of equipment.

.16 Start-up reports prepared by manufacturer's representatives.

.17 List of maintenance tools supplied.

.18 Calibration sheets for all instruments.

.19 Regulatory inspection certificates.

.20 Warranty certificates for materials and equipment that have warranty periods greater than one (1) year.

.21 Reduce set of record drawings (supplied by Contract Administrator).

.22 Provide a maintenance schedule.

.3 Information shall be provided in the form of original Manufacturer's printed literature, supplemented by typed sheets when necessary. Originals are to be provided for all three (3) manuals. Faxes or poor-quality photocopies are not acceptable.

1.5 Documents by Contract Administrator

.1 The Contract Administrator will insert reduced Record Drawings with changes submitted by the Contractor.

.2 The Table of Contents shall identify that these documents are included in the Manual.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

DEMOLITION FOR MINOR WORKS

1. GENERAL

1.1 References

.1 Canadian Standards Association (CSA):

.1 CSA Z783, Deconstruction of Buildings and Their Related Parts.

.2 CSA S350, Code of Practice for Safety in Demolition of Structures.

.2 American National Standards Institute (ANSI):

.1 ANSI A10.8-2011, Scaffolding Safety Requirements.

.3 National Fire Protection Association (NFPA):

.1 NFPA 241-09, Standard for Safeguarding Construction, Alteration, and Demolition Operations.

.4 Provincial Legislation:

.1 Legislation specific to Authority Having Jurisdiction for work governed by this Section.

.5 All Reference Standards shall be the latest edition at the time of Contract award.

1.2 Submittals

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit Hot Work Permit sample form(s) prior to construction activities.

.3 Submit on-going Hot Work Permits as the Work progresses.

1.3 Definitions

.1 Demolish: Detach items from existing construction and legally dispose of them off Site, unless indicated to be removed and salvaged or removed and reinstalled.

.2 Remove and Salvage: Detach items from existing construction and deliver them to City ready for reuse.

.3 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

.4 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed, removed and salvaged, or removed and reinstalled.

.5 Hazardous Material: Product, substance, or organism that is used for its original purpose; and that is either dangerous goods or a material that may cause adverse impact to environment or adversely affect health of persons, animals, or plant life when released into the environment.

.1 Reference City supplied Asbestos Report(s) in Appendix A.

1.4 Examination

.1 Visit and examine the site and note all characteristics and irregularities affecting Work of this Section. Submit a pre-demolition inspection report. Ensure the Contract Administrator is represented at inspection.

.2 Prepare a per individual Site photographic or video record of existing grounds, grass conditions, exterior concrete aprons and on-site concrete drive aisles, exterior building conditions, all exposed surfaces of existing process units including electrical panels, in and around the work area(s).

.1 Contractor shall submit photographic log in JPEG format to the Contract Administrator prior to the construction initiation at each Site.

.2 Quality and quantity of photographic log shall be at the sole discretion of the Contract Administrator.

.3 Stop Work and notify the Contract Administrator should suspected hazardous materials are encountered during Work of this Section.

1.5 Site Conditions

.1 Notify Contract Administrator before disrupting building access.

1.6 Quality Assurance

.1 Conform to requirements of all authorities having jurisdiction and this Section.

.2 Work of this Contract shall be executed by company having a minimum of five (5) years continuous experience and able to deploy adequate equipment and skilled personnel to complete Work expediently in an efficient and orderly manner.

.3 Apply for, secure, arrange and pay for all permits, notices and inspections necessary for proper execution and completion of Work in this Section.

1.7 Protection

.1 Prevent damage of surrounding vegetation by construction.

.2 Prevent debris from blocking surface drainage inlets and mechanical and electrical systems which remain in operation.

.3 Temporarily suspended Work that is without continuous supervision shall be closed to prevent entrance of unauthorized persons.

1.8 Remaining and Adjacent Structures

.1 Do not interfere with, encumber, endanger, or create nuisance, from any cause due to demolition Work, to public property or any adjacent attached and/or detached structures in

possession of City or others, which are to remain, whether occupied or unoccupied during this Work.

.2 Make good damage to such structures resulting from Work under this Section at no cost to the City. Make good adjacent building surfaces damaged by Work of this Section.

1.9 Protection of Services and Structures

.1 Take necessary precautions to guard against movement, settlement or collapse of existing adjacent utility services, public property and/or structures, whether to remain or not. If these or other unforeseen conditions develop, take immediate emergency measures, report to Contract Administrator, confirm in writing, and await instructions before proceeding with any further related demolition work.

1.10 Existing Services

.1 Post warning signs on all electrical lines and equipment which must remain energized to serve other areas during period of demolition. Disconnect electrical and telephone service lines in demolition areas to the requirements of local authority having jurisdiction.

.2 Existing services and distribution of potable water are to be maintained on active process trains at each site.

1.11 Existing Warranties

.1 Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

2. PRODUCTS

2.1 Debris, Salvaged Material and Equipment Disposal

.1 All materials and or equipment salvaged from demolition work becomes property of demolition Contractor unless designated otherwise.

.2 At no cost to the City repair or replace material and/or equipment scheduled to remain which is damaged by demolition Work. Do not sell any salvaged material or equipment directly from project Site.

.3 Remove waste debris continually and entirely from project site during demolition work in accordance with Section 01 74 23 - Cleaning. Do not load vehicles transporting such debris beyond their safe capacity or in a manner which might cause spillage on public or private property. If spillage does occur, clean up immediately to prevent traffic hazards or nuisance.

2.2 Protection

.1 Protection of In-Place Conditions:

.1 Keep noise, dust, and inconvenience to local residences to minimum.

.2 Protect building systems, services and equipment.

.3 Provide temporary dust screens, covers, railings, supports and other protection as required.

.4 Maintain a safe access for City operations staff to the building throughout demolition.

.5 Erect temporary dust screens to prevent dust and debris to enter areas of the building which are not scheduled for demolition. Remove temporary dust screens when no longer required.

3. EXECUTION

3.1 General

.1 Exercise caution in dismantling, disconnecting of Work adjacent to existing Work designated to remain.

.2 Carry out demolition in a manner to cause as little inconvenience to the adjacent properties and City buildings and structures on site as possible.

.3 Carry out demolition in an orderly and careful manner.

.4 Selling or burning of materials on Site is not permitted.

.5 Lower waste materials in a controlled manner; do not drop or throw materials from heights.

.6 At end of each day's work, leave in safe condition so that no part is in danger of toppling or falling.

3.2 Safety and Security

.1 Maintain security of the building at all times during demolition Work.

.2 Provide and maintain fire prevention equipment and alarms accessible during demolition.

3.3 Examination

.1 Inspect existing roof with Contract Administrator and verify extent and location of items designated for removal, disposal, and items to remain.

.2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.

.3 Notify and obtain approval of utility companies before starting demolition.

.4 Disconnect, cap, plug or divert, as required, existing public utilities within the property where they interfere with the execution of the Work, in conformity with the requirements of the authorities having jurisdiction. Support, shore up and maintain pipes and conduits encountered.

.1 Immediately notify Contract Administrator in case of damage to any utility or service, designated to remain in place.

3.4 Access Routes

.1 Restrict operations to designated access routes.

.2 Do not obstruct roads, parking lots, sidewalks, and fire hydrants.

3.5 Selective Demolition

.1 Provide necessary shoring and supports to assure safety of structure prior to cutting and coring.

.2 Minimize saw cutting and torch cutting of existing piping to be demolished.

.3 Demolish, cut-out and remove from site all other work required to permit new construction.

.4 Do not allow water to accumulate or flow beyond work area. Mop-up water used as Work proceeds.

3.6 Hot Work Permits

.1 For cutting, grinding and welding within the building area of the MacLean RPS and McPhillips RPS, the Contractor shall utilize Hot Work Permits.

.2 Record start time for each Hot Work Permit.

.3 Complete Hot Work Permits in accordance with CSA-W117.2 including the following:

.1 Fire Watcher to be continuous for one (1) hour followed by half hour (30 minutes) spot checks for the next three (3) hours (total six (6) spot checks) before sign-off on the permit is completed.

3.7 Excessive Demolition

.1 Where excessive demolition occurs, Contractor shall be responsible for cost of replacing such Work.

.2 Contract Administrator shall determine extent of such 'over-demolition' and method of rectification.

3.8 Completion

.1 Leave project Site as directed, reasonably clean and presentable, free from above grade debris, any salvaged material and equipment except those designated to remain.

.2 Maintain access to exits clean and free of obstruction during removal of debris.

END OF SECTION

SHOP PAINTING

1. GENERAL

1.1 Description

.1 Provide shop painting as specified and in compliance with Contract Documents.

1.2 References

.1 American Society for Testing and Materials International (ASTM):

.1 B117: Standard Practice for Operating Salt Spray (Fog) Apparatus.

.2 D870: Standard Practice for Testing Water Resistance of Coatings Using Water Immersion.

.3 D4541: Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

.4 D4544: Standard Practice for Estimating Peat Deposit Thickness.

.5 D4585: Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation.

.6 G8: Standard Test Methods for Cathodic Disbonding of Pipeline Coatings.

.2 The Society for Protective Coatings (SSPC):

.1 SP6: Commercial Blast Cleaning.

.2 SP10: Near-White Blast Cleaning.

1.3 Submittals

.1 Submit the following Shop Drawings in accordance with Section 01 33 00.

.2 Manufacturer's specifications and data on the proposed primers and detailed surface preparation, application procedures and dry mil thicknesses, including list of items and surfaces to receive shop painting.

1.4 Quality Assurance

.1 Comply with the requirements specified in Section 01 45 00.

1.5 Delivery Storage and Handling

.1 Comply with the requirements specified in Section 01 66 10.

.2 Deliver materials to application area in original, unbroken containers, plainly marked with name and analysis of product, manufacturer's name, and shelf-life date. Do not store or use contaminated, outdated, prematurely opened, or diluted materials.

.3 Store coated items to prevent damage or contamination of coatings. Avoid need for special cleaning, and store coated items out of contact with ground or pavement. Place suitable blocking under coated items during storage.

.4 Do not expose surfaces to weather for more than six (6) months before being topcoated, or less time if recommended by coating manufacturer.

.5 Protect surfaces not to receive paint coatings during surface preparation, cleaning, and painting.

.6 Protect coatings from damage during shipment and handling by padding, blocking, use canvas or nylon slings, and use care when handling.

.7 At time of delivery of shop-painted items to the Site, ensure coatings are undamaged and in good condition.

1.6 Project/Site Conditions

.1 Environmental Requirements:

.1 Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be applied.

.2 Do not apply coatings when dust is being generated.

2. PRODUCTS

2.1 Materials

.1 Coatings are divided into the following service types, as determined by conditions:

.1 Non-Potable Water:

.1 All ferrous metals not subject to potable water provide one coat with a dry film thickness of 2.5 to 3.0 mils.

.2 Manufacturers:

.1 Series 1 Prime made by Tnemec Co.

.2 Carbozinc 859 by Carboline Co.

.3 Multiprime EFD Epoxy Fast Day Inhibitive Primer 94-109 made by PPG Protective & Marine Coatings (4.0 – 6.0 DFT).

.3 Performance Data:

.1 ASTM- D4541 - Adhesion - no less than 1250 psi pull.

.2 ASTM- D4585 - Humidity - no affect after 4800 hours with< 1% rust.

.3 ASTM - B117 Salt Spray - no cracking , delamination or >1/64 creep after 9800 hours.

.2 Potable Water:

.1 Ferrous metals which are submerged or subject to splash action with potable water, provide one (1) coat with a dry mil thickness of 3.0 to 3.5 mils of a certified NSF Standard 61 product.

.2 Manufacturers:

.1 94 H20 Urethane Zinc Rich Primer made by Tnemec Co.

.2 Carboguard 561 made by Carboline Co.

.3 Aquapon High Build Potable Water Epoxy 95-132 Series made by PPG Protective & Marine Coatings (4.0 – 6.0 DFT).

.3 Performance Data:

.1 ASTM D4541 Adhesion - no less than 1700 psi.

.2 ASTM-G8 Method A Cathodic Disbondment - no effect after thirty (30) days.

.3 ASTM D870 Immersion - no effect after twenty-two (22) months.

.4 ASTM B117 Salt Spray - no effect of coating film, less than one-sixteenth creep after 9900 hours.

.2 Shop prime with primers guaranteed by the manufacturer to be compatible with their corresponding primers and finish coats specified in Section 09 91 13 for use in the field and which are recommended for use together.

3. EXECUTION

3.1 Application

.1 Surface Preparation and Priming:

.1 Sandblast clean in accordance with SSPC-SP-6, Commercial Grade, immediately prior to priming non-submerged components scheduled for priming, as defined above.

.2 Sandblast clean in accordance with SSPC-SP-10, Near White, immediately prior to priming submerged components scheduled for priming, as defined above.

.3 Before priming, provide surfaces dry and free of dust, oil, grease and other foreign material.

.4 Shop prime in accordance with the accepted manufacturer's printed recommendations.

.2 Non-primed Surfaces: Apply accepted coating in accordance with manufacturer's printed recommendation.

3.2 Touch-Up

.1 Repair or replace damaged or defective coated areas. Resultant shop painting: Paint items as specified.

.2 Remove damaged or defective coatings by specified blast cleaning to meet surface cleaning requirements, just before recoating. When small areas of coating need touch up, surface preparation may be done with suitable power needle gun to match specified blast cleaning.

END OF SECTION

FIELD APPLIED COATINGS

1. GENERAL

1.1 Work Included

.1 Provide, apply, and maintain the specified field applied protective and maintenance coating systems. Coatings are required on all process and mechanical equipment, vessels and pipes unless specifically deleted.

.2 Refer to Drawings and schedules for the type, location and extent of coatings required and include for all field coating necessary to complete all the Work shown, specified or scheduled.

1.2 Reference Standards

.1 Reference to the SSPC Good Painting Practice and the National Association of Corrosion Consultants specifications refers to the latest edition of these specifications.

.2 Apply all coating in accordance with manufacturers' recommendations, and to SSPC Standard. Specifications contained therein take precedence over manufacturers' recommendations.

.3 Strictly observe all safety rules and regulations of PCA, applicable governing bodies, and insurance underwriters in the storage, handling, use and application of coating system material, solvents, and cleaning agents.

.4 Employ qualified and competent personnel to perform the Work in a neat and workmanlike manner, conforming to all PCA, AHJ and relevant safety standards and regulations.

1.3 Shipment, Protection, and Storage

.1 Deliver all materials to the Site in sealed containers properly labeled as to the manufacturer's name, type, and colour of contents, date of manufacture, batch number, storage requirements, and shelf-life.

.2 Provide adequately ventilated storage for all materials and ensure compliance with fire prevention regulations.

1.4 Restrictions

.1 Regardless of whatever else is specified in this Section, no paint containing a chromate based additive can be used. Substitute products of equal or greater quality.

2. PRODUCTS

2.1 Manufacturers

.1 All constituents of each coating system are to be provided by the same manufacturer.

2.2 Coating Application

.1 Use application methods in accordance with the coating manufacturer's recommendation for the particular coating being applied, and the requirements of SSPC Good Painting Practice.

.2 Provide traps or separators to remove oil and water from the air, so that the air from the spray gun impinging onto the steel substrate shows no condensed water or oil.

.3 Hand brush all welded and hard-to-spray areas prior to the first spray coat application, with coating mixed to manufacturer's recommended procedures.

.4 Coat by brush, roller, sheepskin dauber, or other suitable method, all areas inaccessible to the spray gun.

.5 Do not apply coatings to a surface at a temperature that will cause blistering, separation or otherwise be detrimental to the life of the coating.

.6 Only thinners specified by the manufacturer are acceptable.

.7 Materials that exceed manufacturer's published shelf life are not be acceptable.

.8 Immediately brush out all runs, sags, blisters, etc., or remove and repair the area prior to the next application.

.9 Apply the coating using a 3-coat, 2-colour system.

.10 Apply coating by conventional or airless spray as power coating manufacturer's data sheet.

.11 Follow manufacturer's application procedures as closely as possible as to recommended pressures, atomization, etc.

.12 Provide final dry film coating thickness in accordance with the coating manufacturer's specification.

.13 Apply the coating 100 percent (100%) holiday free.

2.3 Drying and Curing

.1 Accommodate all drying and re-coat times in accordance with the manufacturer's specifications.

.2 Cure in accordance with the manufacturer's recommended specifications. Force curing specifications are available from manufacturer if required.

.3 Supply indirect fired heaters and ducting as required to maintain drying and curing temperatures during coating operations.

2.4 Quality Control and Acceptance

.1 Apply, cure, and handle coatings using procedures which produce a final product that complies to the manufacturer's published literature and performance testing conducted by the City.

.2 Ensure the finished coating is free of obvious defects such as runs, sags, blisters or pinholes, air entrapment, fish-eyes and foreign matter.

.3 Provide film thickness, as determined by a calibrated Mikrotest gauge or equivalent, in accordance with SSPC Good Painting Practice.

.4 Apply all immersion coating 100 percent (100%) holiday free.

.5 Conduct wet sponge holiday testing in accordance with proposed NACE Standard, "Holiday Detection of Internal Tubular Coatings" (less than 0.254 mm (10 mil) thickness).

.6 A "holiday" is an area of applied coating with electrical resistance less than 80,000 ohms as identified by a detection instrument connected to a clean sponge wetted with a solution of one teaspoon of detergent per 3.78 L of tap water.

.7 No immersion coating will be accepted or released from coating applicators until fully cured. Cure test will be performed using the M.E.K. rub test in conjunction with a time and temperature relationship for the coatings being used.

.8 Repair or replace at the Contractor's expense any coating not meeting the requirements of this Specification.

2.5 Surface Treatment

.1 Remove all organic substances such as oil, grease, paraffin, etc. in accordance with SSPC-1, "Solvent Cleaning", prior to commencement of sandblast cleaning operations.

.2 Provide proper traps or separators to remove all oil and water from the air supply. The air from the blast nozzle is to be free of condensed water or oil that will impinge onto steel substrata. In high humidity areas, the use of air dryers may be required.

.3 Do not blast surfaces when surface temperatures are less than 10°C, when substrata is less than 3°C above the dew point, when the relative humidity is greater than 80 percent (80%), or when there is a possibility that the blasted surface will be subject to wetting prior to the primer coat being applied.

.4 Blow down all surfaces with clean, dry air; brush and vacuum free of dust before the surface is primed.

.5 Do not blast more surface than can be prime coated before visible or detrimental re-rusting occurs.

.6 Use siliceous sand, free of dirt, clay or other foreign material, graded 16/30 or 20/40 mesh to give an anchor pattern 0.038 mm to 0.076 mm (1.5 to 3.0 mil).

2.6 Schedule of Surface Treatments

.1 The schedule of Surface Treatments defines the components of the protective coating systems.

Reference	Description	Surface Treatment
A	Solvent Cleaning	as SSPC – SP1
B	Hand Tool Cleaning	as SSPC – SP2
C	Power Tool Cleaning	as SSPC – SP3
D	Brush Blast	as SSPC – SP7
E	Near White Metal Blast	as SSPC – SP10
F	White Metal Blast	as SSPC – SP5 (NACE #1)
G	Abrasion	The surface shall be lightly abraded using steel wool or abrasive cloth to provide a key for the next coat, to remove runs or excessive brushmarks
H	Vinyl Wash Primer	DFT 13 micron To be overcoated within 24 hr
I	Water-borne Acrylic Primer	Nominal DFT 40 micron
J	Inorganic Zinc Primer	Zinc in ethyl silicate vehicle Minimum DFT 40 micron
K	Industrial Enamel (to 100°C)	To CGSB 1-GP-61M Alkyd Enamel Minimum DFT 40 micron
L	High Build Epoxy	Black Polyamine cured Minimum DFT 200 micron
M	Bituminous Paint	To AWWA C230 MIL-P-151470
N	Silicone Alkyd (100°C to 150°C)	Minimum 60% Solids by Wt Nominal DFT 25 micron
O	Silicone Enamel (150°C to 400°C)	To CGSB 1-GP-143M Nominal DFT 40 micron
P	Fast Drying Aluminum Sealer	To CGSB 1-GP-69M Nominal DFT 25 micron
Q	Canvas Insulation Sealer	Acrylic or PVA Latex
R	Epoxy Gloss Enamel	To CGSB 1-GP-146 Nominal DFT 50 micron
SSPC: Steel Structures Painting Council Pittsburgh PA 15213 Surface Preparation Specifications 1985		

2.7 Schedule of Protective Systems

.1 The schedule of protective systems defines the combination of surface treatments required in each system and the sections of the plant to which it is to be applied. The systems have been grouped into there categories as follows:

.1 Category A: Immersed Service - equipment or material fully, partially or intermittently immersed in sewage during routine plant operation.

.2 Category B: Exposed Service - equipment or material exposed to the normal range of atmospheric conditions and conditions common to sewage treatment facilities (high humidity, H_2S, etc.)

.3 Category C: Indoor Service - equipment or material inside buildings or other ventilated spaces.

2.8 Category A

.1 Category A: all category A systems will be tested by the Contract Administrator using a wet sponge holiday detector set at 67.5 volts. Touch-up will be required at points where the detector is grounded.

Reference	Surface Treatments	Typical Applications
A1	A, D, I, L	Equipment or piping delivered with inorganic zinc primer, e.g., clarifier mechanisms, mixers, etc.
A2	A, F, J, L ,L	Equipment or piping delivered uncoated or with coatings not compatible with high build epoxy, e.g., ductile iron, cast iron or steel pipe and pipe sleeves inside treatment units. External surfaces at valves, ferrous weir plates, weirs, penstocks, fabricated pipe supports, brackets, etc.
A3	A, G, M	Aluminum surfaces in contact with concrete, e.g. stop log guides, access cover frames
A4	A, E	Ferrous metal surface cast concrete, e.g., penstocks, sluice gates
A5	A	Stainless steels, plastics, and fiberglass products
A6	A, E, J, M, M	Ferrous metal immersed in abrasive environment, listed below: - grit tanks

2.9 Category B

.1 Schedule:

Reference	Surface Treatments	Typical Applications
B1	A, B, R, R	Equipment or piping delivered with inorganic zinc primer, e.g. clarifier motor, gearbox and motor, valve headstocks, piping above ground and outside treatment units, hydrants, etc.
B2	A, B, J, R ,R	Equipment or piping delivered not supplied with an inorganic zinc prime coat or with a prime coat not compatible with an inorganic zinc overcoat
B3	A, G, R, R	Equipment delivered with factory applied paint which is to be painted for identification only
B4	A	Stainless steel or aluminum products, e.g. insulation recovering

2.10 Category C

.1 Schedule:

Reference	Surface Treatments	Typical Applications
C1	A, B, K, K	Equipment or piping delivered comes with factory finished coatings. Coated for system identification and maintenance. Surface temperature during operation not exceeding 100°C, e.g., pumps, air handling units, valves, etc.
C2	A, G, K, K	Equipment or accessories fully primed. Surface temperatures not exceeding 100°C, e.g. pumps, steel piping
C3	A, C, I, N, N	Equipment or accessories as C1 or C2 but with operating surface temperatures between 100°C and 150°C, e.g. air compressors, blowers
C4	E, J, O	Equipment or accessories as C1 or C2 but with operating surface temperatures between 150°C and 400°C, e.g. boiler fittings
C5	B, P, K, K	Piping or valves with bituminous or tar coatings. Surface temperatures not exceeding 100°C, e.g., cast iron and ductile iron pipe, valves
C6	A, K, K	PVC pipe, fittings or accessories, coated for identification only
C7	A, H, K, K	Aluminum insulation recovering coated for identification only
C8	A, Q, G, N, N	Canvas insulation recovering

Reference	Surface Treatments	Typical Applications
Notes:		
(1)	Surface preparation "G" abrasion, has not been fully scheduled but is to be carried out between all coatings.	
(2)	No bare ferrous metal surfaces are permitted. Pipe hangar rods etc. unless zinc or cadmium plated are to be at least prime coated. Cut ends of plated surfaces (Uni-Strut, etc.) are to be spot primed.	

2.11 Acceptable Products

.1 Amercoat Ltd.

.2 Carboline

.3 General Paints Ltd.

.4 ICI Paints Ltd.

.5 Plasite

.6 Rust Oleum

.7 Valspar

3. EXECUTION

3.1 Quality Assurance

.1 Apply and cure all paints and coatings strictly in accordance with the manufacturer's directions.

.2 Pay particular attention to ensure the compatibility of each surface treatment with the preceding and subsequent surface treatment and coatings. Be responsible for the compatibility of all surface treatments and coatings.

3.2 Environmental Conditions

.1 Apply no coating when the ambient or surface temperature is below 10°C or less than 3°C above the dew point.

.2 Provide a minimum of 300 lux illumination on surface to be treated.

.3 Do not apply coatings where dust is being generated.

3.3 Protection

.1 Provide sufficient drop cloths, shields and protective equipment to prevent spray or droppings from fouling surfaces not being painted. Make good any damage resulting from inadequate or unsuitable protection.

.2 Maintain all coated surfaces until completion of the Work. Make good within seven (7) days any damage to coatings.

.3 Place cotton waste, cloths, and material which may constitute a fire hazard in closed metal containers and remove from the site at suitable intervals.

.4 Adequately mask, or remove and replace after painting, all grease nipples, bright metal surfaces, identification plates and other items not to be painted. Do not use solvent that may remove permanent lacquer finishes.

3.4 Condition of Surfaces

.1 Prior to starting Work, thoroughly examine all surfaces to be treated or coated. Report, in writing, to the Contract Administrator any condition or defect that may affect the integrity or quality of the finished coating. Do not start Work on any section until all such defects in that section have been corrected.

.2 On all factory primed or coated equipment, touch-up defects prior to the application of subsequent coatings.

.3 Be responsible for the condition of surfaces and for correcting defects and deficiencies in the surface.

3.5 Inspection

.1 The Contract Administrator has the right to request tests, to witness the performance of tests, or to perform tests.

.2 Such inspection does not relieve any responsibility for guarantee of the coating application from the Applicator.

3.6 Clean-Up

.1 After acceptance of coating, remove all masking, grease, etc., from all equipment which was not intended to be coated.

.2 Remove all unused material, containers, etc., from the Site upon completion of Work.

END OF SECTION

1. GENERAL

1.1 References

.1 Canadian Standards Association (CSA):

.1 CSA C22.1, Canadian Electrical Code, Part 1), Safety Standard for Electrical Installations.

.2 CSA C22.3 No.7, Underground Systems.

.3 CAN/CSA-C22.3 No. 1, Overhead Systems.

.4 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.2 Institute of Electrical and Electronics Engineers (IEEE):

.1 IEEE 100, The Authoritative Dictionary of IEEE Standards Terms.

1.2 Definitions

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these Contract Documents, are those defined by IEEE 100.

1.3 General Requirements

.1 Refer to Division 1 for General Requirements related to the Contract Documents.

.2 Refer to Division 40 for process and instrumentation work related to the electrical installation.

.3 Refer to Division 26 for finishes related to electrical installation.

.4 Refer to P&ID, loop drawings, plan drawings, and Process Mechanical drawings for more information about the electrical systems interconnection requirements.

.5 Refer to all Sections of Division 26 and Drawings.

.1 The intent of the Specifications and Drawings is to include all labour, products, and services necessary for complete Work, tested and ready for operation.

.2 Symbols used to represent various electrical devices often occupy more space on the Drawing than the actual device does when installed. In such instances, do not scale locations of devices from electrical symbols. Install these devices with primary regard for usage of wall space, convenience of operation and grouping of devices. Refer to installation details where they exist.

.3 Responsibility to determine which Division provides various products and work rests with the Contractor. Additional compensation will not be considered because of differences in interpretation of the present specifications.

1.4 Design Requirements

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.3 Language operating requirements: provide identification nameplates and labels for control items in English.

1.5 Submittals

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings:

.1 In accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure coordinated installation.

.3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.

.4 Indicate of Contract Document clearances for operation, maintenance, and replacement of operating equipment devices.

.5 If changes are required, notify Contract Administrator of these changes before they are made.

.6 Contract Administrator will not assume the responsibility for searching out deviations in the Contractor drawings.

.7 Shop Drawings shall be first checked by the Contractor for space, dimension, performance characteristics and general conformance to the Drawings and Specifications and shall be so stamped. Shop Drawings not stamped as specified will be returned to Contractor without action. Contractor’s stamp shall include name and address of Contractor, the date checked, the initials of the checker and the status of the checking, including conclusive mark-ups.

.8 Shop Drawings shall include manufacturer’s name and address, equipment or material descriptive names, and catalog number. Shop Drawings shall indicate dimensions, voltage and current characteristics, wire sizes, test or conformance data, construction and rough-in data of all material to be used.

.9 Submit only Shop Drawing documentation relevant to the product supplied and clearly marked as such. Entire catalog sections lacking clear indication of the relevant documentation will be rejected.

.10 Submit Shop Drawings and/or product literature for system components as called below, but not limited to:

.1 Cables & Accessories.

.2 Cable Trays, & Installation Accessories.

.3 Power Circuit Breakers (PCB).

.4 Switches, Receptacles, Heavy Duty Receptacles & Power connectors.

.5 Equipment Cabinets, Racks & Consoles.

.6 Control and Smart Relays.

.7 Terminal and Wire Marking System.

.3 Testing:

.1 Check resistance to ground before energizing. Submit ground resistivity measurement study to the Contract Administrator for analysis.

.4 Quality Control:

.1 Provide CSA certified equipment and material. Where CSA certified equipment and material is not available, submit such equipment and material inspection authorities for special acceptance approval before delivery to Site.

.2 Submit test results of installed electrical systems and instrumentation.

.3 Permits and fees: in accordance with General Conditions of Contract.

.4 Submit, upon completion of Work, load balance report as described in Part 3.22.7 – Load Balance.

.5 Submit certificate of acceptance from Authority Having Jurisdiction upon completion of Work to Contract Administrator.

.5 Manufacturer's Field Reports: submit to the Contract Administrator Manufacturer's written report, within three (3) days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in Part 3.22 - Field Quality Control.

.6 Drawings of Record:

.1 One (1) complete set of construction drawings shall be kept on Site. Records during construction will be maintained.

1.6 Quality Assurance

.1 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid license in accordance with Authorities Having Jurisdiction.

.1 Employees registered in provincial apprenticeship program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.

.2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

1.7 Delivery, Storage, and Handling

.1 Material Delivery Schedule: Provide Contract Administrator with schedule within two (2) weeks after award of Contract.

1.8 Waste Management and Disposal

.1 Separate waste materials for reuse and recycling.

.2 Collect and separate paper, plastic, polystyrene and corrugated cardboard packaging material for recycling.

.3 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Contract Administrator.

.4 Fold up metal banding, flatten and place in designated area for recycling.

.5 Remove from Site and dispose of all packaging materials at appropriate recycling facilities.

.6 Place materials defined as hazardous or toxic waste in designated containers.

.7 Ensure emptied containers are sealed and stored safely for disposal away from children and wildlife.

.8 Unused sealant material must not be disposed of into sewer system, streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.

.9 Do not dispose of preservative treated wood through incineration.

.10 Do not dispose of preservative treated wood with other materials destined for recycling or reuse.

.11 Dispose of treated wood, end pieces, wood scraps, and sawdust at a sanitary landfill approved by Contract Administrator.

1.9 System Start-up

.1 Instruct the Contract Administrator and operating personnel in operation, care and maintenance of systems, system equipment and components.

.2 Arrange and pay for services of Manufacturer's factory service Contract Administrator to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Arrange and pay for services of an instrumentation technician to check, adjust, balance and calibrate components and instruct operating personnel.

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

1.10 Operating Instructions

.1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

.2 Operating instructions as per Section 01 78 00 - Closeout Submittals to include following:

.1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

.2 Service instructions: including a list of spare pars and replacement parts and the names and addresses of all suppliers.

.3 Maintenance instructions: including start-up, proper adjustment, operating, lubrication, and shutdown procedures.

.4 Installation instructions.

.5 Safety precautions.

.6 Operating instructions, including procedures to be followed in event of equipment failure.

.7 Other items of instruction as recommended by Manufacturer of each system or item of equipment.

.3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.

.4 Post instructions where directed.

.5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.11 Compliance

.1 Failure to comply with the drawings and specifications shall be cause for rejection and the Contractor shall be required to make good at no additional cost to the City or their agents.

2. PRODUCTS

2.1 Materials and Equipment

.1 Provide materials and equipment.

.2 All equipment shall be manufactured by experienced manufacturers who can demonstrate in-use records for all equipment offered.

.3 Where there are multiple instances of similar equipment, they shall be all by the same manufacturer.

.4 Requests for approval of alternative suppliers shall be submitted to the Contract Administrator prior to tender closing.

.5 Material and equipment to be CSA Certified. Where CSA Certified material and equipment are not available, obtain special approval from inspection authorities before delivery to site and submit such approval as described in Section 01 33 00 - Submittal Procedures.

.6 Factory assemble control panels and component assemblies.

2.2 Electric Motors, Equipment and Controls

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

.2 Control wiring and conduit: in accordance with Division 26 05 21 - Wire and Cables (0-1000V) and Division 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

2.3 Warning Signs

.1 Warning Signs: in accordance with requirements of Authority Having Jurisdiction, inspection authorities, and Contract Administrator.

.2 Lamacoid, red with white lettering, minimum size 175 x 250 mm.

2.4 Wiring Terminations

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

.2 Lugs, connectors, or any other termination devices shall be rated for 75°C.

2.5 Equipment Identification

.1 Identify electrical equipment and devices with nameplates as follows:

.1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, black face, white core, lettering accurately aligned and engraved into core mechanically attached with self-tapping screws.

.2 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.

.3 Wording on nameplates and labels to be approved by Contract Administrator prior to manufacture.

.4 Allow for minimum of twenty-five (25) letters per nameplate and label.

.5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.7 Terminal cabinets and pull boxes: indicate system and voltage.

.8 Transformers: indicate capacity, primary and secondary voltages.

.9 All distributions, panelboard, transfer switches, MCC's, Splitters, transformers, VFD's, reactors, filters, etc. provide circuit panel designations and where fed from.

2.6 Wiring Identification

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders, branch circuit wiring and neutrals.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.7 Conduit and Cable Identification

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

.4 Colour as per the Electrical Design Guide and the City Identification Standards.

2.8 Finishes

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel.

.1 Paint outdoor electrical equipment light gray finish.

.2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

3. EXECUTION

3.1 Installation

.1 The complete installation shall be carried out in accordance with the latest CSA C22.1 - Canadian Electrical Code, except where specified otherwise.

.2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.

.3 All work shall be executed in accordance with the latest current codes, standards, statutes or recommendations of the following technical societies, trade organizations, and governing agencies, and shall be subject to the inspection of those departments having jurisdiction.

.4 Install all equipment in accordance with the manufacturer's recommendations and in a manner that will ensure satisfactory operation upon completion.

.5 Provide all labour and all necessary equipment including lifts, scaffolding, tools and rigging materials for installation of the equipment.

.6 The Contractor shall be responsible for coordinating all mechanical, instrumentation and other works for the equipment being installed.

.7 No Work shall commence without the appropriate permits from the Authority Having Jurisdiction.

3.2 Workmanship

.1 Workmanship shall be the best quality, executed by workers qualified to do electrical work as defined in Section 1.6 - Quality Assurance.

.2 Qualified tradesman shall be used for the transformer and switchgear installation and all cable installation and terminations.

.3 The Contract Administrator reserves the right to require the dismissal from the Site of workers deemed incompetent.

.4 The Contract Administrator reserves the right to require the proof of competency for the site superintendent, project coordinator, data and fiber installer and cable termination electricians. The Contract Administrator reserves the right to dismissal from Site of workers deemed incompetent. The Contractor is responsible to ensure the proper competencies for the Work performed.

.5 In cases of dispute, decisions as to the quality, fitness or workmanship rest solely with the Contract Administrator, whose decision is final.

.6 If any of the work is such as to make it impractical to produce required results, immediately notify the Contract Administrator.

.7 All exposed parts of the electrical wiring systems such as exposed conduits, flush plates, cabinet trim, fixtures, etc., shall be square and true with the building construction.

3.3 Drawings and Specifications

.1 The Drawings and Specifications shall be used together, and all materials and labor mentioned in one but omitted from the other shall be considered as sufficiently specified and shall therefore be supplied and installed.

.2 The location of various items on the drawings is approximate, unless specified otherwise, and is subject to slight revisions as the Work is installed in order to accommodate construction conditions.

.3 Where equipment and material dimensions are dependent upon building dimensions take field measurements, do not scale the drawings.

.4 The construction drawings are not intended to be scaled for roughing-in measurements nor to serve as Shop Drawings.

.5 The Contractor shall consult the architectural, structural, mechanical, or equipment drawings for dimensions, obstructions, and location of equipment of other trades. Any discrepancies between architectural, structural, mechanical, or equipment drawings and the work shown on the electrical drawings shall be reported to the Contract Administrator for adjustment.

.6 The installation details, instructions, and recommendations of the manufacturer of the product used, or modified to obtain the best end result, shall be the basis of attaining installation of the products for usage on this project except where definite and specific instructions are set forth herein or details are shown on the Drawings.

.7 Outlet devices, switches, panels, cabinets, fixtures and special equipment are shown on the drawings only in a schematic manner and not necessarily in their specific location. The Contractor shall be responsible for exact locations of the outlets to form a functional and aesthetic installation either by careful review of all architectural elevations, tile patterns, surface finishes, and equipment arrangements or by consultation with the Contract Administrator and other trades involved.

3.4 Errors and Omissions

.1 In the event of errors or discrepancies between the Drawings and Specifications, the Contractor shall obtain a ruling before Tenders are submitted.

.2 If a ruling has not been requested, it shall be assumed that in event of a discrepancy, the Contractor has allowed for the more expensive alternative.

.3 Where the Authority Having Jurisdiction has indicated that changes are required which will cause delay and/or additional costs, the Contractor shall notify the Contract Administrator of the proposed changes as soon as practicable.

3.5 Alternative Equipment

.1 The Contractor is required to submit a base Tender for the specified equipment and show a separate price increase or reduction complete with detailed descriptions for alternative equipment.

.2 The Contract Administrator shall review alternate equipment after Tender submissions and be the sole judge of the acceptability of alternatives. Alternate proposals shall include comprehensive details and any perceived benefits to the City.

.3 After the award of the Contract Documents, any request for a substitution must be made in writing by the Contractor (not material supplier or subcontractor). Such request shall state the name of the product specified, the name of the product proposed for substitution, the reason for requesting the substitution, and any change in Contract Amount resulting from the substitution. No such substitution shall be made until an appropriate Contract Modification has been issued and approved.

3.6 As-Built Drawings

.1 The Contractor is required to keep current a marked-up set of drawings recording all modifications to the electrical equipment on site and upon request provide to the Contract Administrator for review.

.2 After commissioning the Contractor shall transfer all changes to a single set of Drawings.

.3 Obtain a CAD set of Drawings (wiring & control diagrams) from AECOM and use professional services for CAD and transfer the “As-Built” condition for all components on those Drawings.

.4 No Substantial Performance shall be issued until final “Record Drawing” CAD files and one (1) set of prints have been received and accepted by the Contract Administrator.

3.7 Guarantee / Warranty

.1 The Contractor shall guarantee/warrant all equipment supplied by the Contractor and replace with new at the Contractor’s expense any part which may fail or prove defective within a period of twelve (12) months after final acceptance.

3.8 Grounding

.1 All circuits shall be installed with dedicated green insulated ground wire.

3.9 Dedicated Neutrals

.1 Each circuit shall have its own dedicated neutral wire. Shared neutral for more than 1 circuit shall not be permitted.

3.10 Area Category and Classifications

.1 The Pump Station area has the following electrical categories and classifications as defined in the CEC:

.1 Process Areas: Category 1.

.2 Electrical/Control Room: General.

3.11 Enclosures

.1	Dry/General	NEMA 1
.2	Wet/Outdoor/Corrosive/Category 1 or Category 2	NEMA 4X
.3	Hazardous	Rated for hazardous location
.4	MCC	NEMA 12.

3.12 Nameplates and Labels

.1 Ensure Manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.13 Conduit and Cable Installation

.1 Install conduit and sleeves prior to pouring of concrete.

.1 Sleeves through concrete: schedule 40, sized for free passage of cabling and protruding 100 mm.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

.4 Do not mix wiring and/or cables from different panels within the same conduit runs or pull boxes. Provide equipment barriers where acceptable and where applicable.

3.14 Location of Outlets and Luminaires

.1 Electrical Drawings are, unless otherwise indicated, drawn to scale and approximate distances and dimensions may be obtained by scaling. Figured dimensions shall govern over scaled dimensions. Where exact dimensions and details are required, refer to Architectural and Structural Drawings.

.2 Outlet and equipment locations shown on the Contract Documents are approximate. Locations may be revised up to 3 m to suit construction and equipment arrangements without additional cost, provided that the Contractor is notified prior to the installation of the outlets, or equipment.

.3 Maintain luminaire locations where ever possible. Notify the Contract Administrator of conflicts with other services.

.4 Unless otherwise specified or shown, install products in accordance with recommendations and ratings of Manufacturer’s.

.5 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

.6 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

.7 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

.8 Locate light switches on latch side of doors, unless noted otherwise on Drawings.

3.15 Sleeves

.1 Provide sleeves of galvanized steel pipe with machine cut ends of ample size to accommodate conduits passing through walls, partitions, ceilings, floors, etc.

.2 For wall, partitions and ceilings the ends shall be flush with the finish on both sides but for floors they shall extend 4" above finished floor level.

.3 The space between the sleeve and the conduit shall be fire stopped in accordance with Division 1 and caulked around the top and bottom with approved permanently resilient,

non-flammable and weatherproof silicone base compound and ensure that the seal is compatible with the floor and ceiling finishes.

.4 Locate and position sleeves exactly prior to construction of walls, floors.

3.16 Coordination of Protective Devices

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

3.17 Separation of Services

.1 Maintain separation between electrical wiring system and piping, ductwork, etc. so that wiring system is isolated (except at approved connections to such systems) to prevent galvanic corrosion.

.2 In particular, contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is not permitted.

.3 Do not support wiring from pipes, ductwork, etc. Hangers for suspended ceilings may be used for the support of wiring only when approval is obtained from the Contract Administrator and the ceiling installer, and approved clips or hangers are used.

3.18 Mounting Heights

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation. Install electrical equipment at following heights unless indicated otherwise.

.1 Local switches: 1400 mm.

.2 Wall receptacles:

.1 General: 300 mm.

.2 In mechanical rooms: 1400 mm.

.3 In wet or outdoor locations: minimum 1000 mm above finished grade/floor.

.4 In Corridor room: 1400 mm.

.5 electrical rooms: 300 mm.

.6 In chemical room: 1400 mm.

.7 In new pump room: 1400 mm.

.3 Panelboards: as required by Code or as indicated.

.4 Telephone and LAN outlets:

.1 General: 300 mm.

.2 Above top of counters or desk: 175 mm.

3.19 Location of Equipment

.1 Examine and study the Architectural, Structural and Mechanical drawings for items affecting the installation of the Work under this specification and locate conduit runs, pull and junction boxes, disconnects, controlled equipment and panels accordingly and such that working clearances and maximum ceiling heights can be maintained, and to avoid conflict with other installations.

.2 Any device, panel or equipment which is miss-located as a result of failure to observe the foregoing instructions shall be relocated without extra cost.

.3 If a specific equipment location is in question, request directions from the Contract Administrator.

3.20 Alignment of Electrical Components

.1 Where there are two (2) or more equipment items (switches, outlets, panels or related equipment) are installed together, they shall be aligned vertically and/or horizontally to present a neat orderly appearance.

.2 They shall also be aligned and symmetrical with architectural elements.

3.21 Accessibility

.1 Install all Work to be readily accessible for adjustment, operation and maintenance.

.2 Install all devices and protective systems to be accessible as per CEC (latest revision requirements.

3.22 Field Quality Control

.1 The Contractor shall conduct and pay for tests as identified in clause 3.22.6.

.2 Provide a manufacturer’s certificate or letter confirming that the entire installation as it pertains to each system had been installed in accordance with the manufacturers’ instructions.

.3 Carry out tests in presence of the Contract Administrator or City Representative.

.4 Ground fault detectors shall be dynamically tested by injecting current flow into the zero sequence current sensor.

.5 Submit test results for Contract Administrator’s review.

.1 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.2 Provide upon completion of work, load balance report as directed in Division 1: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

.6 Conduct following tests:

.1 Point to point wire continuity test for all conductors.

.2 Power generation and distribution system including phasing, voltage, grounding and load balancing.

.3 Lighting and its control.

.4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.5 Circuits originating from branch distribution panels.

.6 Test resistance to ground of the completed grounding electrodes.

.7 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Check resistance to ground before energizing.

.7 Load Balance:

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.8 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.9 Manufacturer's Field Services:

.1 Obtain written report from Manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in Section 01 33 00 – Submittal Procedures.

.2 Provide Manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with Manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in Section 1.6 - Quality Assurance.

.10 Submit test results for Contract Administrator’s review.

3.23 Construction Period Tests

.1 All the Work which is required to be placed within the construction or concealed shall be carefully tested and inspected before being permanently covered up.

.2 All tests shall be made in the presence of the Contract Administrator or the City Representative and shall meet with their approval.

3.24 Start-Up, Testing and Commissioning

.1 Upon completion of the installation, the Contractor shall be responsible for testing to determine correct system operation and sequences as intended in the Contract Documents.

.2 When preliminary checks have been completed and equipment is operating or ready to operate, individual systems shall be setup in accordance with the specifications and/or manufacturer's recommendations. After setup the system shall be placed in operation in conjunction with the Contract Administrator and/or the City's designated operating personnel.

.3 In general, the start-up and commissioning shall be in accordance with Section 01 65 00 - Facility Start-up/Commissioning and Section 26 05 03 - Commissioning of Electrical Systems.

3.25 Care and Operation

.1 Instruct the City’s Representatives in the operation, care and maintenance of equipment.

3.26 Cleaning

.1 Clean and touch-up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Clean and prime exposed non-galvanized hangers, racks, and fastenings to prevent rusting.

.3 In addition to final cleaning in accordance with the Special Conditions and Description of the Work, clean interiors and surfaces of all electrical equipment and general work area periodically to continuously maintain a clean working environment.

3.27 Contractor’s Responsibility

.1 The Contractor shall be responsible for the equipment and work until its completion and final acceptance.

.2 The Contractor shall replace any item which may be damaged, lost or stolen without additional cost to the City.

.3 Install all the Work promptly and in advance of concrete pouring or similar construction.

.4 Co-ordinate with other Divisions the placement of in-slab conduits and sleeves prior to pouring.

.5 Co-ordinate the Work with other Divisions such that all equipment, conduits and wiring will be installed in the best arrangement.

.6 Protect finished and unfinished work from damage. Any equipment or material damaged by weather, mishandling or other incident shall be replaced with new equipment and material at the direction of the Contract Administrator and at no additional cost.

.7 Before acceptance clean all exposed surfaces of lighting luminaries, lamps, Starters, Motor Control Panels and other electrical equipment of dust and plaster. Restore any damaged paint surfaces to factory-quality finish.

.8 Lighting luminaries’ lenses shall be washed and dried before commissioning.

.9 Furnish all work and materials in accordance with CSA codes, provincial and local inspection department, and local utility regulatory requirements.

3.28 Substantial Completion Inspection

.1 Prior to substantial completion inspection, submit written confirmation that:

.1 The installation as specified is completely assembled and wired.

.2 All wiring devices, plates, motor control, lighting fixtures and other equipment are operational, clean and correctly labeled.

.3 All systems have been tested as required and are in proper working order.

.4 Panel-board directories have been completed and all lamicoid nameplates have been installed.

.5 Factory finished equipment has been cleaned, touched-up or refinished to present a new appearance.

.6 Switchboards, MCC's, VFD and parameters have been set up and functionally tested.

.7 Protection relays and/or instrumentation (circuit breakers, overload relays, ground fault detectors, metering equipment) has been set up and tested as per Coordination Study. Results were provided and approved by the Contract Administrator.

.8 Communication Networks, Device Level Busses, have been setup, addressed, tested and are fully functional.

.9 Maintenance manuals have been submitted.

END OF SECTION

SCOPE OF ELECTRICAL WORK

1. GENERAL

1.1 Requirements

.1 Supply and install all material, equipment, wiring, and labour necessary for the installation, testing and commissioning of the systems detailed on the Contract Documents in accordance with the latest edition of the Canadian Electrical Code (CEC) and in accordance with amendments from the Manitoba Electrical Code (MEC).

1.2 Work Included

.1 General Requirements:

.1 General clean-up.

.2 All inspections and obtaining all permits, licenses required by various Inspection Agencies and local regulations related to Electrical Trade.

.3 Scaffolding.

.4 All necessary tools, equipment, and supplies.

.5 Shop Drawings.

.6 Project Record Documents (As-constructed Drawings).

.7 Testing and Commissioning

.8 Operating and Maintenance Data, where specified.

.2 Additional Requirements:

.1 Provision of all necessary testing, detailed wiring continuity checks, wiring completion checks, installation integrity checks, functional equipment operation checks and written system verification reports to provide a complete system that is ready for commissioning and start-up.

.2 Provision of commissioning and start-up of all systems included in the Scope of Work as per Section.

.3 Contractor shall field verify that existing infrastructure to remain is suitable for the Work as described within this Division, the Drawings, and Division 40 prior to commencing work. In case of discrepancies, inform Contract Administrator as soon as practicable.

.4 General:

.1 Provide all cabling required making a complete and operational facility. Provide conduit systems to allow complete installation for all cables. Provide underground cabling as per code with mechanical protection from digging. Provide mechanical protection for cable risers from vehicles and off road vehicles. Seal all penetrations with firestopping. Seal air tight and water tight chambers with seals that maintain the rating. Seal finishes to match the architectural appearance of the structure.

.2 Provide complete grounding as herein specified and indicated on the Contract Documents. All grounding shall comply with the Canadian Electrical Code and local amendments to this code.

.3 Provide electrical wiring, conduit and other appurtenances required to provide power connections as required from the PLC cabinets, UPS panel, and electrical power distribution panel.

.4 Provide power connections from the control panel to the various items of electrical equipment, motors, instrumentation and control equipment.

1.3 Materials

.1 Bus systems including all forms of buses integral with the electrical power system, together with their associated insulation, supports, bus ducts and protective devices.

.2 Conductors, including all types of wires, conductors, cables, which form an integral part of the electrical power system.

.3 Cables and bus support systems which are intended to enclose or support all forms of electrical conductors used for any purpose covered by this scope. This includes cable trays, raceways and all forms of rigid, flexible, metallic and non-metallic conduit, and including conduit for communication systems or others, which may be installed at a later date, or buried conduit for wiring work by others, only when such buried conduit is indicated in the Contract.

.4 Control panels associated with any electrical equipment covered under this Section of Work including modifications to existing control panel unless otherwise noted.

.1 Any modified control panels will need to be recertified for CSA by a special CSA inspection.

.5 Components required for modifications to existing equipment.

.6 Circuit breakers of all types and for all applications associated with electrical equipment, which receives its power supply from the main, auxiliary or emergency system.

.7 Grounding systems, as required by the Canadian Electrical Code, or as otherwise specified in the Contract.

.8 Control and instrumentation systems - electrical or electronic instrumentation systems, with auxiliary equipment and components, unless specified otherwise.

.9 Transformers of various types, dry, encapsulated etc., and for all applications.

.10 Electronic data processing and transmission systems, including auxiliary equipment, interface and components.

1.4 Units of Measure

.1 The following three (3) conversion methods were used in product and location dimensions:

.1 Hard Conversion: industry available products which are manufactured in metric measurements.

.2 Soft Conversion: products which are still manufactured in Imperial units and are converted in Specifications using arithmetic conversion factors.

.3 Rationalized Conversion: dimensions which are soft converted and rounded off for ease of measurements.

.2 In cases where measurements may be open for interpretation, dual dimensions have been incorporated until hard conversions can be used exclusively.

1.5 Definitions

.1 All terminologies, abbreviations, and acronyms used in this Document are as listed in the various Standards, Codes, Rules, and Bulletins used herein.

.2 Where the word *install* is used, unless specifically specified, is also meant to include the supply of the equipment.

1.6 Measurement and Payment

.1 Scope of Electrical Work:

.1 Scope of Electrical Work as described in this Specification will be paid for at the Contract Lump Sum Price for “Electrical” including all items incidental to the Work included in this Specification.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

WIRE AND BOX CONNECTORS 0-1000 V

1. GENERAL

1.1 References

.1 Canadian Standards Association (CSA), latest adopted edition of:

.1 CSA C22.2 No.18.3-12, Conduit, Tubing, and Cable Fittings.

.2 CSA C22.2 No.18.4-15, Hardware for the Support of Conduit, Tubing, and Cable.

.3 CSA C22.2 No.18.5-13, Positioning Devices.

.4 CSA C22.2 No.65-13, Wire Connectors.

2. PRODUCTS

2.1 Materials

.1 Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Clamps or connectors for armoured cable, aluminum sheathed cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required to: CSA-C22.2 No.18.3, 18.4 and 18.5.

3. EXECUTION

3.1 Installation

.1 Remove insulation carefully from ends of conductors and:

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

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

END OF SECTION

1. GENERAL

1.1 References, Codes, and Standards

.1 Canadian Standards Association (CSA), latest adopted revisions:

.1 CSA C22.2 No. 0.3-09, Test Methods for Electrical Wires and Cables, and Update No. 1.

.1 CSA-C22.2 No. 131-14, Type TECK 90 Cable, and Update No. 1.

.2 CSA C22.2 No. 38, Thermoset-Insulated Wires and Cables.

1.2 Product Data

.1 Submit product data in accordance with Division 26.

2. PRODUCTS

2.1 Building Wires

.1 Conductors: stranded for #10 AWG and larger, minimum power conductor size #12 AWG.

.2 Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene (XLPE) material rated RW90.

.3 All underground wiring in conduit to be RW90 type.

.4 All direct-buried underground wiring and in wet locations to be TECK90 type.

2.2 Teck Cable

.1 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, minimum size #12 AWG or as indicated.

.2 Outer Jacket:

.1 Thermoplastic polyvinyl chloride material with heat, flame, and moisture retardant properties.

.2 Flame retardancy of outer jacket to be rated in accordance with CSA C22.2, No. 0.3.

.3 Armour: interlocking aluminum.

.4 Inner Jacket: polyvinyl chloride material.

.5 Insulation:

.1 Type: ethylene propylene rubber.

.2 Chemically cross-linked thermosetting polyethylene rated type RW90, 1000 V.

.6 Fastenings:

.1 One-hole malleable iron straps to secure surface cables 50 mm and smaller. Two-hole steel straps for cables larger than 50 mm.

.2 Channel type supports for two (2) or more cables at 1500 mm centers.

.3 Six (6) mm diameter threaded rods to support suspended channels.

.7 Connectors:

.1 Watertight, approved for TECK cable.

.2 To reduce corrosion based on dissimilar metals, TECK connectors to be of the same type of metal (if applicable) as to the enclosure it is fastened to.

.3 Hazardous Locations:

.1 CSA approved.

.2 Watertight type with:

.1 An elastomeric bevelled bushing.

.2 A funnel entry, splined gland nut.

.3 A non-magnetic, stainless steel grounding device with dual grounding action.

.4 A taper threaded hub.

.5 A hexagonal body and gland nut.

.3 Integral seal type with metal-to-metal contact construction.

.4 Sealing of multi-conductor cable shall be accomplished with a liquid type polyurethane compound.

.5 The fitting must:

.1 Provide an environmental seal around the outer jacket of the cable and electrically bond the fitting to the cable armour prior to potting the explosion-proof seal.

.2 Allow the possibility of disconnection without disturbing the environmental seal, the electrical bonding or the explosionproof seal.

.6 All metal-clad cable fittings, for jacketed and non-jacketed interlocked armour cable, shall incorporate an easily-removable armour stop (not requiring fitting disassembly) ensuring proper positioning of the cable armour during cable termination.

2.3 Control Cables: 600 V Teck 90

.1 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, as indicated and minimum #14 AWG otherwise.

.2 Outer Jacket:

.1 Thermoplastic polyvinyl chloride material with heat, flame, and moisture retardant properties.

.2 Flame retardancy of outer jacket to be rated in accordance with CSA C22.2, No. 0.3.

.3 Armour: interlocking aluminum.

.4 Inner Jacket: polyvinyl chloride material.

.5 Insulation:

.1 Type: ethylene propylene rubber.

.2 Chemically cross-linked thermosetting polyethylene rated type RW90, 600 V.

.6 Fastenings:

.1 One-hole malleable iron straps to secure surface cables 50 mm and smaller. Two-hole steel straps for cables larger than 50 mm.

.2 Channel type supports for two (2) or more cables at 300 mm centers.

.3 Six (6) mm minimum diameter threaded rods to support suspended channels.

.7 Connectors:

.1 Watertight, approved for TECK cable.

.2 To reduce corrosion based on dissimilar metals, TECK connectors to be of the same type of metal (if applicable) as to the enclosure it is fastened to.

.3 Hazardous Locations:

.1 CSA approved.

.2 Watertight type with:

.1 An elastomeric bevelled bushing.

.2 A funnel entry, splined gland nut.

.3 A non-magnetic, stainless steel grounding device with dual grounding action.

.4 A taper threaded hub.

.5 A hexagonal body and gland nut.

.3 Integral seal type with metal-to-metal contact construction.

.4 Sealing of multi-conductor cable shall be accomplished with a liquid type polyurethane compound.

.5 The fitting must:

.1 Provide an environmental seal around the outer jacket of the cable and electrically bond the fitting to the cable armour prior to potting the explosion-proof seal.

.2 Allow the possibility of disconnection without disturbing the environmental seal, the electrical bonding or the explosionproof seal.

.6 All metal-clad cable fittings, for jacketed and non-jacketed interlocked armour cable, shall incorporate an easily-removable armour stop (not requiring fitting disassembly) ensuring proper positioning of the cable armour during cable termination.

2.4 Control Cables: Armoured/Unarmoured Control and Instrument Cables (ACIC/CIC)

.1 Cable: to CAN/CSA-C22.2 No. 239, Control and Instrumentation Cables.

.2 Conductors:

.1 Minimum #18AWG or as noted on the Drawings.

.2 Seven (7) strand concentric lay.

.3 Class B tinned copper.

.4 Twisted pairs/triads.

.5 Number of pairs as indicated on Drawings.

.3 Insulation: PVC TW75, 75°C Wet, 105 °C Dry (-40°C), Voltage as noted.

.4 Inner jacket: XLPE.

.5 Overall armour: interlocking aluminum armour.

.6 Overall outer jacket: FT4 flame-retardant rated outer jacket.

.7 Shielding:

.1 Individual twisted pairs/triads with complete electrical isolation between shields.

.2 Induvial shielded pairs/triads.

.3 Aluminum/mylar shield with ST drain wire, 100% shield.

.4 Overall aluminum/mylar shield with ST drain wire.

.5 Individual drain wires one size smaller than conductor AWG.

.8 Cable shall be provided with a black, white, colour code and number code for each pair.

.9 The entire cable assembly to be suitable for pulling in conduit or laying in cable tray.

.10 Fastenings:

.1 One-hole malleable iron straps to secure surface cables 50 mm and smaller. Two-hole steel straps for cables larger than 50 mm.

.2 Channel type supports for two (2) or more cables at 300 mm centers.

.3 Six (6) mm minimum diameter threaded rods to support suspended channels.

.11 Connectors:

.1 Watertight, approved for TECK cable.

.2 To reduce corrosion based on dissimilar metals, TECK connectors to be of the same type of metal (if applicable) as to the enclosure it is fastened to.

.3 Hazardous Locations:

.1 CSA approved.

.2 Watertight type with:

.1 An elastomeric bevelled bushing.

.2 A funnel entry, splined gland nut.

.3 A non-magnetic, stainless steel grounding device with dual grounding action.

.4 A taper threaded hub.

.5 A hexagonal body and gland nut.

.3 Integral seal type with metal-to-metal contact construction.

.4 Sealing of multi-conductor cable shall be accomplished with a liquid type polyurethane compound.

.5 The fitting must:

.1 Provide an environmental seal around the outer jacket of the cable and electrically bond the fitting to the cable armour prior to potting the explosion-proof seal.

.2 Allow the possibility of disconnection without disturbing the environmental seal, the electrical bonding or the explosionproof seal.

.6 All metal-clad cable fittings, for jacketed and non-jacketed interlocked armour cable, shall incorporate an easily-removable armour stop (not requiring fitting disassembly) ensuring proper positioning of the cable armour during cable termination.

2.5 Single Conductor Cable

.1 Single conductor wire to be 98% conductivity copper type TEW or TBS insulation rated at (208 V) 600 V, solid or stranded conductor as required, size as noted on Contract Documents and specified herein, minimum #14 AWG with 90°C.

3. EXECUTION

3.1 General

.1 Install and rate power cables in accordance with the latest edition of the Canadian Electrical Code requirements.

.2 Install in accordance with manufacturer's recommendations, observing requirements for minimum bending radius and pulling tensions.

.3 Minimum power conductor including luminaire drops to be #12 AWG.

.4 Minimum conductor size #14 AWG for all discrete control cables.

.5 Minimum conductor size #18 AWG for twisted pair analog signal cables.

.6 At each end of the run leave sufficient cable length for termination.

.7 Protect all conductors against moisture during and after installation.

.8 Protect wiring against damage from welding spatter and other construction activity by suitable means.

.9 If available blockouts through slabs or walls are insufficient in size or location, enlarge, chip or drill additional openings to suit the Work.

.10 Do not use TC cable in areas classified as hazardous locations.

.11 Arrange wiring in process area such that motor connection boxes and other field mounted devices are entered at the side or bottom of the connection box or enclosure.

.12 Provide sufficient length of "free" cable for motors mounted on slide rails to permit the motor to travel the full length of the rails.

.13 Install reducing bushings where threaded entry in a motor connection box is larger than the hub size of the cable connector.

.14 In-line splices are not acceptable unless done in a junction or splice box.

.15 At the discretion of the Contract Administrator damage to a cable jacket may be repaired in accordance with the manufacturer's recommendation. If requested by Contract Administrator, replace the entire length of a damaged cable.

.16 Arrange cable supports such that maintenance work or removal of the equipment served by the cable, will not cause any damage to the cable.

1.2 Terminations and Splices

.1 Wire nuts are permitted only in the following circuits:

.1 Lighting circuits.

.2 Receptacle circuits.

.2 Exercise care in stripping insulation from wire. Do not nick conductors.

.3 Strictly follow manufacturer's instructions with regards to tool size and application methods of terminations and compounds.

.4 Where screw-type terminals are provided on equipment and instrumentation, terminate field wiring with insulated fork tongue terminals.

.5 Do not make splices in any of the instrumentation cable runs.

.6 All instrumentation and control equipment supplied shall be equipped with terminal blocks to accept conductor connections.

.7 Instrumentation conductors, where terminated at equipment terminals other than clamping type terminal blocks, shall be equipped with self-insulated, locking type terminators, sized as required to fit conductors and screw terminals.

1.3 Re-Use of Existing Wiring

.1 Except where specifically identified or approved, reuse of existing wiring is not permitted.

.2 Ensure all existing wiring is tagged prior to disconnection of equipment.

.3 Tag spare wires to remain as “Spare” and indicate the location of the other end of the wire.

3.1 Installation of Building Wires

.1 Install wiring as follows:

.1 In conduit systems in accordance with Division 26.

.2 In cabletroughs in accordance with Division 26.

.3 In wire ways and auxiliary gutters.

3.2 Installation of Teck Cable 0-1000 V

.1 Install cables.

.2 Group cables wherever possible on channels.

.3 Lay cable in cable troughs in accordance with Division 26.

.4 Terminate cables in accordance with Division 26.

.5 Use TECK cable or wire and conduit in accordance with this Division for power to instruments, for 120 V signals other than those mentioned Digital and Analog signals and as otherwise indicated on the Drawings. Use stranded wire and cable to supply power to instruments.

.6 Install cables from FDS-1 to top of cable tray in metal conduit, and secured conduit to wall with steel unistruct.

3.3 Installation of Control Cables

.1 Install control cables in conduit or cable troughs.

.2 Ground control cable shield at one end only. Shields to be continuous over entire run.

.3 Use Twisted Pair Shielded Cables(TPSH) cable for all low level input (24 V and below) and output signals to the control system.

.4 Provide separation of cables from sources of noise, including other cables.

.1 For control signals < 50 V, provide separation distances as follows:

.1 120 VAC, 8 AWG and smaller: 50 mm.

.2 120 VAC, >8 AWG: 300 mm.

.3 600 VAC power: 300 mm.

.4 VFD or other high harmonic cable: 300 mm in metallic conduit/600 mm other raceway.

.5 Medium Voltage: 450 mm.

.2 For control signals 120 VAC, provide separation distances as follows:

.1 120 VAC, 8 AWG and smaller: none.

.2 120 VAC, >8 AWG: metal barrier or 150 mm.

.3 600 VAC power: metal barrier or 150 mm.

.4 VFD or other high harmonic cable: 150 mm in metallic conduit / 300 mm other raceway.

.5 Medium Voltage: 450 mm.

.3 Advise the Contract Administrator if these separations cannot be achieved.

.4 Ground shields at one end only. Where possible, ground shields at the end where power is supplied to the cable. Utilize shield grounding bar in panels, where present, to ground overall shields. Individual pair shields to be grounded on appropriate terminals.

.5 Shield drain wires, at the ungrounded end, are to be taped back to the cable. Do not cut the shield drain wire off.

3.4 Cutting, Patching and Drilling

.1 Provide all cutting and patching as required.

.2 Return exposed surfaces to an as-found condition.

.3 Exercise care where cutting/drilling holes in existing concrete elements so as not to damage existing reinforcing, or any other systems run in the concrete.

.1 Locate reinforcing and other existing systems using ground penetrating radar, X-Ray or other suitable means. Mark out on the surface of the concrete the locations of rebar and all other systems.

.2 For all holes larger than 50 mm passing through reinforced concrete, mark the location of the desired hole and all embedded systems. Obtain approval from the Contract Administrator prior to cutting.

.4 Firestop and seal all penetrations.

.5 Ensure that water ingress will not occur.

.6 Provide expansion joints for penetrations where shifting can occur.

3.5 Anchor Installation

.1 The Contractor shall exercise care where installing anchors into existing concrete elements so as not to damage existing reinforcing. All anchors shall be installed utilizing carbide tip drill bits. The existing reinforcing shall be located utilizing a reinforcing bar locator and marked out on the surface of the concrete. The drill holes shall be advanced to the required depth for installation of the anchors. Should reinforcement be encountered while drilling, the hole shall be terminated and repositioned to clear the reinforcement. Do not use core bits that can easily intercept and damage/cut the reinforcing during drilling.

3.6 Workmanship

.1 Before pulling wire, ensure conduit is dry and clean. If moisture is present, thoroughly dry out conduits; vacuum if necessary. To facilitate pulling, recognized specially manufactured wire pulling lubricants may be used. Do not use grease. Employ suitable techniques to prevent damage to wire when ambient temperature is below the minimum permitted for each insulation type. Do not pull wires into incomplete conduit runs.

.2 Installation to be free of opens and grounds. Before energization, measure insulation resistance and comply with the Manitoba Electrical Code. Submit data sheet with values measured.

.3 Do not install any power conductor smaller than #12 AWG, except where specifically indicated otherwise, i.e., for genset control wiring, smoke detectors, etc. fire alarm system station circuits, P.A. wiring, etc.

.4 Provide conductors as shown on Contract Documents and cable schedule. Minimum conductor sizes are indicated. Voltage drop from lighting panels to farthest outlet must not exceed 2% at full load in any case. Advise Contract Administrator if problem is foreseen.

.5 Exercise care in stripping insulation from wire. Do not nick conductors.

3.7 Identification, Coding and Balancing

.1 For branch circuit wiring, follow identification system shown on the Contract Documents and as specified in Division 26.

.2 For branch circuit wiring, follow identification system shown on the Contract Documents and as specified in Division 26.

.3 Connect single phase equipment to minimize imbalance on feeders. Adjust branch circuiting shown as required for optimum balancing. Record all changes on As-Constructed Drawings.

.4 Colour code all feeders at all terminations, at all points where taps are made, and at all panel boards, switchboards, motor control centres, etc. Use two wraps of 3M #471 plastic film tape 48 mm wide.

.5 Conductors sized No. 10 and smaller are required to be factory coloured or numbered, not taped on Site.

.6 For direct current wiring use red for positive and black for negative.

.7 Identify each instrumentation conductor with wire numbers using a machine printed heat shrink wire marker.

.8 Install cable tags at control panel end of cable.

3.8 Testing

.1 All power and control wiring shall be tested for insulation resistance value with a megger. Resistance values shall be as recommended by the cable manufacturer.

.2 Test all conductors for opens, shorts, or grounds.

.3 All wire test results shall be properly tabulated, signed, dated, and submitted to the Contract Administrator.

END OF SECTION

GROUNDING

1. GENERAL

1.1 Description

.1 Supply and install a complete grounding system to include new equipment provided in this Contract. Securely and adequately ground all components of the electrical system in accordance with the requirements of all related sections in the latest Canadian Electrical Code, Local Building Code, and the local Electrical Inspection Branch.

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

1.2 References

.1 American National Standard Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE):

.1 ANSI/IEEE 837, Standard for Qualifying Permanent Connections Used in Substation Grounding.

.2 IEEE 80 (2013), IEEE Guide for Safety in AC Substation Grounding.

.2 Canadian Standards Association (CSA):

.1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations).

2. PRODUCTS

2.1 Equipment

.1 Conductors:

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

.2 PVC insulated coloured green, stranded soft annealed copper wire No. 10 AWG for grounding meter and relay cases.

.3 Uninsulated ground wires shall be bare stranded copper, soft annealed, CSA FT1 for outdoors. Size as indicated.

.2 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Thermit welded type conductor connectors.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

.7 Wire connectors and terminations: as indicated.

.8 Acceptable Manufacturers:

.1 Erico.

.2 Burndy.

.3 Or approved equal.

.3 Compression Connection – “C” Tap

.1 Requirements:

.1 Material: solid copper.

.2 Type: “C” Tap.

.2 Acceptable Manufacturer and Model:

.1 Burndy YGHC.

.2 Or approved equal.

.4 Compression Connection – Butt Splice:

.1 Requirements:

.1 Material: solid copper.

.2 Type: heavy duty splice.

.2 Acceptable Manufacturer and Model:

.1 Burndy YGHS.

.2 Or approved equal in accordance with B7.

.5 Exothermic Connection:

.1 Required material: copper.

.2 Acceptable Manufacturer and Model:

.1 Burndy ThermOweld or BurndyWeld product lines.

.2 Or approved equal.

3. EXECUTION

3.1 General

.1 Install complete permanent, continuous grounding system, including conductors, accessories.

.2 All connectors shall be installed in accordance with Manufacturers' requirements.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Make buried connections and connections to electrodes, using copper welding by thermit process to ANSI/IEEE 837.

.5 Soldered joints shall not be permitted.

.6 All frames and metallic enclosures of all electrical equipment and electrically operated equipment shall be grounded via a ground wire.

.7 All loads fed from control panels, panelboards, and splitters fed from the MCC transformers, switchgear, MCCs, panel boards and splitters shall be grounded by grounding conductors sized as shown. The ground wire shall be terminated at each end with an appropriate grounding lug which shall be connected to the equipment ground bus. Ground wire to be green TWH.

.8 Use mechanical connectors for grounding connections to equipment provided with lugs.

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

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

.11 All bolted connections must be accessible.

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

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

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

.15 Use compression connectors for all grounding splices and terminations unless otherwise shown on the Contract Documents.

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

.17 Conduit installed buried in earth or installed in or under grade floor slabs shall have separate ground wire installed.

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

.19 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.20 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

.21 Exterior run grounding conductors shall be run in rigid PVC conduit where required for support or mechanical protection.

.22 Minimum bending radius for grounding conductors shall be 2 inches.

.23 Install conductors with a minimum of bends and without kinking. Where bends are unavoidable, make bends as smoothly as possible.

.24 Install electrical room ground bus to wall, utilizing insulated off sets.

3.2 Electrode Installation

.1 Make special provision for installing electrodes that will give acceptable resistance to ground value, where rock or sand terrain prevails.

.2 Install rod electrodes and make grounding connections as shown on the Drawings.

.3 Connect multiple rod electrodes together as shown on the Drawings.

.4 Locate all existing underground services in the area prior to installation of ground electrodes. Ensure no existing underground pipes or cables are damaged during the installation of the electrodes.

3.3 Equipment Grounding

.1 Install grounding connections to all electrical equipment.

3.4 Field Quality Control

.1 Perform tests in accordance with Division 26.

.2 Perform ground continuity and resistance tests using method appropriate to Site conditions and to approval of Contract Administrator and local Authority Having Jurisdiction over installation. Perform ground resistance test before backfill.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

END OF SECTION

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

1. GENERAL

1.1 Work Included

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

2. PRODUCT

2.1 Framing and Support System

.1 Materials:

.1 Intermediate duty supporting structures shall employ 41 mm square strut channel together with the Manufacturer's connecting components and fasteners for a complete system.

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

.3 Shall be rated for use in hazardous locations and category environments as necessary.

.2 Finishes:

.1 Hot dipped galvanized.

.2 Nuts, bolts, machine screws: cadmium plated.

.3 Square strut channel:

.1 Section 41 mm square strut channel or as required for load and span, with mounting screws, or approved. 41 mm square strut channel is a minimum standard for supporting conduits 50 mm and larger.

2.2 Concrete and Masonry Anchors

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

.2 Components: non-drilling anchors for use in predrilled holes, sized to safely support the applied load with a minimum safety factor of four (4).

2.3 Non-Metallic Anchors

.1 Material: plastic anchors for sheet metal screws.

2.4 Cable Supports and Clamps

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

3. EXECUTION

3.1 General

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

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

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

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

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

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

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

3.2 Installation

.1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields.

.2 Secure equipment to concrete with expandable inserts.

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

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

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

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

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

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

.6 Suspended support systems.

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

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

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

.8 Shot driven pins may only be used with written approval of the Contract Administrator.

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

.10 Support outlet boxes, junction boxes, panel tubs, etc., independent of conduits running to them. Support conduits within 600 mm of outlet boxes. Support surface mounted panel tubs with a minimum of four (4) 6 mm fasteners.

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

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

.13 For surface mounting of two or more conduits, refer to Section 26 05 34 - Conduits, Conduit Fastenings and Fittings.

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

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

END OF SECTION

SPLITTERS, JUNCTION BOXES, PULL BOXES AND CABINETS

1. GENERAL

1.1 References

.1 National Electrical Manufacturers Association (NEMA):

.1 NEMA ICS 6, Industrial Control and Systems: Enclosures.

1.2 Shop Drawings and Product Data

.1 Submit Shop Drawings and product data for cabinets in accordance with Section 26 05 00.

.2 Provide Manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

2. PRODUCTS

2.1 Junction Boxes, Cabinets, and Pull Boxes

.1 NEMA Type of enclosure refer to Division 26.

.1 All installations in hazardous areas shall be NEMA4X.

.2 All installations in outdoor or wet locations shall be NEMA4x.

.2 Materials:

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

.2 Components:

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

.2 Use rolled edges for surface boxes.

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

2.2 Cabinets

.1 Materials:

.1 Locks: to match panelboards.

.2 Components:

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

.2 Install a back mounting plate for DIN rail mounted terminal blocks. Plate to be painted white enamel.

.3 Install metal divider in cabinets with more than one voltage.

.4 Surface or flush with trim and hinged door, latch and lock and two (2) keys, size as indicated or to suit. Keyed to match panel board keys 19 mm.

3. EXECUTION

3.1 Installation

.1 Junction Boxes and Pull Boxes:

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

.2 Boxes installed in party walls to be offset by a minimum of one (1) stud space.

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

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

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

.6 Terminate cables and conductors as required.

.7 Make all necessary cable entry holes in junction boxes supplied by Contractor or others, regardless of material.

.2 Cabinets:

.1 Mount cabinets with top not greater than 1980 mm above finished floor, coordinated with masonry, panelboards, fire hose cabinets and similar items.

.2 Install terminal block where indicated.

.3 Identification:

.1 Provide equipment identification in accordance with Division 26.

.2 Install identification labels indicating system name, voltage, and phase.

END OF SECTION

OUTLET BOXES, CONDUIT BOXES AND FITTINGS

1. GENERAL

1.1 Work Included

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

1.2 References

.1 Canadian Standards Association (CSA):

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

2. PRODUCTS

2.1 Outlet and Conduit Boxes General

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

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

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

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

2.2 Outlet Boxes for Metal Conduit

.1 Materials:

.1 Surface mounting exposed: cast ferrous for threaded conduit, with attached lugs, two (2) coats corrosion resistant finish.

.2 Components:

.1 Ceiling outlets, surface mounting:

.1 Cast outlet boxes suitable for rigid conduit.

.2 Manufacturer: Crouse-Hinds VXF/VFT series or approved equal.

.2 Wall outlets, surface, exposed mounting or used for outdoor outlets:

.1 One or more gang.

.2 Manufacturer: Crouse-Hinds FS series or FD series, Condulet, or approved equal.

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

2.3 Conduit Boxes

.1 Cast FS or FD Feraloy boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

2.4 Fittings - General

.1 Bushing and connectors with nylon insulated throats.

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

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

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

2.5 Cable Transit Boxes and Seals

.1 Multidiameter sealing modules.

.2 Wedge kit and stay plate to ensure adequate seal (gas transit, firestopping, etc.) as per manufacturer's instructions.

.3 Transit frame suitable for bolting to transition surface.

.4 Manufacturer approved lubricant for suitable for cable and module installation.

3. EXECUTION

3.1 Installation

.1 NEMA Type of boxes refer to Division 26.

.2 Support boxes independently of connecting conduits.

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

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

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

.6 Surface mount above suspended ceilings, or in unfinished areas.

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

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

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

.10 Do not use sectional boxes.

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

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

.13 Outlets installed in partition walls to be offset by a minimum of one (1) stud space.

.14 Primary bushings in termination box for cable connection.

.15 Secondary bushings in termination box for bus duct connection.

END OF SECTION

CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS

1. GENERAL

1.1 References

.1 Canadian Standards Association (CSA):

.1 CSA C22.2 No. 18.1 Metallic Outlet Boxes.

.2 CSA C22.2 No. 18.2 Non-metallic Outlet Boxes.

.3 CSA C22.2 No. 18.3 Conduit, Tubing, and Cable Fittings.

.4 CSA C22.2 No. 18.4 Hardware for the Support of Conduit, Tubing, and Cable.

.5 CSA C22.2 No. 18.5 Positioning Devices.

.6 CSA C22.2 No. 45.1 Electrical Rigid Metal Conduit – Steel.

.7 CSA C22.2 No. 45.2 Electrical Rigid Metal Conduit — Aluminum, Red Brass, and Stainless Steel.

.8 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.9 CSA C22.2 No. 83, Electrical Metallic Tubing.

.10 CSA C22.2 No. 227.3, Non-metallic Mechanical Protection Tubing (NMPT).

2. PRODUCTS

2.1 Conduits

.1 Rigid metal conduit: to CSA C22.2 No. 45.2, aluminum threaded.

.2 Epoxy coated conduit: to CSA C22.2 No. 45.1, with zinc coating and corrosion resistant epoxy finish inside and outside.

.1 Coated with Columbex Green-Guard inside and outside. All joints and conduit scratches shall be repaired with Green-Guard surface cleaner, primer, and touch-up compound.

.3 Flexible metal conduit: to CSA C22.2 No. 56, aluminum liquid-tight flexible metal.

.4 Rigid PVC conduit: to CSA C22.2 No. 211.2.

2.2 Conduit Fastenings

.1 One (1) hole stainless steel straps to secure surface conduits 50 mm and smaller.

.2 Two (2) hole stainless steel straps for conduits larger than 50 mm.

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

.4 Channel type supports for two or more conduits at 1 m on centre.

.5 Threaded stainless steel rods, 9 mm diameter, to support suspended channels.

2.3 Conduit Fittings

.1 Fittings: to CSA C22.2 No. 18.3, No. 18.4, and No. 18.5, manufactured for use with conduit specified. Coating: same as conduit.

.2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.

2.4 Fish Cord

.1 Polypropylene.

3. EXECUTION

3.1 Installation

.1 Install all conduit, conduit fittings and accessories in accordance with the latest edition of the CEC in a manner that does not alter, change, or violate any part of the installed system components or the CSA/cUL certification of these components.

.2 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.3 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.

.4 Use epoxy coated conduit underground, in concrete, and in Category 2 locations.

.5 Install conduit sealing fittings in hazardous areas. Fill with compound rated for the application and to manufacturer’s instructions.

.6 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment.

.7 Use explosion proof flexible connection for connection to explosion proof motors.

.8 Minimum conduit size for lighting and power circuits: 19 mm.

.9 Bend conduit cold. Replace conduit if kinked or flattened more than $1/10^{th}$ of its original diameter. Use bending equipment specifically intended for the purpose.

.10 Mechanically bend steel conduit over 19 mm in diameter.

.11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.12 Install fish cord in empty conduits.

.13 Remove and replace blocked conduit sections.

.1 Do not use liquids to clean out conduits.

.14 Dry conduits out before installing wire.

.15 Connect conduit to equipment securely to maintain continuity for the purpose of bonding to ground.

.16 Provide for the expansion and contraction of the conduit system.

3.2 Surface Conduits

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended or surface mounted aluminum channels.

.5 Do not pass conduits through structural members except as indicated. Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.3 Concealed Conduits

.1 Run parallel or perpendicular to building lines.

.2 Do not install conduits in terrazzo or concrete toppings.

3.4 Cleaning

.1 Proceed in accordance with Section 01 78 00 - Closeout Submittals.

.2 On Completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

WIRING DEVICES

1. GENERAL

1.1 References

.1 National Electrical Manufacturers Association (NEMA):

.1 NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 NEMA ICS 6, Industrial Control and Systems: Enclosures.

.2 Canadian Standards Association (CSA):

.1 C22.2 NO. 42-10 (R2015) - General use receptacles, attachment plugs, and similar wiring devices.

.2 C22.2 NO. 42.1-13 - Cover plates for flush-mounted wiring devices (Bi-national standard, with UL 514D).

.3 C22.2 NO. 55-15 - Special use switches.

.4 C22.2 NO. 111-10 (R2015) - General-use snap switches (Bi-national standard, with UL 20).

2. PRODUCTS

2.1 Manufacturer

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

.2 Acceptable Manufacturers:

.1 Arrow-Hart (Cooper/Eaton).

.2 Crouse-Hinds (Eaton).

.3 Hubbell Inc.

.4 Schneider.

2.2 Devices

.1 The catalogue numbers shown below are for the particular Manufacturer's series and all necessary suffixes shall be added for the requirements as stated. All devices shall be specification grade minimum.

.2 Devices to be with stainless steel coverplates in all but mechanical areas unless noted otherwise.

.3 Use galvanized steel coverplates in mechanical areas and for surface mounted devices.

.4 Category 2, hazardous locations, and outdoor areas shall use NEMA 4X boxes and coverplates.

2.3 Switches

.1 120-277 V, 20 A, single and double pole, three-way and four-way industrial grade switches to CSA-C22.2. No.55 and CSA-C22.2 No. 111 as required.

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

.3 For Category 2 area, switches shall be marked and CSA approved for use in wet or corrosive area and be NEMA 4X or better.

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

.1 Terminal holes approved for AWG # 10 wire.

.2 Silver alloy contacts.

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

.4 Suitable for back and/or side wiring.

.5 Toggle-operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

2.4 Receptacles

.1 Receptacles to be of one manufacturer throughout project.

.2 Duplex 15 A, 120 V, 3 wire, U-ground, with the following features:

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

.2 Eight (8) back wired entrances, four (4) side wiring screws.

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

.4 Triple wipe contacts and riveted grounding contacts.

.3 Duplex 15 A, 120 V, 3 wire, U-ground ground fault receptacle.

.4 Provide coverplates for all wiring devices.

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

.6 Use stainless steel 1 mm thick coverplates on all wiring devices mounted in flush-mounted outlet boxes unless otherwise specified.

.7 Receptacles located in the wet areas and on the exterior of the building to be weatherproof construction, complete with wet-while-in-use covers.

.8 Receptacles exposed to weather shall have wet location cover plates complete with “Extra Duty” designation.

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

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

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

.12 For Category 2 areas switches shall be marked and CSA approved for use in wet or corrosive area and be NEMA 4X or better.

.13 Single 15 A, 120 V, 3-wire housekeeping receptacle with stainless steel plate engraved with Housekeeping.

2.5 Cover Plates

.1 Cover plates to be of one manufacturer throughout project.

.2 Provide stainless steel cover plates for all wiring devices.

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

.4 Use stainless steel 1 mm thick cover plates on all wiring devices mounted in flush-mounted outlet boxes unless otherwise specified.

.5 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for single receptacles or switches.

.6 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

.7 Use gasketed DS cast covers on FS and FD type boxes.

3. EXECUTION

3.1 Installation

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

.2 Mounting dimensions are to the centre of the devices. Final instructions on mounting heights shall be given by Contract Administrator at the Site. The above shall be used as a guide, but shall be subject to final verification prior to installation.

.3 Switches:

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

.2 Install switches vertically in gang type outlet box when more than one (1) switch is required in one (1) location.

.4 Receptacles:

.1 Install receptacles vertically in gang type outlet box when more than one (1) receptacle is required in one (1) location.

.2 Install receptacles exposed to weather at least 1000 mm above finished grade. Where 1000 mm is not achievable due to site conditions, receptacles shall be mounted facing downward at an angle of 45^{o} from the horizontal.

.5 Cover Plates:

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

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

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

END OF SECTION

PROCESS EQUIPMENT INSTALLATION

1. GENERAL

1.1 Description

.1 This Section describes the installation and testing of equipment supplied under other Sections in Division 26 and Division 40.

1.2 Definitions and Interpretations

.1 Testing: In Division 26 and Division 40, testing is defined as the operation of a specific item of equipment under actual and/or simulated conditions for the purpose of ensuring the equipment satisfies its basic design criteria. Testing shall be conducted by the Contractor. All materials, labour, power and equipment required to conduct the tests shall be the Contractor's responsibility. The Manufacturer is to provide technical assistance to the Contractor for the installation, testing, start-up and commissioning of the equipment supplied.

.2 Commissioning: In Division 26 and Division 40, commissioning is defined as the operation of equipment systems under actual and/or simulated conditions for the purpose of ensuring the system performs its intended functions. Refer to Section 01 65 00 - Facility Start-up/ Commissioning.

1.3 Submittals

.1 Refer to Specification Section 01 33 00 - Submittal Procedures.

.2 Check all the Shop Drawings relative to the equipment and materials, dimensions, measurements, size, type of materials, controls, list of equipment being supplied, names of Manufacturers, and other details to affirm that they are correct and conform to the requirements and intent of the Contract.

2. PRODUCTS

2.1 Equipment Schedule

.1 Unless indicated otherwise, supply and install all equipment detailed on the equipment Specification sheets, or shown on the Drawings.

.2 Determine the extent of equipment to be supplied from the Specifications, list of equipment and materials and Manufacturer's Drawings covering the equipment. Furnish and install all additional materials necessary to complete the installation.

.3 Incorporate all ancillary devices in the installation including those providing for lubricant supply, process drains, electrical connections, and instrumentation and control requirements.

2.2 Mounting Requirements

.1 Provide all supports, anchorage, and mounting of all equipment in accordance with the Manufacturer's recommendations, the National Building Code, and industry standard requirements, unless otherwise specified. Submit the Manufacturer's recommended

mounting requirements as per Section 01 33 00 - Submittal Procedures, together with the related process equipment.

.2 Design and provide all elements required to resist the calculated forces described herein or required by the Manufacturer.

3. EXECUTION

3.1 Coordination

.1 Coordinate the Work specified under this Section with the Work of other Sections to produce a complete and workmanlike job.

3.2 Preparation

.1 Before commencing installation of the Work, inspect and take field measurements and ensure that Work conducted previously in the area is not prejudicial to the proper installation of the Works.

.2 Refer to the equipment Specifications and Specification sheets for assistance in determining the form in which equipment is to be shipped and the extent of field assembly required.

.3 Dimensions shown on the Contract Documents for equipment bases, piping connections, etc., are approximate and must be corrected by the Contractor to suit the exact dimensions of the equipment provided for each application. Arrange any necessary modifications to piping connections, pipework, or other ancillaries after acceptance by the Contract Administrator at no additional cost to the City.

.4 Schedule Manufacturer's Representative Site visits. Cooperate in their supervision of the installation and start-up. Follow all reasonable instructions of the Manufacturer's Representative. Should the Contractor require the Manufacturer's Representative to attend for longer or more frequent periods, the Contractor shall arrange this, at their own expense, with the Manufacturer.

3.3 Installation of Equipment

.1 Install all equipment specified in other Sections, detailed on the equipment Specification sheets, or shown on the Drawings.

.2 Supply and install all necessary shims, gaskets, etc., required to complete the installation.

.3 Provide for the use of all necessary lifting and loading equipment and all tools required to complete the installation.

.4 Comply with the specific requirements for installation noted in other Sections of this Specification and with the instructions of the Manufacturer. Where there is a conflict in these requirements, identify the conflict with the Contract Administrator and proceed as directed.

3.4 Lubricants

.1 Extend any inaccessible lubrication points and lubricant drains to convenient locations.

.2 Remove storage lubricant and provide the initial fill of new lubricants for the equipment. Lubricant grade to be as recommended by the Manufacturer.

.3 Provide a Lubrication Schedule for all process equipment. Include the following:

.1 Equipment name and number.

.2 Date(s) of lubrication.

.3 Lubricant type installed.

.4 Frequency of lubrication.

3.5 Quality Assurance Forms

.1 Disinfect all items which will be used for the conveyance or storage of potable water according to Specification Section 40 23 19.03 - Disinfection of Structures and Piping.

.2 Test all process equipment to ensure the equipment operates in accordance with the basic design criteria listed in the Specification Sections or equipment Specification sheets. Complete the series of forms that attest to the proper installation and functioning of the equipment. Refer to Section 01 65 00 - Facility Start-Up/Commissioning, for the forms.

END OF SECTION

GENERAL PROCESS PROVISIONS

1. GENERAL

1.1 Description

.1 The Work requires the supply and installation of such components that are necessary to construct complete functional and operational systems for all sections of the Work.

.2 Provide complete, fully tested and operational process systems to meet requirements described herein and in complete accordance with applicable codes and ordinances.

.3 Contract Documents and Drawings of this Division are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions.

.4 Follow Manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.

.5 Install equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space. Remove and replace improperly installed equipment to satisfaction of the Contract Administrator at no extra cost.

.6 Install equipment to provide access and ease of maintenance.

.7 Connect to equipment specified in other Sections and to equipment supplied and installed by other contractors. Uncrate equipment, move into place and install complete, start-up and test.

1.2 Discrepancies and Omissions

.1 These Specifications shall be considered as an integral part of the Drawings, which accompany them, and neither the Drawings nor Specifications shall be used alone. Any items or subject omitted from one, but which is mentioned and/or indicated in the other shall be considered as properly and sufficiently specified and shall therefore be provided.

1.3 Definitions and Interpretations

.1 Where the term "Provide" is used herein, it shall be understood to include labour, materials, and services necessary to supply, install and make functional the items or Work referenced.

.2 Where the term "Instructions" or "As Instructed" or "Where Instructed", etc. is used herein, it shall be understood to mean as instructed in writing by the Contract Administrator.

.3 Where the term "Listed" is used herein, it shall be understood to mean that the materials or equipment have been tested in accordance with applicable standards and methods, have been approved and listed for the intended use by a testing authority which itself has been approved by the Authorities Having Jurisdiction.

.4 Where the term "Approved", "Approval", etc. is used herein, it shall be understood to mean approved by Authorities having jurisdiction as conforming to Codes, Standards, By-Laws, etc.

.5 Where the term “Acceptable” or “Acceptance”, etc. is used herein, it shall be understood to mean acceptable to the Contract Administrator as conforming to the requirements of the Contract Documents.

.6 Where the term “Submit for Review” is used herein, it shall be understood to mean submit to the Contract Administrator.

.7 Where the term “shall” is used herein, it indicates a mandatory requirement.

.8 Where the term “Subject to Review” etc. is used herein, it shall be understood to mean Work shall be laid out for review by the Contract Administrator. No Work shall proceed until written instructions have been obtained from the Contract Administrator. Submit further information, Shop Drawings, samples, etc. as specified and/or as may be reasonably requested by the Contract Administrator.

.9 Where the term “Accessible” is used herein, it shall be understood to mean readily approachable by person or tools as required and where obstacles may be removed and replaced without cutting or breaking out materials.

.10 Where working pressure or pressure ratings are specified or shown on the Drawings for valves, piping, fittings, equipment, etc., these items shall be suitable for operating at specified pressures and corresponding temperature unless noted otherwise.

1.4 Shop Drawings

.1 Refer to Section 01 33 00 - Submittal Procedures, for the general requirements for Shop Drawings.

.2 Shop Drawings will be rejected if cut sheets do not clearly state model numbers, all material, sizes and all other relevant information on the item being supplied.

.3 For specific requirements for Shop Drawings for various pieces of equipment, refer to the relevant specific Sections describing the equipment.

1.5 Delivery, Handling and Storage

.1 Coordinate the equipment and material delivery schedule with the Suppliers of the equipment and materials supplied under this Contract to suit the construction schedule.

.2 Be responsible for unloading the equipment and materials supplied under this Contract and examine all packages on delivery, compare with the shipping list, and inform the Supplier, the Contract Administrator and the carrier of any visible damages or defects. The Contractor shall arrange with the Supplier to have the Supplier replace any damaged or defective items.

.3 Protect equipment and materials in storage on-site during and after installation until Substantial Performance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.

.4 Protect equipment with polyethylene covers and crates.

.5 Thoroughly clean both existing and new piping, ducts and equipment of dirt, cuttings and other foreign substances.

.6 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

1.6 Coordination

.1 Coordinate with other Divisions the location of openings, housekeeping pads and anchor bolts.

.2 Coordinate the connection of the services of other Divisions to the equipment and material supplied under this Division.

1.7 Minor Changes

.1 Equipment and materials shall be located and arranged as shown on the Drawings. However, minor changes may be required to suit the precise requirements of the actual equipment or materials supplied, or to avoid conflict between services.

.2 Prior to the installation of the relevant equipment or materials, the Contractor shall advise the Contract Administrator of the requirement for any minor changes (including box-outs and coring) and shall undertake such minor changes as instructed by the Contract Administrator. Such changes shall be undertaken at no extra cost except where the connection or arrangement is modified in length, or alignment, or position, by more than 1 m; or if the change involves the addition of more than two (2) fittings greater than 150 mm in diameter.

1.8 Cutting and Patching

.1 Provide holes and sleeves, cutting and fitting required for mechanical Work. Relocate improperly located holes and sleeves.

.2 Drill for expansion bolts, hanger rods, brackets, and supports.

.3 Obtain written approval from the Contract Administrator before cutting or burning structural members.

.4 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials as specified in the relevant Section.

1.9 Substantial Performance and Construction Completion

.1 The Contractor shall provide qualified personnel in appropriate numbers to complete the Work until Substantial Performance is declared.

.2 Prior to Substantial Performance, provide a complete list of items which are deficient at the time of the Substantial Performance inspection.

.3 Perform the following prior to Substantial Performance inspection:

.1 Make systems capable of operation with alarm controls functional and automatic controls in operation generally, but not necessarily finally calibrated.

.2 Make necessary tests on equipment including those required by regulatory authorities. Obtain certificates of approval.

.3 Paint equipment, piping and install escutcheons.

.4 Lubricate equipment as per Manufacturer's instructions.

.5 Submit warranty forms to Manufacturer. Provide copy of original warranty for equipment which has a warranty period or Manufacturer's guarantee period longer than one (1) year.

.6 Submit Operation and Maintenance Manuals as per Section 01 91 51 - Operation and Maintenance Manual.

.4 Prior to Final Completion provide declaration in writing that deficiencies noted at time of Substantial Performance Inspection have been corrected and the following items completed:

.1 Complete final calibration of controls.

1.10 Temporary Usage

.1 Usage by the City of any process device, apparatus, machinery or equipment prior to Final Completion being issued is not to be construed as Acceptance.

1.11 Painting

.1 Refer to Section 09 91 10 and Section 09 91 13 for details on painting and protection coatings.

1.12 Acceptable Products and Acceptable Manufacturers

.1 All equipment and related coatings, lubricants, etc. shall be certified to NSF/ANSI Standard 60/61.

.2 Where one or more Acceptable Products or Acceptable Manufacturers have been listed for an item of equipment, these are accepted as equivalent in concept to the Design Standard, if a Design Standard is listed. Incorporation of equipment options to satisfy the intent of the Specifications such that the process system would function as intended with the Design Standard is the responsibility of the Contractor. Modifications to the equipment services, supports, structure, etc., to suit Acceptable Products shall be the responsibility of the Contractor.

.3 It remains the responsibility of the Contractor to ensure the Products supplied are equal to the specified Products in every respect, operate as intended, and meet the performance Specifications and physical dimensions of the specified Product.

.4 The Contractor shall be fully responsible for any additional Work or materials, to accommodate the use of equipment from the Acceptable Manufacturers and Suppliers list.

1.13 Spare Parts and Special Tools

.1 If spare parts or special tools are to be provided with any equipment specified, the specific parts or tools will be listed in the relevant Specification Section and are to be supplied with the equipment.

.2 Where the operation of the equipment for a period of two (2) years would require that some specific spare parts are likely to be required, but are not listed in the Specification, the Contractor shall so inform the Contract Administrator. Costs, delivery periods, and any other information relevant to the procurement of the identified spare parts shall be identified.

.3 Where some specific special tools are required for the maintenance and/or operation of a specific item of equipment, but are not listed, the Contractor shall so inform the Contract Administrator. Costs, delivery periods, and any other information relevant to the procurement of the identified special tools shall be provided.

.4 This clause does not relieve the Contractor of the responsibility to provide, at no additional cost to the City, any spare parts required during the warranty period to repair malfunctioning or failed equipment. At the end of the warranty period, the spare parts inventory shall be replenished to allow for the above.

1.14 Abbreviations

.1 The following abbreviations are found in the Process Specifications:

AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	ASTM International
AWWA	American Water Works Association
AWS	American Welding Society
BFV	Butterfly Valve
CP	Control Panel
CSA	Canadian Standards Association
cUL	Underwriters Laboratories Canada
DCS	Distributed Control System
DC	Direct Current
FAT	Factory Acceptance Test
FOCS	Fibre Optic Communication Subsystem
FPI	Full Profile Insertion
HART	Highway Addressable Remote Transducer
HMI	Human-Machine Interface
HVAC	Heating, Ventilating, and Air Conditioning
I&C	Instrumentation and Control
IEEE	Institute of Electrical and Electronics Engineers
I/O or IO	Input and Output
ISA	International Society of Automation
ISO	International Organization for Standardization
LCP	Local Control Panel
MCC	Motor Control Center
MLD	Million Liters per Day
MSS	Manufacturers Standardization Society
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NPSH3	Net Positive Suction Head Required (for 3% head drop)
NSF	NSF International
O&M	Operations and Maintenance
OWS	Operator Work Station
P&ID	Process and Instrumentation Diagram

PC	Personal Computer
PCS	Process Control System
PCU	Process Control Unit
PICS	Process Instrumentation and Control System
PLC	Programmable Logic Controller
PW	Potable Water
RPS	Regional Pumping Station
SAT	Site Acceptance Test
SIFT	System Integration Functional Test
SIT	Site Integration Test
SSPC	Structural Steel Painting Council
UL	Underwriters Laboratories
UPS	Uninterruptible Power Supply
UV	Ultraviolet
VAC	Volts Alternating Current
VFD	Variable Frequency Drive

END OF SECTION

1. GENERAL

1.1 Description

.1 Provide process valves and appurtenances as indicated in the Drawings and in compliance with Contract Documents.

.2 Use the general requirements specified in this Section integrally with the more specific requirements listed in Section 40 23 13.01 - Detailed Process Valve Specification Sheets.

1.2 Standards

.1 American Society of Mechanical Engineers (ASME):

.1 B1.20.7: Hose Coupling Screw Threads.

.2 B16.1: Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.

.3 B16.4: Cast-Iron Threaded Fittings, Class 125 and 250.

.4 B16.10: Face-to-Face and End-to-End Dimensions of Ferrous Valves.

.2 ASTM International (ASTM):

.1 A48: Standard Specification for Gray Iron Castings.

.2 A126: Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

.3 A536: Standard Specification for Ductile Iron Castings.

.3 American Water Works Association (AWWA):

.1 C500: Metal-Seated Gate Valves for Water Supply Service.

.2 C504: Rubber-Seated Butterfly Valves.

.3 C509: Standard Specifications for Resilient-Seated Gate Valves for Water and Sewage Systems.

.4 C516: Large Diameter Rubber-Seated Butterfly Valves.78-inch (2000 mm) and Larger

.5 D102: Coating Steel Water-Storage Tanks.

.4 NSF International (NSF):

.1 61: Drinking water system components Health effects.

1.3 Submittals

.1 Submit the following in accordance with Section 01 33 00 - Submittal Procedures:

.1 Data regarding valve characteristics and performance including Cv.

.2 Shop Drawing data for accessory items.

.3 Manufacturer's literature as needed to supplement certified data.

.4 Operating and maintenance instructions and parts lists.

.5 Valve shop test results.

.6 Shop and Field inspections reports.

.7 List of recommended spare parts other than those specified.

.8 Recommendations for short- and long-term storage.

.9 Special tools.

.10 Shop and field-testing procedures and equipment to be used.

.11 Manufacturer’s product data and specifications for shop painting.

.12 Provide a layout drawing, plan and section showing orientation of valves and actuators and nearest obstructions for each valve.

.13 Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.

.14 The latest ISO 9001 series certification or quality system plan.

.15 Material Certification:

.1 Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the City.

.2 Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

.16 A copy of this Specification Section with addenda and all referenced Specification Sections with addenda, with each paragraph check-marked to indicate Specification compliance or marked to indicate requested deviations and clarifications from the specified requirements.

.1 If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

.2 Failure to include a copy of the marked-up Specification Sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up Specification and justification are resubmitted with the entire package.

1.4 Quality Assurance

.1 Comply with the requirements specified in Section 01 45 00 - Quality Control.

.2 Contractor shall be responsible for verifying outside diameter of pipe to be tapped.

.3 Services of Manufacturer's Representative as stated in Section 01 45 00 - Quality Control and specified herein.

.4 Manufacturer of valve shall have a minimum of five (5) operating installations of the same size specified and in the same service as specified operating for no less than five (5) years.

.5 If the equipment proposed is heavier, taller, or requires more operating space than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the City.

.1 If equipment is heavier than specified, the Contractor shall provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

1.5 Delivery, Storage and Handling

.1 Deliver valves to Site and use loading methods which do not damage casings or coatings.

.2 Clearly tag valves stating size, type, coatings and mating parts.

.3 Store on-site until ready for incorporation in the Works using methods recommended by the Manufacturer to prevent damage, undue stresses, or weathering.

2. PRODUCTS

2.1 General

.1 Provide valves of the same type, size range and service from a single manufacturer.

.2 Provide new, unused valves for the Work.

.3 Valve materials to be free from defects or flaws, with true alignment and bores.

.4 Unless otherwise indicated on the Drawings or specified in other Sections, valves shall be the same size as the pipe run in which they are to be installed.

2.2 Double Offset Butterfly Valves

.1 Valve 80 thru 3650 mm AWWA Class 150B.

.2 Provide all valves designed, manufactured and tested in accordance with American Water Works Association Standards ANSI/AWWA C504 and C516.

.3 Provide all valves certified to NFS/ANSI 61 Drinking Water System Components - Health Effects and certified to be Lead-Free in accordance with NSF 61/ANSI 372.

2.3 Manufacturers

.1 DeZurik.

.2 Val-Matic.

.3 Or approved equal.

2.4 Design

.1 Valve Shafts:

.1 Sizes 750 mm and larger: Stub shaft type design. Provide through-type shafts for valves 750 mm and larger valves when specified and indicated.

.2 Provide shafts locked to the disc by O-ring sealed taper pins retained with stainless steel nuts.

.2 Valve Discs: Solid type without external ribs or vanes to obstruct flow.

.3 Resilient Seats: Provide seats located on the valve disc and provide a 360-degree continuous, uninterrupted seating surface.

.1 Provide seats mechanically retained with a stainless-steel retaining ring and stainless steel Nylok® cap screws which pass through both the resilient seat and the retaining ring.

.2 Provide a continuous retaining ring or investment cast with overlapping sections, serrated grooves, and shoulders providing a Tri-Loc® system.

.3 Resilient Seat Mating Surface: 360-degree continuous, uninterrupted stainless steel body seat ring.

.4 Provide resilient seats field adjustable and replaceable without requiring epoxy, syringes, needles or pressure vessels to replace or adjust.

.4 Provide sleeve bearings in the valve hubs.

.1 Self-lubricating Nylatron or Teflon lined, fiberglass backed.

.5 Thrust Bearings: Provide adjustable on valves 750 mm and larger.

.6 Shaft Seals: V-type and replaceable without removal of the valve from the line or the shaft from the valve.

2.5 Ends

.1 Flanged:

.1 Class 125: Conform to ANSI B16.1.

.2 All flanges: flat faced.

.2 Mechanical Joint for buried valves 1200 mm and smaller:

.1 ANSI/AWWA C111/A21.11.

2.6 Materials

.1 Body:

.1 Class 150B valve bodies:

.1 ASTM A126, Class B gray iron.

.2 ASTM A536 Grade 65-45-12 ductile iron.

.2 Disc: ASTM A536 Grade 65-45-12 ductile iron.

.3 Shafts: ASTM A564, Type 630 Stainless Steel.

.4 Seat: Resilient seat Buna-N or EPDM and mate to a Type 316 Stainless Steel body seat ring.

.1 Hardware: All seat retaining hardware shall be Type 316 stainless steel.

2.7 Actuators

.1 Electric Motor Operator: Provide in accordance with City Standardized Agreement RFP 331-2014 with Rotork Controls Canada.

.1 Contractor shall provide coordinated supply of actuators and valves.

.2 Contact:

Brett Kinaschuk, Sales Manager
T: (403) 569-9455 ext. 12251
C: (403) 993-5522
E: brett.kinaschuk@rotork.com
120S 3030-3rd Ave N.E.
Calgary, AB T2A 6T7

.2 Manual:

.1 Provide traveling nut design with characterized closure per AWWA C504 and equipped with externally adjustable closed position stops capable of withstanding 2001 N (450 ft-lbs) as specified herein.

.2 Provide actuators lubricated with EP-2 grease and fully enclosed in an iron housing sealed against the entry of water.

.3 All fasteners: Type 316 stainless steel.

.4 All exposed input shafts: Electroless nickel plated or stainless steel.

.5 Provide chainwheels where required as specified herein.

2.8 Coating

.1 Provide valve exteriors for above ground service coated with a fusion bonded epoxy.

.2 Provide valve interiors coated with:

.1 NSF/ANSI 61 epoxy coating approved for potable water.

2.9 Shop Painting

.1 Coat internal and external ferrous surfaces of valve with NSF Certified Epoxy in accordance with ANSI/NSF Std. 61, and in conformance to AWWA D102 Inside System No. 1 for all valves not specified to have a fusion bonded epoxy coating.

3. EXECUTION

3.1 Installation

.1 Prior to installation, protect stored valves and appurtenances from damage due to exposure to sunlight, heat, dirt, debris, freezing and thawing, vandalism, etc.

.2 Clean all debris, dirt, gravel, etc., from inside of piping before placing valves in place.

.3 Prior to the installation of the valves, field measure and check all equipment locations, pipe alignments, and structural installation. Ensure that the valve location and orientation provide suitable access to manual operators and that sufficient space and accessibility is available for pneumatic and electric actuators.

.4 Erect and support valves in respective positions free from distortion and strain on appurtenances during handling and installation. Inspect material for defects in workmanship and material. Clean out debris and foreign material from valve openings and seats, test operating mechanisms to check functioning, and check nuts and bolts for tightness.

.5 Refer to Specification Section 40 23 19.03 - Disinfection of Structures and Piping, for the disinfection requirement of all items which will be used for the conveyance of potable water.

.6 Repair, valves and other equipment which do not operate easily or are otherwise defective at no additional cost to the City.

.7 Set plumb and support valves in conformance with instructions of manufacturer. Shim valves mounted on face of concrete vertically and grout in place. Install valves in control piping for access.

.8 Provide bolted split sleeve coupling or flexible type grooved coupling on downstream side of buried valves to assist in valve removal.

.9 Where indicated provide Type 316 stainless steel stem extension to operating floor elevation as shown and provide the bevel gear operator with a fabricated steel floorstand and handwheel.

3.2 Field Testing

.1 Pressure test valves with pipeline pressure testing.

.2 Test functions of each valve.

.3 Make all adjustments necessary to place valves in specified working order at time of above tests.

.4 Remove and replace valves and appurtenances at no additional cost to the City with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Contract Administrator that valves will perform the service specified, indicated and as submitted and accepted.

3.3 Field Touch-up Painting

.1 After installation and accepted testing by the Contract Administrator, apply touch-up paint to all scratched, abraded and damaged shop painted surfaces. Coating type and color shall match shop painting.

3.4 Contract Closeout

.1 Provide in accordance with Section 01 78 00 - Closeout Submittals.

END OF SECTION

DETAILED PROCESS VALVE SPECIFICATION SHEETS

1. GENERAL

1.1 Description

.1 Provide the valve type as indicated in the Drawings by the valve symbol shown. See the valve table within this Section for guidance on specific valve types suitable for a given commodity and line size.

.2 Comply with Section 40 23 13 - Process Valves and Appurtenances.

1.2 Definitions

.1 Abbreviations used:

.1 BFV – Butterfly Valve.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

DETAILED PROCESS VALVE SPECIFICATION SHEETS

BFV

GENERAL						
TYPE OF VALVE	**SYMBOL**	**TYPE OF COMMODITY**	**OPERATING LIMITS**		**DESIGN LIMITS**	
			PRESSURE (kPag)	**TEMP. (°C)**	**PRESSURE (kPag)**	**TEMP. (°C)**
Butterfly Valve	**BFV**	Potable Water	500	0-30	1000	40

TYPICAL SERVICE
For isolation of North and South discharge header at the MacLean RPS.

VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIAL**	Reference Document	
Body	Cast Iron, ASTM A126, Class B	Size	750 mm
Disc	ASTM A536 Grade 65-45-12 ductile iron	Rating	1000 kPa (150 psi)
Disc Trim	See Note 1	Valve Ends	Flanged, ASME B16.1 Class 125
Seats	Buna-N or EPDM and mate to a Type 316 Stainless Steel body seat ring	Pattern	Coordinate to match other fittings
Shaft	ASTM A564, Type 630 Stainless Steel	Operator	Handwheel with minimum of 600 mm diameter
Trim	Bronze	Actuator	Electric Motor Operator
		Lining	NSF 61 epoxy coating
		Coating	Per Section 40 23 13

NOTES

1. Provide all valves designed, manufactured and tested in accordance with American Water Works Association Standards ANSI/AWWA C504 and C516.
2. Stainless steel or epoxy coated ductile iron disc with chrome or stainless steel trim. Full bronze disc for valves below 200 mm.
3. The valve body shall be a short body construction.

ACCEPTABLE PRODUCTS

DeZurik	Val-Matic	Approved equal	

END OF SECTION

1. GENERAL

1.1 Description

.1 Provide and test steel pipe 250 mm in diameter and larger, fittings and appurtenances as indicated and in compliance with Contract Documents.

.2 Use the general requirements specified in this Section integrally with the more specific requirements listed in Section 40 23 19.01 - Detailed Pipe Specification Sheets.

.3 The Contractor shall provide the necessary submittals and ensure the proper registration of piping systems and system components as per AWWA and ASME requirements.

1.2 Standards

.1 ASTM International (ASTM):

.1 A36: Standard Specification for Carbon Structural Steel.

.2 A53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

.3 A307: Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile.

.4 A325: Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi minimum Tensile Strength.

.2 American National Standards Institute (ANSI):

.1 B31.1: Power Piping.

.2 B16.5 - Pipe Flanges and Flanged Fittings.

.3 B16.9 - Pipe Fittings.

.4 NSF 61: Drinking Water System Components – Health Effects.

.3 American Society of Mechanical Engineers (ASME):

.1 B1.1: Unified Screw Threads.

.2 B31.3: Process Piping.

.3 B18.2.2: Square and Hex Nuts.

.4 American Water Works Association (AWWA):

.1 C200: Standard for Steel Water Pipe, 6 Inches and Larger.

.2 C205: Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4-in. and Larger - Shop Applied.

.3 C206: Standard for Field Welding of Steel Water Pipe.

.4 C207: Standard for Steel Pipe Flanges for Waterworks Service, sizes 4 in. through 144 in.

.5 C208: Standard for Dimensions for Steel Water Pipe Fittings.

.6 C209: Standard for Cold Applied Tape Coatings for Special Sections, Connections and Fittings for Steel Water Pipelines.

.7 C210: Standard for Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.

.8 C213: Standard for Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.

.9 C214: Standard for Tape Coating Systems for the Exterior of Steel Water Pipelines.

.10 C222: Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings.

.11 C602: Standard for Cement-Mortar Lining of Water Pipelines - 4-in. and Larger - In Place.

.12 C604: Installation of Buried Steel Water Pipe – 4 inches (100 mm) and Larger.

.5 Expansion Joint Manufacturers Association: Standards.

.6 Fluid Sealing Association - Technical Handbook.

.7 Structural Steel Painting Council (SSPC):

.1 SSPC-SP10.

1.3 Submittals

.1 Submit the following in accordance with Section 01 33 00 - Submittal Procedures:

.1 Submit documentation listing pipe, fittings, flexible connectors, expansion joints, linings, coatings, and valving to be used for each pipe size and category.

.2 Radiographic Weld Testing: Submit the name and qualifications of at least two (2) independent firms for the radiographic weld testing to be undertaken by the Construction Contractor if and as required by the applicable Code. The selected firm will be subject to the review and acceptance of the Contract Administrator.

.3 Product Samples: Where specified or when directed by the Contract Administrator, provide mill test results or product samples.

.4 Welding: Prior to commencing any welding of steel pipe, prepare and submit to the Contract Administrator a written description of welding techniques including but not limited to materials, methods, and quality control. Identify differences in shop and field techniques. Written procedures will be stamped and sealed by a Professional Engineer and qualified for welding design.

.5 Radiographic weld test results.

.6 Prior to the commencement of welding, submit current and complete documentation of the welder's qualifications.

.7 Certified shop and erection drawings. Contractor shall submit electronic files of the piping layout including:

.1 Pipe layouts in full detail.

.2 Location of hangers and supports.

.3 Location and type of anchors.

.4 Location of couplings and expansion joints.

.5 1 mm = 25 mm scale details of all wall penetrations and fabricated fittings or special fittings.

.6 Schedules of pipe, fittings, expansion joints and other appurtenances.

.7 Electronic files shall conform to the following minimum requirements:

.1 Electronic Files: AutoCAD latest version, drawn to scale.

.2 Submit electronic files as part of the Shop Drawing submittal.

.3 Drawings shall be in conformance with all other requirements as specified in this Specification.

.8 Sworn certificates in duplicate of shop tests showing compliance with appropriate standard.

.9 Reports of ASME Section IX welding certifications.

.10 Catalog cuts of joints, couplings, harnesses, expansion joints, gaskets, fasteners and other accessories.

.11 Brochures and technical data on coatings and linings and proposed method for application and repair.

.12 Provide Record Drawings.

.13 Provide tag names and numbers for all sections of piping and fittings.

.2 Material Certification:

.1 Provide certification from the piping and fittings Manufacturer that the materials of construction specified are recommended and designed for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation

for a minimum of five (5) years. Provide proposed materials at no additional cost to the City.

.2 Where materials are not specified, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated.

.3 A copy of the contract mechanical process, civil and structural drawings, with addenda that are applicable to the equipment specified in this Section, marked to show all changes necessary for the equipment proposed for this Specification Section. If no changes are required, mark all Drawings with “No changes required” or provide a statement that no changes are required.

.1 Failure to include all Drawings or a statement applicable to the equipment specified in this Section will result in submittal return without review until a complete package is submitted.

.2 A copy of this Specification Section with addenda and all referenced Specification Sections with addenda, with each paragraph check-marked to indicate Specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

.1 If deviations and clarifications from the Specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

.2 Failure to include a copy of the marked-up Specification Sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up Specifications and justifications are submitted in a complete package.

1.4 Quality Assurance

.1 Welding:

.1 Use cutting and welding methods that minimize damage to the lining of the existing pipes.

.2 Welding Certification:

.1 All welders to be certified under the AWS or BS Code or Practice and API Pressure Vessels Safety Act and Regulations.

.2 All welders shall provide the correct documentation.

.3 Weld Tests:

.1 Perform radiographic tests on all flange welds.

.2 All piping welds shall be 100% visually inspected by a registered inspector and any imperfections shall be made good as required by the applicable Code and to the satisfaction of the Contract Administrator.

.3 For piping required by the applicable Code to be subject to radiographic inspection, or for welds not found satisfactory during the Contract Administrator's visual inspection provide for one (1) full circumference radiographic inspection for every twenty (20) welded pipe-to-pipe and pipe-to-fitting joints. All sizes and types of pipe welds to be tested at locations identified by the Contract Administrator.

.4 Have radiographic test firm evaluate welds in accordance with ANSI/ASME B31.3 Process Piping Code Normal Service and prepare report summarizing results.

.5 Have radiographic weld test report, complete with results, submitted directly to Contract Administrator.

.6 For each defective weld, three (3) additional radiographic inspections, at locations identified by the Contract Administrator, will be required plus a radiograph of the repair, at the Contractor's expense.

.4 Regulatory Submissions:

.1 Complete all other submissions as required by other regulatory authorities.

1.5 Conflicts

.1 Review the Drawings prior to installation of piping, conduit services, and fixtures by this or any other Division. Identify any conflicts and cooperate with the Contract Administrator to determine the adjustments necessary to resolve these conflicts.

.2 Confirm the routing of each section of pipework with other services prior to commencement of installation. Advise the Contract Administrator of any conflicts with existing services or services yet to be installed. Where necessary, amend the routing of pipework to avoid conflict and confirm with the Contract Administrator.

1.6 Delivery, Storage and Handling

.1 Provide in accordance with Section 01 66 10 - Delivery, Storage and Handling.

.2 Deliver pipe, fittings, and specials to site using loading methods which do not damage pipe, linings or coatings.

.3 Piping materials delivered to site will be clearly marked to indicate size, type, class/schedule and coatings.

.4 Until ready for incorporation in the Works, store on site as recommended by the piping materials Manufacturer to prevent damage, undue stresses, or weathering.

.5 Store materials at least 200 mm above ground with sufficient supports to prevent undue bending.

.6 Protect non-ultraviolet (UV) light inhibited plastic from sunlight.

.7 Ship pipe expansion joints, anchors, guides and flexible connectors pre-assembled to the degree which is practical.

.8 Provide shipping devices to maintain the face-to-face dimension of each expansion joint during shipment, storage and installation. Design and place shipping devices so as not to inhibit installation of the joints.

1.7 Existing Piping

.1 Existing piping and lining at each RPS:

	Location	**Piping Material**	**Lining Material**
MacLean RPS	Immediately upstream and downstream of the existing meters	ASTM A283 B, C, D ASTM A285 C, max C=35% ASTM A36	Gunite
MacLean RPS	Short pipes, adjacent to proposed secondary flowmeter, and imbedded in the structural walls	Prestressed concrete pressure pipe fabricated to AWWA C301 type B	NA
McPhillips RPS	Immediately upstream and downstream of the existing meters	ASTM A283 C Steel	Cement
McPhillips RPS	Adjacent to proposed secondary flowmeter (Pump 3 header)	Material is unknown. Contractor to investigate and submit material testing data sheets to Contract Administrator.	Material is unknown. Contractor to investigate and submit material testing data sheets to Contract Administrator.

2. PRODUCTS

2.1 Pipe Material

.1 Provide the pipe materials, fittings, and appurtenances as described below, for the piping systems shown.

.2 New piping shall match the existing flange holes.

.3 Match the existing flange face for an effective gasket seal. Machine flange face if required.

.4 Cold bending of pipe NOT ACCEPTABLE.

.5 All pipe materials to be new, free from defects and conforming to the reference standards identified.

.6 Where any standard referenced has been superseded prior to bidding, the Contractor shall comply with the new standard.

2.2 Manufacturers

.1 Northwest Pipe.

.2 Ameron.

.3 Hanson.

.4 American Spiral Weld.

.5 Mid America.

2.3 Materials

.1 Steel pipe 750 mm to 1200 mm: ASTM A53 Type E or S, Grade B, Black:

Nominal Pipe Size, mm	Minimum Wall Thickness, mm Interior Piping
750	6.35
800	6.35
900	6.35
1000	6.35
1050	6.35
1200	6.35

.2 Interior piping wall thickness: Increase wall thickness to limit combined stress (circumferential longitudinal and localized) to 75% of the minimum yield of the steel used.

2.4 Pipe

.1 Fabricate to sizes, dimensions, and shapes indicated.

.2 Sizes, Pipe, Fittings and Specials:

.1 300 mm and Smaller: Nominal.

.2 350 mm thru 600 mm: Actual outside diameter.

.3 350 mm and Larger: Nominal size indicated to be I.D. after lining.

.3 Seams:

.1 Except for seamless mill type pipe, provide piping fabricated from steel plates rolled into cylinders or sections thereof with longitudinal seams or spiral seams butt welded.

.2 Do not use more than two (2) longitudinal seams in piping 1800 mm and smaller in size.

.3 Butt weld girth seams at least 2 m apart, except in specials and fittings.

2.5 Fittings

.1 Fabricate in accordance with AWWA C208.

.2 Provide reducing sections with same shell thicknesses required for larger ends.

.3 Provide concentric reducers in all lines unless shown otherwise.

.4 Special Sections:

.1 Provide fittings and special sections with ends as indicated and fabricated to shapes, sizes, and dimensions indicated.

.5 Small Branch Connections:

.1 Provide branch connections 65 mm and smaller fabricated with welding fittings with threaded outlets.

.2 Provide branch connections 80 mm through 300 mm fabricated with pipe nipples or with welding fittings.

.3 Provide pipe nipples and welding fittings welded to pipe shell and reinforced to meet working and test pressure requirements.

.4 Provide pipe nipples of black steel pipe in accordance with ASTM A53 Type E or S Grade B, minimum thicknesses as listed in the above table.

.5 Provide threaded and welded outlets as indicated.

.6 Provide small branch connections located so as not to interfere with joints, supports, or other details.

.6 Provide fittings shop fabricated from previously hydrostatically tested straight pipe with magnetic particle non-destructive testing of all welds that were not previously tested in the straight pipe.

2.6 Field joints

.1 Type as indicated:

.1 Location and type of joint may be modified to provide for lining, coating and flexibility in field assembly as accepted by the Contract Administrator.

.2 Provide pipe end preparation and tolerances in accordance with AWWA C200.

2.7 Flanges

.1 Provide in accordance with AWWA C207 depending on pressures.

.2 Provide flanged end pipe fitted with slip-on flanges. Provide longitudinal or spiral welds ground flush to accommodate type of flanges provided.

.1 Provide bolts and bolt-studs in accordance with AWWA C207 with hexagonal or square heads, coarse thread fit, threaded full length with ends chamfered or rounded.

.2 Project bolt ends 6 mm beyond surface of nuts.

.3 Provide hexagonal nuts with dimensions in accordance with ANSI B18.2.2 and coarse threads in accordance with ASME B1.1.

.3 Provide face and finish flanges per AWWA C207.

.4 Provide flanges attached normal to axis of pipe for alignment.

.5 Provide flanges tested, after welding to pipe, for true plane and reface, to bring them within specified tolerances.

.6 Blind Flanges: Conforming in diameter, drilling, and thickness to flanges to which they mate and reinforced to produce a watertight joint under test pressures indicated in the Specification Section 40 23 19.01 - Detailed Piping Specification Sheets.

.7 Gaskets:

.1 Provide new gaskets per AWWA C207 made from 3 mm thick compressed non-asbestos material.

.2 The gasket materials shall be Viton.

2.8 Welded Joints

.1 Welds:

.1 Sound and free from embedded scale or slag, with tensile strength of weld not less than that of thinner of connected sections. Welds to be watertight.

.2 Field welding of lined pipe is not acceptable unless otherwise indicated.

.3 Field welds of interior piping: Butt welds.

.1 Outside back-up bar may be used.

.4 Field welds of buried piping: Bell and spigot lap welds with single weld inside or outside.

.5 Provide field welds, in accordance with AWWA C206.

2.9 Grooved Joint Couplings

.1 Joints for piping greater than 600 mm nominal diameter:

.1 Housing: ductile iron conforming to ASTM-A-536 grade 65-45-12.

.2 Housing coating: alkyd phenolic primer.

.3 Coupling gasket: Grade E EPDM temperature range -34 to +110°C, compatible with potable water service.

.4 Bolts/nuts: heat-treated plated carbon steel, track-head conforming to physical properties of ASTM A-183 minimal tensile strength 110,000 psi (758,340 kPa).

.5 Ring/collar adapters with grooves or shouldered ends.

.6 Products:

.1 Victaulic Style 44 with Vic-Ring (type “D” or type “E”) adapters.

.2 Or equivalent.

2.10 Flanged Coupling Adapters

.1 Manufacturers:

.1 Dresser “Style 128”.

.2 Baker.

.3 Viking Johnson.

.4 Romac.

.2 Provide restrained flanged coupling adapters.

.3 Provide tie rods of sufficient number and strength to restrain coupling at test pressure as indicated in Specification Section 40 23 19.01 - Detailed Piping Specification Sheets.

2.11 Expansion Joints

.1 Manufacturers:

.1 Mechanical Expansion Joints:

.1 Dresser “Style 63”.

.2 Baker.

.3 Viking Johnson.

.4 Romac.

.2 Flexible Connectors and Bellows Expansion Joints:

.1 Garlock.

.2 General Rubber.

.3 Goodall.

.4 Mercer.

.5 Unaflex.

.2 Materials:

.1 Joint movements of 11 mm or greater and rotations of 1/2-degree or greater to be located as indicated or specified. Provide all other joints to allow a minimum of 11 mm pipe expansion (joint compression) and pipe compression (joint expansion). Provide in accordance with Fluid Sealing Association, Series B for Bellows expansion joints.

.2 Provide single arch Bellows joints at equipment for isolation design in accordance with Fluid Sealing Association, Series B.

.3 Provide flexible connectors constructed with a filled arch to eliminate sedimentation of solids in arched area.

.4 Provide tie rods at flexible connectors and expansion joints of sufficient number and strength to restrain connection at test pressure as indicated in Specification Section 40 23 19.01 - Detailed Piping Specification Sheets. Provide a minimum of two (2) 16 mm diameter tie rods at connections. Provide tie rods placed to provide movement at hinged expansion joints where movements cause lateral rotation of the expansion joint occur. Angle of rotation as indicated.

.5 Provide flexible connectors and expansion joints guided in accordance with Manufacturer's recommendations.

.6 Elastomer material to be compatible with the flowing medium and the operating temperature as indicated in the Specification Section 40 23 19.01 - Detailed Piping Specification Sheets.

2.12 Lining

.1 The lining material shall be NSF 61 certified.

.2 Provide lining to the interior of steel pipe, fittings, sleeve couplings and manholes.

.3 Provide type of lining as indicated in the Specification Section 40 23 19.01 - Detailed Piping Specification Sheets.

.4 Polyurethane Lining:

.1 Provide lining in accordance with AWWA C222.

.2 For buried piping provide 20 mils (500 µm) interior and 25 mils (625 µm) exterior.

.3 For exposed piping provide 20 mils (500 µm) interior and painting as specified for the exterior.

.4 Applied per Manufacturer's written instruction.

.5 Liquid Epoxy Lining:

.1 Epoxy-phenolic lining shop applied over grit blast cleaned surface, near white per SSPC-SP10.

.2 Minimum of two coats providing a total dry film thickness of at least 12 mils (300 µm) of liquid epoxy in accordance with AWWA C210 Tnemec FC22 or fusion bonded epoxy in accordance with AWWA C213 certified.

.3 Applied per Manufacturer's written instruction.

.6 Cement Lining:

.1 Provide in-place lining in accordance with AWWA C602 or factory lined in accordance with AWWA C205 as indicated in the Section 40 23 19.01 - Detailed Piping Specification Sheets.

.2 If piping is factory lined, provide field line welded joints or O-ring field joints in accordance with Section 7 of AWWA C205.

.3 Applied per Manufacturer's written instruction.

2.13 Coating

.1 Where sleeve couplings are used, provide coating to pipe ends and exterior surface for a distance of 228 mm with same material as specified for lining.

.2 Exposed exterior surfaces of pipe within the building: Commercial blast (SSPC-SP6) and paint with one shop coat of universal primer compatible with field painting Section 09 91 13.

.3 Exterior of buried pipe: Coat and wrap with prefabricated multilayer cold-applied polyethylene tape coating in accordance with AWWA C214 Standard.

.1 The total nominal thickness of coating: 80 mils (2000 µm) consisting of: Primer, 20 mil (500 µm) inner wrap for corrosion protection and two 30 mil (750 µm) outer wraps for mechanical protections.

.2 Coat and wrap fittings and field joints with prefabricated multilayer cold-applied polyethylene tape coating in accordance with AWWA C209 Standard. The total thickness of coating shall be 70 mils (1780 µm) consisting of: Primer and 2 wraps of 35 mil (890 µm) tape.

.1 Alternate field joint coating: Heat-Shrink sleeves per AWWA C216. Interior welding of joints with Heat-Shrink sleeves can begin once 1 m of backfill is placed on the pipe.

2.14 Shop Painting

.1 Provide in accordance with Section 09 91 10.

3. EXECUTION

3.1 Installation of Pipe

.1 Prior to installation, inspect and field measure to ensure that previous work is not prejudicial to the proper installation of piping.

.2 Make all minor modifications to suit installed equipment and structural element locations and elevations.

.3 Install pipelines per AWWA C604 and parallel to building walls wherever possible. Install piping to lines and grades indicated and support. Provide temporary supports where required to prevent shifting or distortion of pipe. Provide for expansion.

.4 Slope piping toward low points and provide for draining at low points.

.5 Before assembly, remove debris from inside pipes and fittings.

.6 Before flanges pieces are assembled, remove rust resistant coating from machined surfaces, clean gaskets and smooth burrs. Make up flanged joints tight and prevent strain upon valves or other pieces of equipment.

.1 Bolt threads must fully engage the nuts. At a minimum the bolt must be flush with the nut and no more than 13 mm excess thread protruding from the nut.

.7 Install tierods, pipe clamps or bridles when sleeve type couplings or fittings are used in piping system as indicated, and at changes in direction or other places to prevent joints from pulling apart under pressures indicated in the Section 40 23 19.01 - Detailed Piping Specification Sheets.

.8 Examine pieces for damage. Do not install pieces that are damaged according to the Contract Administrator. If any damaged piece should be discovered after having been installed, remove and replace with a sound piece at no additional cost to the City.

.9 Handle pipe with equipment such as nylon slings and padded skids, designed to prevent damage to the coating. Repair abrasions and injuries to the coating prior to the application of insulation or prior to the application of final field coating.

3.2 Installation of Lining and Coating

.1 After installation of pipe, fittings, and specials, clean, prime, line, and coat as specified for pipe adjacent to weld unlined or uncoated ends adjacent to field welded joints, including weld proper.

.2 Any damage resulting from local cutting, welding, handling, or installation to the existing and new lining shall be repaired in accordance with the Manufacturer’s recommendations and at the Contractor’s cost.

.3 Remove foreign matter, including all damaged lining or coating materials, by scraping, chipping, or brushing, and leave surfaces cleaned to bright metal free of all rust, slag, and scale by means of wire brushing or sand blasting.

.4 Use open ends or access manholes for entry for application of interior linings to unlined ends.

.5 Pour holes are not allowed.

.6 Where defective lining is identified, repair or replace using new material.

.7 After installation of pipe, fittings, and specials, shop coat on exterior shall be touched up followed by a field coat prior to encasing in concrete.

3.3 Installation of Flanged Coupling Adapters

.1 Install flange coupling adapters in strict accordance with coupling Manufacturer's recommendations.

3.4 Installation of Pipe Supports

.1 Provide in accordance with Section 40 23 19.02 - Process Pipe Hangers and Supports.

.2 Proceed with installation of pipe supports only after required building structural work has been completed and concrete has reached its 28-day compressive strength.

.3 Support piping to prevent forces applied on valves and equipment.

3.5 Physical Checkout, Field and Functional Testing

.1 Clean dirt, dust, oil, grease and other foreign material, before pressure and leakage tests.

.2 Water for testing provided by the Contractor.

.3 Pressure and Leakage Tests shall be done per AWWA C604:

.1 Provide temporary testing plugs or caps, pressure pumps, pipe connections, meters, gages, equipment, and labor.

.2 Test pipelines in sections of accepted length.

.3 Fill section of pipe with water and expel air.

.4 Pressure and leakage test consists of first raising pressure (based on elevation of lowest point of section under test and corrected to gauge location) to pressure in psi numerically equal to test pressures indicated in the Specification Section 40 23 19.01 - Detailed Piping Specification Sheets.

.5 No visible leakage in joint is acceptable.

.6 If unable to achieve and maintain specified pressure for one hour with no additional pumping, section has failed to pass test.

.7 If section fails pressure and/or leakage test, locate, uncover, and repair or replace defective pipe, fitting, or joint, and conduct additional tests and repairs until section passes test at no additional cost to the City and without any time extensions.

.4 Test all existing piping where it connects to new piping to the first valve in the existing piping. Repair any failures in existing piping which occur as a result of the test after informing the Contract Administrator of such failure.

.5 Make piping connections to equipment with pipe in a free supported state and without application of vertical or horizontal forces to align piping with the equipment flanges.

3.6 Disinfection

.1 Disinfect lines intended for potable water service after testing in accordance with AWWA C651. Refer to Specification Section 43 23 19.03 - Disinfection of Structures and Piping for disinfection of potable water retaining piping.

3.7 Field Painting

.1 Provide in accordance with Section 09 91 13.

3.8 Contract Closeout

.1 Provide in accordance with Section 01 78 00.

END OF SECTION

DETAILED PIPING SPECIFICATION SHEETS

1. GENERAL

1.1 Description

.1 The piping specification sheets on the following pages detail the requirements for each type of process pipe included in the Work.

.2 Comply with Specification Section 40 23 19 - Steel Pipe and Fittings.

1.2 Definition

.1 Abbreviations used in the Detailed Piping Specification Sheets.

Abbreviation	Commodity	Pipe Material
PW	Potable Water	Carbon Steel

2. PRODUCTS

2.1 Schedule

.1 Connections to all major equipment and valves shall be flanged. Grooved, butt welded or solvent welded connections are not permitted without prior approval from the Contract Administrator.

.2 All wetted components (piping, fitting, valves, lining, etc.) shall be NSF 61 certified.

DETAILED PIPING SPECIFICATION SHEETS

PW

GENERAL					
PROCESS FLUID	**SYMBOL**	**MAXIMUM CONDITIONS**		**TEST CONDITIONS**	
		PRESSURE (kPa)	**TEMP. (°C)**	**PRESSURE (kPa)**	**DURATION (Min.)**
Potable Water	PW	0-750	1-30	1200	120

PIPE					
LOCATION	**SIZE (mm)**	**MATERIAL**	**RATING**	**SPECIFICATIONS**	**REMARKS**
All	Up to 1200	Carbon Steel	Std. Wt.	ASTM A53, Type E or S, Grade B, Black	

Coating					
Location	**SIZE (mm)**	**MATERIAL**	**RATING**	**SPECIFICATIONS**	**REMARKS**
All	All sizes			Refer to 40 23 19	

Lining					
Location	**SIZE (mm)**	**MATERIAL**	**RATING**	**SPECIFICATIONS**	**REMARKS**
All	All sizes	Liquid Epoxy	300 microns	Factory Applied, AWWA C210, NSF 61 certified	Refer to 40 23 19
		Polyurethane	500 microns	Factory Applied, AWWA C222, NSF 61 certified	
		Cement		Factory Applied, AWWA C205, NSF 61 certified	

JOINTS					
LOCATION	**SIZE (mm)**	**TYPE**	**MAXIMUM SPACING**	**SPECIFICATIONS**	**REMARKS**
All	>600	Grooved Joint	20 m	AWWA C606	
	>600	Flanged		AWWA C207	

DETAILED PIPING SPECIFICATION SHEETS

FITTINGS AND APPURTENANCES					
ITEM	**SIZE (mm)**	**MATERIAL**	**RATING**	**SPECIFICATIONS**	**REMARKS**
Flanges, FF or RF	≥75	Carbon Steel	Class 150	AWWA C207	
ELL – Short Radius ELL – Long Radius, Tees, Reducers, Reducing Outlets, Laterals and Caps Sample Lines	≥75	Carbon Steel	Same as Pipe	AWWA C207 AWWA C208	
4 Pce ELL, Tees, Reducers, Crosses, Laterals	>600	Carbon Steel	Same as Pipe	Material: Same as Pipe AWWA C207 AWWA C208	
Plug	≥75	Carbon Steel	Class 150	Material: ASTM A181, Gr. 1 Dimensions: AWWA C207	
Flanged Adaptors	≥75	Same as Pipe	Same as Pipe	Flange: AWWA C207, AWWA C219	
Flanged Gaskets	All sizes	Viton		AWWA C207	
Grooved Joint Gaskets	≥75			AWWA C606	
Valves					
ITEM	**SIZE (mm)**	**SPECIFICATIONS**			**REMARKS**
Butterfly valve	≥750	Refer to Specification Section 40 23 13.01			

END OF SECTION

PROCESS PIPE HANGERS AND SUPPORTS

1. GENERAL

1.1 Description

.1 Supply and installation of hangers and supports for all process piping systems specified in Section 40 23 19 - Steel Pipe and Fittings.

.2 Engage a Professional Engineer (Contractor's Engineer) registered in the Province of Manitoba to be responsible for the final aspects of the piping support system design, including details and spacing of all supports. The support system will ensure that the weight of the pipework and equipment and the need for lateral and vertical support are considered fully. Contractor to provide a complete piping system design as described in Section 40 23 19 - Steel Pipe and Fittings.

.3 Contractor is responsible for the design and supply of a complete and adequate support system.

.4 All supports and parts shall conform to the latest requirements of ASME/ANSI B31.3 and MSS SP-58, SP-69, SP-89 and SP-90 except as supplemented or modified by the requirements of this Specification.

.5 Pipe support locations and types for piping 13 mm and larger shall be determined by the Contractor using the guidelines for support spacing specified herein and other criteria contained in this specification. Guidelines for pipe supports may need to be adjusted based upon field coordination, field routing, or other considerations outlined herein such as structural load limits. The Contractor may revise the pipe support locations and details through accepted shop drawing submittals stamped by a Registered Professional Engineer registered in the Province of Manitoba as specified herein. The Contractor is responsible for the proper design, coordination, installation and fabrication of all pipe supports in accordance with the specified requirements.

.6 For pipe supports 13 mm and larger, pipe support Shop Drawings together with a marked up piping drawing showing support number, location and typical type shall be submitted by the Contractor for acceptance.

1.2 Standards

.1 American Society of Mechanical Engineers (ASME):

.1 B31.3: Process Piping.

.2 ASTM International (ASTM):

.1 A307: Standard Specification for Carbon Steel Externally Threaded Standard Fasteners,

.3 Manufactures Standardization Society (MSS):

.1 SP-58: Pipe Hangers and Supports - Materials and Design.

.2 SP-69: Pipe Hangers and Supports - Selection and Application.

.3 SP-89: Pipe Hangers and Supports - Fabrication and Installation Practices.

.4 SP-90: Guidelines on Terminology for Pipe Hangers and Supports.

1.3 Submittals

.1 Submit the following for information in accordance with Section 01 33 00 - Submittal Procedures:

.1 Pipe Support Drawings:

.1 Indicate hanger and support locations and provide legend summarizing load information and hanger and support component selection at each location.

.2 Stamp of a Professional Engineer registered in the Province of Manitoba, experienced in pipe support design and pipe stress analysis as specified herein.

1.4 Hanger and Support Selection

.1 Piping supports are generally not shown on the Drawings. Therefore, select pipe hangers and supports as specified in this Section. Typical support details and structural attachments shown on the Drawings indicate the level of quality that will be considered acceptable. Where specific supports are illustrated on the process mechanical or structural Drawings or where a specific standard detail is noted on the Drawings, provide that type of support for that particular pipeline.

.2 All piping to be supported in accordance with as per ASME B31.1.

.3 Review the final piping layout in relation to the surrounding structure and adjacent piping and equipment before selecting the type of support to be used at each hanger point.

.4 Hangers and supports shall withstand all static and specified dynamic conditions of loading to which the piping and associated equipment may be subjected. As a minimum, consideration shall be given to following conditions:

.1 Weights of pipe, valves, fitting, insulating materials, suspended hanger components, and normal fluid contents.

.2 Weight of hydrostatic test fluid or cleaning fluid if normal operating fluid contents are lighter.

.3 Reaction forces due to the operation of safety or relief valves.

.4 Wind, snow, or ice loadings on outdoor piping.

.5 Install pipe supports to provide indicated pipe slopes. Do not exceed maximum pipe deflection allowed by ANSI B31.3 and pipe manufacturer.

.6 Size hangers and supports to fit the outside diameter of pipe, tubing, or where specified, the outside diameter of insulation.

.7 Where negligible movement occurs at hanger locations, use rod hangers for suspended lines, whenever practical. Use bases, brackets, or structural cross members for piping supported from below.

.8 Hangers for the suspension of pipe and tubing sizes 65 mm and larger shall be capable of vertical hanger component adjustment under load.

.9 Provide the supporting systems to allow for free or intended movement of the piping including its movement in relation to that of connected equipment.

.10 Design the system to support the operating loads with a safety factor of 4.0.

.11 Where there is horizontal movement at a suspended type hanger location, select hanger components to allow for swing. The vertical angle of the hanger rod shall not, at any time, exceed four degrees (4°).

.12 No contact is allowed between a pipe and hanger or support components of dissimilar metals. Prevent contact between dissimilar metals when supporting copper tubing with copper-plated, rubber, plastic, or vinyl coated, or stainless steel hanger and support components.

.13 Do not use existing pipes and supports to support new piping.

.14 Do not attach pipe support components to equipment or pressure vessels unless otherwise specified.

.15 Use stock hanger and support components wherever practical.

.16 Provide supplementary structural members, where structural bearings are not in suitable locations.

.1 Make provision for expansion, contraction, slope, and anchorage.

.2 Where necessary, pipe support systems shall withstand the additional load of electrical or instrumentation trays. Coordinate with other Divisions. Design and provide support system accordingly.

2. PRODUCTS

2.1 Acceptable Manufacturers

.1 The following Manufacturers' Products to provide the specified features and to meet specified operating conditions:

.1 B-Line.

.2 Anvil (formerly Grinnell).

.3 Unistrut.

.4 Or approved equal.

2.2 Support Spacing

.1 In the case of concentrated loads, the supports shall be placed as close as possible to the load to reduce the bending stress.

.2 Where changes in direction of the piping system occur between supports, the total length between supports shall be kept to less than three-fourths of the full span. When practical, a support shall be placed immediately adjacent to any change in direction of the piping system.

.3 Maximum support spacing shall be as listed in the following table:

Pipe Size Nominal (mm)	**Maximum Spacing (m)**
30 and under	2.1
30 to 40	2.1
40 to 50	2.1
60 to 75	3.0
100	3.7
150	4.3
200	4.6
250	4.9
300	5.2
350	5.8
400	6.1
500	6.7
600 and greater	6.7

.4 Provide additional supports at any valves or other heavy piping element.

2.3 Materials

.1 Non-Corrosive Environments (Buildings):

.1 Unless otherwise specified, pipe hangers and supports, structural attachments, fittings and accessories are hot-dipped galvanized after fabrication.

.2 Provide cadmium plated hardware (nuts, bolts, washers, threaded rods).

.3 Touch up cadmium and galvanized material with zinc rich coating where the material has been cut. Exposed bare steel is not acceptable.

.2 Exterior, Submerged or Corrosive Environments:

.1 Pipe hangers, supports, structural attachments, fittings, accessories and hardware are all stainless steel.

.2 Any areas that may be considered corrosive and are in question should be reviewed with the Contract Administrator in advance of securing the materials.

.3 Provide AISI, Type 304 stainless steel concrete inserts.

2.4 Pipe Hangers and Supports

.1 Type 3 - Double Bolt Pipe Clamp: Provide galvanized steel or copper plated steel pipe clamps, with configuration and components as follows:

.1 Steel pipe (insulated) - B-Line B3144, Grinnell Figure 295, or approved equal in accordance with B7, with insulation shield. Insulation shield is optional for hot and ambient systems.

.2 Steel pipe (uninsulated) - B-Line B3144, Grinnell Figure 295, or approved equal in accordance with B7.

Copper pipe (insulated only) - B-Line 3144, Grinnell Figure 295, or approved equal in accordance with B7, with insulation shield.

.2 Type 8 - Adjustable Pipe Roller Support: Provide cast iron rollers and sockets, and galvanized steel or copper plated steel cross rod and support rods with configuration and components as follows:

.1 Steel pipe (insulated) - B-Line B3122, Grinnell Figure 177 with insulation shield, or approved equal in accordance with B7.

.2 Steel pipe (uninsulated) - B-Line B3122, Grinnell Figure 177, or approved equal in accordance with B7.

.3 Plastic pipe - B-Line B3122, Grinnell Figure 177, or approved equal in accordance with B7.

.3 Type 9 - Welded Pipe Stanchion: Provide a galvanized steel or copper plated steel, standard schedule pipe stanchion, cut pipe to match contour of pipe elbow. Use only for ambient commodity systems.

.4 Type 10 - Pipe Stanchion saddle: provide galvanized steel or copper plated steel saddles and yokes as follows:

.1 Steel pipe (insulated) - B-Line B3900, Grinnell Figure 259 with insulation shield, or approved equal in accordance with B7.

.2 Steel pipe (uninsulated) - B-Line 3090, Grinnell Figure 259, or approved equal in accordance with B7.

.3 Plastic pipe - B-Line B3090, Grinnell Figure 259, or approved equal in accordance with B7.

.5 Type 12 - Riser Clamp: provide stainless steel riser clamps with configuration and components as follows:

.1 Steel pipe (insulated) - B-Line B3373, Grinnell Figure 261, Superstrut C-720 or Unistrut No. 82, or approved equal in accordance with B7.

.2 Steel pipe (uninsulated) - B-Line B3373, Grinnell Figure 261, Superstrut C-720 or Unistrut No. 82, or approved equal in accordance with B7.

.3 Plastic pipe - B-Line B3373, Grinnell Figure 261C, or Superstrut C-720 or Unistrut No. 82, or approved equal in accordance with B7.

.6 Structural Attachments:

.1 Type H - Double Channel Bracket: Provide single channel attachment as specified in .6. Provide a galvanized steel or copper plated steel double framing channel cantilever bracket assembly; B-Line B297-12 through B297-36, Powerstrut PS809 or Unistrut P2542 series, or approved equal in accordance with B7.

.2 Type K - Wall Mounted Channel: Provide 41 mm x 62 mm galvanized steel or copper plated steel framing channel; B-Line B12 or Unistrut P5500, or approved equal in accordance with B7.

.3 Type L - Pipe Stanchion Attachment: Provide minimum 12 mm thick galvanized steel or copper plated steel baseplate. Anchor bolt holes: 1.6 mm larger than bolt diameter. Provide non-shrink grout between the baseplate and upstand, or approved equal in accordance with B7.

.4 Type M - Welded Steel Bracket: Provide galvanized steel or copper plated steel brackets which comply with MSS Type 32 and FEDSPEC Type 33 for medium welded bracket: Grinnell Figure 195. Heavy welded bracket to comply with MSS Type 33 and FEDSPEC Type 34; Grinnell Figure 199, or approved equal in accordance with B7.

.5 Type P - Framing Channel Post Base: Provide galvanized steel or copper plated steel post bases of stranded design manufactured by framing channel manufacture. Single channel: Unistrut P2072A, B-Line B280 Powerstrut PS3025. Double channel: Unistrut P2073A, B-Line B281 or Powerstrut PS3064, or approved equal in accordance with B7.

.7 Accessories:

.1 Weldless Eye Nut: Provide forged steel eye nuts and comply with MSS and FEDSPEC Type 17; Grinnell Figure 290 or B-Line B3200 or approved equal in accordance with B7.

.2 Welded Eye Rod: Provide galvanized steel or copper plated steel eye rods with eye welded closed. Inside diameter of eye to accommodate a bolt diameter 3.2 mm larger than the rod diameter; Grinnell Figure 278 or B-Line B3211 or approved equal in accordance with B7.

.3 Turnbuckle: Provide galvanized steel or copper plated steel turnbuckles; Grinnell Figure 230 or B-Line B3202 or approved equal in accordance with B7.

.4 Framing Channels: Provide 41 mm x 62 mm roll formed galvanized steel or copper plated steel framed channel, having a thickness of 2.7 mm. Channel to have a continuous slot along one side with in-turned clamping ridges. Single Channel: Unistrut P5500. Double Channel: Unistrut P5501 or approved equal in accordance with B7.

.5 Anchor bolts shall be A316 stainless steel with epoxy grout.

3. EXECUTION

3.1 Hanger and Support Location

.1 Locate hangers and supports as near as possible to concentrated loads such as valve, flanges, etc. Locate hangers, supports, and accessories within the maximum span lengths specified on Drawings to support continuous pipeline runs unaffected by concentrated loads.

.2 Provide hangers and/or base supports within 1000 mm of each change in direction on each leg, on one side of each valve, and on the first spool piece or fitting extending from a piece of equipment.

.3 Locate hangers and supports to ensure that connections to equipment, tanks, etc., are substantially free from loads transmitted by the piping.

.4 Ensure that where piping is connected to equipment, a valve, piping assembly, etc. that will require removal for maintenance, the piping will be supported in such a manner that temporary supports will not be necessary for this procedure.

.5 Support piping so that no pockets will be formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves, and fittings.

.6 Install spring hangers where required to offset expansion in horizontal runs which follow long vertical risers.

3.2 Installation

.1 Do not use hanger components for purposes other than for which they were designed. Do not use hanger components for rigging and erection purposes.

.2 Install items to be embedded before concrete is poured. Fasten embedded items securely to prevent movement when concrete is poured.

.3 Install thermal pipe hanger shields on insulated piping at required locations during hanger and support installation. Butt joint connections to pipe insulation shall be made at the tie of insulation installation in accordance with the Manufacturer's recommendation.

.4 All minor modifications to accommodate installed equipment and structural components are subject to review. Do not commence Work on related piping until written acceptance by the Contract Administrator has been received.

.5 Include any piping support modifications on the Shop Drawings submitted prior to fabrication or installation.

.6 Prior to installation, inspect and field measure to ensure that previous Work is not prejudicial to the proper installation of piping.

.7 Hanger and support components in contact with plastic pipe shall be free of burrs and sharp edges.

.8 Finished floor beneath Type L structural attachments and framing channel post bases shall be roughed prior to grouting. Grout between base plate and floor shall be free of voids or foreign material.

.9 Cut and drill base plates to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.

.10 Provide plastic or rubber end caps at the exposed ends of all framing channels that are located up to 2100 mm above the floor.

.11 Review the Drawings prior to installation of piping, conduit, and fixtures by this or any other Division. Identify any conflicts and confirm the routing of each section of pipe prior to commencement of installation. Advise of any conflicts with existing services. Where necessary, amend the routing of pipework to avoid conflict and provide Shop Drawings showing proposed routing.

3.3 Adjustment

.1 Adjust hangers and supports to obtain required pipe slope and elevation. Use shims made of material that is compatible with the piping material. Adjust stanchions prior to grouting of base plates.

END OF SECTION

DISINFECTION OF STRUCTURES AND PIPING

1. GENERAL

1.1 Description

.1 This Section describes the requirement for disinfection of water-retaining structures and piping. Where work is undertaken within existing or new piping used for the storage or conveyance of treated water, the piping shall be clean from all debris, dirt, gravel, etc., from inside of piping and disinfected prior to being put back into service.

1.2 Standards

.1 American Water Works Association (AWWA):

.1 B300: Standard for Hypochlorites.

.2 C651: Disinfecting Water Mains.

.3 C652: Disinfection of Water Storage Facilities.

.4 C653: Disinfection of Water Treatment Plants.

.5 Standard Methods for the Examination of Water and Wastewater.

1.3 Coordination

.1 The Contractor shall disinfect all items which will be used for the conveyance or storage of potable water; these include but are not limited to the following structures and piping:

.1 All pipework conveying treated water.

.2 Coordinate with other Divisions to ensure there are no conflicts in the Work.

.3 The City is to be consulted for coordination of disinfection procedures. The disinfection procedures shall be witnessed by the Contract Administrator.

2. MATERIALS

2.1 Water

.1 Water for disinfection shall be provided by the City. The water shall be free from all suspended and deleterious material. The water can be obtained from the existing pumping station after consultation with the City.

2.2 Calcium Hypochlorite

.1 Calcium hypochlorite shall comply with AWWA B300.

2.3 Sodium Hypochlorite

.1 Sodium hypochlorite shall comply with AWWA B300.

3. EXECUTION

3.1 Applicable Standards

.1 Except as otherwise specified, the work shall be undertaken in accordance with the following standards:

.1 AWWA C651 Disinfecting Water Mains.

.2 AWWA C652 Disinfection of Water Storage Facilities.

.3 AWWA C653 Disinfection of Water Treatment Plants.

3.2 Cleaning

.1 The pipework to be disinfected shall be thoroughly cleaned prior to disinfection.

.2 All construction material not part of the permanent structure shall be removed.

.3 The surfaces of walls, floor and roof of structures shall be cleaned using a high pressure jet, sweeping, scrubbing or equally effective means.

.4 Pipes shall be flushed to remove all dirt prior to disinfection. If necessary, the pipe shall be cleaned by swabbing or other mechanical means as directed by the Contract Administrator.

3.3 Disinfection of Piping

.1 Pipework shall be disinfected by adding a chlorine compound to the filling water during the pipe pressure test to produce an initial even concentration of at least 50 mg/L of free chlorine. The pipes shall be left full of chlorinated water for twenty-four (24) hours and the free chlorine residual after twenty-four (24) hours shall not be less than 10 mg/L.

.2 If the chlorine residual is less than 10 mg/L after twenty-four (24) hours, the main shall be flushed and the procedure repeated.

3.4 Disposal of Chlorinated Water

.1 After the disinfection process is complete, the heavily chlorinated water shall be drained and disposed of in an approved manner, and in accordance with Division 1.

.2 Coordinate with the City regarding water disposal so as not to interfere with other waste streams.

.3 Heavily chlorinated water shall not be discharged to local sewers without first obtaining the permission of local regulatory authorities.

.4 If other disposal methods are impractical, dechlorinate the chlorinated water using methods outlined in AWWA C653.

3.5 Filling of Piping and Structures

.1 Immediately following the disposal of the heavily chlorinated water, the piping and structure shall be filled with potable water.

.2 It is recommended that the potable water used for filling of the structures be sampled to ensure that no bacteriological contamination exists in the fill water prior to placement in the pipes or structures.

3.6 Bacteriological Testing

.1 After the chlorination procedure is complete and the piping and structure has been filled with potable water, duplicate samples shall be taken at least thirty (30) minutes apart and shall be tested for coliforms in accordance with the Standard Methods for the Examination of Water and Wastewater. Two (2) consecutive negative tests are required in order for the bacteriological testing to pass.

.2 For piping and pipelines a minimum of one sample shall be collected for every 500 m of line disinfected.

.3 Bacteriological testing is to be performed at an accredited laboratory that is able to perform the tests. All costs associated with transportation and testing of samples shall be borne by the Contractor.

3.7 Disinfection

.1 If the initial disinfection fails to produce satisfactory bacteriological samples, the pipes shall be reflushed and water resampled.

.2 If check samples show the presence of coliform organisms, then the main or reservoir and pipes shall be redisinfected until satisfactory results are obtained.

.3 All costs associated with the redisinfection and testing shall be borne by the Contractor.

3.8 Placing Into Service

.1 No piping, structure or tank that is required to be disinfected shall be placed into service until bacteriological samples indicate the absence of contamination.

3.9 Entry into Existing or Previously Disinfected Potable Watermains or Structures

.1 Where entry is required either into existing potable water storage structures or piping or into previously disinfected new structures, the Contractor shall assure that the following measures are taken:

.1 All personnel shall wear clean, dirt-free protective overalls and disinfected, clean rubber footwear. Such footwear shall be reserved solely for use within the affected areas and shall not be worn in undisinfected areas.

.2 All tools and equipment shall be clean, grease free and spray disinfected before use. Equipment which shows evidence of fuel, oil or grease leakage shall not be used.

.3 The immediate area surrounding the access point for the structures concerned shall be cleaned and spray disinfected prior to the start of Work. All previously disinfected footwear, tools, or equipment removed outside this area of the affected structures shall be redisinfected on return.

.4 Disinfection of footwear, tools, equipment and access areas shall be by spraying with a 200 mg/L concentrated chlorine/water solution.

.5 Workmen who show signs of illness shall not work within the affected structures or surrounding access area.

3.10 Costs

.1 The Contractor shall bear the cost for chemicals, de-chlorination, and disposal of water.

END OF SECTION

INSTRUMENTATION SPECIFICATION SHEETS

1. GENERAL

1.1 Description

.1 The Work includes the provision of instrument specification sheets for all instruments supplied for this project.

.2 Includes Work called out in other Divisions.

.3 Comply with Specification Sections 40 91 37 - Inline Electromagnetic Flowmeter and Section 40 91 38 - Full Profile Insertion Magnetic Flowmeter.

1.2 Standards

.1 Canadian Standards Association (CSA):

.1 C22.1: Canadian Electrical Code.

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

.2 International Society of Automation (ISA):

.1 ISA 20: Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.

.3 National Electrical Manufacturers Association (NEMA):

.1 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 ICS: Industrial Control and Systems: Enclosures.

.4 Underwriters Laboratories (UL):

.1 508A: Industrial Control Panels.

1.3 Instrument Specification Sheets

.1 The provided Specification Sheets and Contract Documents provide guidance for the intended instrumentation and controls. It is the Contractor’s responsibility to ensure the selected devices meet the Contract requirements, and all pertinent literature including manufacturer electrical and mechanical installation requirements are included with the submissions.

.2 Provide data sheets to itemize detailed as-built information regarding the specification of instruments included as part of this Work for each instrument supplied. The data sheets already included in this Section list specific minimum requirements for applications.

.3 Use forms in accordance with the ISA 20 as a template for the preparation of the specification sheets.

2. PRODUCTS

2.1 Specification Sheets

.1 Refer to the following Specification Sheets.

DESCRIPTION:	McPhillips RPS North and South Primary Flowmeters
DEVICE:	Flowmeter
TAG:	FE-M1521, FE-M1531
SERVICE:	Potable water
MEASUREMENT METHOD:	Inline electromagnetic
CERTIFICATION:	NSF-61 approved
SIZE:	750 mm
RANGE:	28 – 129 MLD
OPERATING PRESSURE	500 KPa
OPERATING TEMPERATURE:	0 ◦C to 30°C
INACCURACY:	Less than ± 1% for flows above 30 MLD
END CONNECTIONS:	Flanged (AWWA Class B C207 CS)
LINER MATERIAL:	Teflon or Rubber liner, suitable for potable water service.
ELECTRODES:	Hastelloy C or 316 Stainless Steel
GROUNDING:	Built-in ground probes or ground rings
OUTPUT:	HART 4 to 20 mA DC into maximum 500 ohm load Totalizer Pulse 3 Configurable alarm relays including a dedicated fault relay
POWER SUPPLY:	120 VAC
INDICATION:	Local indication of flow rate and totalized flow
CABLE LENGTH:	Field Verify
ENCLOSURE:	IP68 Remote wall-mount transmitter and required cables. CSA/NEMA 4X transmitter and separate sensor housing.
ACCESSORIES:	Include flange self-centering gaskets (x2)
MANUFACTURER AND MODEL:	Refer to Specification Section 40 91 37.

INSTRUMENTATION SPECIFICATION SHEETS

DESCRIPTION:	MacLean RPS North and South Primary Flowmeters
DEVICE:	Flowmeter
TAG:	FE-M1511, FE-M1541
SERVICE:	Potable water
MEASUREMENT METHOD:	Inline electromagnetic
CERTIFICATION:	NSF-61 approved
SIZE:	750 mm
RANGE:	18 – 128 MLD
OPERATING PRESSURE	550 KPa
OPERATING TEMPERATURE:	0 ◦C to 30°C
INACCURACY:	Less than ± 1% for flows above 30 MLD
END CONNECTIONS:	Flanged (AWWA Class B C207 CS)
LINER MATERIAL:	Teflon or Rubber liner, suitable for potable water service.
ELECTRODES:	Hastelloy C or 316 stainless steel
GROUNDING:	Built-in ground probes or ground rings
OUTPUT:	HART 4 to 20 mA DC into maximum 500 ohm load Totalizer Pulse 3 Configurable alarm relays including a dedicated fault relay
POWER SUPPLY:	120 VAC
INDICATION:	Local indication of flow rate and totalized flow
CABLE LENGTH:	Field Verify
ENCLOSURE:	IP68 Remote wall-mount transmitter and required cables. CSA/NEMA 4X transmitter and separate sensor housing.
ACCESSORIES:	Include flange self-centering gaskets (x2)
MANUFACTURER AND MODEL:	Refer to Specification Section 40 91 37.

INSTRUMENTATION SPECIFICATION SHEETS

DESCRIPTION:	McPhillips RPS Secondary Flowmeter
DEVICE:	Flowmeter
TAG:	FE-M1522
SERVICE:	Potable water
MEASUREMENT METHOD:	Full profile insertion electromagnetic
CERTIFICATION:	NSF-61 approved
SIZE:	600 mm
RANGE:	72 - 100 MLD
OPERATING PRESSURE	500 KPa
OPERATING TEMPERATURE:	0 ◦C to 30°C
INACCURACY:	Less than ± 0.5% for flows above 30 MLD
CONNECTION TYPE:	50 mm tap and ball valve
INSERTION HARDWARE:	316 Stainless Steel
COMPRESSION SEAL:	Silicone rubber
COATING:	NSF 61 certified epoxy coating
GROUNDING:	Built-in ground probes
OUTPUT:	4 to 20 mA DC into maximum 500 ohm load HART Totalizer Pulse 3 Configurable alarm relays including a dedicated fault relay
POWER SUPPLY:	120VAC to Transmitter
INDICATION:	Local indication of flow rate and totalized flow
CABLE LENGTH:	Field Verify
ENCLOSURE:	IP68 Remote wall-mount transmitter and required cables. CSA/NEMA 4X transmitter and separate sensor housing.
BI-DIRECTIONAL FLOW	No
MANUFACTURER AND MODEL:	McCrometer, FPI 395L forward flow

INSTRUMENTATION SPECIFICATION SHEETS

DESCRIPTION:	MacLean RPS Secondary Flowmeter
DEVICE:	Flowmeter
TAG:	FE-M1531
SERVICE:	Potable water
MEASUREMENT METHOD:	Full profile insertion electromagnetic
CERTIFICATION:	NSF-61 approved
SIZE:	1200 mm
RANGE:	18 – 128 MLD
OPERATING PRESSURE	550 KPa
OPERATING TEMPERATURE:	0 ◦C to 30°C
INACCURACY:	Less than ± 0.5% for flows above 30 MLD
CONNECTION TYPE:	50 mm tap and ball valve
INSERTION HARDWARE:	316 Stainless Steel
COMPRESSION SEAL:	Silicone rubber
COATING:	NSF 61 certified epoxy coating
OUTPUT:	4 to 20 mA DC into maximum 500 ohm load HART Totalizer Pulse 3 Configurable alarm relays including a dedicated fault relay
POWER SUPPLY:	120VAC to Transmitter
INDICATION:	Local indication of flow rate and totalized flow
CABLE LENGTH:	Field Verify
ENCLOSURE:	IP68 Remote wall-mount transmitter and required cables. CSA/NEMA 4X transmitter and separate sensor housing.
BI-DIRECTIONAL FLOW	Yes
MANUFACTURER AND MODEL:	McCrometer, FPI 394L bi-directional flow

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section gives general requirements for Instrumentation and Control related items. It is supplemental to the requirements defined in other Specification Sections.

.2 Comply with latest edition of all applicable codes and standards whether referenced in this Section or not.

.3 In the event any inconsistency is discovered between the Specifications, codes or standards, the most stringent shall apply.

1.2 References

.1 The following is a list of codes and standards are applicable as required:

.1 Institute of Electrical and Electronics Engineers (IEEE):

.1 C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

.2 The International Society of Automation (ISA):

.1 S5.1, Instrumentation Symbols and Identification.

.2 S50.1, Compatibility of Analog Signals for Electronic Industrial Process Instruments.

.3 62443, Security for Industrial Automation and Control Systems.

.3 Canadian Standards Association (CSA):

.1 C22.1 Canadian Electrical Code.

.2 C22.2, Electrical Safety Code.

.4 National Electrical Manufacturers Association (NEMA).

.5 National Fire Code, National Fire Protection Association (NFPA).

.1 NFPA 820, Fire Protection in Wastewater Treatment Plants.

.6 City of Winnipeg WWD Automation Design Guide.

.7 City of Winnipeg WWD Electrical Design Guide.

.2 Complete installation in accordance with the latest version of CSA C22.1.

.3 Comply with all laws, ordinances, rules, regulations, codes, and orders of all Authorities Having Jurisdiction relating to this Work.

1.3 Acronyms and Abbreviations

.1 CP: Control Panel

.2 DCS: Distributed Control System

.3 FAT: Factory Acceptance Test

.4 FOCS: Fibre Optic Communication Subsystem

.5 HVAC: Heating, Ventilating, and Air Conditioning

.6 I&C: Instrumentation and Control

.7 I/O or IO: Input and Output

.8 HMI: Human-Machine Interface, alias for Operator Interface

.9 LCP: Local Control Panel

.10 MCC: Motor Control Center

.11 O&M: Operation and Maintenance

.12 OWS Operator Work Station

.13 PC: Personal Computer

.14 PCS: Process Control System comprising PLC's, and HMIs, communications systems and related hardware and software

.15 PCU: Process Control Unit, a DCS subsystem

.16 PICS: Process Instrumentation and Control System

.17 P&ID: Process and Instrument Diagram.

.18 PLC: Programmable Logic Controller

.19 SAT: Site Acceptance Test

.20 SIT: Site Integration Test

.21 SIFT: System Integration Functional Test

.22 UPS: Uninterruptible Power Supply

.23 VFD: Variable Frequency Drive

1.4 Submittals

.1 General:

.1 Submit proposed Submittal breakdown list consisting of all PICS component submittals. Sequencing and packaging of information to be in accordance with Progress Schedule.

.2 Partial Submittals not in accordance with Progress Schedule will not be accepted.

.3 Obtain Contract Administrator's approval if Submittals for a PICS subsystem are to be made in multiple packages.

.4 Provide submittals sufficiently in advance of requirements to allow ample time for review.

.2 Shop Drawings and Product Data:

.1 Prior to delivery of any Products to job Site, submit Shop Drawings and Product Data as specified in Section 01 33 00 - Submittal Procedures for all equipment as required in the Specifications

.2 Prior to submitting the Shop Drawings to the Contract Administrator, the Contractor shall review the Shop Drawings to determine that the equipment complies with the requirements of the Specifications and Drawings.

.3 The term "Shop Drawing" means drawings, diagrams, illustrations, schedules, performance characteristics, brochures and other data, which are to be provided by the Contractor to illustrate details of a portion of the Work. Indicate materials, methods of construction and attachment of support wiring, diagrams, connections, recommended installation details, explanatory notes and other information necessary for completion of Work. Where equipment is connected to other equipment, indicate that such items have been coordinated, regardless of the section under which the adjacent items will be supplied and installed. Indicate cross-references to design drawings and Specifications. Adjustments made on Shop Drawings by the Contract Administrator are not intended to change the contract price. If adjustments affect the value of the Work, state such in writing to the Contract Administrator prior to proceeding with the Work.

.4 Equipment identifiers shall be included on all Shop Drawing and product data submittals to clearly identify the equipment they apply to.

.5 Manufacture of Products shall conform to revised Shop Drawings.

.3 Informational Submittals:

.1 Provide informational submittals in accordance with other Specification Sections including but not limited to the following:

.1 Testing and Commissioning Forms: In accordance with other Specification Sections.

.2 Operation and Maintenance Data: In accordance with Section 01 91 51 - Operation and Maintenance Manuals and in addition to the following:

.1 Outline of O&M data.

.2 Sufficient detail to allow operation, removal, installation, adjustment, calibration, maintenance and purchasing replacements for each PICS component.

.3 As-Built Drawings: In accordance with Section 01 78 00 - Closeout Submittals.

.2 Extra Materials:

.1 List of proposed spares, expendables, and test equipment. Separate Submittals for each PICS subsystem.

.2 Recommended Spare Parts: List of, and descriptive literature for, additional spares, expendables, and test equipment recommended by PICS Integrator. Include quantities, unit prices, and total costs.

1.5 Drawings and Specifications

.1 The intent of the Drawings and Specifications is to indicate labor, products, and services necessary for a complete, installed, tested, commissioned and functional installation.

.2 PICS drawings may indicate approximate route to be followed by conduits and cables and general location of electrical equipment. They do not show all structural, architectural and mechanical details. The details on exact cable or conduit routing, and exact equipment installation location is to be determined on Site and coordinated with all other trades.

.3 To provide sufficient detail and maximum degree of clarity on the drawings, symbols used for various electrical devices, particularly wall mounted devices, take up more space on the drawings than devices physically do. Locate devices with primary regard for convenience of operation, accessibility and space utilization, rather than locating devices to comply with the exact scaled locations of the electrical symbols.

.4 The PICS Specifications and Drawings and the Specifications of all other Divisions shall be considered as an integral part of the Work. Any item or subject omitted from either the Specifications or the Drawings but which is mentioned or reasonably specified by the Drawings or Specifications of other Divisions, shall be considered as properly and sufficiently specified and shall be provided.

.5 If discrepancies or omissions in the Drawings or Specifications are found, or if the intent or meaning is not clear, advise the Contract Administrator for clarification before submitting a Bid.

.6 Provide all minor items and work not shown or specified but which are reasonably necessary to complete the Work.

.7 Various package unit types of equipment are included in the Work. It is the responsibility of the Contractor to familiarize himself with the requirements of the equipment vendor, and to include all materials and labor for a complete and working installation. In some cases this means that control panels, instruments, actuators, etc. need to be wired and connected in the field. The Contractor shall include all costs to perform such services as part of his Tender submittal. Coordination between the equipment vendor and the contractor shall be performed prior to tender bid closing date, and all costs shall be included in the tender. Request for extras due to lack of coordination between the Contractor and the equipment vendors will not be accepted.

.8 Cables schedules/lists where shown do not include all cables required to perform the complete facility installation. They shall be used as a general guide. Accurate cable lists, quantities, take-offs remain the responsibility of the Contractor.

1.6 Care, Operation and Start-Up

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

.2 Where services of a manufacturer's factory service engineer is required, arrange and pay for services to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

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

1.7 Permits, Fees and Inspection

.1 The Contract Administrator will submit to Electrical Inspection Department and Supply Authority necessary number of Drawings and Specifications for examination and approval prior to commencement of Work.

.2 The Contractor shall pay associated fees as required by the Electrical Inspections and Permitting department.

.3 Notify the Contract Administrator of changes required by Electrical Inspection Department prior to making changes.

.4 Furnish a Certificate of Final Inspection and approvals from inspection authority to the Contract Administrator.

1.8 Materials and Equipment

.1 Provide materials and equipment in accordance with Section 01 60 00 - Material and Equipment.

.2 Equipment and material to be CSA or cUL certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.

.3 Minimum enclosure type to be used is NEMA 12 unless otherwise specified.

.4 Junction Boxes:

.1 All field wiring connections to be located in junction boxes with terminals. The design documents show the expected junction boxes to be required. However, the Contractor must provide all junction boxes required, whether or not the junction boxes are shown in the design documents.

1.9 PICS Coordination

.1 Coordinate Work with all other trades to ensure that conflicts do not occur.

.2 Coordinate requirement of mechanical equipment requiring electrical connection with the mechanical contractor.

1.10 Finishes

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel.

.1 Paint enclosures light grey to ANSI 61 grey enamel, unless otherwise specified.

.2 Clean and touch-up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

1.11 Equipment Identification

.1 Identify PICS equipment with nameplates.

.2 Nameplates:

.1 Lamacoid, 3 mm thick plastic nameplates, mechanically attached with self tapping stainless steel screws, white face with black lettering. Note: “Sheet Metal Screws” or other sharp pointed screws are NOT acceptable.

.3 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	40 x 90 mm	2 lines	8 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	5 mm high letters
Size 8	35 x 100 mm	3 lines	5 mm high letters
Size 9	45 x 100 mm	4 lines	5 mm high letters
Size 10	75 x 160 mm	3 or 4 lines	8 mm high letters
Size 11	150 x 250 mm	3 or 4 lines	10 mm high letters

.4 Wording on nameplates to be approved by Contract Administrator prior to manufacture.

.5 Allow for average of fifty (50) letters per nameplate.

.6 Identification to be in English.

.7 Provide nameplates for the following, sizes as shown:

.1 Cabinets – Size 8.

.2 Small Junction Boxes (150 mm x 150 mm or smaller) – Size 1.

.3 Large Junction Boxes – Size 2.

.4 Control panels – Size 8.

.5 Field Devices (Instruments, Actuators, etc.) – Size 4.

1.12 Wiring Identification

.1 Identify wiring with permanent indelible identifying markings on both ends as shown on Drawings.

.2 Wire tags to be heat shrink type with mechanically printed black letters on white background.

1.13 Conduit and Cable Identification

.1 Colour code conduits, boxes and cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 5 m intervals.

.3 Colours: 38 mm wide prime colour and 19 mm wide auxiliary colours.

.1 Colours as per the Electrical Design Guide and Identification Standard.

.4 Cable Identification: Supply and install lamacoid type cable identification tags for all cables. Install identification tag at both ends.

1.14 As-Built Drawings and Documents

.1 Refer to Section 01 78 00 - Closeout Submittals - for additional requirements for As-Built Drawings and documents.

.2 The Contractor shall keep one (1) complete set of white prints at the Site during the Work, including all addenda, change orders, Site Instructions, clarifications, and revisions for the purpose of As-Built Drawings. As the Work on-site proceeds, the Contractor shall clearly record in Red Pencil all as-built conditions, which deviate from the original Contract Documents.

.3 The Contractor shall keep one completed set of automation documents at the Site during the work, including all addenda, change orders, Site Instructions, clarifications, and revisions for the purpose of As-Built documents. This includes, but is not limited to the following:

.1 I/O Lists.

.2 Instrument Lists.

.3 IP Address Lists.

.4 Functional Requirements Specifications.

.5 Automation Equipment List.

.6 PLC Module List.

.4 On completion of the Work, minimum of four (4) weeks prior to final inspection, submit As-Built Drawings and documents to the Contract Administrator for review. The Contractor shall certify, in writing signed and dated, that the As-Built Drawings are complete and that they accurately indicate all electrical services, including exposed as well as concealed items.

.5 Comply with all other MWSB standards and requirements.

1.15 Operations and Maintenance (O&M) Manuals

.1 Provide operation and maintenance manuals as specified herein and in accordance with the general conditions. Refer to Section 01 91 51 - Operations and Maintenance Manual.

.2 Include in the operations and maintenance manuals a minimum of:

.1 Cover page including project name, year, and name of owner. Cover page shall be enclosed in a clear plastic cover.

.2 Index.

.3 List of manufacturers and supplier for all items.

.4 Names, address and phone number of all local suppliers for items included in maintenance manual.

.5 Stamped and signed Shop Drawings.

.6 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of portions or features of the installation.

.7 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature not acceptable.

.8 All test results performed. This includes, but is not limited to fibre optic tests; Control System network tests; Profibus Network Tests; FAT, SIFT, SIT and SAT tests.

.9 As-Built Drawings.

.10 Signed and dated warranty certificate.

.11 Signed and dated approval by the local Electrical Inspections Department.

.12 All other requirements outlined in the Specifications.

.3 Submit draft document prior to the start of commissioning.

1.16 Environmental Conditions

.1 Equipment and systems are to be rated to correctly operate in the environment in which they are to be installed.

.2 Exterior devices shall be rated to operate in an exterior environment with temperature range of minus 40°C to plus 40°C.

1.17 Quality Assurance

.1 Qualifications:

.1 For work involving specialties, including, but not limited to, the installation of sound and intercommunication systems, fire alarm systems, lightning protection systems, grounding systems, instrumentation, controls, electronic access, security systems, fibre optics systems, etc. employ only workers fully trained, qualified and experienced in the aspects of such Work.

2. PRODUCTS

2.1 General

.1 The design is based upon the manufacturers and model numbers shown on the Drawings and in the Specifications. If a manufacturer chosen after project award is different from that on which the design is based, the design must be modified by the Contractor based on the chosen manufacturer. If additional engineering work is required, the Contractor must provide an Engineer's seal for the change to the design.

.2 Substitutes:

.1 Provide all additional and modified wiring, raceway, enclosures, intrinsically safe barriers, and accessories at no additional cost associated with approved substitutes.

.3 Like Equipment Items:

.1 Use products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's services.

.2 Implement all same or similar functions in same or similar manner. For example, control logic, sequence controls, and display layouts.

3. EXECUTION

3.1 Preparation and Protection

.1 Schedule expediting of materials and execution of Work in conjunction with associated work of other trades in order to meet the required work schedule.

.2 Post engraved warning signs to meet requirements of local by-laws, Inspection Authority and Contract Administrator.

.3 Protect those working on or in vicinity of exposed electrically energized equipment from physical danger. Shield and mark live parts in accordance with local regulations. Indicate the appropriate voltage.

.4 Arrange for installation of temporary doors, barriers and similar items for access to rooms and areas containing electrical equipment. Keep these doors locked at all times, except when under direct supervision.

.5 Permanently identify with lamacoid nameplate, equipment energized from multiple power sources, noting voltages, power source locations, supply disconnect designations and grounding electrode location.

3.2 Warning Signs

.1 As specified and to meet the requirements of Electrical Inspection Department and the Contract Administrator.

.2 Lamacoid 3 mm thick plastic engraving sheet, red face, white core, mechanically attached with self tapping stainless steel screws, 20 mm text.

3.3 Mounting Heights

.1 Unless otherwise noted, or in contravention of codes and standards, mount equipment replacing existing equipment at the same height.

.2 Mounting height of equipment is from finished floor to centerline of equipment unless specified or indicated otherwise.

.3 Typical mounting heights are as follows:

.1	Wall mounted instruments:	1.5 m Above Finished Floor (AFF)
.2	Wall mounted junction boxes:	1.5 m AFF
.3	Wall mounted small panels:	1.5 m AFF
.4	Wall mounted large panels:	Top of cabinet at 2.0 m AFF
.5	Gas detection horns and strobes:	2.0 m to 4.0 m AFF
.6	Motor control hand switches:	1.5 m AFF
.7	Valve actuator control stations:	1.5 m AFF

.4 If mounting height of equipment is not indicated, verify with the Contract Administrator before proceeding with the installation.

3.4 Modifications to Existing Cabinets

.1 Where significant modifications are made to existing cabinets, the cabinet shall be inspected by the Authority Having Jurisdiction.

3.5 IP Addresses

.1 IP Addresses will be provided to the Contractor for all network devices after project award. The Contractor will be required to sign a Non-disclosure Agreement and confidentiality agreement in relation to the IP Addresses.

3.6 Devices with Integral Leads

.1 For devices with integral leads, if the location of the device does not allow the leads to reach the junction box as shown on the Drawings, provide additional wiring, conduit and boxes as required to extend the leads to the associated junction box.

3.7 Location of Devices

.1 Allow for change of location of devices at no extra cost or credit, provided that the distance does not exceed 3000 mm (10') from that shown on the Drawings, when the requirement is made known prior to installation.

3.8 Conduit and Cable Installation

.1 Sleeves through concrete: schedule 40 galvanized steel pipe, sized for free passage of conduit.

.2 For wall, partitions, and ceilings the sleeve ends shall be flush with the finish on both sides but for floors they shall extend 25 mm (1") above finished floor level.

.3 Fire stop openings with ULC approved assembly for the installation conditions.

.4 Provide a detailed proposed conduit routing plan to the Contract Administrator prior to proceeding with the installation of conduit.

.5 If possible, avoid routing conduits through hazardous areas.

.6 Separate cables of different voltage levels when cables are installed parallel to each other.

3.9 Cutting, Patching, and Drilling

.1 Provide all cutting and patching as required.

.2 Return exposed surfaces to an as-found condition.

.3 Exercise care where cutting/drilling holes in existing concrete elements so as not to damage existing reinforcing, or any other systems run in the concrete.

.1 Locate reinforcing and other existing systems using ground penetrating radar, X-Ray or other suitable means. Mark out on the surface of the concrete the locations of rebar and all other systems.

.2 For all holes larger than 50 mm passing through reinforced concrete, mark the location of the desired hole and all embedded systems. Obtain approval from the Contract Administrator prior to cutting.

.4 Firestop and seal all penetrations.

.5 Ensure that water ingress will not occur.

.6 Provide expansion joints for penetrations where shifting can occur.

3.10 Anchor Installation

.1 The Contractor shall exercise care where installing anchors into existing concrete elements so as not to damage existing reinforcing. All anchors shall be installed utilizing carbide tip drill bits. The existing reinforcing shall be located utilizing a reinforcing bar locator and marked out on the surface of the concrete. The drill holes shall be advanced to the required depth for installation of the anchors. Should reinforcement be encountered while drilling, the hole shall be terminated and repositioned to clear the reinforcement. Do not use core bits that can easily intercept and damage/cut the reinforcing during drilling.

3.11 Field Quality Control

.1 All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks - the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties. A maximum of one (1) apprentice is permitted per qualified electrician.

.2 The Work of this Division to be carried out by a contractor who holds a valid Master Electrical contractor license as issued by the Province of Manitoba.

3.12 Touch-Up Painting

.1 Clean and touch-up surfaces of shop painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Obtain necessary touch-up paint of original type and quality from equipment manufacturer.

.3 Clean surfaces to be painted. Feather out edges of scratch marks. Make patch inconspicuous.

.4 Apply one or more coats until damaged surface has been restored to original finish condition.

.5 Clean and prime exposed non galvanized hangers, racks and fastenings to prevent rusting.

.6 Do not paint nameplates, tags, CSA labels, warning plates and operating instructions. Observe field painting of electrical equipment or raceways. Labels shall be visible and legible after the equipment is installed.

3.13 Cleaning

.1 Clean construction debris and materials from enclosures, before final electrical tests. Vacuum the interior and exterior of enclosures to ensure all equipment is free from debris. No loose items shall be in the bottom of cabinet before the final electrical tests. Any spare parts, drawings, documentation, etc. should be stored in the appropriate area in the cabinet.

3.14 Provision for Future Expansion

.1 In each location where space for future equipment is indicated, leave such space clean. Install conduit, wiring and other work in such a manner that necessary connections can be made in future without dismantling existing equipment, raceways or wiring. Consult with Contract Administrator whenever necessary.

END OF SECTION

1. GENERAL

1.1 Description

.1 Section Includes:

.1 Magnetic flowmeters.

.2 Converters.

.3 Interconnecting cable.

.2 Comply with Section 40 70 00 - Instrumentation Specification Sheets.

1.2 Standards

.1 All standards referenced in the specifications are referring to the most recent version of the published standard.

.2 American Water Works Association (AWWA):

.1 C751-16: Magnetic Inductive Flowmeters.

.3 American National Standards Institute (ANSI):

.1 ANSI/NCSL Z540.3: Requirements for the Calibration of Measuring and Test Equipment.

.4 International Organization for Standardization (ISO):

.1 ISO/IEC 17025: General Requirements for the Competence of Testing and Calibration Laboratories.

.5 International Society of Automation (ISA):

.1 S5.1: P&IDs and Tagging

.2 S5.4: Instrument Loop Diagrams

.3 S7: Instrument Air

.4 S12: Electrical Equipment for Hazardous Locations

.5 S18.2: Alarm Management

.6 S20: Instrument Specifications

.7 S50: Electrical Control Signals

.8 S75: Control Valve Design, Specification and Testing

.9 S96: Valve Actuators

.10 S99: Control System Cyber Security

.11 101: Human-Machine Interfaces

1.3 Submittals

.1 Submit the following in accordance with Section 01 33 00 - Submittal Procedures:

.2 Product Data:

.1 Catalog cuts and Manufacturer's specification for each meter and converter.

.2 Equipment make and model, material of construction, weight of product, electrical requirements, and all electrical and mechanical components.

.3 General equipment dimensions, and layout requirements.

.4 List of any special tool(s) required for installation and maintenance.

.3 Shop Drawings:

.1 Drawing showing location of meter in pipe system.

.2 Standard wiring diagram.

.4 Operation and Maintenance (O&M) Data:

.1 Hydraulic calibration results including printout of actual calibration data giving indicated vs. actual flows at minimum of 0.3 m/sec flow rate for each meter. List test results by location and serial number of meters.

.5 A copy of this Specification Section with any applicable addenda and all referenced Specification Sections with each paragraph check marked to indicate Specification compliance or marked to indicate requested deviations and clarifications from the specified requirements shall be provided with the detailed Shop Drawing.

.1 If deviations and clarifications from the Specifications are indicated and therefore requested by the Manufacturer, provide a detailed written justification for each deviation and clarification.

.2 Failure to include a copy of the marked-up Specification Sections and or the detailed justifications for any requested deviation or clarification may result in disqualification of Bid.

1.4 Maintenance

.1 Spare Parts:

.1 One (1) spool piece for each diameter of meter.

1.5 Quality Assurance

.1 Equipment shall be the product of one Manufacturer. Provide equipment of Manufacturers' latest and proven design.

.2 The Manufacturer shall be regularly engaged in the design, manufacture and servicing of electromagnetic flowmeters for potable water application. Manufacturer to submit evidence of a proven track record with at least two (2) operating flowmeter installations of the same size, accuracy and model as prescribed here installed within the last five (5) years.

2. PRODUCTS

2.1 System Description

.1 Design Requirements:

.1 Ratio of flow velocity to reference voltage signals generated shall be identical for each meter size. Meter shall be compatible with secondary readout instrument without circuit modifications.

.2 Changes in density, viscosity, temperature, pressure or conductivity within limits of flowmeter shall not affect accuracy. Maintain accuracy for field repairs performed by Manufacturer’s service technician during warranty period.

.3 Design is based on minimum average velocity of 1 m/sec through meter. Meters requiring greater velocities to meet specified accuracy and proper performance are not acceptable.

.4 Flowmeter system accuracy shall be ±1% or less of actual flow rate from 0.8 m/sec to 9 m/sec. Repeatability shall be ±0.1% and response time programmable from 1 sec to 100 sec.

.5 Meter shall meet accuracy with one (1) straight pipe diameter upstream and zero (0) straight pipe diameters downstream from the meter.

.2 Classification:

.1 The flow tube, signal converter, and related ancillaries shall have environmental ratings suitable for their respective process areas. In no case shall the flow tube or signal converter environmental rating be less than NEMA 4X.

.2 Hazardous location rating:

.1 Flow tube: hazardous rating not required.

.2 Transmitter: hazardous rating not required.

.3 Operating Temperature: -40°C to 40°C

.4 Location rating:

.1 Flow Tube: Category 2 (corrosive) and Category 1 (wet).

.2 Transmitter: Category 1 (wet).

.3 Flowmeter to be factory potted and rated for submersion, minimum IP68. Field-installed potting kit is not permitted.

.5 Operating Pressure: Refer to Section 40 70 00 - Instrumentation Specification Sheets.

.3 Service: suitable for potable water industry.

.4 Performance:

.1 Flow range: Refer to Section 40 70 00 - Instrumentation Specification Sheets.

.5 Approvals: CSA or cUL.

2.2 Products and Manufacturers

.1 Ultramag by McCrometer.

.2 Promag W 400 by Endress+Hauser (EH).

.3 Optiflux 2300 by Krohne.

.4 Or approved equal.

2.3 Magnetic In-line Flowmeters

.1 Magnetic in-line flowmeters provided for the Work shall all be sourced from the same Manufacturer and in compliance with this Specification:

.1 Flow tubes shall be flanged and lined full-lay-length flow tube suitably rated for the process piping pressure rating.

.2 Flow tube sizes shall be as shown on the contract drawings. Notify the Contract Administrator if the proposed flowmeter size will result in flow velocity lower than 0.3 m/s or greater than 5 m/s during normal operation.

.3 Liner material shall be selected for compatibility with potable water characteristics and operating temperature range.

.4 Measuring electrodes and built-in grounding electrodes shall be 316SS bullet-nose or Hastelloy C.

.5 Provide the same liner material and the same electrodes for the flowmeters in all three Sites.

.6 Provide grounding ring from meter Manufacturer from ground rings to meter and meter to ground, using green size 10 AWG (6mm) ground wire.

.7 Fabricated grounding rings from a third party shall not be accepted.

.8 Install ground as directed by the meter Manufacturer or to nearest water pipe.

.9 Signal converters shall be suitable 120 VAC power supply and shall have an accuracy of 0.5 percent of calibrated span or better. Outputs shall include 4-20 maDC analog and a Totalizer Pulse output as a minimum.

.10 Provide remote wall mounted signal transmitters with pre-terminated power and signal cables to facilitate installation of the signal converter in place of existing locations.

2.4 Signal Transmitter

.1 Remote mounted, microprocessor controlled.

.1 Operate on 120 VAC, 60 Hz power.

.2 Provide pulsed DC voltage to magnet coils of magnetic flowmeter to establish magnetic field.

.3 Convert flow signal from magnetic flowmeter to analog and digital output signals, for bidirectional flow.

.2 Span shall be continuously adjustable between 0.3 and 10 m/s. Adjustment shall be by keypad.

.3 Display flow rate scaled in field selectable engineering units. Display shall have 2 rows of 16 alpha numeric characters. Top row shall indicate instantaneous flow.

.4 Converter interchangeable with magnetic flowmeter element and require no additional flow calibration.

.5 Isolated 4-20 maDC analog current output into 0 to 500 ohm load and 24 VDC scaled, software adjustable pulse output.

.6 Cast aluminum NEMA 4X enclosure.

.7 Noise reduction feature to stabilize flow reading.

.8 Automatic empty pipe detection.

.9 Suitable for -40°C to 40°C ambient temperature.

2.5 Cable

.1 Provide sufficient length of Manufacturer’s standard signal cable to connect meter primary element and converter.

.2 Use single conduit run between converter and meter.

2.6 Warranty

.1 The Manufacturer of the electromagnetic flowmeter shall provide a two-year warranty that the equipment shall be free from defects in design, workmanship, or materials. Extended warranties up to five (5) years shall be available for additional cost.

.2 The Manufacturer of the electromagnetic flowmeter shall provide a Lifetime Guarantee on the flow tubes liner.

.3 In the event a component fails to perform as specified or is proven defective in service during the warranty period, the Manufacturer shall promptly repair or replace the defective part at no cost to the City.

3. EXECUTION

3.1 Installation

.1 Install in accordance with the Contract Drawings and Manufacturer's written instructions and approved submittals.

.2 Locate meter as recommended by Manufacturer with respect to other piping components to ensure meter will meet specified accuracy.

.1 For MacLean RPS and McPhillips RPS in-line magnetic flowmeters, flow tubes shall be installed in a designated meter run as specified in the Contract Drawings, comprising a minimum upstream straight pipe length of 1D and a minimum downstream straight pipe length of 0D of the nominal pipe diameter. There shall be no valves, reducers, bends, tees, process taps, or other flow-disturbing fittings located within the meter run.

3.2 Field Quality Control

.1 Manufacturer's Field Services:

.1 Manufacturer's technician for equipment specified herein shall be present at job Site or classroom designated by the City for person-day indicated, travel time excluded, for assistance during construction, startup, equipment calibration, and training of personnel for operation. Each flowmeter would be installed and commissioned one at a time. Include minimum of:

.1 MacLean RPS:

.1 Two (2) person-days of installation and training services for each flowmeter.

.2 This results in a total of 2 two-person-day service trips for all flowmeters.

.2 McPhillips RPS:

.1 Two (2) person-days of installation and training services for each flowmeter.

.2 This results in a total of 2 two-person-day service trips for all flowmeters.

.2 Manufacturer shall direct services to system and equipment operation, maintenance, and troubleshooting and system related areas other than process design and philosophy.

3.3 Calibration

.1 Each flowmeter shall be factory calibrated according to ANSI/NCSL Z540.3 and ISO/IEC 17025.

.1 The calibration should be conducted in a NIST traceable flow facility.

.2 The calibration shall be conducted with at least three (3) equally spaced flows including the minimum, average and maximum flows as specified in Section 40 70 00 - Instrumentation Specification Sheets for each individual flowmeter.

.3 The calibration report shall be reviewed and signed by the Contractor's Professional Engineer of record registered in the Province of Manitoba.

.4 Submit calibration reports for review by the Contract Administrator and include copies of reviewed and accepted calibration reports in the O&M manuals.

.2 Each flowmeter calibration shall be verified on-site:

.1 In-line liquid flowmeter calibrations shall be verified in-situ using volumetric draw down or similar test approved by the Contract Administrator.

.3 Provide calibration reports of the factory calibration and as-commissioned in-situ calibration check including all smart device configuration parameters.

3.4 Closeout Activities

.1 Provide in accordance with Section 01 78 00 - Closeout Submittals.

END OF SECTION

FULL PROFILE INSERTION MAGNETIC FLOWMETER

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Full Profile Insertion (FPI) magnetic flowmeters.

.2 Transmitters.

.3 Interconnecting cable.

.2 Comply with Section 40 70 00 - Instrumentation Specification Sheet.

1.2 Standards

.1 All standards referenced in the specifications are referring to the most recent version of the published standard.

.2 American Water Works Association (AWWA):

.1 C751-16: Magnetic Inductive Flowmeters.

.3 American National Standards Institute (ANSI):

.1 ANSI/NCSL Z540.3: Requirements for the Calibration of Measuring and Test Equipment.

1.3 Submittals

.1 Submit the following in accordance with Section 01 33 00 - Submittal Procedures:

.2 Product Data:

.1 Catalog cuts and Manufacturer's specification for each meter and converter. Include complete parts list.

.2 Equipment make and model, material of construction, weight of product, electrical requirements, and all electrical and mechanical components.

.3 General equipment dimensions, and layout requirements.

.4 List of any special tool(s) required for installation and maintenance.

.3 Shop Drawings:

.1 Drawing showing location of meter in pipe system.

.2 Wiring diagram between meter and converter.

.4 Operation and Maintenance (O&M) Data:

.1 Hydraulic calibration results including printout of actual calibration data giving indicated vs. actual flows at minimum of 0.3 m/s flow rate for each meter.

.5 A copy of this Specification Section with any applicable addenda and all referenced Specification Sections with each paragraph check marked to indicate Specification compliance or marked to indicate requested deviations and clarifications from the specified requirements shall be provided with the detailed Shop Drawing.

.1 If deviations and clarifications from the Specifications are indicated; and, therefore requested by the Manufacturer, provide a detailed written justification for each deviation and clarification.

.2 Failure to include a copy of the marked-up Specification Sections and or the detailed justifications for any requested deviation or clarification may result in disqualification of Bid.

1.4 Maintenance

.1 Spare Parts:

.1 One (1) spool piece for each diameter and length of meter.

1.5 Quality Assurance

.1 Equipment shall be the product of one Manufacturer. Provide equipment of Manufacturers' latest and proven design.

.2 The Manufacturer shall be regularly engaged in the design, manufacture and servicing of electromagnetic flowmeters for potable water application. Manufacturer to submit evidence of a proven track record with at least two (2) operating flowmeter installations of the same size, accuracy and model as prescribed here installed within the last five (5) years.

2. PRODUCTS

2.1 System Description

.1 Design Requirements:

.1 Ratio of flow velocity to reference voltage signals generated identical shall be for each meter size. Meter shall be compatible with secondary readout instrument without circuit modifications.

.2 Changes in density, viscosity, temperature, pressure or conductivity within limits of flow meter shall not affect accuracy. Maintain accuracy for field repairs performed by Manufacturer’s service technician during warranty period.

.3 Design is based on minimum average velocity of 1 m/s through meter. Meters requiring greater velocities to meet specified accuracy and proper performance are not acceptable.

.4 Flowmeter system accuracy shall be ±0.5% of actual flow rate from 0.8 to 9 m/s. Repeatability shall be ±0.1% and response time programmable from 1 seconds to 100 seconds.

.5 Meter shall meet accuracy with two (2) straight pipe diameter upstream and one (1) straight pipe diameters downstream from the meter.

2.2 Products and Manufacturers

.1 FPI 395L for forward flow by McCrometer.

.2 FPI 394L for bi-directional flow by McCrometer.

.3 Or approved equal.

2.3 Magnetic FPI Flowmeters

.1 The insertion flowmeters provided for the Work shall all be sourced from the same Manufacturer and in compliance with this Specification.

.2 The electromagnetic insertion flowmeter shall consist of a flow sensor based on Faraday's Law of Electromagnetic Induction and a microprocessor-based signal converter.

.3 Sensor:

.1 Construction: The sensor material shall be constructed of 316 stainless steel or hastelloy electrodes and coated with NSF 61 certified epoxy coating.

.2 Installation hardware shall include a stainless steel 50 mm full ported valve with a stainless steel nipple.

.4 Transmitter:

.1 Electronic enclosure: Shall be a IP68 rated enclosure.

.2 Converter/display: Background illumination with alphanumeric 8-line graphical backlit LCD display with 6-key touch programming to indicate flow rate, totalized values, settings, and faults.

.3 Power supply:

.1 100-240 VAC / 45-66 Hz.

.4 5. Outputs:

.1 Two (2) 4-20 mA.

.1 Configure signal range to process range.

.2 Two (2) separate digital programmable outputs:

.1 Open collector transistor usable for pulse frequency.

.2 Fault alarm.

.5 Communications:

.1 HART.

.2 Modbus.

.3 AMI Smart Output (Sensus, Itron 6, Itron 9).

.6 Converter self diagnostics – Optional data logger and built-in verification:

.1 Power & signal cabling: The power and signal between the converter and sensor are isolated and placed in separate cables.

.2 Flow direction measurement: Forward and reverse flow indication and forward, reverse, net totalization is available.

2.4 Signal Transmitter

.1 Remote mounted, microprocessor controlled.

.1 Operate on 120 VAC, 60 Hz power.

.2 Convert flow signal to analog and digital output signals, for bidirectional flow.

.2 Span shall be continuously adjustable between 0.3 and 10 m/s. Adjustment shall be by keypad.

.3 Display flow rate scaled in field selectable engineering units (ft/sec, m/s). Display shall have 2 rows of 16 alpha numeric characters. Top row shall indicate instantaneous flow.

.4 Isolated 4-20 maDC analog current output into 0 to 500 ohm load and 24 VDC scaled, software adjustable pulse output.

.5 IP68 enclosure.

.6 Noise reduction feature to stabilize flow reading.

.7 Suitable for -40°C to 40°C ambient temperature.

2.5 Cable

.1 Provide sufficient length of Manufacturer's standard signal cable to connect meter primary element and converter as specified in Section 40 70 00 - Instrumentation Specification Sheet.

.2 Use single conduit run between converter and meter.

2.6 Warranty

.1 The Manufacturer of the electromagnetic flowmeter shall provide a two-year warranty that the equipment shall be free from defects in design, workmanship, or materials. Extended warranties up to five (5) years shall be available for additional cost.

.2 The Manufacturer of the electromagnetic flowmeter shall provide a Lifetime Guarantee on the flow tubes Ultra Liner fusion bonded epoxy liner.

.3 In the event a component fails to perform as specified or is proven defective in service during the warranty period, the Manufacturer shall promptly repair or replace the defective part at no cost to the City.

3. EXECUTION

3.1 Installation

.1 Install in accordance with the Contract Drawings and Manufacturer's written instructions and approved submittals.

.2 Follow Manufacturer's instructions for minimum installation clearance requirements. The sensor installation hardware will protrude from the pipe during installation requiring sufficient clearance from any obstruction.

.3 Follow Manufacturer's recommendation for the minimum upstream and downstream installation requirements for the flow element. Locate meter as recommended by Manufacturer and Contract Drawings with respect to other piping components to ensure meter will meet specified accuracy.

.4 Wiring between flow element and remote mounted signal converters shall use cable type and procedures as per the Manufacturers' recommendations.

3.2 Hot-Tap Process Ventilation

.1 The Contractor shall ensure proper ventilation to prevent the buildup of flammable gases, vapors, or fumes.

.1 Use portable exhaust systems to capture fumes directly at the source.

.2 Deploy fans or blowers to create positive airflow in confined or enclosed spaces.

.3 Discharge exhaust gases to a safe, designated location to prevent re-entry into the work area.

3.3 Field Quality Control

.1 Manufacturer's Field Services:

.1 Manufacturer's technician for equipment specified herein shall be present at job Site or classroom designated by the City for person-day indicated, travel time excluded, for assistance during construction, startup, equipment calibration, and training of personnel for operation. Each flowmeter would be installed and commissioned one at a time. Include minimum of:

.1 MacLean RPS:

.1 Two (2) person-days of installation and training services for each flowmeter.

.2 This results in a total of 1 two-person-day service trips for all flowmeters.

.2 McPhillips RPS:

.1 Two (2) person-days of installation and training services for each flowmeter.

.2 This results in a total of 1 two-person-day service trips for all flowmeters.

.2 Manufacturer shall direct services to system and equipment operation, maintenance, and troubleshooting and system related areas other than process design and philosophy.

3.4 Calibration

.1 Each flowmeter shall be factory calibrated according to ANSI/NCSL Z540.3.

.1 The calibration should be conducted in a NIST traceable flow facility.

.2 The calibration shall be conducted in at least three flows, including the minimum, average and maximum flows as specified in Section 40 70 00 - Instrumentation Specification Sheet for each individual flowmeter.

.3 The calibration report shall be signed by the Contractor's Professional Engineer of record registered in the Province of Manitoba.

.4 Submit calibration reports for review by the Contract Administrator and include copies of reviewed and accepted calibration reports in the O&M Manuals.

.2 Each flowmeter calibration shall be verified on Site:

.1 In-line liquid flowmeter calibrations shall be verified in-situ using volumetric draw down or similar test approved by the Contract Administrator.

.3 Provide calibration reports of the factory calibration and as-commissioned in-situ calibration check including all smart device configuration parameters.

3.5 Closeout Activities

.1 Provide in accordance with Section 01 78 00 - Closeout Submittals.

END OF SECTION

1. GENERAL

1.1 Summary

.1 All control panels shall be built by a CSA/cUL approved manufacturer and shall bear the CSA/cUL seal with the manufacturer's file number.

.2 All new control panels shall be factory assembled and pre-wired. The control panel wiring shall be verified at the manufacturer's factory and completely tested before being shipped to the Site. Do not ship control panels until approval from the Contract Administrator is received.

.3 Existing control panels that are substantially modified from the original installation shall have a new CSA/cUL seal applied.

.4 Supply, install, wire and test all components inside the control panels according to the specifications herein and the Drawings.

1.2 References

.1 Comply with latest edition of the codes and standards applicable and/or referenced in Division 26 and this Section.

.2 The following is a list of standards which may be applicable in this Section:

.1 Canadian Standards Association (CSA):

.1 CSA C22.1, Canadian Electrical Code, Part I - Safety Standard for Electrical Installations.

.2 CSA C22.2 No. 14-13, Industrial control equipment.

.2 National Electrical Manufacturers Association (NEMA).

1.3 Acronyms and Abbreviations

.1 FAT: Factory Acceptance Test

.2 PLC: Programmable Logic Controller

.3 SIFT: System Integration Functional Test

1.4 Submittals

.1 Submit Shop Drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings:

.1 Complete specifications, catalog cuts, and descriptive literature, which shall include make and model of all components.

.2 Control panel layout drawings.

.3 Complete bill of materials.

.4 Electrical schematic and wiring diagrams, interconnection diagram showing power and control interfaces among all control panel components. The diagrams are to be fully comprehensive so that every circuit loop can be followed completely.

.5 Configuration/parameter sheets including switch settings, parameter settings, and addresses. Show factory default settings and proposed settings.

.6 Diagram showing dip switches complete with proposed settings.

.7 Control panel support frame design drawings signed and stamped by a structural engineer registered in the province of Manitoba.

.3 Prior to construction:

.1 Submit stamped red-line mark-ups of any proposed control panel modifications. If significant modifications are proposed/required, AutoCAD drawings will be supplied to the Contractor for revision.

.4 FAT and SIFT requirements:

.1 Refer to Division 26 FAT and SIFT Procedures for submittal requirements.

.5 Prior to shipment:

.1 Submit electronic pictures of enclosure exterior and interior, including door interior. For enclosures that are similar, one set of photos for each type may be submitted.

.1 Pictures to be of sufficient resolution to read component labels.

.2 Submit As-built Drawings. Minor changes may be made via red-line mark-ups. Significant changes shall be made via red-line mark-ups with the associated change submitted on separate AutoCAD drawings.

1.5 Inspection

.1 A factory inspection of the control panels will be performed at the discretion of the Contract Administrator based upon the pre-shipment submittals.

.2 Demonstrate and test the control panel in the presence of the Contract Administrator designated representative as part of the FAT and SIFT.

2. PRODUCTS

2.1 General

.1 Construction of the control panels is required in accordance with the supplied drawings.

.2 Devices of each function shall be of the same type and manufacturer.

2.2 Enclosures – Surface Mount

.1 Provide all required hardware and accessories for a complete installation.

.2 Install lamacoids as per the control panel layout drawings, with stainless steel screws.

.3 Minimum CSA/NEMA ratings are as follows:

.1 In areas where corrosive gases are present – NEMA 4X, or as indicated on the Drawings.

.2 In outdoor areas where no corrosive gasses are present- NEMA 3R, or as indicated on the Drawings.

.4 All enclosure angles and cut-outs shall be free of dents, gouges or weld marks, and shall present a clean, smooth appearance.

.5 No screws, fittings or other fastenings shall be used on external panel faces, which must be free of any marks, scratches or defaults.

.6 Minimum Metal Thickness: 14 gauge.

.7 The exterior of the control panel shall be painted ANSI 61 grey.

.8 The interior of the control panel shall be painted gloss white.

.9 Component mounting plates shall be three (3) mm thick steel and shall be painted with one (1) coat of primer and one (1) coat of white baked enamel.

.10 Doors:

.1 All control panel doors shall be 900 mm (36 inches) wide maximum.

.2 All control panel doors shall open through 180 degrees without restriction.

.3 Provide door mount document pocket in each panel.

.4 Provide both exterior lockable door and interior door. Interior panel door latch shall be mechanically interlocked such that the panel is fully de-energized before interior live electrical components are exposed.

.11 Gasket:

.1 Seamless foam-in-place gasket (UL component recognized) on all external components.

.12 Manufacturers:

.1 Hoffman (nVent).

.2 Or approved equal.

2.3 Power Source

.1 Each power source must be protected by a CSA approved circuit breaker or fuse.

.2 The location of each power source must be clearly shown.

.3 Panels powered by more than one electrical source shall display on their door “Caution: This panel is electrically powered by more than one source”.

2.4 Components

.1 Unless written approval for use of unapproved components is received from the Contract Administrator, all electrical materials (e.g., conduit, fittings, wireways, etc.) shall be CSA or cUL approved.

.2 Rails (DIN Rails):

.1 Rails used must be DIN Rail style TS 35 mm, slotted.

.2 When used to mount terminals, rails shall be mounted on straight raisers (rail support / mounting feet) so as to raise them so that the top of the terminals are at the same height as the top of the adjacent wiring duct.

.3 Raisers (rail support/mounting feet) shall not be used when rail hosts heavy components.

.3 Terminals:

.1 Quantity:

.1 Accommodate present and spare indicated needs.

.2 One (1) wire per terminal for field wires entering/exiting enclosures.

.3 Maximum of two (2) wires on each side of a terminal for internal enclosure wiring.

.4 Installed Spare Terminals: As shown on the Drawings.

.2 General:

.1 Connection Type: Screw compression clamp.

.3 Compression Clamp:

.1 Complies with DIN-VDE 0611.

.2 Hardened steel clamp with transversal grooves that penetrate wire strands providing a vibration-proof connection.

.3 Guides strands of wire into terminal.

.4 Screws: Hardened steel, captive, and self-locking.

.5 Current Bar: Copper or treated brass.

.6 Insulation:

.1 Thermoplastic rated for minus 55°C to plus 110°C.

.2 Two (2) funneled shaped inputs to facilitate wire entry.

.7 Mounting:

.1 Standard DIN rail.

.2 Terminal block can be extracted from an assembly without displacing adjacent blocks.

.3 End Stops: Minimum of one (1) at each end of rail.

.8 Jumpers: Allow jumper installation without loss of space on terminal or rail.

.9 Marking System:

.1 Terminal number shown on both sides of terminal block.

.2 Markings must be machine printed. Hand written markings are not allowed.

.3 Terminal strip numbers shown on end stops.

.4 Mark terminal block and terminal strip numbers as shown on panel control diagrams and loop diagrams.

.10 Terminal blocks shall be designed for the size of the wires to be connected to them. Terminal blocks used for analog, digital, and power cables shall be identified and physically separated from each other.

.11 Drawings and templates supplied may not detail all hardware components such as labels, stoppers, rail lifters, end plates, separators, etc. The supplier must supply and install such components when required.

.12 Loose Spare Requirements:

.1 Provide either 30 or 3%, whichever is less, of each type of terminal used on the Project.

.13 Terminal Block Types:

.1 Control wiring – General:

.1 Connection type: Screw connection.

.2 Mounting: NS 35 mm DIN rail.

.3 Approval: CSA.

.2 Manufacturer and Series:

.1 Phoenix Contact UT 4 and UTTB 4 series.

.2 Or approved equal.

.3 Terminal Block, Feed-through:

.1 Rated Voltage: 600 VAC.

.2 Rated Current: 30 Amp.

.3 Wire Size: 26 to 10 AWG.

.4 Color: Gray body.

.5 Width: 6.2 mm.

.6 Bridging: Plug-in bridge.

.7 Standard of acceptance: Phoenix Contact 3046184.

.4 Terminal Block, Ground:

.1 Wire Size: 26 to 10 AWG.

.2 Color: Green and yellow body.

.3 Width: 6.2 mm.

.4 Grounding: Electrically grounded to mounting rail.

.5 Standard of acceptance: Phoenix Contact 3046207.

.5 Terminal Block, Knife Disconnect:

.1 Rated Voltage: 600 VAC.

.2 Rated Current: 16 A.

.3 Wire Size: 26 to 10 AWG.

.4 Color: Gray body, orange switch.

.5 Width: 6.2 mm.

.6 Bridging: Plug-in bridge.

.7 Standard of acceptance: Phoenix Contact 3046139.

.6 Terminal Block, Fused:

.1 Rated Voltage: 600 VAC.

.2 Rated Current: 6.3 A.

.3 Wire Size: 26 to 10 AWG.

.4 Color: Gray body.

.5 Width: 6.2 mm.

.6 Bridging: Plug-in bridge.

.7 Fuse: 5 mm x 20 mm.

.8 Standard of acceptance: Phoenix Contact 3046142, 3036806.

.7 Terminal Block, Double Level, Fused:

.1 Rated Voltage: 500 VAC.

.2 Rated Current: 6.3 A.

.3 Wire Size: 26 to 10 AWG.

.4 Color: Gray.

.5 Width: 6.2 mm.

.6 Bridging: Plug-in bridge.

.7 Fuse: 5 mm x 20 mm.

.8 Standard of acceptance: Phoenix Contact 3044720, 3036806.

.8 Power wiring over 6.3 A.

.1 Connection type: Screw connection.

.2 Mounting: NS 35 mm DIN rail.

.3 Approval: CSA.

.9 Manufacturer and Series:

.1 Phoenix Contact UK 10/16 series.

.2 Or approved equal.

.10 Terminal Block, Feed-through:

.1 Rated Voltage: 600 VAC.

.2 Rated Current: 85 A.

.3 Wire Size: 14 to 4 AWG / 12 to 6 AWG flexible.

.4 Color: Gray body.

.5 Width: 12.2 mm.

.6 Bridging: Fixed Bridge.

.7 Standard of acceptance: Phoenix Contact 3006043 (UK 16 N).

.11 Terminal Block, Fused:

.1 Rated Voltage: 300 VAC.

.2 Rated Current: 10 A.

.3 Wire Size: 20 to 6 AWG.

.4 Color: Gray body.

.5 Width: 12 mm.

.6 Bridging: Fixed Bridge.

.7 Fuse: 6.3 mm x 32 mm.

.8 Standard of acceptance: Phoenix Contact 3005507.

.4 Electronic Circuit Protector – Class 2 current limiting:

.1 Electronic Circuit Protectors for disconnection of 24 VDC loads as per control panel layout drawings.

.2 Requirements:

.1 Overload disconnection.

.2 Active current limitation.

.3 Manual On/Off button.

.4 Current rating: As required.

.5 Approvals: CSA.

.6 DIN rail mounting.

.3 Manufacturer and Model:

.1 Weidmuller, ESX10-T series.

.5 Ground Bus Bar:

.1 Supply a ground bus bar in each control panel. Supply an isolated ground bus bar where shown on the Drawings.

.2 Requirements:

.1 Tapped holes with screws.

.2 Bar to have sufficient connection points for all cables entering the control panel, plus 25% spare.

.3 Maximum one wire termination per screw.

.4 Manufacturer and Model: ILSCO D167 series.

.5 Or approved equal.

.6 Pushbutton, Non-Illuminated:

.1 General:

.1 Function: Initiate discrete control functions.

.2 Type: 30 mm, heavy-duty, oiltight, industrial, momentary contact.

.3 Approvals: CSA.

.2 Mounting:

.1 Panel cut out: 30.6 mm single round hole.

.2 Panel thickness: 1.59 mm to 4.76 mm.

.3 Pushbutton Features:

.1 Operator: Pushbutton, flush or extended head as noted.

.2 Cap colour: Black, unless otherwise noted.

.3 Cap text: None, unless otherwise noted.

.4 Boot: None, unless otherwise noted.

.4 Legend Plate:

.1 Standard size (46.4 H x 45.2 W, mm), unless otherwise noted.

.2 Text: As noted or shown.

.3 Material:

.1 Non-corrosive environment: Aluminum.

.2 Corrosive environment: Plastic.

.7 Signal Interface:

.1 Contact Block:

.1 Type: Silver-coated butting, unless otherwise noted.

.2 Rating: 10 amps continuous at 120 VAC or as noted.

.3 Sequence: Break-before-make, unless otherwise shown.

.4 Arrangement: Normally open or normally closed as shown, or perform functions noted.

.5 Electrical design life: 1,000,000 cycles.

.6 Terminals: Screw with strap clamp, unless otherwise noted.

.8 Manual small motor switches:

.1 Manufacturers:

.1 Schneider Type K or SK.

.2 Or approved equal.

.9 Pushbutton, Emergency Stop:

.1 General:

.1 Function: Initiate shutdown of equipment.

.2 Type: 30 mm, heavy-duty, oil-tight, industrial, push-pull, maintained position.

.2 Mounting:

.1 Panel cutout: 30.6 mm single round hole.

.2 Panel thickness: 1.59 mm to 4.76 mm.

.3 Pushbutton Features:

.1 Operator: Pushbutton, mushroom head.

.2 Cap colour: Red.

.3 Text: None.

.4 Illumination: None.

.5 Boot: None, unless otherwise noted.

.4 Legend Plate:

.1 Standard size (46.4 H x 45.2 W, mm), unless otherwise noted.

.2 Text: As noted or shown.

.3 Material:

.1 Non-corrosive environment: Aluminum.

.2 Corrosive environment: Plastic.

.5 Signal Interface:

.1 Contact Block:

.1 Type: Silver-coated butting, unless otherwise noted.

.2 Rating: 10 amps continuous at 120 VAC or as noted.

.3 Sequence: Break-before-make, unless otherwise shown.

.4 Arrangement: Normally open or normally closed as shown, or perform functions noted.

.5 Electrical design life: 1,000,000 cycles.

.6 Terminals: Screw with strap clamp, unless otherwise noted.

.10 Pilot Light:

.1 General:

.1 Function: Display discrete control functions.

.2 Type: 30 mm, heavy-duty, oil-tight, industrial.

.3 Approvals: CSA.

.2 Mounting:

.1 Panel cutout: 30.6 mm single round hole.

.2 Panel thickness: 1.59 mm to 4.76 mm.

.3 Light Features:

.1 Lights: LED, unless otherwise noted.

.2 Voltage: As noted.

.3 Lens Color: As noted.

.4 Legend Plate:

.1 Standard size (46.4 H x 45.2 W, mm), unless otherwise noted.

.2 Text: As noted or shown.

.3 Material:

.1 Non-corrosive environment: Aluminum.

.2 Corrosive environment: Plastic.

.5 Signal Interface:

.1 Terminals: Screw with strap clamp, unless otherwise noted.

.11 Pilot Light, Push-to-Test:

.1 Function:

.1 Push to test light, display discrete control functions; or

.2 Initiate and display discrete control functions.

.3 Type: 30 mm, heavy-duty, oil-tight, industrial, momentary contact.

.4 Approvals: CSA.

.2 Mounting:

.1 Panel cutout: 30.6 mm single round hole.

.2 Panel thickness: 1.59 mm to 4.76 mm.

.3 Light Features:

.1 Lights: LED, unless otherwise noted.

.2 Voltage: As noted.

.3 Lens Color: As noted.

.4 Pushbutton Features:

.1 Operator: Pushbutton.

.2 Boot: None, unless otherwise noted.

.5 Legend Plate:

.1 Standard size (46.4 H x 45.2 W, mm), unless otherwise noted.

.2 Text: As noted or shown.

.3 Material:

.1 Non-corrosive environment: Aluminum.

.2 Corrosive environment: Plastic.

.6 Signal Interface:

.1 Contact Block:

.1 Type: Silver-coated butting, unless otherwise noted.

.2 Rating: 10 A continuous at 120 VAC or as noted.

.3 Sequence: Break-before-make, unless otherwise shown.

.4 Arrangement: Normally open or normally closed as shown, or perform functions noted.

.5 Electrical design life: 1,000,000 cycles.

.6 Terminals: Screw with strap clamp, unless otherwise noted.

.12 Selector Switch:

.1 General:

.1 Function: Select discrete control functions.

.2 Type: 30 mm, heavy-duty, oil-tight, industrial, maintained contact.

.3 Approvals: CSA.

.2 Mounting:

.1 Panel cutout: 30.6 mm single round hole.

.2 Panel thickness: 1.59 mm to 4.76 mm.

.3 Switch Features:

.1 Operator: Black non-illuminated lever on switch, unless otherwise noted.

.2 Boot: None, unless otherwise noted.

.3 Positive indexing with stops to limit travel to the number of positions shown.

.4 Legend Plate:

.1 Standard size (46.4 H x 45.2 W, mm), unless otherwise noted.

.2 Text: As noted or shown.

.3 Material:

.1 Non-corrosive environment: Aluminum.

.2 Corrosive environment: Plastic.

.5 Signal Interface:

.1 Contact Block:

.1 Type: Silver-coated butting, unless otherwise noted.

.2 Rating: 10 amps continuous at 120 VAC or as noted.

.3 Sequence: Break-before-make, unless otherwise shown.

.4 Arrangement: Normally open or normally closed contact(s) as shown, or perform functions noted.

.5 Electrical design life: 1,000,000 cycles.

.6 Terminals: Screw with strap clamp, unless otherwise noted.

.13 Potentiometer:

.1 General:

.1 Function: Adjustable analog setpoint.

.2 Type: Heavy-duty, industrial, oil-tight.

.2 Performance:

.1 Resistance: 1000 ohms, unless otherwise noted.

.2 Temperature, operating: 0°C to 55°C.

.3 Humidity, operating: 50% at 40°C.

.4 Mechanical design life: 25,000 cycles.

.5 Rated for 300 V AC maximum.

.3 Mounting:

.1 30.6 mm single round hole.

.2 Panel thickness:

.1 1.59 to 4.76 mm.

.2 Counterboring required for thicknesses greater than 4.76 mm.

.4 Legend Plate:

.1 Standard size (46.4 H x 45.2 W, mm), unless otherwise noted.

.2 Scale: 0 to 100%, unless otherwise noted.

.3 Legend: As noted or shown.

.4 Material:

.1 Non-corrosive environment: Aluminum.

.2 Corrosive environment: Plastic.

.5 Signal interface: Three-wire.

.14 Relays – General Purpose Miniature industrial relays:

.1 General:

.1 Approvals: CSA.

.2 Coil voltage: As Noted.

.3 Relay Mounting: plug-in type socket.

.4 Socket type: Screw terminal.

.5 Socket mounting: 35 mm DIN rail.

.2 Control Circuit Switching Relay:

.1 Type: Compact general purpose plug-in.

.2 Contact Arrangement: As noted.

.3 Contact Rating: As noted or shown.

.4 Contact material: Silver tin oxide alloy.

.5 Coil voltage: As noted or shown.

.6 Coil operating voltage display: LED.

.7 Operation temperature: -40°C to 70°C.

.8 Expected mechanical life: 10,000,000 cycles.

.3 Manufacturer and Series:

.1 Finder 46 Series.

.2 Or approved equal in accordance with B7.

.15 Relays – I/O:

.1 General:

.1 Approvals: CSA.

.2 Relay Mounting: plug-in type socket.

.3 Socket type: Screw terminal.

.4 Socket mounting: 35 mm DIN rail.

.2 Control Circuit Switching Relay:

.1 Type: Compact general purpose plug-in.

.2 Contact Arrangement: As noted.

.3 Contact Rating: As noted or shown.

.4 Coil voltage: As noted or shown.

.5 Coil operating voltage display: LED.

.6 Operation temperature: -40°C to 55°C.

.7 Expected mechanical life: 20,000,000 cycles.

.3 Manufacturer and Series:

.1 Phoenix Contact PLC-RSC Series.

.2 Or approved equal.

.4 Standard of Acceptance:

.1 Relay interface for PLC Discrete Inputs, SPDT:

.1 Coil rating: 3.5 mA at 120 VAC.

.2 Contact material: Gold-plated silver tin oxide alloy.

.3 Contact switching voltage: 36 VDC max.

.4 Contact minimum switching current: 1 mA.

.5 Contact maximum inrush current: 50 mA.

.6 Wire Size: 26 to 14 AWG for both input and output side.

.7 Color: Gray body.

.8 Width: 6.2 mm.

.9 Bridging: Plug-in bridge.

.10 Approvals: cULus.

.11 Standard of acceptance: Phoenix Contact 2966281.

.2 Relay interface for PLC Discrete Outputs, SPDT: Coil rating: 9 mA at 24 VDC.

.1 Contact material: Silver tin oxide alloy.

.2 Contact switching voltage: 5 VAC min, 250 VAC max.

.3 Contact limiting continuous current: 6 A.

.4 Wire Size: 26 to 14 AWG for both input and output side.

.5 Color: Gray body.

.6 Width: 6.2 mm.

.7 Bridging: Plug-in bridge.

.8 Approvals: cULus.

.9 Standard of acceptance: Phoenix Contact 2966171.

.3 Relay interface between PLCs, SPDT:

.1 Coil rating: 11 mA at 24 VAC/DC.

.2 Contact material: Gold-plated silver tin oxide alloy.

.3 Contact switching voltage: 36 VDC max.

.4 Contact minimum switching current: 1 mA.

.5 Contact maximum inrush current: 50 mA.

.6 Wire Size: 26 to 14 AWG for both input and output side.

.7 Color: Gray body.

.8 Width: 6.2 mm.

.9 Bridging: Plug-in bridge.

.10 Approvals: cULus

.11 Standard of acceptance: Phoenix Contact 2966278.

.16 Relays – Motor Starting and Solenoids:

.1 Approvals: CSA.

.2 Coil voltage: As per the Drawings.

.3 Relay Mounting: Plug-in type socket.

.4 Socket Type: Screw terminal interface with wiring.

.5 Socket Mounting: Rail.

.6 Furnish hold-down clips.

.7 Control Circuit Switching Relay:

.1 Type: Compact general purpose plug-in.

.2 Contact Arrangement: As noted.

.3 Contact Rating: 16 A.

.4 Contact single phase motor rating: 1/3 Hp at 120 VAC.

.5 Contact Dielectric Strength: 1000 VAC.

.6 Contact Material: Silver cadmium oxide alloy.

.7 Coil Voltage: As noted or shown.

.8 Coil Power: 0.5 watts (dc), 1.2 VA (AC).

.9 Expected Mechanical Life: 10,000,000.

.10 Indication Type: LED indicator lamp.

.11 Ambient temperature: -40°C to 70°C.

.8 Manufacturer:

.1 Finder 48.61 Series.

.2 Or approved equal.

.17 Analog Signal Isolators:

.1 Provide galvanic isolation between analog signals where not already provided by the programmable logic controller or other components.

.2 Input: 0-5 V, 1-5 V, 0-10 V, and 4-20 mA (switch selectable).

.3 Output: 4-20 mA.

.4 Channels per isolator: 2 or 4.

.5 DC input resistance:

.1 Current inputs: 50 Ω.

.2 Voltage inputs: 1 MΩ.

.6 Performance:

.1 Output ripple: < 10 mV peak-to-peak measured across a 250 Ω resistor.

.2 Isolation: 1000 V rms input-to-output and channel-to-channel.

.3 Common mode rejection: > 95dB @ 60 Hz, 500V rms maximum.

.7 Features:

.1 Adjustable zero and span for each channel via potentiometers.

.2 Removable wiring connectors.

.8 Environmental:

.1 Temperature range, operating: -40°C to 70°C.

.2 Relative humidity, operating: 0-95% non-condensing.

.3 Ambient temperature effect: plus or minus 0.015% of span/°C maximum.

.9 Manufacturers:

.1 Acromag.

.2 Moore Industries.

.3 MTL Instruments.

.4 Phoenix Contact.

.18 Intrinsic Safety Barriers:

.1 Monitor discrete signals that originate in hazardous area and are used in a safe area.

.2 Interface analog signals as they pass from hazardous area to safe area.

.3 Isolation Method: Galvanic Isolation.

.4 Approvals: CSA or cUL

.5 Manufacturers:

.1 Phoenix Contact.

.2 Pepperl+Fuchs.

.3 MTL Instruments.

.19 Wiring Interface: Terminate and identify wiring entering or leaving enclosures.

.1 Analog and Discrete Signal Wires: Terminate at numbered terminal blocks as shown on the wiring diagrams.

.2 Wiring for Special Signals: Terminate communications, digital data, and multiplexed signals using manufacturer's standard connectors for the device to which the signals terminate.

.20 Wiring:

.1 All analog signal wiring shall be 18 AWG shielded twisted pair.

.1 Shield wires exiting the jacket must be covered with a black heat shrink, and the overall cable at the jacket end must also be covered with a heat shrink.

.2 Standard of Acceptance:

.1 Belden No. 8760.

.2 All 24 VDC discrete signal panel wiring shall be 16 AWG TEW/MTW stranded conductor with 300 V, 105°C insulation.

.3 All 120 VAC discrete signal panel wiring shall be 14 AWG TEW/MTW stranded conductor with 300 V, 105°C insulation.

.4 All 24 VDC and 120 VAC power wiring shall be 12 AWG minimum unless shown otherwise.

.5 The sizes and colours of wires shall be in accordance with the CSA and the Canadian Electrical Code, and Wire Colour Coding.

.6 Provide wire barrel ferules where possible.

.7 Ethernet Patch Cords:

.1 Requirements:

.1 Cat-6, shielded twisted pair.

.21 Wiring Duct:

.1 All wires shall be run in narrow slot wiring duct, unless shown otherwise.

.2 Wiring Duct shall be installed on both sides of the panel and between the DIN rails as per the Drawings.

.3 Wire or cable, connected to internal device or arriving from external device, shall be uncovered by Wiring Duct for a maximum of 100 mm or as required by its minimum bending radius.

.4 120 VAC wires cannot share wiring duct with 12 VDC, 24 VDC or 4-20 mA wires, but may cross their path.

.5 All DC, AC, and communication wiring shall be routed in separate wireways to prevent signal interference. 24 VDC Class 2 circuits and communication wiring may share the same wiring duct.

.6 Wire ties shall be non-metallic.

.7 Where the voltage level and/or type of signal is shown on the Drawings, provide an adhesive label to the cover of the wiring duct with this information.

.8 Manufacturer:

.1 Panduit.

.2 Or approved equal.

.9 Wire Identification: Numbered and tagged at each termination.

.1 Wire Tags: Machine printed, heat shrink.

.2 Standard of Acceptance:

.1 Brady PermaSleeve.

.2 Tyco Electronics.

.22 Wire Color Coding:

.1 Follow the Electrical Design Guide and Identification Standard.

.23 Overcurrent Protection:

.1 Panel-mounted devices and all control circuits shall be protected by appropriately sized fuses or circuit breakers.

.24 Control Power Transformer:

.1 Function: Provide required secondary voltage level with high degree of stability.

.2 Type: Single phase, indoor, industrial.

.3 Ratings:

.1 Power Rating: As shown on the drawings.

.2 Primary voltage: 600 VAC.

.3 Secondary voltage: 120 VAC.

.4 Frequency: 60 Hz.

.5 Temperature rise 55°C, insulation class 105°C

.4 Mounting: Directly to enclosure back panel with mounting feet made of heavy steel and welded or bolted to the core.

.5 Standard secondary and optional primary fuse kits.

.6 With Finger Guards.

.7 Approvals: cULus.

.8 Manufacturer and model:

.1 Hammond PH100PG, FG2.

.2 Or approved equal.

.25 Power Supplies and Redundancy Modules (24 VDC):

.1 Approvals: CSA.

.2 Type: Regulated switch mode.

.3 Watt Rating: As noted.

.4 Input: 100-240 VAC, 45-65 Hz.

.5 Output: 24 VDC.

.6 Mounting: NS 35 DIN rail.

.7 Capable of redundant operation with redundancy module.

.8 Redundancy module:

.1 MOSFET based.

.2 Adjustable output voltage.

.3 Loss of redundancy alarm LED and contact.

.4 Power fail alarm contact.

.9 Performance:

.1 Load regulation: < 2%.

.10 Temperature derating: 2.5%/°C from 60°C.

.11 Output ripple: < 30 mV peak-to-peak.

.12 Efficiency: 93% or greater.

.1 Features:

.1 Capable of parallel operation.

.2 Power boost: 130% handle start-up loads and temperature derating effect.

.3 Input transient surge protection.

.4 Input overcurrent protection.

.5 Output overcurrent protection.

.2 Status lights:

.1 DC OK LED: active, green.

.2 Alarm LED: red.

.3 Power boost LED: power boost active, yellow.

.13 Status contacts:

.1 Power supply failure, qty 1 normally open (Form A), contact closed during normal operation.

.14 Environmental:

.1 Temperature, operating: -25°C to 60°C.

.2 Humidity, operating: max 95%, non-condensing.

.3 Manufacturer and series:

.1 Phoenix Contact, Quint Series.

.2 Or approved equal.

.26 Internal Lighting:

.1 All control panels of a depth greater than or equal to twelve (12) inches shall be equipped with a lighting device with a door switch. Whenever the door is opened, the lighting system shall automatically be activated.

.2 Fixture mounting: top-centre of enclosure, unless otherwise noted.

.3 Lights: LED, white.

.4 Power supply: 120 VAC.

.5 Manufacturer:

.1 Hoffman (nVent)

.2 Or approved equal.

.27 Cooling and Heating Systems

.1 Control panels shall be designed for the environmental conditions of the installation location. Cooling and heating systems shall be in accordance with the specific NEMA rating required by NEMA ICS 6 and NEMA 250.

.28 CSA/NEMA Rating:

.1 All components mounted into the enclosure wall, or to the enclosure shall be rated equal or greater than the CSA/NEMA rating of the enclosure. All wall penetrations shall be sealed to maintain the CSA/NEMA rating of the enclosure.

2.5 Spare Components

.1 Provide the following in a clear plastic bag attached to the panel door interior of each panel:

.1 Two (2) spares of each fuse type and rating.

.2 One (1) spare of each Electronic Circuit Protector – Class 2 rating, as applicable.

.3 One (1) spare of each type of door mounted pilot device.

3. EXECUTION

3.1 General

.1 Construct control panels in accordance with CSA C22.2 No. 14.

3.2 Wiring

.1 Panel wiring shall be installed in a neat and orderly manner.

.2 All conductors shall be securely fastened to terminals at both ends; no splices are allowed inside the panel.

.3 No more than two (2) conductors may be terminated under each terminal screw. All internal panel conductors shall be connected to the same side of a terminal block, and external conductors to the other side. The only exception is for fused terminals which require connection to the field side for internal wiring.

.4 All wires and cables inside the control panels shall be identified on both ends using nonerasable labels.

.5 Identification shall follow the supplied documents, such as wiring diagrams.

.1 Label both ends of each wire.

.2 Utilize machine printed non-slip labels. Wrap-around or self-adhesive markers shall not be permitted.

.3 Wherever possible wire labels shall be positioned to be read from the panel opening without removal of wire duct covers or other wiring.

.6 Individual conductors or wires exiting a cable shall be identified using non-erasable labels.

.7 The routing of all analog, digital, and power cable wiring inside control panels shall be segregated as much as possible, in distinct wiring ducts, by the type of signal they are carrying. All wires shall be physically protected by wiring ducts with covers. The wiring ducts shall be of sufficient size to be filled to a maximum of 40% when all wires are inside.

.8 Group and form wiring into a loop when going from a fixed part of the panel to a door such that there is sufficient slack to minimize strand fatigue and breaking. Secure at each end so that bending or twisting will be around longitudinal axis of wire. Protect bend area with sleeve.

.9 Provide abrasion protection for wire bundles that pass through holes or across edges of sheet metal.

.10 Connections to Screw Type Terminals:

.1 Locking-fork-tongue or ring-tongue lugs.

.2 Use manufacturer’s recommended tool with required sized anvil to make crimp lug terminations.

.3 Wires terminated in a crimp lug, maximum of one (1).

.4 Lugs installed on a screw terminal, maximum of two (2).

.11 Connections to Compression Clamp Type Terminals:

.1 Strip, prepare, and install wires in accordance with terminal manufacturer’s recommendations.

.2 Wires installed in a compression screw and clamp, maximum of one for field wires entering enclosure, otherwise maximum of two (2).

.12 The wiring arrangement shall not interfere with access to panel-mounted devices or spaces for future equipment.

.13 Arrange wiring to allow access for testing, removal, and maintenance of circuits and components.

.14 Locate entry points of cables to control panel to allow for wiring duct designations to be utilized as shown on panel layout drawings.

3.3 Grounding

.1 All control panel components shall be adequately grounded in accordance with the component manufacturer's instructions, especially control system components.

.2 Firmly bond all panel mounted devices on or within the panels to ground. Provide supplementary bonding conductors for back panels and doors. Attach a separate bonding conductor to all devices that are not firmly fastened to the panels with screws for such devices as case mounted instruments, meters, etc.

.3 Where ground bars are installed on to the rear or side wall of the enclosure, seal screw penetrations to maintain enclosure rating.

.4 Ground terminal block rails to ground bus.

3.4 Component Installation

.1 Components on the front of the panel shall be identified with an individual permanent nameplate installed in an organized manner. The nameplate must identify the component's function.

.2 Install acorn nuts and rubber washers on all machine screws that protrude out of the panel.

.3 Each component inside the control panel shall be identified with a nameplate corresponding to the Drawings. Identification nameplates for relays shall be installed on the enclosure back panel rather than the pluggable relay.

.4 All non-DIN rail mountable devices in the control panel shall be mechanically affixed to the back panel with either tapped or self-tapping screws.

.5 All control devices shall be mounted so that any component can be replaced without removing the sub-panel or other components.

.6 Components and/or auxiliary instruments mounted at the rear of the panel shall be readily accessible and their installation shall not be affected by or interfere with the removal of any panel instrument.

.7 Nameplates shall be made of lamacoid material with a white background and engraved black letters for internal and external components. Nameplates must resist harsh industrial conditions. Fasten lamacoids using stainless steel self-tapping screws. Supply and install all required fuses.

.8 Control devices must be spaced adequately to allow for cooling, replacement, servicing, and wiring access.

.9 Control devices shall be grouped according to voltage and function to reduce electrical noise.

.10 Cut-outs for instruments shall be within the tolerances specified by the instrument manufacturer.

.11 If cut-outs are specified for future instruments, the cut-outs shall be covered by removable steel plates 3 mm (1/8 inch) thick. The cover plates shall be finished and painted with the same paint as applied to the front panel.

.12 If any panel-mounted item is not available for installation before the panel is scheduled for shipment, wiring from the terminal block to the panel location for the item shall be completed, wire ends shall be formed exactly to the configurations required, and identifying sleeves shall be applied, ready for connection.

.13 Panel areas designated for future equipment shall be kept clear of stiffening members, rear-mounted equipment, wiring, and all other interferences.

.14 Ample space shall be provided for the entrance of external cables into the panel and for routing the cables to terminating points within the panel.

.15 Jumper bars shall be used instead of jumpers where possible.

.1 Hinge Wiring: Secure at each end so that bending or twisting will be around longitudinal axis of wire. Protect bend area with sleeve.

.16 Provide manufacturer-recommended clearances around heat-generating components such as 24 VDC power supplies and programmable logic controllers.

3.5 Identification

.1 Perform terminal identification using a computerized device. Handwriting is not acceptable.

.2 Label terminals as shown on Drawings.

.3 Install label above each terminal block with terminal block name.

3.6 Testing

.1 Testing of the control panels shall be completed to the greatest extent possible prior to the FAT, and shall include at minimum:

.1 Provide a signed and dated inspection sheet with all tests performed listed on it.

.2 The list of the various test procedures described hereunder is not restrictive and does not relieve the control panel manufacturer of his responsibility to perform any other work that is not mentioned but requested to verify the good operation of the control panels.

.3 Isolate all instruments and components of the control panels as required to protect them from any damage during tests.

.4 Provide the services of qualified personnel as well as tools and equipment required to perform all tests and inspection of the control panels.

.5 Tests to include:

.1 Power supply functionality.

.2 PLC component functionality.

.3 Point to point tests of all inputs and outputs.

.4 Power terminal voltage verification.

.5 Relays and switches functionality.

.6 E-stop system component functionality.

.7 Receptacle and lighting functionality.

.8 Ethernet switch and fibre transceiver functionality.

.9 Profibus and Modbus gateways, Profibus DP/PA link couplers, and associated components functionality.

.6 If the panel is modified after tests have been performed, tests shall be repeated.

3.7 FAT Requirements

.1 Perform FAT and SIFT.

3.8 Shipment

.1 If any panel-mounted item is not available for installation before the panel is scheduled for shipment, wiring from the terminal block to the panel location for the item shall be completed, wire ends shall be formed exactly to the configurations required, and identifying sleeves shall be applied, ready for connection.

.2 Shipment of any panel having shortages of equipment shall be approved in writing by the Contract Administrator.

.3 Transportation method to Site shall be in an air ride van or equivalent.

END OF SECTION